

**Date and Time:** Monday 9 September 2024 16:49:00 CEST

**Job Number:** 233028268

**Documents (100)**

1. [*Global maps of twenty-first century forest carbon fluxes*](https://advance.lexis.com/api/document?id=urn:contentItem:671W-P2B1-JCWX-C2NX-00000-00&idtype=PID&context=1516831)

**Client/Matter:** -None-

**Search Terms:** removals and target or removals and emissions or removals and land or removals and forest or target and emissions or target and land or target and forest or emissions and land or emissions and forest or land and forest

**Search Type:** Terms and Connectors

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| News | Tijdlijn: jul 14, 2020 tot jul 14, 2021; Locatie: International; Plaats van publicatie: Europe; Taal: English |

2. [*EU plan puts spotlight on carbon sinks to tackle climate change*](https://advance.lexis.com/api/document?id=urn:contentItem:634G-8KB1-JCF9-40H7-00000-00&idtype=PID&context=1516831)

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3. [*DAFM says Ireland's forests are not a net emitter of greenhouse gases*](https://advance.lexis.com/api/document?id=urn:contentItem:61VP-DNK1-JC8V-43HB-00000-00&idtype=PID&context=1516831)

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4. [*Commission under fire for including 'carbon sinks' into EU climate goals*](https://advance.lexis.com/api/document?id=urn:contentItem:60VX-YYJ1-DYXB-V1SC-00000-00&idtype=PID&context=1516831)

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5. [*Official: EU taking first steps to bring forestry into carbon market*](https://advance.lexis.com/api/document?id=urn:contentItem:6146-03S1-DYXB-V32S-00000-00&idtype=PID&context=1516831)

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6. [*Europe's carbon-farming future slowly takes shape*](https://advance.lexis.com/api/document?id=urn:contentItem:618G-NS51-JC8V-40D8-00000-00&idtype=PID&context=1516831)

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7. [*Climate Change Response Act 2002*](https://advance.lexis.com/api/document?id=urn:contentItem:61TT-21Y1-JDG9-Y43P-00000-00&idtype=PID&context=1516831)

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8. [*Europe revives carbon farming but without access to carbon markets*](https://advance.lexis.com/api/document?id=urn:contentItem:60YH-TJ71-DYXB-V008-00000-00&idtype=PID&context=1516831)

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9. [*Greenhouse gas emissions fell in 2019, emission reduction targets for 2013 to 2020 attainable*](https://advance.lexis.com/api/document?id=urn:contentItem:61K5-XCF1-JDG9-Y0MH-00000-00&idtype=PID&context=1516831)

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10. [*The carbon opportunity cost of animal-sourced food production on land*](https://advance.lexis.com/api/document?id=urn:contentItem:671W-P2M1-JCWX-C29S-00000-00&idtype=PID&context=1516831)

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11. [*Bioenergy with carbon capture 'will not deliver negative emissions'*](https://advance.lexis.com/api/document?id=urn:contentItem:628J-6221-JBNF-W28P-00000-00&idtype=PID&context=1516831)

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12. [*Farmers stumped as hold-ups in licensing stop them felling timber Ministry bottlenecks and environmental rule changes halt planting of trees to trap carbon, writes Valerie Flynn*](https://advance.lexis.com/api/document?id=urn:contentItem:6341-NGR1-JCBW-N11M-00000-00&idtype=PID&context=1516831)

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13. [*Forestry's climate impact 'invisible' under UN rules, experts say*](https://advance.lexis.com/api/document?id=urn:contentItem:6141-6BG1-DYXB-V1SC-00000-00&idtype=PID&context=1516831)

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14. [*Field trial will see thousands of trees planted*](https://advance.lexis.com/api/document?id=urn:contentItem:62W6-XYF1-JCBW-N3P9-00000-00&idtype=PID&context=1516831)

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15. [*From tree planting to CO2-sucking machines: How could 'negative emissions' help to tackle the climate crisis?*](https://advance.lexis.com/api/document?id=urn:contentItem:61YW-6H41-DY4H-K4YD-00000-00&idtype=PID&context=1516831)

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16. [*World's most comprehensive analysis of forest resources launched today in an innovative format*](https://advance.lexis.com/api/document?id=urn:contentItem:60DK-0KV1-JDG9-Y4KJ-00000-00&idtype=PID&context=1516831)

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17. [*To achieve climate-neutrality, the EU needs a carbon sink strategy. Here's why*](https://advance.lexis.com/api/document?id=urn:contentItem:61BK-J801-F0YC-N09M-00000-00&idtype=PID&context=1516831)

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18. [*Critical adjustment of land mitigation pathways for assessing countries’ climate progress*](https://advance.lexis.com/api/document?id=urn:contentItem:671W-P2B1-JCWX-C2RF-00000-00&idtype=PID&context=1516831)

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19. [*EU mulls over plan to boost carbon-storage on farmlands*](https://advance.lexis.com/api/document?id=urn:contentItem:60W0-5671-JCF9-42HX-00000-00&idtype=PID&context=1516831)

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20. [*U.S Nature4Climate Launches to Highlight Role of Natural Climate Solutions to Slow Climate Change*](https://advance.lexis.com/api/document?id=urn:contentItem:60XM-D1N1-F0YC-N3W9-00000-00&idtype=PID&context=1516831)

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21. [*European Green Deal: Commission proposes transformation of EU economy and society to meet climate ambitions*](https://advance.lexis.com/api/document?id=urn:contentItem:634X-WX21-F0YC-N27R-00000-00&idtype=PID&context=1516831)

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22. [*Irish forestry is 'net emitter of greenhouse gases'*](https://advance.lexis.com/api/document?id=urn:contentItem:615V-WN41-DYS1-053C-00000-00&idtype=PID&context=1516831)

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23. [*EU drafts plan to grow 'carbon sinks' in climate change fight*](https://advance.lexis.com/api/document?id=urn:contentItem:633D-V981-F03R-N28J-00000-00&idtype=PID&context=1516831)

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24. [*Constraints and enablers for increasing carbon storage in the terrestrial biosphere*](https://advance.lexis.com/api/document?id=urn:contentItem:693W-H851-F129-P0J8-00000-00&idtype=PID&context=1516831)

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25. [*Welcome clarification from Climate Change Committee - Barton*](https://advance.lexis.com/api/document?id=urn:contentItem:62D9-2361-F15H-216W-00000-00&idtype=PID&context=1516831)

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26. [*Eating lentils, beans and nuts instead of 'land-hungry meat and dairy' could remove up to 16 years' worth of CO2 emissions by 2050, scientists say*](https://advance.lexis.com/api/document?id=urn:contentItem:60SM-DPD1-JCJY-G103-00000-00&idtype=PID&context=1516831)

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27. [*How farmers will be paid to capture carbon*](https://advance.lexis.com/api/document?id=urn:contentItem:62PJ-6RH1-JC8V-431M-00000-00&idtype=PID&context=1516831)

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28. [*USDA Natural Resources Conservation Service Announces Signup for Funding to Remove Cogongrass Infestations in Florida*](https://advance.lexis.com/api/document?id=urn:contentItem:625T-7FK1-F0YC-N0BD-00000-00&idtype=PID&context=1516831)

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29. [*Leaving forests to regrow naturally 'could be better option than replanting'*](https://advance.lexis.com/api/document?id=urn:contentItem:60X2-FG11-JBNF-W1VC-00000-00&idtype=PID&context=1516831)

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30. [*The race to net-zero is on. This is how we can cross the finish line*](https://advance.lexis.com/api/document?id=urn:contentItem:62T4-CJ81-JDG9-Y3J6-00000-00&idtype=PID&context=1516831)

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31. [*NGOs attack plans to include carbon offsets into EU climate goals*](https://advance.lexis.com/api/document?id=urn:contentItem:60YP-K7N1-JCF9-417P-00000-00&idtype=PID&context=1516831)

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32. [*McSally Moves to Prevent Catastrophic Wildfires with New Bill*](https://advance.lexis.com/api/document?id=urn:contentItem:60W4-SDV1-JDG9-Y1HV-00000-00&idtype=PID&context=1516831)

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33. [*USDA awards new partnership projects in Washington to help mitigate climate change and protect natural resources while supporting America ’s producers*](https://advance.lexis.com/api/document?id=urn:contentItem:62JP-43F1-F0YC-N1BK-00000-00&idtype=PID&context=1516831)

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34. [*Planting 20% more trees throughout Europe could not only help climate change, but it could boost rainfall during the summer by nearly 8%*](https://advance.lexis.com/api/document?id=urn:contentItem:6331-MM11-JBNF-W2H1-00000-00&idtype=PID&context=1516831)

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35. [*EU climate plan blows hot and cold on forestry, biomass*](https://advance.lexis.com/api/document?id=urn:contentItem:60X0-TSP1-JCF9-42DR-00000-00&idtype=PID&context=1516831)

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36. [*Tree Seedlings Available Nov 2-6*](https://advance.lexis.com/api/document?id=urn:contentItem:616H-BV31-JDG9-Y2H7-00000-00&idtype=PID&context=1516831)

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37. [*Corporate-led $1bn forests scheme is ‘just the beginning’*](https://advance.lexis.com/api/document?id=urn:contentItem:62T4-RNH1-F039-608B-00000-00&idtype=PID&context=1516831)

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| News | Tijdlijn: jul 14, 2020 tot jul 14, 2021; Locatie: International; Plaats van publicatie: Europe; Taal: English |

38. [*How to save the world's forests with carbon credits*](https://advance.lexis.com/api/document?id=urn:contentItem:62VM-J6K1-F0YC-N239-00000-00&idtype=PID&context=1516831)

**Client/Matter:** -None-

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39. [*EU countries clinch new mandate for talks on climate law, raising hopes of a deal*](https://advance.lexis.com/api/document?id=urn:contentItem:62FS-1RM1-DYXB-V2NY-00000-00&idtype=PID&context=1516831)

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40. [*EU Commission clashes with Parliament over 'net' 2030 climate target*](https://advance.lexis.com/api/document?id=urn:contentItem:624T-DRR1-JCF9-42Y7-00000-00&idtype=PID&context=1516831)

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41. [*Carbon uptake in re-growing Amazon forest threatened by climate and human disturbance*](https://advance.lexis.com/api/document?id=urn:contentItem:62B9-0GS1-JDG9-Y4W1-00000-00&idtype=PID&context=1516831)

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42. [*Boris Johnson’s climate plan missing nature-based solutions, campaigners say*](https://advance.lexis.com/api/document?id=urn:contentItem:61B0-MY11-JBNF-W093-00000-00&idtype=PID&context=1516831)

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43. [*Methods for removing carbon dioxide from the air*](https://advance.lexis.com/api/document?id=urn:contentItem:60VG-B4F1-JBK9-2387-00000-00&idtype=PID&context=1516831)

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44. [*Climate change: Are forests carbon sinks or carbon sources?*](https://advance.lexis.com/api/document?id=urn:contentItem:620X-DMM1-F0YC-N32G-00000-00&idtype=PID&context=1516831)

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45. [*Green Climate Fund approves new projects*](https://advance.lexis.com/api/document?id=urn:contentItem:60NK-WHN1-JDG9-Y0S1-00000-00&idtype=PID&context=1516831)

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46. [*Is carbon offsetting really helping the planet? sustainability carbon offsetting Nick Hughes BrewDog, Accolade Wines and Cranswick are just some of the big names using offsetting to reach net zero goals. But is it effective - or simply detracting from the bigger picture?*](https://advance.lexis.com/api/document?id=urn:contentItem:62B9-3CV1-DYTY-C2MY-00000-00&idtype=PID&context=1516831)

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47. [*Green recovery post-COVID-19: Promoting healthy and restored forests*](https://advance.lexis.com/api/document?id=urn:contentItem:60YG-C941-JDG9-Y2H7-00000-00&idtype=PID&context=1516831)

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48. [*Ask an Expert The Green Glacier: What is Conifer Encroachment and Why is it Bad?*](https://advance.lexis.com/api/document?id=urn:contentItem:631X-HKW1-F0YC-N4TP-00000-00&idtype=PID&context=1516831)

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49. [*Plans submitted for solar power site*](https://advance.lexis.com/api/document?id=urn:contentItem:615H-CWR1-F0JC-M15K-00000-00&idtype=PID&context=1516831)

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50. [*Forest planting falls 70pc short of Government target for 2020*](https://advance.lexis.com/api/document?id=urn:contentItem:632Y-YX51-JCBW-N1TW-00000-00&idtype=PID&context=1516831)

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51. [*Climate and nature crises: solve both or solve neither, say experts*](https://advance.lexis.com/api/document?id=urn:contentItem:62WG-20D1-DY4H-K341-00000-00&idtype=PID&context=1516831)

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52. [*FIT FOR 55 LEGISLATIVE PACKAGE*](https://advance.lexis.com/api/document?id=urn:contentItem:634G-2K11-F0YC-N4YC-00000-00&idtype=PID&context=1516831)

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53. [*The EU's imported deforestation problem - a closer look*](https://advance.lexis.com/api/document?id=urn:contentItem:619S-JV41-DYXB-V0C2-00000-00&idtype=PID&context=1516831)

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54. [*Agrifood Brief: The agri-side of Europe's man on the moon moment*](https://advance.lexis.com/api/document?id=urn:contentItem:61VW-R821-JCF9-43YD-00000-00&idtype=PID&context=1516831)

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55. [*Lab-grown 'chicken' meat made without slaughtering any animals will go on sale in Singapore after gaining world-first regulatory approval*](https://advance.lexis.com/api/document?id=urn:contentItem:61DY-K4J1-JBNF-W0GX-00000-00&idtype=PID&context=1516831)

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56. [*Annual Climate Report 2021: Emissions in Finland declined in the exceptional year*](https://advance.lexis.com/api/document?id=urn:contentItem:6314-6JG1-JDG9-Y4TS-00000-00&idtype=PID&context=1516831)

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57. [*Reactions: Deal on EU's 2030 climate target is a big step, but won't close the gap to 2050*](https://advance.lexis.com/api/document?id=urn:contentItem:61HP-JN61-JCF9-432P-00000-00&idtype=PID&context=1516831)

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58. [*- University of Virginia : REMOVE CARBON DIOXIDE FROM THE AIR? DON'T BET ON IT BEFORE EXAMINING COSTS, RESEARCHERS SAY*](https://advance.lexis.com/api/document?id=urn:contentItem:60PG-C3J1-F0K1-N1M0-00000-00&idtype=PID&context=1516831)

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59. [*'Burn now and pay later': is net zero a dangerous trap? ScientistJames Dyke believeshumanity has gambled its civilisation on no more than promises of future solutions*](https://advance.lexis.com/api/document?id=urn:contentItem:62VJ-FJ11-F072-44W1-00000-00&idtype=PID&context=1516831)

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60. [*New Study: U.S Needs to Double Nursery Production*](https://advance.lexis.com/api/document?id=urn:contentItem:624H-FGK1-F0YC-N33B-00000-00&idtype=PID&context=1516831)

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61. [*How Nestlé is leveraging agriculture and forestry to fight climate change*](https://advance.lexis.com/api/document?id=urn:contentItem:62KM-7KD1-DYNP-M182-00000-00&idtype=PID&context=1516831)

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62. [*North Yorkshire energy boss says decarbonisation would support 17,000 local jobs*](https://advance.lexis.com/api/document?id=urn:contentItem:61W4-PSB1-F0JC-M0YW-00000-00&idtype=PID&context=1516831)

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63. [*UK greenhouse gas emissions decreased by 2.8% in 2019*](https://advance.lexis.com/api/document?id=urn:contentItem:61XC-D5B1-JDGR-53T4-00000-00&idtype=PID&context=1516831)

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64. [*Opinion: The climate crisis can't be solved by carbon accounting tricks*](https://advance.lexis.com/api/document?id=urn:contentItem:6250-SKJ1-JDG9-Y2B4-00000-00&idtype=PID&context=1516831)

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65. [*How the EU plans to reshape its economy to limit climate change*](https://advance.lexis.com/api/document?id=urn:contentItem:634S-82Y1-F039-6471-00000-00&idtype=PID&context=1516831)

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66. [*Off-farm activities are a growing share of food-system greenhouse gas emissions*](https://advance.lexis.com/api/document?id=urn:contentItem:62WG-YCT1-JDG9-Y23P-00000-00&idtype=PID&context=1516831)

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67. [*Amazon rainforest now emitting more CO2 than it absorbs*](https://advance.lexis.com/api/document?id=urn:contentItem:634R-CSH1-DY4H-K1C4-00000-00&idtype=PID&context=1516831)

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68. [*What would happen to the climate if we reforested the entire tropics?*](https://advance.lexis.com/api/document?id=urn:contentItem:62VM-J6K1-F0YC-N22Y-00000-00&idtype=PID&context=1516831)

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69. [*We can't burn our way out of the climate crisis*](https://advance.lexis.com/api/document?id=urn:contentItem:62S7-NS51-JCF9-42YB-00000-00&idtype=PID&context=1516831)

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70. [*First carbon-negative power plant*](https://advance.lexis.com/api/document?id=urn:contentItem:62TY-DRT1-JBPJ-72JH-00000-00&idtype=PID&context=1516831)

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71. [*No pollinators mean no agriculture, Commission Vice-President warns*](https://advance.lexis.com/api/document?id=urn:contentItem:6111-KYT1-JCF9-40GF-00000-00&idtype=PID&context=1516831)

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72. [*Walmart Raises Targets To Zero Emissions By 2040*](https://advance.lexis.com/api/document?id=urn:contentItem:60WN-03T1-J9XT-N190-00000-00&idtype=PID&context=1516831)

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73. [*Upward expansion and acceleration of forest clearance in the mountains of Southeast Asia*](https://advance.lexis.com/api/document?id=urn:contentItem:671W-P2M1-JCWX-C2GK-00000-00&idtype=PID&context=1516831)

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74. [*How trees and forests reduce risks from climate change*](https://advance.lexis.com/api/document?id=urn:contentItem:671W-P2B1-JCWX-C2RR-00000-00&idtype=PID&context=1516831)

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| News | Tijdlijn: jul 14, 2020 tot jul 14, 2021; Locatie: International; Plaats van publicatie: Europe; Taal: English |

75. [*CSF and Fellow Conservation Organizations Support Amendments to Regional Conservation Partnership Program (RCPP) Eligibility Criteria*](https://advance.lexis.com/api/document?id=urn:contentItem:613Y-RXP1-JDG9-Y2BP-00000-00&idtype=PID&context=1516831)

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76. [*Drax boss: We need to go further on carbon storage to hit net-zero commitments*](https://advance.lexis.com/api/document?id=urn:contentItem:61X6-T6B1-JDG9-Y51J-00000-00&idtype=PID&context=1516831)

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77. [*UN : Indigenous peoples are best guardians of Latin America's forests LATIN AMERICA FORESTS*](https://advance.lexis.com/api/document?id=urn:contentItem:6296-4G71-DYB6-53KD-00000-00&idtype=PID&context=1516831)

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78. [*IOC reveals details of its “Olympic Forest” project*](https://advance.lexis.com/api/document?id=urn:contentItem:62XY-R6T1-JDG9-Y1DH-00000-00&idtype=PID&context=1516831)

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79. [*Food–energy–water implications of negative emissions technologies in a +1.5 °C future*](https://advance.lexis.com/api/document?id=urn:contentItem:671W-P2B1-JCWX-C2JB-00000-00&idtype=PID&context=1516831)

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80. [*New research finds sage grouse populations grow faster in areas with juniper tree removal*](https://advance.lexis.com/api/document?id=urn:contentItem:62XG-WD41-JDG9-Y4WR-00000-00&idtype=PID&context=1516831)

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81. [*Deforestation and reforestation impacts on soils in the tropics*](https://advance.lexis.com/api/document?id=urn:contentItem:693W-H851-F129-P0H0-00000-00&idtype=PID&context=1516831)

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82. [*Three-quarters of the eco-friendly Generation Z 'are disgusted by lab-grown meat' and say they would NOT eat it*](https://advance.lexis.com/api/document?id=urn:contentItem:60ST-WTK1-F021-617X-00000-00&idtype=PID&context=1516831)

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83. [*Sustainable farming needs reform and new blood Letters*](https://advance.lexis.com/api/document?id=urn:contentItem:62DT-HKT1-DYTY-C15G-00000-00&idtype=PID&context=1516831)

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84. [*Manulife sets out net zero road map*](https://advance.lexis.com/api/document?id=urn:contentItem:62M7-K2J1-DXSP-90M7-00000-00&idtype=PID&context=1516831)

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85. [*Nestlé sets carbon target for KitKat : ‘We are reducing and removing emissions to reach carbon neutrality by 2025’*](https://advance.lexis.com/api/document?id=urn:contentItem:62GV-M5D1-JC6M-X2T3-00000-00&idtype=PID&context=1516831)

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86. [*Congressman Panetta, Colleagues Introduce Bipartisan, Bicameral Legislation to Plant 1.2 Billion Trees on National Forests*](https://advance.lexis.com/api/document?id=urn:contentItem:627R-F6B1-JDG9-Y147-00000-00&idtype=PID&context=1516831)

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87. [*Forestry - all eyes on the future*](https://advance.lexis.com/api/document?id=urn:contentItem:611N-S0S1-F0JC-M3S4-00000-00&idtype=PID&context=1516831)

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88. [*5 facts you might not know about why forest biodiversity matters*](https://advance.lexis.com/api/document?id=urn:contentItem:624K-W9R1-F0YC-N0NH-00000-00&idtype=PID&context=1516831)

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89. [*- Cornell University : Green practices can negate climate emissions on NY farms*](https://advance.lexis.com/api/document?id=urn:contentItem:60KG-8TN1-F0K1-N0N9-00000-00&idtype=PID&context=1516831)

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90. [*The battle for a greener economy*](https://advance.lexis.com/api/document?id=urn:contentItem:62GS-C511-JCBW-N3T4-00000-00&idtype=PID&context=1516831)

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91. [*Grant Opens Door to Find Ways to Improve Our Land, Water and Economy*](https://advance.lexis.com/api/document?id=urn:contentItem:612P-18B1-F0YC-N21P-00000-00&idtype=PID&context=1516831)

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92. [*Pacific Women lead the region in combating deforestation and forest degradation*](https://advance.lexis.com/api/document?id=urn:contentItem:60G2-4W01-JDG9-Y4JY-00000-00&idtype=PID&context=1516831)

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93. [*Shaheen & Hassan Join Bipartisan Push to Support Renewable Energy & New Hampshire ’s Forest Products Industry*](https://advance.lexis.com/api/document?id=urn:contentItem:62H2-9KX1-F0YC-N3P8-00000-00&idtype=PID&context=1516831)

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94. [*Everyday shopping from brands like Heinz and Yakult helps destroy rainforests, report claims*](https://advance.lexis.com/api/document?id=urn:contentItem:61WF-KCS1-DY4H-K2V0-00000-00&idtype=PID&context=1516831)

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95. [*Sens. Braun, Coons introduce bipartisan climate legislation to support global Trillion Trees initiative & combat deforestation*](https://advance.lexis.com/api/document?id=urn:contentItem:61GN-DF71-F0YC-N021-00000-00&idtype=PID&context=1516831)

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96. [*Mondelēz plants more than 2.2m non-cocoa trees to help restore ecosystems on cocoa farms*](https://advance.lexis.com/api/document?id=urn:contentItem:62JJ-CMG1-DYNP-M0MT-00000-00&idtype=PID&context=1516831)

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97. [*Net zero emissions in agriculture*](https://advance.lexis.com/api/document?id=urn:contentItem:619Y-2MW1-F0YC-N2PG-00000-00&idtype=PID&context=1516831)

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98. [*Bennet Joins Colleagues in Calling for Investments in Natural Infrastructure Restoration, Resilience in American Jobs Plan*](https://advance.lexis.com/api/document?id=urn:contentItem:6324-BD01-F0YC-N3Y1-00000-00&idtype=PID&context=1516831)

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99. [*Radionuclides from the Fukushima Daiichi Nuclear Power Plant in terrestrial systems*](https://advance.lexis.com/api/document?id=urn:contentItem:693W-H851-F129-P0H8-00000-00&idtype=PID&context=1516831)

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100. [*Congressman Panetta Introduces Bipartisan Legislation to Restore America ’s National Forests*](https://advance.lexis.com/api/document?id=urn:contentItem:60GP-P2M1-F0YC-N03T-00000-00&idtype=PID&context=1516831)

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# [***Global maps of twenty-first century forest carbon fluxes***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:671W-P2B1-JCWX-C2NX-00000-00&context=1516831)

Nature Climate Change

January 2021

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**Section:** Pg. 234-240; Vol. 11; No. 3; ISSN: 1758-678X,1758-6798

**Length:** 8362 words

**Byline:** [*nharris@wri.org*](mailto:nharris@wri.org)

**Body**

Main

Climate change must be addressed by various actors including scientists, policymakers, companies, investors and civil society, all of whom operate under different mandates and capabilities. Both IPCC reports, and the Paris Agreement recognize that climate change mitigation goals cannot be achieved without a substantial contribution from ***forests*** but monitoring the extent to which ***forests*** impact atmospheric greenhouse gas (GHG) concentrations is challenging. Opposing fluxes (***emissions*** from sources (+) and ***removals*** by sinks (-)) occur simultaneously within regions on the basis of where and when disturbance and management take place, interannual variability can be high and ***land***-use patterns are more dynamic and operate on finer spatiotemporal scales than reflected in most global models. Furthermore, ability to distinguish anthropogenic from non-anthropogenic effects is limited on the basis of direct observation and most estimation methods offer few details about where, when and why ***forest*** fluxes occur. Yet understanding the magnitude, drivers and spatial distribution of carbon fluxes across the world’s ***forests***, and how they can be managed both to reduce ***emissions*** and enhance ***removals***, is increasingly important for climate policy and the various actors developing nature-based solutions.

Current estimates of terrestrial GHG fluxes vary with respect to scope, definitions, assumptions and level of transparency and completeness. At the global scale, the net annual carbon dioxide (CO2) flux from anthropogenic ***land***-use and ***land***-cover change—driven mainly by tropical deforestation—is estimated in IPCC reports, and the Global Carbon Project by a bookkeeping model, or by dynamic global vegetation models. The remaining non-anthropogenic sink of atmospheric carbon on ***land***—predominantly ***forests***—is then inferred as the residual of the other terms of the global carbon budget. Another approach compiles national GHG inventories (GHGIs), which reflect methodologies developed by the IPCC and agreed to under the United Nations Framework Convention on Climate Change,. The quality, methodological complexity and sources of data used by each country vary, as do the completeness and frequency of reporting. These approaches produce dissimilar global net ***forest*** fluxes; GHGI estimates compiled from country reports are 4.3 GtCO2 yr−1 lower than global estimates from models summarized in IPCC reports—a discrepancy larger than the total annual ***emissions*** of India, the world’s third highest emitter. A substantial part of this discrepancy (about 3.2 GtCO2 yr−1) can be explained by conceptual differences in what is counted in the anthropogenic ***forest*** sink. Beyond this large disparity in global estimates, data and methodological mismatches also exist across project, subnational and national ***forest*** GHG measurement systems, leading to complications around integrating smaller-scale activities into larger national or subnational monitoring programmes and around the potential international transfer of ***forest***-related ***emission*** reductions versus those achieved as part of a country’s own nationally determined contribution. In sum, the complexity and lack of spatial detail in GHG measurement systems contributes to confusion about the role ***forests*** play in climate mitigation ***targets*** and discourages the transformational action and ambition needed in the ***forest*** sector to achieve global climate goals.

Here, we introduce a transparent, independent and spatially explicit global system for monitoring the collective impact of ***forest***-related climate policies implemented by diverse actors across multiple scales. We complement existing global ***forest*** carbon flux estimation approaches of large area vegetation models and aggregation of national inventories with a third approach that capitalizes on recent advances in Earth observation. Using recently revised IPCC guidelines as a methodological framework,, we separately map GHG ***emissions*** (sources) and carbon dioxide ***removals*** (sinks) from global ***forest*** ***lands*** at 30-m resolution between 2001 and 2019 (). Areas of ***forest*** extent, loss and gain from the Global ***Forest*** Change product of Hansen et al. form the basis of the activity data. By co-locating activity data with spatially explicit ***emission*** and ***removal*** factors developed from integrating ground and Earth observation monitoring data on ***land*** use and management type, ***forest*** type, ***forest*** age class, fire history and biomass and soil carbon stocks, we separately map gross annual carbon ***removals*** occurring within natural, seminatural and planted ***forests*** and gross annual ***emissions*** arising from five dominant drivers of ***forest*** disturbance. We then map the difference between gross ***emissions*** (+) and gross ***removals*** (−) as the net annual ***forest***-related GHG flux, which may be positive or negative in an area depending on the balance of gross fluxes. Tracking gross ***emissions*** and ***removals*** separately, rather than solely the net balance between the two, underscores the dual role of ***forests*** as sources and sinks in the global carbon cycle and facilitates more complete and transparent accounting of the individual pathways involved in ***forest***-based mitigation (reducing ***emissions*** and increasing ***removals***).

Global distribution of ***forest*** ***emissions*** and ***removals***

Between 2001 and 2019, deforestation and other satellite-observed ***forest*** disturbances resulted in global gross GHG ***emissions*** of 8.1 ± 2.5 GtCO2e yr−1 (mean ± s.d.). Carbon dioxide (CO2) was the dominant GHG; methane (CH4) and nitrous oxide (N2O) ***emissions*** from stand-replacing ***forest*** fires and drainage of organic soils in deforested areas accounted for 1.1% of gross ***emissions*** (0.088 GtCO2e yr−1). Over the same period, gross carbon ***removals*** by ***forest*** ecosystems were −15.6 ± 49 GtCO2e yr−1. Taken together, the balance of these opposing fluxes (gross ***emissions*** and gross ***removals***) yields a global net GHG ***forest*** sink of −7.6 ± 49 GtCO2e yr−1 (Table and Fig. ). The large uncertainties in global gross ***removals*** and net flux are almost entirely due to extremely high uncertainty in ***removal*** factors from the IPCC Guidelines applied to old secondary temperate ***forests*** outside the United States and Europe (Supplementary Table ).

***Forest***-related GHG fluxes by climate domain and ***forest*** type

| **Climate domain** | ***Forest* type** | ***Forest* extent 2000 (Mha)** | **GtCO2e yr?1, 2001?2019** | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Gross *emissions*** | **Percentage of global total** | **Gross *removals*** | **Percentage of global total** | **Net GHG flux** | **Percentage of global totald** |
| Boreal | Primarya | 38 | 0.26 | 3.2 | ?0.044 | 0.28 | 0.22 |  |
| Old secondary (>20 yr) | 1,030 | 0.60 | 7.4 | ?2.4 | 15 | ?1.8 |  |  |
| Young secondary (?20 yr) | 22 | 0.015 | 0.19 | ?0.037 | 0.24 | ?0.022 |  |  |
| Plantations/tree cropsb | 0.21 | 0.000056 | 0.00070 | ?0.0027 | 0.017 | ?0.0027 |  |  |
| **Total boreal** | **1,090** | **0.88** ± **0.42** | **11** | **?2.5** ± **0.96** | **16** | **?1.6** ± **1.1** | **21** |  |
| Temperate | Primarya | 2.3 | 0.036 | 0.45 | ?0.0092 | 0.059 | 0.027 |  |
| Old secondary (>20 yr) | 560 | 0.71 | 8.8 | ?4.2 | 27 | ?3.5 |  |  |
| Young secondary (?20 yr) | 16 | 0.049 | 0.60 | ?0.039 | 0.25 | 0.0092 |  |  |
| Plantations/tree cropsb | 12 | 0.071 | 0.88 | ?0.14 | 0.92 | ?0.073 |  |  |
| **Total temperate** | **590** | **0.87** ± **0.60** | **11** | **?4.4** ± **48** | **28** | **?3.6** ± **48** | **47** |  |
| Subtropical | Primarya | 3.6 | 0.0062 | 0.076 | ?0.0058 | 0.037 | 0.00035 |  |
| Old secondary (>20 yr) | 270 | 0.46 | 5.7 | ?0.84 | 5.4 | ?0.38 |  |  |
| Young secondary (?20 yr) | 13 | 0.11 | 1.3 | ?0.067 | 0.43 | 0.040 |  |  |
| Plantations/tree cropsc | 54 | 0.40 | 5.0 | ?0.71 | 4.6 | ?0.31 |  |  |
| Mangroves | 0.070 | 0.000066 | 0.00082 | ?0.0040 | 0.026 | ?0.0040 |  |  |
| **Total subtropical** | **340** | **1.0** ± **0.59** | **12** | **?1.6** ± **0.56** | **10** | **?0.65** ± **0.81** | **8.6** |  |
| Tropical | Primarya | 1,010 | 1.8 | 22 | ?1.9 | 12 | ?0.12 |  |
| Old secondary (>20 yr) | 880 | 1.9 | 23 | ?3.8 | 24 | ?1.9 |  |  |
| Young secondary (?20 yr) | 47 | 0.76 | 9.5 | ?0.40 | 2.5 | 0.37 |  |  |
| Plantations/tree cropsc | 47 | 0.89 | 11 | ?0.73 | 4.7 | 0.16 |  |  |
| Mangroves | 7.2 | 0.010 | 0.12 | ?0.16 | 1.0 | ?0.15 |  |  |
| **Total tropical** | **1,990** | **5.3** ± **2.4** | **66** | **?7.0** ± **7.6** | **45** | **?1.7** ± **8.0** | **22** |  |
| Global | Primary | 1,060 | 2.1 | 26 | ?2.0 | 13 | 0.13 |  |
| Old secondary (>20 yr) | 2,750 | 3.7 | 45 | ?11 | 72 | ?7.7 |  |  |
| Young secondary (?20 yr) | 99 | 0.9 | 12 | ?0.54 | 3.5 | 0.39 |  |  |
| Plantations/tree crops | 113 | 1.4 | 17 | ?1.6 | 10 | ?0.23 |  |  |
| Mangroves | 8.7 | 0.012 | 0.14 | ?0.20 | 1.3 | ?0.19 |  |  |
| **Total global** | **4,029** | **8.1** ± **2.5** | **100** | **?16** ± **49** | **100** | **?7.6** ± **49** | **100** |  |

Average annual gross GHG ***emissions***, gross GHG ***removals*** and net GHG fluxes across global ***forest*** ***lands*** between 2001 and 2019. Estimates reflect ***forest*** ecosystem fluxes only; harvested wood products are excluded. Uncertainties are expressed as s.d. Large uncertainties in net flux estimates should be interpreted with caution; s.d. are very large relative to the estimates in part because net flux estimates reflect the sum of negative (***removals***) and positive (***emissions***) terms, complicating the combination of their error terms.

aThe extent of primary ***forests*** was delineated differently for tropical and extratropical regions ().

bFluxes occurring within seminatural managed ***forests*** are reported in the relevant secondary ***forest*** category (old or young).

cFluxes reported in the plantation/tree crop category include those associated with conversion of natural ***forests*** to plantations or tree crops (for example, oil palm) over the 2001–2019 analysis period.

dCalculating percentages of net flux by ***forest*** type is complicated by the mixture of sources and sinks among ***forest*** types, and is thus omitted.

***Forest***-related GHG fluxes (annual average, 2001–2019).

a, Gross annual GHG ***emissions***. b, Gross annual GHG ***removals***. c, Net annual GHG flux. For display purposes, maps have been resampled from the 30-m observation scale to a 0.04° geographic grid. Values in the legend reflect the average annual GHG flux from all ***forest*** dynamics occurring within a grid cell, including ***emissions*** from all observed disturbances and ***removals*** from both ***forest*** regrowth after disturbance as well as ***removals*** occurring in undisturbed ***forests***.

Tropical and subtropical ***forests*** contributed the most to global gross ***forest*** fluxes, accounting for 78% of gross ***emissions*** (6.3 ± 2.4 GtCO2e yr−1) and 55% of gross ***removals*** (−8.6 ± 7.6 GtCO2e yr−1) (Table ). While these ***forests*** removed more atmospheric carbon than temperate and boreal ***forests*** on a gross basis (−8.6 versus −4.4 and −2.5 GtCO2e yr−1, respectively), tropical and subtropical ***forests*** contributed just 30% to the global net carbon sink; about two-thirds of the global net sink was in temperate (47%) and boreal (21%) ***forests***, resulting from substantially lower gross ***emissions*** there than in the subtropics and tropics (0.87 and 0.88 versus 6.3 GtCO2e yr−1, respectively).

Just six large ***forested*** countries (Brazil, Canada, China, Democratic Republic of the Congo, Russia and the United States) accounted for 51% of global gross ***emissions***, 56% of global gross ***removals*** and 60% of net flux. ***Forests*** in nearly all countries were net carbon negative, that is, gross carbon ***removals*** from established and regrowing ***forests*** exceeded gross ***emissions*** from ***land***-use change and other ***forest*** disturbances. The main exceptions were in Indonesia, Malaysia, Cambodia and Laos, where annual gross ***emissions*** across these countries (1.36 GtCO2e yr−1), including peat drainage and burning (0.14 GtCO2e yr−1), exceeded gross ***removals*** (−0.83 GtCO2e yr−1) (Fig. ). Globally, 72% of gross ***removals*** were concentrated in older (>20 yr) secondary natural and seminatural ***forests***, 12% in tropical primary ***forests***, 10% in plantations, 3.5% in young (<20 yr) ***forest*** regrowth, 1.3% in mangroves and 0.34% in boreal and temperate intact ***forest*** landscapes (Table ).

Gross and net GHG fluxes from ***forests*** by region (annual average, 2001–2019).

Net ***forest***-related fluxes (grey bars) are shown with their two component gross fluxes: gross ***emissions*** from ***land***-use change and other ***forest*** disturbances (purple) and gross ***removals*** occurring in undisturbed ***forests*** as well as ***removals*** from ***forest*** regrowth after disturbance (green). The top five countries per region are ranked high to low on the basis of gross ***emissions***, with all other countries in the region grouped into ‘other countries’.

Fluxes for specific localities and drivers of ***forest*** change

Our analysis enables consistent evaluation of ***forest*** GHG dynamics across scales and in custom geographies beyond national or climate domain boundaries (Fig. ). For example, ~27% of the global net ***forest*** GHG sink occurred within protected areas. ***Forests*** in the Brazilian Amazon were a net carbon source of 0.22 GtCO2e yr−1 between 2001 and 2019, whereas ***forests*** across the larger Amazon River basin—encompassing 514 Mha of ***forests*** across nine countries—were a net carbon sink of −0.10 GtCO2e yr−1. Although smaller in extent than the Amazon, the net sink in ***forests*** of Africa’s Congo River basin (298 Mha) was approximately six times stronger (−0.61 GtCO2e yr−1), reflecting nearly identical gross ***removals*** (−1.1 versus −1.2 GtCO2e yr−1) but gross ***emissions*** that were half those of the Amazon basin (0.53 versus 1.1 GtCO2e yr−1).

From overlaying ***forest*** GHG flux maps in Fig. with a global map of dominant drivers of ***forest*** disturbance, we estimate that commodity-driven deforestation was the largest source of gross ***forest***-related ***emissions*** between 2001 and 2019 (2.8 GtCO2e yr−1) and occurred primarily in the rainforests of South America and Southeast Asia. ***Forests*** in shifting ***agriculture*** landscapes, a dominant ***land*** use in the tropics characterized by cycles of small-scale ***forest*** clearing of both primary and secondary ***forests*** followed by secondary regrowth, contributed another 2.1 GtCO2e yr−1 to gross ***emissions*** and −3.3 GtCO2 yr−1 to gross ***removals***, leading to a net sink in these areas of −1.2 GtCO2e yr−1. Gross ***emissions*** from stand-replacing ***forest*** fires, occurring primarily in temperate and boreal ***forests***, averaged 0.69 GtCO2e yr−1. Forestry-dominated landscapes, comprised of both plantations and natural and seminatural ***forests***, were a net sink of −3.3 GtCO2e yr−1 between 2001 and 2019. This reflects 2.4 GtCO2 yr−1 of gross ***emissions*** from harvest offset by −5.5 GtCO2 yr−1 of gross ***removals*** from ***forest*** management and regeneration and −0.16 GtCO2e yr−1 of increased carbon storage in harvested wood products.

A flexible data integration framework

The IPCC Guidelines used as the overarching methodological framework in this analysis, provide three tiers of methods, parameters and data sources for GHG flux estimation, where progression from Tier 1 to Tier 3 generally results in more accurate and precise estimates at the expense of more analytical complexity and larger data requirements. For ***forests***, Tier 3 estimates are characterized by the incorporation of repeated, country-specific measurements over time but the ***land***-use definitions and the spatial scale of data sources chosen can impact the resulting estimates. Therefore, in addition to estimating uncertainty in GHG estimates within geographies for which information was available to do so (climate domains), we also conducted sensitivity analyses to demonstrate how estimates change as data inputs and model assumptions are varied within our spatial data integration framework (). At the global scale, GHG flux estimates were relatively insensitive to changes in model assumptions; estimates for most pixels changed less than 15% in either direction and sources stayed sources while sinks stayed sinks.

However, estimates were more affected by changes in data sources, particularly at local scales. For example, replacing the global 30-m biomass map developed in this study as the basis of ***emission*** factors (Extended Data Fig. ) with a coarser (1-km) resolution biomass map produced by Saatchi et al. for the tropics produced 12% lower gross GHG ***emissions*** there than our original estimate. Replacing the 30-m annual tree cover loss data from Hansen et al. in the Brazilian Amazon with annual ***forest*** loss data from Brazil’s national ***forest*** monitoring system, which excludes deforestation events smaller than 6.25 ha, reduced average gross ***emissions*** there from 1.1 to 0.74 GtCO2e yr−1. This difference arises from increased detection of ***emissions*** from small ***forest*** clearings. Both examples highlight the value of our spatially detailed approach in capturing more changes and larger fluxes occurring at small scales where many human-induced ***forest*** changes are occurring. In the United States, replacing Tier 3 ***removal*** factors estimated specifically for US ***forest*** types and age classes from repeated inventory measurements with generalized Tier 1 defaults from the updated IPCC Guidelines led to a 38% stronger net carbon sink there than the original estimate. (See Supplementary Table and Extended Data Figs. – for additional examples.) These analyses quantitatively and spatially demonstrate tradeoffs between globally consistent analyses and locally derived values that are difficult to aggregate globally and may not be available or comparable across regions. The flexible spatial data integration framework introduced here enhances science-policy coordination by providing a more systematic, structured, transparent and verifiable system for exploring differences in data, assumptions and resulting estimates than what has been available previously.

***Forest*** fluxes in the global carbon budget

Our results are not directly comparable to other global estimates because other estimates typically reflect all terrestrial fluxes (versus ***forests*** only), report only net fluxes (versus gross and net fluxes), include only CO2 (versus all relevant GHGs) and make assumptions to partition between anthropogenic and non-anthropogenic net fluxes,. While the spatial, observation-based framework introduced here permits estimation of fluxes for any ***forest*** definition and the inclusion (or exclusion) of any geographic area of interest, it cannot distinguish between anthropogenic versus non-anthropogenic effects or between managed versus unmanaged ***land*** until the requisite spatial data become available to differentiate them. When considering only CO2 fluxes to improve comparability with the Global Carbon Budget, we estimate a larger net CO2 sink by ***forest*** ecosystems (−7.8 GtCO2 yr−1) than its estimate of −5.2 GtCO2 yr−1 for all terrestrial fluxes over the same time period. One potential reason for this difference is that our model underestimates gross ***forest***-related ***emissions*** due to the exclusion of ***forest*** disturbances that go undetected and unquantified in the medium resolution satellite observations that underpin our analysis. Gross ***emissions*** from tropical ***forest*** degradation have been estimated as 2.1 GtCO2e yr−1, with selective logging, fuelwood harvest and non-stand-replacing fires accounting for 53, 30 and 17% of the total, respectively. Adding this (non-spatial) estimate of gross degradation ***emissions*** to our satellite-based gross carbon ***emission*** and ***removal*** estimates occurring within ***forest*** ecosystems, as well as −0.16 GtCO2 yr−1 of net ***removals*** in harvested wood products, yields a revised net ***forest***-atmosphere CO2 flux of −5.8 GtCO2 yr−1 (Table ). Taken together, these estimates of gross ***removals*** (−15.6 GtCO2 yr−1) and gross ***emissions*** related to ***forests*** (including degradation: 10 GtCO2 yr−1) appear to nearly balance the global carbon budget (Table ) but other important fluxes are omitted from our analysis such as those occurring within grasslands, semi-arid savannas and shrublands (due to the 30% per 5 m of tree cover definition used in our analysis), non-stand-replacing fires, degradation outside the tropics and other terrestrial fluxes not previously included in any global budget to date. We include Table to highlight how our gross estimates of ***forest***-related fluxes fit within the context of the global carbon budget but our research is geared towards highlighting ***forest*** ***emission*** and ***removal*** hotspots for policy-relevant applications and stakeholders (Fig. ), not towards producing a comprehensive and precise accounting of the full terrestrial carbon budget.

Comparison of results from this study to the Global Carbon Project, 2001–2018

| **Global carbon budget, 2001?2018 (GtCO2 yr?1)** | | | |
| --- | --- | --- | --- |
| **Global Carbon Project** | | **This study** | |
| **Sources** |  |  |  |
| Fossil fuel and cement | 32.0 | Fossil fuel and cement | 32.0 |
| ***Land***-use change (net, anthropogenic)a | 5.3 | ***Forests*** (gross, all observed disturbances)b | 7.9 |
|  |  | ***Forests*** (gross, unobserved ***emission*** sources)c | 2.1 |
| **Total sources** | **37.3** |  | **42.0** |
| **Sinks** |  |  |  |
| Atmosphere | 16.9 | Atmosphere | 16.9 |
| Ocean | 8.7 | Ocean | 8.7 |
| Terrestrial (net, non-anthropogenic)d | 10.5 | ***Forests*** (gross, all ***forests***)e | 15.6 |
|  |  | Harvested wood products | 0.16 |
| **Total sinks** | **36.1** |  | **41.4** |
| ***Land*** (net, all ***land***) | ?5.2 | ***Forests*** (net, all ***forests***)f | ?5.8 |
| Budget imbalanceg | 1.2 |  | 0.6 |

Estimates from the Global Carbon Project (GCP) and this study are not directly comparable due to differences in scope (all ***land*** versus ***forests***, respectively), data, methodologies and reporting structure. In GCP reporting, ***land***-use change ***emissions*** (sources) reflect the net balance between anthropogenic ***emissions*** (+) and ***removals*** (–), thus the net ***emission*** estimate is lower than gross ***emissions*** reported in this study. Similarly, gross ***removals*** reported in this study reflect ***removals*** across all ***forest*** ***lands***, including ***removals*** implicit (but unreported) in the net ***land***-use change estimate of GCP.

aEstimates only net direct anthropogenic effects, including deforestation, afforestation/reforestation and wood harvest. Gross fluxes higher but not reported.

bGross ***emissions*** from all ***forest*** disturbances (anthropogenic and non-anthropogenic) observed from Landsat data. Estimate includes CO2 only for comparability with GCP; non-CO2 ***emissions*** are 0.086 GtCO2e yr−1.

cGross ***emissions*** from ***forest*** degradation in 74 developing countries covering 2.2 billion hectares of ***forest***, from Pearson et al..

dIn IPCC’s Fifth Assessment Report, calculated as the residual of all other terms in the carbon budget.

eGross ***removals*** from all ***forest*** processes (direct, indirect and natural).

fCalculated as the net balance between gross ***forest*** ecosystem ***emissions*** and ***removals*** (7.9 + 2.1–15.6 GtCO2 yr−1) plus an additional net ***removal*** of −0.16 GtCO2 yr−1 in harvested wood products.

gBudget imbalance is the difference between total sources and total sinks.

Limitations and future improvements

All ***forest*** monitoring systems reflect a balance between data availability, scale of applicability, measurement costs, reducing uncertainties and other constraints. Given the urgency of addressing climate change, the time and costs required to develop monitoring systems that reduce uncertainties as far as practicable must be balanced against the potential benefits of publicly accessible, operational and fit-for-purpose systems that provide enough spatial detail to incentivize real, near-term and sustained investment in nature-based climate solutions on the ground. In this study, we combined publicly available data into a global monitoring framework that generates consistent information on ***forest*** carbon fluxes cost-effectively over large spatial scales. However, this approach encounters limitations that should be addressed as research progresses.

First, the global ***forest*** change data used as the basis of activity data in our analysis are spatially detailed but contain temporal inconsistencies. While the ***forest*** loss product is updated annually through 2019, gain has not been updated past 2012 and represents a cumulative total (2000–2012). Therefore, although gross ***emissions*** can be estimated annually (Extended Data Fig. ), estimating annual trends in gross ***removals*** and net flux is limited by a lack of a consistent time series on ***forest*** regrowth. Globally, GHG flux estimates were relatively insensitive to this limitation; we estimate that expansion of ***forest*** extent observed after 2000 accounted for less than 5% of global gross carbon ***removals***, with the vast majority occurring instead in ***forests*** established before 2000. However, accurate monitoring of the timing of recent regrowth becomes more important in local contexts where rapid ***forest*** loss/gain dynamics are occurring, such as in plantations with short rotation cycles and other dynamic areas dominated by intensive forestry or short-fallow shifting cultivation systems (Extended Data Fig. ). Temporal inconsistencies are also present within the global loss product; one algorithm covers years 2001–2010 and another covers 2011–2019, with later years of loss likely to be more sensitive to changes related to small-scale ***agriculture***, fires and other forms of ***forest*** degradation. For these reasons, we report only long-term averages and not annual trends in ***forest*** GHG fluxes. A forthcoming ‘version 2’ global tree cover loss product and an improved global gain product, already piloted for the lower Mekong region of Southeast Asia, will improve temporal consistency. Incorporating these improvements into the ***forest*** GHG flux model will more accurately capture interannual variability in ***emissions*** and ***removals*** over time and will thus provide a consistent basis for more temporally detailed monitoring of the long-term net impact of ***forests*** on atmospheric GHGs.

Second, information is currently lacking to develop globally consistent and spatially detailed maps of ***forest*** carbon ***removals***. In our analysis, uncertainty in gross ***removals*** is substantially higher than uncertainty in gross ***emissions***, driven primarily by high uncertainty in ***removal*** factors for established ***forests*** in temperate regions (Table and Supplementary Table ). Through the integration of ground and Earth observation data, several biomass and soil carbon maps have been developed that inform spatially explicit ***emission*** factors. However, accurate and precise estimation of ***forest*** carbon ***removal*** factors requires information derived from long-term ***forest*** inventories applied consistently and repeatedly through time across different ***forest*** types and age classes. For many of the world’s ***forests***, this information does not exist. Many developing countries have not completed their first ***forest*** inventory, let alone repeated inventories. Efforts to combine georeferenced plot networks with other spatially explicit data inputs to create maps over large scales of ***forest*** carbon accumulation rates over time, similar to what has been done to develop biomass density maps at a single point in time, have begun but are still in their infancy. We therefore applied ***removal*** factors using a stratification approach, where each ***forest*** pixel is assigned a ***removal*** factor on the basis of its geographic region, ***forest*** type and age class (). ***Removal*** factors reflect both ecological ***forest*** dynamics (tree growth, mortality and recruitment through natural regeneration) and indirect effects (long-term increases in atmospheric CO2 concentrations and temperature, nutrient fertilization). Going forward, new satellite missions such as GEDI, ICESAT-2 and BIOMASS will provide repeated measurements of ***forest*** height and biomass over time that should improve understanding of spatial variation in rates of carbon ***removal*** across heterogeneous ***forest*** landscapes.

The global ***forest*** carbon monitoring framework introduced here, and the main improvements identified above, allow for efficient prioritization and evaluation of how data updates and improvements influence GHG flux estimates and their uncertainties. As satellite- and ground-based ***forest*** monitoring improve, so too will the associated ***forest*** GHG flux estimates.

Conclusions

Our analysis reinforces the need to reduce gross ***emissions*** from tropical deforestation as a climate change mitigation strategy, while also highlighting the substantial but often underappreciated contribution of intact primary and older secondary ***forests*** to carbon dioxide ***removals***. Quantifying gross ***emissions*** and ***removals*** separately and consistently across all ***forest*** ***lands***—and producing maps in addition to tabular statistics—improves transparency in the accounting of factors and geographies contributing to the global net ***forest*** GHG flux. It also provides a framework to integrate new and improved data sources over time. Governments interested in spatially prioritizing implementation and tracking of national and subnational ***forest*** mitigation ***targets*** can increasingly make use of such data. Non-government actors, such as companies aiming to reduce ***emissions*** from deforestation associated with commodity supply chains and emerging market mechanisms considering the inclusion of ***forests*** for carbon offset programs, could benefit from a globally consistent and spatially explicit ***forest*** monitoring system developed using the same internationally accepted methods as national governments use but based on independent observations and with GHG estimates that can be linked to individual actions and generated at scales relevant to diverse climate-related policies, programmes and stakeholders.

The goals of the Paris Agreement—primarily, net zero anthropogenic ***emissions*** in the second half of this century—create an imperative to track ***forest***-related ***emissions*** and ***removals*** transparently and at scales that link more closely to mitigation activities on the ground. As the capacity of national governments to collect, process and analyse data continues to improve, the global ***forest*** carbon monitoring framework introduced here can help to enhance transparency, inform ***forest***-related climate policy and implementation initiatives, underpin independent technical assessments, reconcile differences between national reports and scientific studies, and provide a more consistent and comparable basis for tracking progress at local scales and for assessing atmospheric impacts of global ***forest*** change under the Paris Agreement’s forthcoming Global Stocktake.

Methods

Study design and scope

We mapped gross and net GHG ***emissions*** by sources and ***removals*** by sinks from global ***forest*** ***lands*** by synthesizing information collected from more than 637,000 ground plots, 707,561 waveform lidar observations and other satellite data into a spatial ***forest*** carbon monitoring framework. The analysis covers 2001 to 2019 but can be extended to include later years as data are updated. To the extent possible, we adhered to IPCC Guidelines developed for the ***agriculture***, forestry and other ***land*** use (AFOLU) sector,. In the context of IPCC ***land***-use categories, our analysis covers only ***forest***-related transitions (***forest*** to non-***forest***, non-***forest*** to ***forest*** and ***forest*** remaining ***forest***). We applied the IPCC gain-loss method (versus the stock-difference method), in which ***forest*** carbon (C) stocks in five ecosystem pools were estimated for a base year (2000) after which changes in C stocks were estimated by considering both annual C losses from ***land***-use change and disturbance (conventionally represented by a + sign) as well as annual C gains from ***forest*** regrowth (represented by a – sign). We included harvested wood products as a sixth (human-created) carbon pool. We also included methane (CH4) and nitrous oxide (N2O) ***emissions*** from stand-replacement ***forest*** fires and drainage of organic soils associated with a loss of tree cover. We summarized GHG fluxes across all relevant gases and reported in units of CO2 equivalents (CO2e) using 100-yr Global Warming Potentials (without climate feedbacks) from the IPCC Fifth Assessment Report.

We set all data inputs to a common resolution of 0.00025° × 0.00025° to match the resolution of Landsat-based tree cover change data of Hansen et al.. Gross ***emissions*** and ***removals*** were modelled at this common resolution across approximately 90 billion individual pixels of global ***forest*** cover (defined below). We resampled all input layers to this resolution so that outputs can be flexibly aggregated to larger scales. Extended Data Fig. summarizes the overall conceptual approach and Supplementary Table provides a list of data inputs.

***Forest*** definition and extent

Initially, we defined ***forest*** extent in the year 2000 similarly to Hansen et al., that is, any 30-m Landsat pixel that met a tree canopy threshold of at least 30% with trees taller than 5 m in height. This initial definition included natural and seminatural ***forests***, plantations and ***agricultural*** tree crops such as oil palm and agroforestry systems where minimum height and cover thresholds were met. On the basis of available data, we made four modifications to the original tree cover map to refine our global map of ***forest*** extent:

We included pixels of tree cover gain since 2000 in addition to tree cover already present in the year 2000.

We included only tree cover pixels that also had a corresponding value in the aboveground biomass density map (0.031% of tree cover pixels lacked a biomass value).

We excluded all areas of tree cover falling within oil palm plantation boundaries mapped for the year 2000 in Indonesia and Malaysia–.

We replaced tree cover extent from Hansen et al. with mangrove ***forest*** extent using data from Giri et al.; in areas of geographic overlap, mangroves had priority.

***Forest*** aboveground live biomass density in 2000

We created a year 2000 map of aboveground live biomass density (AGB, in Mg ha−1) at 30-m resolution by combining two maps: one developed specifically for mangroves and the other developed to cover all woody vegetation globally (Supplementary ). In areas of geographic overlap, the mangrove biomass map had priority. The basic approach is the same as that used to map tropical biomass at 500-m (ref. ) and 30-m (ref. ) resolution; published height–biomass equations were applied to estimate biomass over specific regions and ***forest*** types around the world (Extended Data Fig. ). These equations, developed by linking observations from airborne or spaceborne lidar to 20,347 ground-measured biomass plots, were applied to estimate aboveground biomass density from spaceborne lidar observations across 707,561 locations globally. To create a continuous biomass map (Extended Data Fig. ), separate random ***forest*** models were trained for each of six biogeographic realms using predictor variables of Landsat imagery (bands 3, 4, 5 and 7), normalized difference vegetation index (NDVI), normalized difference infrared index (NDII), mean percentage tree cover, mean elevation, mean slope and monthly mean precipitation, temperature and bioclimatic data. Additional details are provided in Supplementary .

***Forest*** ecosystem carbon pools in 2000

From the 30-m global AGB map, we mapped belowground live biomass density (BGB) using a ***forest*** root-to-shoot ratio with mangrove-specific ratios based on defaults provided in Table 4.5 of the 2013 IPCC Wetlands Supplement. AGB and BGB values were converted to C density values using a biomass-to-carbon ratio of 0.45 for mangroves and 0.47 for all other ***forest*** types,. From the final 30-m AGB map we estimated dead wood and litter biomass densities per pixel as constant fractions of AGB using a lookup table based on global ecological zone, elevation and precipitation regime (Supplementary Table ). Dead wood and litter biomass densities were converted to C densities using IPCC conversion factors.

Soil organic carbon density in the top 30 cm of mineral soils was mapped using SoilGrids250 (v.2.0) after resampling from its original spatial resolution of 250 m to match the common 30-m resolution of our analysis. For mangrove ***forests***, we used a 30-m soil carbon map developed specifically for mangroves. We delineated locations of organic (peat) soils using maps summarized in Supplementary Table .

We used these five ***forest*** carbon pool maps as the basis for estimating ***emission*** factors associated with various ***forest*** disturbances (see below).

Activity data

Activity data were defined using the global ***forest*** change product of Hansen et al. with loss updated annually on Global ***Forest*** Watch. In the model, all pixels defined as ***forest*** were classified into one of four categories: (1) loss only; (2) gain only; (3) both loss and gain; or (4) no change over the period 2001–2019. Loss is defined by Hansen et al. as a stand-replacement disturbance and includes all disturbances (natural and anthropogenic) observable in Landsat imagery. Gain is defined as a non-***forest*** to ***forest*** change, which includes tree cover gain observed after harvest and other disturbance. The loss product is annual, while the gain product represents a cumulative total (2000–2012). Loss and gain can co-occur on pixels undergoing ***forest*** management or other forms of disturbance and regrowth. Lack of annually updated gain data is addressed through the sensitivity analysis (Extended Data Fig. ). Due to a lack of information about tree cover gain after 2012, we assumed no additional areas of gain from 2012 to 2019. Areas of no change reflect ***forest*** areas established before 2000 that showed no observable disturbance in Landsat imagery between 2000 and 2019.

***Emission*** factors

We assigned ***emission*** factors to tree cover loss pixels following an IPCC ***land***-use classification framework, on the basis of whether each pixel maintained its ***land*** use or was converted to a new use over the analysis period. Since ***forest*** may remain in the same use despite a temporary loss of tree cover, we used the global 10-km map of Curtis et al. (updated through 2019) to attribute tree cover loss to one of five dominant drivers; these influence the C pools affected (Supplementary Table ) and thus the ***emission*** factors assigned to each individual loss pixel. Supplementary Table summarizes ***emission*** factors by ***forest*** type within each climate domain.

Commodity-driven deforestation and shifting ***agriculture***

The initial change in C stocks was estimated as a full loss of C in aboveground, belowground, dead wood and litter pools. In addition to CO2 ***emissions*** resulting from a loss of C stocks, we used IPCC equation 2.27 (ref. ) and a 1-km global burned area map to calculate CH4 and N2O ***emissions*** in loss pixels that overlapped with areas that burned the same year or the year before (to account for lag effects between fire occurrence and observed tree cover loss). For deforestation on mineral soils, soil C loss was estimated using IPCC equation 2.25 (ref. ); default soil stock change factors vary by ecological zone and were assigned spatially using ecozone boundaries. Per IPCC guidelines, 1/20th of the total soil C stock change was apportioned annually from the year of loss through the last year of the analysis period (2019) but assigned to the year of observed tree cover loss. Due to lack of information in the driver attribution map about the specific ***land*** use established after ***forest*** clearing, we assumed for the purposes of soil ***emission*** accounting that all deforested ***land*** on mineral soils for commodity-driven deforestation was converted to annual cropland with full tillage and medium inputs. A different factor was used to estimate loss of soil C on mineral soils (Table 5.10 in the IPCC Guidelines) in areas of shifting ***agriculture***, which were assumed to represent transient ***land***-use conversions to cropland under shortened fallow, where vegetation recovery is not attained before re-clearing. Soil ***emissions*** were not estimated for areas of loss on mineral soils that overlapped with ***forest*** and wood fibre plantations, even if they fell within the broader commodity-driven deforestation or shifting ***agriculture*** classes, consistent with the assumption that loss of tree cover within tree plantations follows the forestry assumptions listed in Supplementary Table (see ***emissions*** from below). For loss on organic soils that overlapped with tropical plantations and tree crops planted since 2000, GHG ***emissions*** associated with drainage were estimated using CO2 and CH4 ***emission*** factors provided in the IPCC Wetlands Supplement. Like ***emissions*** from mineral soils, ***emissions*** from peat drainage were assumed to continue in each year after loss up through the last year of the analysis period (2019) but were assigned to the year of observed tree cover loss. ***Emissions*** (CO2, CH4 and N2O) from peat burning were also calculated on the basis of methods provided in the IPCC Wetlands Supplement where a loss pixel overlapped with areas burned the same year, or the year before, the loss event (on the basis of global burned area data).

Urbanization

The same assumptions and calculations were used for calculating gross ***emissions*** from urbanization as for commodity-driven deforestation and shifting ***agriculture***, except a different factor was used to estimate the loss of soil C on mineral soils. We assumed that ***forest*** ***land*** converted to settlement was paved over and applied the IPCC default assumption that 20% of the soil C relative to the previous ***land*** use was lost as a result of disturbance, ***removal*** or relocation.

Forestry

***Emission*** factors for loss attributed to forestry were estimated as the loss of C in live biomass only, following assumptions outlined in Supplementary Table that there is no net change to the dead organic matter or soil C pools in the case of mineral soils. ***Emissions*** from peat drainage and burning associated with forestry activities, as well as non-CO2 ***emissions*** in the case of ***forest*** fires, were included in the same way as for deforestation and shifting ***agriculture*** above. ***Emission*** factors for loss pixels within the ‘zero or minor loss’ category of the driver attribution map also followed assumptions for forestry (Supplementary Table ).

Wildfire

Within 10-km grid cells of the drivers map labelled wildfire, wildfire ***emission*** factors were applied only for 30-m pixels where loss occurred in the year of, or year after, a fire event in the 1-km burned area map. In these cases, we used IPCC equation 2.27 (ref. ) to estimate both CO2 and non-CO2 ***emissions*** from ***forest*** fire. The AGB map determined the mass of fuel available for combustion and a lookup table (Table 2.6 of the IPCC Guidelines) provided default combustion and ***emission*** factors that were applied on the basis of ***forest*** type (primary versus secondary). For boreal and temperate ***forests***, combustion factors were applied on the basis of the assumption of a ***land***-clearing fire, given that ***forest*** loss is defined in Hansen et al. as a stand-replacement disturbance. In cases where organic soils overlapped with burned areas, ***emissions*** from peat burning (CO2, CH4 and N2O) were estimated following guidance in the IPCC Wetlands Supplement. Forestry ***emission*** factors, rather than wildfire factors, were applied where loss did not overlap with a fire event in the 1-km burned area map.

***Removal*** factors

We developed ***removal*** factors spatially by linking information about each pixel’s geographic region, ecological zone, ***forest*** type and age class to corresponding growth rates on the basis of best available information. Supplementary Table summarizes ***removal*** factors by ***forest*** type in each climate domain. In areas of geographic overlap, the priority of assigning ***removal*** factors to a given pixel reflects the order of data sources listed below. ***Removal*** factors include accumulation in live biomass only and reflect the net increase, accounting for both productivity and mortality. We assumed no change to the dead organic matter and soil organic carbon pools, consistent with the IPCC Tier 1 assumption of no net change to non-biomass pools in ***forest*** ***land*** remaining ***forest*** ***land***. The number of years of carbon accumulation was assigned as 19 yr for undisturbed ***forest***, 6 yr for areas of new tree cover gain and one less than the year in which tree cover loss occurred for loss-only ***forest***.

Mangroves

We applied mangrove-specific growth rates and root-to-shoot ratios from IPCC Tables 4.4 and 4.5 of the Wetlands Supplement, respectively.

Europe

We assigned ***removal*** factors spatially according to a map of dominant tree species developed from 260,000 national inventory plot locations. For each species, we estimated mean annual increment (MAI) values from Table 4.11 of the updated IPCC Guidelines, FAO Planted ***Forest*** Assessment and national inventories (Supplementary Table ). These were converted to aboveground biomass growth rates using species-specific biomass conversion and expansion factors and belowground biomass increment was added on the basis of a root-to-shoot ratio.

Plantations and tree crops

Outside Europe, we assigned ***removal*** factors for plantations and tree crops using a variety of published data sources. For common plantation species, we used MAI and biomass conversion and expansion factors summarized in the updated IPCC Guidelines to estimate aboveground biomass increment and added belowground biomass increment on the basis of a root-to-shoot ratio. Rates in plantations were assigned on the basis of mapped species when known or, when unknown, the most common mix of plantation species grown in the region. ***Removal*** factors for tree crops such as oil palm and rubber as well as various types of agroforestry systems were estimated for areas mapped as such on the basis of regionally specific values derived from the published literature and from Tables 5.1 and 5.3 of the updated IPCC Guidelines. All ***removal*** factors used for plantations and tree crops, along with data sources and assumptions applied, are provided in the companion spatial attribute file associated with the global compilation of planted tree maps used in this analysis.

United States

We developed ***removal*** factors for three age classes (0–20, 20–100 and >100 yr) for ***forest*** types across 11 geographic regions using methods broadly similar to those of Smith et al., except that we included more ***forest*** types in each region, as well as more recent and comprehensive data from the US ***Forest*** Inventory and Analysis database. ***Removal*** factors were developed from approximately 130,000 inventory plot locations. Pixels were assigned ***removal*** factors on the basis of dominant ***forest*** type, age class and geographic inventory region.

Young secondary ***forests***

Outside the United States and Europe, areas of tree cover gain that fell outside boundaries of mangroves and planted trees were assumed to be secondary natural ***forest*** regrowth <20 years old. We assigned natural ***forest*** regrowth ***removal*** factors to these areas using the 1-km map of Cook-Patton et al..

Primary ***forests***

We used ***removal*** factors by ecological zone and continent from IPCC Table 4.9 of the 2019 IPCC Refinement and assigned them spatially between 30° N and 30° S within a tropical primary humid ***forest*** map. Outside 30° N and 30° S, we used a map of intact ***forest*** landscapes as a proxy for primary ***forests***, which is likely to be highly conservative due to the relatively large extent criterion applied but represents the best available information by which to spatially delineate primary from old secondary ***forests*** in boreal and temperate regions.

Old secondary ***forests***

We assigned ***removal*** factors from IPCC Table 4.9 (>20 yr) to all ***forest*** areas that fell outside the types identified above. Given no observed disturbance occurred in these areas since the year 2000, we assumed they were secondary natural ***forests*** at least 20 years old.

Harvested wood products

We used statistics reported in FAOSTAT and methods outlined in the 2019 Refinement to estimate ***emissions*** and/or ***removals*** arising from harvested wood products. Losses of harvested wood products in use were assumed to result in CO2 ***emissions*** to the atmosphere, with no explicit representation of the subsequent retention of disposed wood in solid waste disposal sites (SWDS) and eventual CO2 ***emissions*** from SWDS. Calculations rely on statistics reported by countries on production, import and export volumes for three aggregate semifinished wood product commodity classes: sawnwood, wood-based panels and paper and paperboard.

Uncertainty analysis

We estimated uncertainty in GHG flux estimates globally and at the scale of climate domains by combining uncertainties in the activity data and ***emission***/***removal*** factors following a Taylor series statistical approach as in Roman-Cuesta et al. and Carter et al.. This approach underlies the IPCC Approach 1 (simple error propagation) and produces similar results but reflect exact calculations of variances and s.d., whereas IPCC Approach 1 is an approximated approach that yields 95% confidence intervals.

Uncertainties of all major components of the flux model were included (activity data, affected C pools of the ***emission***/***removal*** factors, combustion and ***emission*** factor uncertainties for fire-related ***emissions***). Errors were assumed to be statistically independent (uncorrelated), normally distributed and without bias. Supplementary Table shows the contribution of each uncertainty component for domain and global gross ***emissions***, ***removals*** and net flux, reported as the percentage reduction in output variances as each of the uncertainty components were assumed to have no variance. Variance of the net GHG flux was reduced the most when ***removing*** variance of the ***removal*** factor for temperate ***forests*** older than 20 yr. Variances are likely to be lower when estimated across smaller geographic regions. Estimation of uncertainty is currently limited to the global and biome scales based on available data for estimating uncertainty in the activity data.

Reporting Summary

Further information on research design is available in the linked to this article.

Online content

Any methods, additional references, Nature Research reporting summaries, source data, extended data, supplementary information, acknowledgements, peer review information; details of author contributions and competing interests; and statements of data and code availability are available at [*https://doi.org/10.1038/s41558-020-00976-6*](https://doi.org/10.1038/s41558-020-00976-6).

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**Notes**

Extended datais available for this paper at [*https://doi.org/10.1038/s41558-020-00976-6.Supplementary*](https://doi.org/10.1038/s41558-020-00976-6.Supplementary) informationis available for this paper at [*https://doi.org/10.1038/s41558-020-00976-6.Peer*](https://doi.org/10.1038/s41558-020-00976-6.Peer) review informationNature Climate Change thanks Gert-Jan Nabuurs, Seth Spawn and the other, anonymous, reviewer(s) for their contribution to the peer review of this work.Publisher’s note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

**Load-Date:** May 3, 2023

**End of Document**



[***EU plan puts spotlight on carbon sinks to tackle climate change***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:634G-8KB1-JCF9-40H7-00000-00&context=1516831)

EurActiv.com

July 13, 2021 Tuesday

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**Length:** 1013 words

**Byline:** Kira Taylor

**Highlight:** Europe will need to increase the amount of carbon stored by its ***forests*** and wetlands to meet a new, more ambitious ***target*** for carbon ***removals*** in Europe, according to a leaked policy draft seen by EURACTIV.

**Body**

The capacity of European ***forests*** to absorb CO2 "has been shrinking" over the years, warned EU climate chief Frans Timmermans as he presented the bloc's 2030 climate goals in September last year.

"The sink has to go back to its previous levels" if Europe wants to reach climate neutrality and preserve biodiversity at the same time, he said.

To achieve this, the European Commission is placing its hopes on the ***land*** use, ***land*** use change and forestry (LULUCF) regulation, which tackles ***emissions*** from ***agriculture*** and forestry.

A leaked draft of the updated regulation, due to be published on Wednesday (14 July), shows that the European Commission wants to build up the amount of carbon stored to 310 million tonnes by 2030.

That is up from the 263 million tonnes in 2018, according to the Commission. The number is the net total once the amount of carbon captured is balanced against the carbon released by ***land*** use practices.

The increase was part of a political agreement made during the negotiations on Europe's climate law. A push to sequester 310 million tonnes of CO2 could see Europe's net ***emissions*** reduce by around 57% by 2030 - just shy of the 60% reduction the European Parliament was calling for.

"I think it's a healthy level of ambition. Any less would not be in line with the challenge of climate neutrality. Whether more is possible is difficult to say, to be honest," said Andreas Graf, project manager for EU energy policy at the think tank Agora Energiewende.

"In Germany, one has anticipated business-as-usual practices would actually lead to a decline of the net sink over the coming years. So very different than an increase. Germany has its work cut out for it to reverse that," he told EURACTIV.

Under the draft policy proposal, EU countries will be assigned a binding ***target*** is for carbon ***removals*** as of 2025. This is expected to be contentious, as EU countries are able to shoulder different levels of ***removals*** depending on their climate and the state of their ***forests*** and ***agriculture***. In places like Sweden and Finland, pressure from the forestry and wood industries is expected to be high.

Across Europe, the increased ambition will require a huge turnaround to grow carbon sinks, which are set to decline to -225 million tonnes under a business-as-usual scenario.

Carbon farming could help achieve that. The leaked LULUCF draft talks about "new business models based on carbon farming incentives," adding that "certification of carbon ***removals*** need to be increasingly deployed in the run up to 2030".

Restoring carbon sinks can only happen if farmers and ***forest*** owners are encouraged with financial incentives, says Artur Runge-Metzger, director at the European Commission's department for climate action.

"The Commission intends to establish an EU certification system," Runge-Metzger told EURACTIV in October last year, saying "there is growing interest in so-called 'carbon farming'" as a way for governments to "incentivise the uptake of carbon in soils or vegetation".

Peter Liese is a German lawmaker from the European People's Party (EPP), the largest political group in the European Parliament.

He says "farmers and ***forest*** owners should use a carbon credit scheme, for example, to participate in efforts of other sectors such as aviation and private companies such as food producing companies. These can be carbon neutral when they support afforestation and methodologies to increase sinks in ***agriculture***," he said in a statement.

Once the accounting system is robust enough, Runge-Metzger says those credits could be brought under the ***emissions*** trading scheme, the EU's carbon market.

[***Official: EU taking first steps to bring forestry into carbon market***](https://www.euractiv.com/section/energy-environment/interview/official-eu-taking-first-steps-to-bring-forestry-into-carbon-market/)

The first step to bring forestry under the EU's ***emissions*** trading scheme is to ensure that every tonne of carbon dioxide in the ***forest*** is counted so that a certification system for carbon ***removals*** can be put in place, Artur Runge-Metzger told EURACTIV.

**Climate concerns**

However, climate campaigners have been less enthusiastic about the draft. Alex Mason from WWF says it does not show enough ambition on the amount of carbon that could be sequestered.

"We and others are calling for 600 million tonnes. The reason for that is because we think the climate emergency - as Greta Thunberg says - should be treated as an emergency and that means we have to go a lot faster to have any hope of staying below 1.5°C and avoiding passing tipping points," he told EURACTIV.

Reaching such a high level of sequestration would mean a significant reduction in ***forest*** harvesting, reduced demand for short term wood products, a more circular economy and rewetting cropland to return it to peatland.

In the European Parliament, the socialists and democrats (S&D) group appears to agree. Delara Burkhardt, a German MEP who is designated LULUCF spokeswoman for the S&D, said the EU goal needs to be examined more closely to see if more ambition can be achieved.

There are also concerns about the European Commission's plan to include non-CO2 ***agriculture*** ***emissions*** in the scope from 2031. The aim would be to reach net zero ***emission*** ***agriculture*** by 2035 and ***agriculture*** with negative ***emissions*** by 2036.

Campaigners have warned against putting too much emphasis on sink ***removals*** because they are not permanent. For instance, ***forest*** fires could destroy a carbon sink and release those ***emissions*** back into the atmosphere.

Alongside this, there are concerns that it will ***remove*** the incentive for the ***agriculture*** sector to decarbonise.

"We think it's a bad idea to be treating those two ***emissions*** and ***removals*** as directly equivalent and it's also not clear why ***agriculture*** - fertiliser use and intensive livestock farming - why that should be gifted the ***forest*** carbon sink rather than any other sector," said Mason.

[***Commission under fire for including 'carbon sinks' into EU climate goals***](https://www.euractiv.com/section/climate-environment/news/commission-under-fire-for-including-carbon-sinks-into-eu-climate-goals/)

The European Commission on Thursday (17 September) defended its plan to bring carbon ***removals*** from ***agriculture***, ***land*** use and forestry into the EU's updated climate ***target*** for 2030, saying this was in line with UNFCCC standards.

*[Edited by Frédéric Simon]*

**Load-Date:** July 13, 2021

**End of Document**



[***DAFM says Ireland's forests are not a net emitter of greenhouse gases***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:61VP-DNK1-JC8V-43HB-00000-00&context=1516831)

Irish Examiner

November 12, 2020 Thursday

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**Section:** FARMING; Pg. 6

**Length:** 748 words

**Byline:** Stephen Cadogan

**Body**

The EU has set an important benchmark for calculating the sum of greenhouse gas ***removals*** and ***emissions*** from Ireland's ***forests*** up to 2025.

The EU Commission has adopted the ***forest*** reference levels (FRLs) for the managed ***forest*** ***lands*** of each member state, and Ireland has been allocated an FRL of an ***emission*** of 112,670 tonnes of carbon dioxide equivalent per year, when harvested wood products and all ***emissions*** and ***removals*** are included.

Only Ireland and Denmark (354,000t) have been given net ***emission*** FRLs for managed ***forest*** ***land***. At the other end of the scale are France, Sweden, Germany, and Spain, with net sequestration FRLs between 32,000t and 56,000t.

In the EU, only ***forests*** (414m tonnes of carbon dioxide equivalent per year) and products from ***forests***, so-called harvested wood (50m t) are net for ***removals***; all other ***land*** uses are net ***emissions***.

This does not mean Ireland's ***forests*** are a net emitter of greenhouse gasses, said the Department of ***Agriculture*** Food and the Marine (DAFM).

"They are and remain a substantial and growing store for carbon dioxide, and recent suggestions which claim otherwise, are misleading insofar as they are looking only at one subset of the estate," said a DAFM spokesperson.

The DAFM said the managed ***forest*** ***lands*** area subset (about 60% of the Irish ***forest*** estate), because of particular circumstances and timing, will be a small emitter over the up coming period, but the amount in question will be far outweighed by what the rest of the ***forest*** estate is storing and sequestering.

Managed ***forest*** ***lands*** are ***forests*** that are older than 30 years in the 2021-2030 period.

When harvested wood products are included, these ***forests*** in Ireland will be a small net source of about 0.1 million tonnes of carbon dioxide per year, said the DAFM, thus confirming the EU's FRL.

But they will be replanted after harvesting, and are then projected to return to being a ***forest*** sink after 2036.

The DAFM says other ***forests*** up to 30 years old in the 2021-2030 ***emissions*** accounting period (***forests*** planted since 1991, and all new ***forests*** planted over the next 10 years) will be a significant sink for carbon dioxide, sequestering well over one million tonnes per year, when harvested wood products are included, over the 2021-2025 period.

The minister of state at the Department of ***Agriculture***, Food and the Marine with responsibility for forestry, Senator Pippa Hackett, said: "I fully understand the alarm with which many greeted reports on Ireland's ***forests*** becoming a net emitter of greenhouse gases, and I am very happy to see my department clarify the situation."

Overall, the national ***forest*** estate is an important and expanding sink for carbon, estimated at over 312m tonnes, and they will remain a net sink by 2050 and beyond, according to the DAFM.

It said Ireland's ***forests*** removed an average of 3.8m tonnes of carbon dioxide equivalent per year from the atmosphere over the period 2007 to 2016.

This figure changes from year to year, as ***forests*** mature and in some cases are harvested and are replanted.

As ***forests*** mature, the sequestration rates of all species decline, but the trees themselves remain a significant store of carbon.

The EU's FRL of ***emission*** of 112,670 tonnes of carbon dioxide equivalent per year, when harvested wood products and ll ***emissions*** and ***removals*** are included, was reduced from 282,687t in Ireland's original submission, and from 141,897t in a revised 2019 submission.

Part of the reduction from the 2019 figure is due to an error which the commission said was identified in transposing FRL data.

The FRL calculation process began in 2018 with each member state submitting a National Forestry Accounting Plan and FRL.

A commission expert group assessed these submissions and made technical recommendations.

Member states submitted revised plans and, where necessary, recalculated their FRLs.

After a further review round and a public feedback mechanism, the final FRLs have now been adopted by the commission.

***Agriculture*** Minister Charlie McConalogue has explained that all EU member states had to submit a National Forestry Accounting Plan which sets out the ***emissions*** and ***removals*** resulting from older ***forests***.

A ***forest*** reference level is needed in order to account and report greenhouse gas changes from 2021 to 2025 against this ***land*** category.

In line with the Paris Agreement, member states should ensure carbon sinks, including ***forests***, are conserved or enhanced, with a view to meeting the ambitious greenhouse gas reduction ***targets*** of the EU.

**Graphic**

Picture, **Only Ireland and Denmark have been given net *emission* reference levels for managed *forest* *land***.

**Load-Date:** January 26, 2021

**End of Document**



[***Commission under fire for including 'carbon sinks' into EU climate goals***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:60VX-YYJ1-DYXB-V1SC-00000-00&context=1516831)

EurActiv.com

September 18, 2020 Friday

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**Length:** 1133 words

**Byline:** Frédéric Simon

**Highlight:** The European Commission on Thursday (17 September) defended its plan to bring carbon ***removals*** from ***agriculture***, ***land*** use and forestry into the EU's updated climate ***target*** for 2030, saying this was in line with UNFCCC standards.

**Body**

"If you look at the logic and the methods applied by UNFCCC, they all include carbon sinks," said Frans Timmermans, the Commission vice-president in charge of climate policy.

"This is exactly what we have done at the European Commission," he told journalists at a press briefing. "So I think we're on solid ground here".

Timmermans was speaking after the EU executive officially unveiled its [*plan to reduce the EU's greenhouse gas* ***emissions*** *by at least 55% by 2030*](https://ec.europa.eu/clima/sites/clima/files/eu-climate-action/docs/com_2030_ctp_en.pdf) compared to 1990 levels, up from 40% currently.

The updated 2030 ***target***, announced the day before by Commission President Ursula von der Leyen, aims to put the EU in line with its commitments under the Paris Agreement and the bloc's broader objective of becoming the first "climate neutral" continent in the world by 2050.

[***'We can do it!': EU chief announces 55% emissions reduction target for 2030***](https://www.euractiv.com/section/climate-environment/news/we-can-do-it-eu-chief-announces-55-emissions-reduction-target-for-2030/)

European Commission President Ursula von der Leyen announced plans on Wednesday (16 September) to ***target*** a 55% cut in greenhouse gas ***emissions*** by 2030 as part of a broader European Green Deal programme aimed at reaching "climate neutrality" by mid-century.

**'Accounting trick'**

But environmental campaign groups denounced the Commission's plan to include carbon sinks in the ***target***, saying this was "an accounting trick" to meet the 2030 goals.

"Relying on ***forests*** to reach climate ***targets*** sends the wrong signal that it's OK to keep polluting because the ***land*** will absorb it," said Sam van den Plas, policy director at Carbon Market Watch, an environmental NGO.

"The Commission is greenwashing its own climate ***target***: including carbon dioxide ***removals*** in the calculations means ***emissions*** will actually go down by a lot less. We're facing a climate emergency, and there isn't time for games," said Alex Mason from the WWF.

In Europe, ***forests*** are currently a net carbon sink because they take in more carbon dioxide than they emit. On a global level, oceans and ***forests*** are the two biggest carbon sinks.

But the capacity of European ***forests*** to absorb CO2 "has been shrinking" over the years, Timmermans warned, saying "the sink has to go back to its previous levels" if Europe wants to reach climate neutrality and preserve biodiversity at the same time.

If left unchecked, ***forest*** sinks could further decline to 225 million tons of CO2 equivalent by 2030, down from 300 million tons CO2 in 2010, the Commission says. According to the EU executive, the ***forests***' declining capacity to absorb carbon dioxide is driven by "further increases in harvesting" and negative impacts from natural hazards such as fires and pests caused by a changing climate and growing demand for biomass.

"We really have to take care of our ***forests***. It's not enough to say we'll plant 3 billion trees, we need to make sure our ***forests*** stay healthy and this is going to be a momentous task," Timmermans said.

Environmental groups applauded the Commission's intention to restore healthy ***forests*** and ecosystems. But they pointed to inconsistencies with the EU's existing climate goal for 2030, which according to them, does not take carbon ***removals*** into account.

"The current EU ***target*** of 'at least 40%' agreed in 2014 does not include sinks," affirms Bert Metz, a climate scientist who co-chaired the mitigation working group of the UN Intergovernmental Panel on Climate Change from 1997 to 2008.

"Including sinks means that the new 55% ***target*** would effectively be less than 50% in the current ***target***'s terms," [*he wrote in an opinion piece for EURACTIV*](https://www.euractiv.com/section/climate-environment/opinion/how-the-eu-could-snatch-defeat-from-the-jaws-of-victory-on-climate/).

"We need to restore Europe's ***forests*** and protect and restore our precious ecosystems, but that must be on top of greenhouse gas reductions, not instead," he insisted, saying the 55% ***target***  "must be a real, absolute reduction," not a net ***target*** that takes carbon ***removals*** into account.

[***How the EU could snatch defeat from the jaws of victory on climate***](https://www.euractiv.com/section/climate-environment/opinion/how-the-eu-could-snatch-defeat-from-the-jaws-of-victory-on-climate/)

The European Commission's commendable move to aim for ***emission*** reductions of "at least 55%" by 2030 risks being completely undermined if the ***target*** also takes into account "reductions and ***removals***" from ***forest*** growth and tree planting schemes, warns Bert Metz.

**53% without carbon *removals***

Timmermans strongly rejected the NGO's accusation that the net ***target*** is an accounting trick.

"I really dispute the idea that this would in fact mean only 50% reduction," he said. "I don't understand the logic, carbon sinks play a role, it takes CO2 out of the atmosphere - isn't that what we want to achieve?"

"I honestly believe there is no problem with that," Timmermans added, saying all that matters is that the EU achieves its 2030 climate goal.

Officials who briefed the press afterwards told a different story however, and did recognise that the 55% ***target*** would be lower by two percentage points without carbon ***removals***. This would translate into an ***emissions*** reduction ***target*** of 53%, not 55.

"The 53% is calculated without taking into account the ***removals***, and the 55% is calculated with ***removals***," the official said. And using the EU's current method to calculate carbon sinks "would shave away probably about half of those 2 percentage points," he explained, suggesting the ***target*** would effectively be around 54% using today's carbon accounting rules.

Green campaigners who analysed the Commission's [*impact assessment*](https://ec.europa.eu/clima/sites/clima/files/eu-climate-action/docs/impact_en.pdf) on the 2030 ***target*** came to different conclusions, however. Depending on the scenarios, the effect of including carbon sinks "varies from just over 2% to nearly 5%, depending on whether you think the sink will be at the low end (225 million tonnes) or the high end (340 million tonnes)," said Alex Mason from the WWF.

"This makes clear that including sinks in the 2030 ***target*** makes a significant difference - it means other sectors such as buildings, transport and ***agriculture*** won't have to cut ***emissions*** by as much."

Mason also insisted that the EU's current 2030 climate ***target*** does not take carbon ***removals*** into account, and accused the Commission of trying to cover up the change in carbon accounting rules.

"The Commission is trying to downplay the significance of this change - and appears even to have [*altered text*](https://twitter.com/1alexmason/status/1306643312066080768) on its website in order to imply that the 40% ***target*** has always been a net ***target***," Mason told EURACTIV.

"But it's clear that the 55% ***target*** Ursula von der Leyen and Frans Timmermans have been trumpeting is not what it seems, and is even further from the 65% cut in ***emissions*** that science demands."

Timmermans himself seemed to admit that carbon sinks were a new element in the EU's climate ***target*** calculation, saying the Commission drew its figures on carbon ***removals*** from the most recent findings of the UNFCCC.

"You could wonder why we didn't include it in the -40% ***target*** at the time, because carbon sink is an important element in all of this," Timmermans said.

"The ***target*** is what counts, we use every method to get there."

*[Edited by Benjamin Fox]*

**Load-Date:** September 18, 2020

**End of Document**



[***Official: EU taking first steps to bring forestry into carbon market***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:6146-03S1-DYXB-V32S-00000-00&context=1516831)

EurActiv.com

October 22, 2020 Thursday

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**Length:** 2776 words

**Byline:** Frédéric Simon

**Highlight:** The first step to bring forestry under the EU's ***emissions*** trading scheme is to ensure that every tonne of carbon dioxide in the ***forest*** is counted so that a certification system for carbon ***removals*** can be put in place, Artur Runge-Metzger told EURACTIV.

**Body**

The first step to bring forestry under the EU's ***emissions*** trading scheme is to ensure that every tonne of carbon dioxide in the ***forest*** is counted so that a certification system for carbon ***removals*** can be put in place, Artur Runge-Metzger told EURACTIV.

*Artur Runge-Metzger is the director at the European Commission's department for climate action, where he is in charge of climate strategy, governance and* ***emissions*** *from non-trading sectors. He spoke to EURACTIV's energy and environment editor, Frédéric Simon.*

**INTERVIEW HIGHLIGHTS**:

* "Every tonne" of carbon dioxide in EU ***forests*** has to be counted, reported and monitored

1. The European Commission is looking at "carbon farming" to encourage farmers to uptake carbon in soils or vegetation
2. The European Commission is working on a certification system for carbon ***removals*** that should be ready "by 2023"
3. Certificates will be issued for each tonne of carbon dioxide stored in ***forests*** or ***agricultural*** ***land***
4. But if a ***forest*** goes up in flames, the corresponding certificate will have to be cancelled
5. ***Forests*** could be brought under the ETS once the certificate is robust enough

**The European Commission's 2030 climate plan presented two weeks ago, places more emphasis on forestry and *agriculture* in the EU's fight against climate change. In particular, the Commission said the capacity of *forests* to act as "carbon sinks" has been decreasing over the years and needs to be reversed. So how does the Commission intend to achieve this?**

Since 2013, the carbon sink decreased in Europe and that is worrying. Farmers and foresters have incentives to do many other lucrative things with their ***land*** than keeping the capacity of ***forests*** and soils to act as carbon sinks.

On top of this comes climate change itself, which is taking its toll in terms of droughts, diseases and pests that are encroaching on European ***forests*** and ***land***. Therefore, a way needs to be found to encourage farmers and foresters to do address these adverse effects - to reforest areas, which might no longer be adapted to the future climate.

And first, ***forests*** need to be counted better - every tonne of carbon dioxide in the ***forest*** has to be counted. Under the Kyoto Protocol, not all ***forest*** was accounted for, there were specific rules and limitations.

So, the first thing is to count the ***forest***. And this is something the Commission outlined clearly already in the long-term climate strategy for 2050, by which time remaining ***emissions*** need to be balanced with carbon ***removals***. And after 2050, this balance will have to go net-negative.

Hence, carbon ***removals*** are going to play an important role, which is why it is important to accurately count and report them. This is being done today in the context of the United Nations Framework Convention on Climate Change. The way it is being reported to the UNFCCC takes the full sink into account. And in order to get to climate neutrality by 2050, we want to start counting in the same way in the year 2030.

**Europe wasn't counting carbon *removals* until now?**

Today, carbon ***removals*** are only partly accounted for. As long as they are not fully counted, it risks not being adequately reflected in the decision making. And that means the incentives are difficult to get right.

Secondly, we want to help in terms of afforestation in Europe and to plant 3 billion trees in the coming decade. This is something that the Commission will work on in the context of the upcoming ***forest*** strategy.

A third important initiative is what is called "carbon farming" to see how Member State governments can incentivise the uptake of carbon in soils or vegetation, and to make sure that these are also permanent ***removals***.

A sink is not *per se* irreversible, it can be reversed. So one always has to carefully monitor in order to get the numbers right in terms of ***removals***.

**The Commission's stated objective is to stop carbon sinks from decreasing and start growing them again. Does this mean the Commission will somehow put a limit on the number of trees that can be harvested in Europe? Is that something that will inevitably come at some point?**

I don't think this is going to be necessary. Looking at the projections for 2050, and in particular at the balance between ***removals*** and remaining ***emissions***, some greenhouse gas ***emissions*** will be inevitable - for instance cows will continue to emit methane. In order to find a way to balance these residual ***emissions***, there will be a demand for carbon ***removals***.

In principle, carbon ***removals*** can be achieved in different ways than through ***forest*** and soils - there are also technical solutions like carbon capture and storage. However, there are limitations to CCS in terms of cost, storage capacity and public acceptance.

At the end of the day, there will have to be a balance between demand and supply for such carbon ***removals***. This will provide an incentive for forestry activities or soil conservation. In this way, limits would not have to be set.

[***EU climate plan blows hot and cold on forestry, biomass***](https://www.euractiv.com/section/biomass/news/eu-climate-plan-blows-hot-and-cold-on-forestry-biomass/)

While recognising the positive role of ***forests*** in mitigating global warming, the European Commission has riled the agroforestry and biomass industries by stating its intention of limiting growth in the sector.

**What metrics is the Commission going to use to monitor the evolution of the carbon sink in Europe? How are you going to measure that?**

We will follow the metrics and guidelines that have been developed by the IPCC. Since 2008, the beginning of the first commitment period of the Kyoto Protocol, ***land*** use, ***land*** use change and forestry have been monitored and reported.

These measurements have improved a lot in those twelve years with the help of the UNFCCC peer-reviews. International peers regularly looked at the different parts of the national inventories. Looking back at the early years of the UN carbon accounting system, there were many suggestions to improve LULUCF monitoring, and these can be further improved in the future.

One of the avenues to be explored is to use remote sensors through satellite observation. Doing inventories for ***land*** use and forestry is very expensive because the areas are so vast and so heterogeneous. In some cases, ***forest*** inventories are done only every 5 to 10 years. This can possibly be improved using Europe's Copernicus earth observation satellites by comparing these numbers with the inventories.

**And the base year will be 1990?**

Yes, 1990 is always the base year when it comes to Europe's climate commitments. There are estimates of the size of the ***forest*** sink back in 1990.

In the beginning, it might not be 100% accurate, as one will start at a certain point. What is important is that measurement becomes better over time, so that we can detect whether the trend is going in the right direction or not.

On certain categories, we will have to become more granular over time, for example when it comes to harvested wood products. At the moment, default values are used for how long these wood products are going to be there, but if we want to look after that stock more carefully, then we need to better understand the stock and how exactly it is changing.

**Does that then require some additional reporting maybe on the part of the foresters or the farmers under the Common *Agricultural* Policy (CAP)?**

This is something that will have to be investigated in the coming years. But one must be cautious not to create red tape. It will have to be done in a measured and reasonable way and it is one of the reasons to explore using satellite imaging, because it might be something that can be automated. One needs to get a robust proxy that is going to be good enough to monitor accurately what is happening to the sinks.

**Forestry can be positive or negative for the climate depending on the uses. Wood for instance has different carbon footprints depending on what you do with it - whether it's used to produce paper, building materials or furniture or whether you burn it in a biomass plant. So how can those different uses of wood be accounted for in a way that reflects their true carbon footprint?**

In terms of carbon accounting one needs to monitor where the CO2 actually is and goes: in the atmosphere, stocked in a tree or in a table, or being burned in a power plant.

**Can that be measured at all?**

One can measure what is standing in terms of CO2 in the ***forest***. And the way those stocks are changing from year to year can be observed. If something is harvested, then it is recorded in the inventory as a negative.

**But then you don't know how it ends up - in a table, in paper production or in a biomass plant.**

At the moment, this is often done in a simple way. We assume for example what amount goes into harvested products because there are industry statistics for that. The harvested product is given a certain lifetime and then it is going back into the atmosphere after an average period of time. This is how the accounting works at the moment.

**It's based on industry reporting then?**

It is based on reporting that goes through the statistical systems of the member states. At the moment, it is done relatively roughly so in the future, this might need refinement. This reporting can become more granular.

In a similar way, there are estimates for how much biomass is being burned in power plants. The ***emission*** of this biomass is already reported when the tree is cut. So, it does not have to be counted again when it is burned in the power plant.

**Some are calling for a kind of certification scheme to account for carbon *removals*, whether in *agriculture*, or forestry. Is that something the commission is looking into? And how could it work?**

In the circular economy action plan, the Commission announced that a certification system for ***removals*** should be developed by 2023. This will be worked on in the coming years.

**Are there any particular difficulties? What are you trying to achieve?**

In the end, a robust system needs to ensure that a tonne of carbon dioxide is a tonne of carbon dioxide. One challenge for the ***land*** sink will be the potential "reversibility" of the carbon ***removals***.

For instance, what happens if a certified ***forest*** sink goes up in flames? The legislation will have to be able to deal with such a situation in order to make sure that, at the end of the day, there is a physical ***removal*** for each certificate - or currency - that has been issued.

Another question: what if the ***forest*** goes up in flames but somebody has used this certificate to balance an ***emission***? Who is going to be liable in such a situation? The same holds for a geological carbon storage. If there is a leak, what does it mean for the certificates that have been issued?

These are tricky questions that will need responses to ensure we have an environmentally robust system in place at the end of the day.

**When you talk about a "currency" are you referring to allowances that can be traded on the *Emissions* Trading Scheme (ETS)?**

If the standard is good enough and one can be sure that a tonne is tonne, then we might be able to recognise them like an ***emission*** allowance under the ETS. Therefore, it is important to get the certification right to make sure it is robust.

In the past, some experience has been made with the clean development mechanism at the UN level, which is also certifying certain ***emission*** reductions. So, the questions are quite similar: How can the ***emissions*** reductions or ***removals*** be established? On what basis? What does it need to be compared with? How many certificates can be issued at the end of the day? All these steps will have to be defined in the certification process.

**That means effectively bringing *agriculture* and forestry under the ETS?**

This can only be discussed once a good certification system is up and running. At the moment, there is no link between ***land*** use and the EU's ***Emissions*** Trading System, for good reasons.

Conversely, there is a link at the moment between ***land*** use and the effort sharing regulation, which is capped to a certain amount. This might be a subject for the next round of impact assessments that will be done for the June 2021 package.

The reference point, in the long-term, will be 2050 and the net-zero greenhouse gas ***emissions*** ***target***. By then, remaining ***emissions*** will have to be balanced with carbon ***removals***. And that might not leave room for any auctioning under the ETS. Between now and 2050 there is a 30-year time period, and the question is how best to manage the transition from here to there.

[***The hyping of negative emissions***](https://www.euractiv.com/section/biomass/opinion/the-hyping-of-negative-emissions/)

EU lawmaker Jytte Guteland has proposed ambitious EU climate ***targets***, but a cornerstone for reaching them remains shaky, says Kelsey Perlman.

***Emissions* from *agricultural* and forestry are currently regulated by different sets of rules at EU level: forestry falls under the LULUCF regulation, while biomass falls under the ETS and *agriculture* falls under the burden sharing regulation, together with transport and buildings. Does the European Commission aim to have a more streamlined system to deal with forestry and *agriculture* *emissions* in the future?**

Different options are discussed in the 2030 Climate ***Target*** Plan. One option could be to bring together ***Land*** Use ***Land*** Use Change and Forestry (LULUCF) with the non-CO2 ***emissions*** from ***agriculture***. This sector also falls under the Common ***Agricultural*** Policy. And that might make it easier for policymakers at the national level to deal with those sectors.

**Let's talk about incentives now. At the end of the day, *forest* owners and farmers need incentives to grow the capacity of their *land* or *forests* to act as carbon sinks. So what ideas do you have at the Commission to encourage them to do it?**

What is happening already now are voluntary markets, which issue certificates in exchange for carbon capture or carbon ***removal*** projects. Some supermarket chains for example are using this to offset their ***emissions***. These voluntary offset markets are growing in number and are also expanding in terms of the types of carbon ***removals*** that they certify.

**So they need to be regulated at some point?**

The Commission intends to establish an EU certification system. There is growing interest in so-called 'carbon farming'. In Northern Germany for instance, there is a project called 'Moor Futures'. We are currently studying these kind of systems to learn from them.

The Commission supports pilot projects, for instance, to test new methodologies for the measurement of carbon ***removals***. Last year, the European Parliament voted for an additional (EURO)2 million in the budget for pilot projects. A Finnish project is exploring robust measurement systems. This experience will enrich the debate.

In the discussions with ***agriculture*** ministers in the context of the Common ***Agricultural*** Policy it is also encouraged to use eco schemes to reward farmers if they do more, in terms of storing carbon in the soils, or foresters storing carbon through afforestation and reforestation. There are different ways of encouraging learning by doing.

Then the next step will be to look at developing a robust regulatory framework. And in the longer term, one might look at whether and how this could be brought to the ETS.

**In Germany, policymakers are debating a "tree premium" of (EURO)125 per hectare that would basically reward *land* owners for keeping their *forests* untouched. Is that something the Commission is looking into?**

These are part of the incentive systems that should be studied. From a climate viewpoint, it needs to be established how much CO2 is stored at the end of the day.

**Foresters say that if they're being paid to leave the trees standing, they won't have any incentives to do regular *forest* maintenance - like thinning or harvesting dead wood for example - which brings benefits like preventing fires. Do you see a tradeoff here?**

There can be trade-offs. However, when it comes to carbon storage, one also needs to make sure that the carbon stock is protected. If the ***forest*** goes up in flames, then a certificate should also go up in flames. Preventing fires is one risk that foresters will need to manage.

Other questions are: can timber be stored in a way that it does not deteriorate? This is what is done when wood is put into tables and walls, which becomes part of the carbon stock. How far can this stock be increased? What will be done with it at the end of its use: will it be burned and the CO2 goes back into the atmosphere, or can it be safely stored?

These are some of questions that will have to be considered further in the future.

[***Forestry's climate impact 'invisible' under UN rules, experts say***](https://www.euractiv.com/section/energy-environment/news/forestrys-climate-impact-invisible-under-un-rules-experts-say/)

***Forests*** are the planet's biggest carbon "sink" - absorbing more CO2 from the atmosphere than they emit - but their contribution to cooling the earth's climate are currently not fully accounted for under UN rules, experts point out.

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**End of Document**



[***Europe's carbon-farming future slowly takes shape***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:618G-NS51-JC8V-40D8-00000-00&context=1516831)

Irish Examiner

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**Section:** FARMING; Opinion and analysis; Pg. 3

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**Byline:** Stephen Cadogan

**Body**

The European Commission's recent announcements on the carbon ***removal*** role of ***agriculture*** and forestry open up a new vista for rural Europe.

Much maligned for its belching cows and environmental damage, rural Europe can't be blamed for worrying about its future in a world of climate action, but the commission made it clear it sees the sector as the only one which can be a net carbon sink, by sequestering carbon from the atmosphere and storing it in soils, biomass, and harvested wood products.

The commission spelled out how sequestering carbon from the atmosphere and storing it in soils, biomass, and harvested wood can generate carbon credits for member states.

The plan to store more carbon on European farmlands and ***forests*** should be pursued through a "robust carbon ***removal*** certification scheme", according to a recent European Commission Climate Law update.

That role takes on increased importance now that European Commission president Ursula von der Leyen has announced the EU's new 2030 ***target*** to reduce ***emissions***, increased from 40% to at least 55%, compared to 1990. In its accompanying assessment of national energy and climate plans, the commission said the ***agriculture***, ***land*** use, and forestry sectors have an important role to play in storing carbon.

"With smart co-operation among farmers, with the use of technologies such as precision farming and with support to investments, advice and innovation, these sectors can already become climate neutral and begin to generate carbon ***removals*** by 2035," said the commission.

"Not only does this present a business opportunity for farmers; actions such as afforestation, restoration of wetlands, peatlands and degraded ***land*** area lso beneficial for biodiversity."

Becoming climate neutral and generating carbon ***removals*** is a realistic ***target*** because the ***agriculture*** sector produces only about 10% of the EU's total greenhouse gases (GHG) ***emissions*** (according to the European Environment Agency, the EU agency tasked to provide independent information on the environment).

According to the commission's assessment of national energy and climate plans to reduce ***land***-related ***emissions***: "While these ***emissions*** can never be fully eliminated under existing technology and management options, they can be significantly reduced, while ensuring food security is maintained in the EU.

"Efficient use of fertilisers, precision farming, a healthier herd, and the deployment of anaerobic digestion producing biogas, as well as valorising organic waste, are listed as examples of existing technologies that could help cope with ***emissions*** reduction."

Such measures are being built into the national strategic plans which member states must submit as part of the Common ***Agricultural*** Policy (CAP) and its rural development programmes which will take shape over the next year.

The CAP will be the main tool for supporting measures to reduce ***agricultural*** ***emissions*** and enhance sustainable ***forest*** management, as well as afforestation and ***forest*** resilience.

In order to facilitate this, 30% of the (EURO)750bn post-coronavirus "Next Generation EU" recovery package, is to be ringfenced for climate-friendly projects. It's a lot of money for new green technologies and tos upport member state programmes to reduce ***emissions***, and will hopefully be followed by private investment diverted from fossil-fuel related investment.

Amendments are to be published by June 2021 to make the EU's climate and energy legislation "fit for 55%". Included will be the ***Land*** Use, ***Land*** Use Change and Forestry (LULUCF) Regulation, and the Renewable Energy Directive.

The new legislation and the new ***emissions*** reduction ***target*** of 55% will be legally binding and must be reflected innational member state climate change legislation and policy, such as Ireland's new Climate Action Bill, which the Government published this week, the legislation designed to achieve ***emissions*** reductions in rolling five-year plans up to 2050.

In the EU plan to store more carbon on European farmlands and ***forests***, the European Commission insists that carbon offsets should meet the highest quality standards.

Nothing fits that bill better than afforestation.

The Irish Government was criticised for last week's rushing of legislation through the Oireachtas which sought to ***remove*** logjams in forestry licensing and in dealing with appeals against licences. Such logjams threatened to bring new afforestation in Ireland to a halt. But the Government's decisive action shows its faith in forestry for verifiable ***removal*** and storage of carbon from the atmosphere, to help Ireland meet our 2030 EU climate commitments.

Ireland has the best potential of most EU member states to increase ***forest*** cover from our relatively low 11%. In contrast, the capacity of European mainland ***forests*** to absorb carbon has been shrinking due to increases in ***forest*** harvesting, and damage from fires and pests.

In order to be counted as a carbon sink, more carbon must be taken in than would have occurred if ***agriculture*** or ***forest*** management practices continued unchanged.

Grassland makes a huge contribution as a carbon sink, but there is little scope for Ireland to increase pasture and therefore make it a new carbon sink. However, existing grassland must be maintained, for its role in ***removing*** carbon from the atmosphere and storing it in the topsoil of farmland.

***Agricultural*** soils in the EU contain around 14bn tonnes of carbon in the topsoil, considerably more than the 4.4bn tonnes of GHG emitted annually by all the EU's 27 countries.

That sink must be maintained, and improved in EU countries (by techniques such as no-till farming) where soil carbon has been reduced by over-exploitation for crops.

This "carbon farming" will be included in the EU's post-2020 CAP.

It spells a future of pasture, afforestation, "green" energy such as from anaerobic digestion, protection of natural areas such as carbon-rich soils wetland and peatland, and organic conversion.

But the big one for Ireland is achieving 8,000 hectares per annum of afforestation, and sustainable management of existing ***forests***, for a cumulative abatement of 21 Mt of CO2 equivalent up to 2030.

**Graphic**

Picture **The European Commission says that only rural sectors such as *agriculture* and forestry can be a net carbon sink, by sequestering carbon from the atmosphere and storing it in soils, biomass, and harvested wood products, and this should be pursued through a 'robust carbon *removal* certification scheme'**.

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**End of Document**



[***Climate Change Response Act 2002***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:61TT-21Y1-JDG9-Y43P-00000-00&context=1516831)

Impact News Service

January 21, 2021 Thursday

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**Body**

Wellington: Parliamentary Counsel Office, New Zealand has issued the following news release:

Climate Change Response Act 2002Public Act 2002 No 40Date of assent 18 November 2002Commencement see section 2Note

Changes authorised by subpart 2 of Part 2 of the Legislation Act 2012 have been made in this official reprint.

Note 4 at the end of this reprint provides a list of the amendments incorporated.

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[***Europe revives carbon farming but without access to carbon markets***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:60YH-TJ71-DYXB-V008-00000-00&context=1516831)

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**Byline:** Gerardo Fortuna

**Highlight:** The concept of soil carbon sequestration, a cornerstone of regenerative farming, is regaining strength as a key measure in both climate mitigation and adaptation.

**Body**

The concept of soil carbon sequestration, a cornerstone of regenerative farming, is regaining strength as a key measure in both climate mitigation and adaptation.

The potential of "carbon farming" to sequester CO2 ***emissions*** while regenerating degraded ***agricultural*** soil has been viewed positively by EU lawmakers in the attempt to scale up the EU's ambition for obtaining climate neutrality by 2050.

In order to do so, the Commission proposed to increase the 2030 ***target*** for ***emission*** reduction from 40% to 55% and vowed that all legislation will be revised to make it fit for purpose.

Crops are natural carbon "sinks" for carbon dioxide, ***removing*** the equivalent of around 51 billion tonnes of CO2 from the atmosphere each year and storing them in the topsoil.

***Agricultural*** soils in the EU contain around 14 billion tonnes of carbon in the topsoil, which is considerably more than the 4.4 billion tonnes of greenhouse gases (GHG) emitted annually by all the EU's 27 countries.

At the same time, carbon sequestration has the effect of restoring organic matter in cropland soils, a regenerative 'gift' that can boost soil fertility biologically.

And as a regenerative practice, 'carbon farming' has been included among the main Good ***Agricultural*** and Environmental Conditions (GAECs) of the eco-scheme, the new green architecture in the EU's post-2020 Common ***Agricultural*** Policy (CAP).

In particular, GAEC 2 aims to protect carbon-rich soils such as wetland and peatland, considered among the most effective carbon sinks.

According to the CAP reform proposal, GAEC 2 will be applied to all eligible ***agricultural*** ***land*** but member states will have to precisely identify peatland and wetland areas by establishing specific cartography at ***land*** parcel level.

Furthermore, rewetting techniques to remedy past degradation of drained peatlands, [*paludiculture*](https://www.moorwissen.de/en/paludikultur/paludikultur.php) or other ***agricultural*** practices resulting in carbon sequestration in these areas could be financially supported with additional CAP payments via eco-schemes and rural development interventions.

[***Carbon-capture crops need incentives through CAP, EU ministers said***](https://www.euractiv.com/section/agriculture-food/news/carbon-capture-crops-need-incentives-through-cap-eu-ministers-said/)

Soil carbon sequestration and other measures intended to reduce net greenhouse ***emissions*** in farming require proper funding and a degree of flexibility, EU ***agriculture*** ministers agreed at an informal meeting hosted by the Finnish Council presidency.

However, this new push on carbon sinks is seen by some as a smokescreen for the overall ambition on climate ***targets***.

Environmental campaign groups have denounced the Commission's plan to include soil carbon sequestration in the climate ***target***, saying this was "an accounting trick" to meet the 2030 goals.

"Relying on ***forests*** to reach climate ***targets*** sends the wrong signal that it's OK to keep polluting because the ***land*** will absorb it," said Sam van den Plas, policy director at Carbon Market Watch, an environmental NGO.

In Europe, ***forests*** are currently a net carbon sink because they take in more carbon dioxide than they emit. Globally, oceans and ***forests*** are the two biggest carbon sinks.

[***Commission under fire for including 'carbon sinks' into EU climate goals***](https://www.euractiv.com/section/climate-environment/news/commission-under-fire-for-including-carbon-sinks-into-eu-climate-goals/)

The European Commission on Thursday (17 September) defended its plan to bring carbon ***removals*** from ***agriculture***, ***land*** use and forestry into the EU's updated climate ***target*** for 2030, saying this was in line with UNFCCC standards.

**Carbon market taboo**

The plan to store more carbon on European farmlands and ***forests*** should be pursued through a "robust carbon ***removal*** certification scheme," the recent [*update of the European Commission's Climate Law*](https://www.euractiv.com/section/agriculture-food/news/eu-mulls-over-plan-to-boost-carbon-storage-on-farmlands/) reads

However, the increase of the GHG reduction ***target*** to at least 55%, would keep the ***agricultural*** and ***land***-use sector outside the bloc's carbon market - the ***Emissions*** Trading Scheme (ETS) - the Commission has informed.

The EU executive only plans to overhaul several pieces of legislation by June 2021, such as the ***Land*** Use, ***Land*** Use Change and Forestry regulation (LULUCF) and the Effort Sharing regulation.

European farmers have so far been prevented from participating in carbon markets, which would allow them to get paid for storing carbon in their farmlands by trading greenhouse gases.

In order to overcome the carbon markets taboo, the European Parliament's ***Agriculture*** Committee (COMAGRI), included proposals for a soil carbon sequestration scheme supported by establishing a separate trading scheme for negative ***emissions*** in its opinion on the Climate Law.

The importance of ***removals*** or negative ***emissions*** is paramount as currently ***removals*** and ***emission*** reductions are treated equally in carbon markets.

However, a ton of carbon removed from the atmosphere ought to be priced differently from a ton of carbon that is not emitted into the atmosphere, say EU lawmakers.

"From a political point of view, I believe the Commission should explore the possibility of establishing a separate trading scheme for negative ***emissions***," said Asger Christensen, the liberal MEP who drafted the opinion.

"That is an important message in our opinion, because it might generate substantial climate finance and benefit climate, environment, and biodiversity."

[***EU mulls over plan to boost carbon-storage on farmlands***](https://www.euractiv.com/section/agriculture-food/news/eu-mulls-over-plan-to-boost-carbon-storage-on-farmlands/)

Farmers and foresters need to be "directly incentivised" to put in practice carbon-capture crops and other measures intended to reduce net greenhouse gases (GHG), according to an update of the European Commission's Climate Law.

[Edited by Benjamin Fox]

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[***Greenhouse gas emissions fell in 2019, emission reduction targets for 2013 to 2020 attainable***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:61K5-XCF1-JDG9-Y0MH-00000-00&context=1516831)

Nordic Daily

December 21, 2020 Monday

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**Body**

Helsinki: Government of Finland has issued the following press release:

According to Statistics Finland's preliminary data, the total ***emissions*** of greenhouse gases in 2019 correspond with 53.1 million tonnes of carbon dioxide equivalent (CO2 eq.), being 18.2 million tonnes less than in the comparison year 1990. ***Emissions*** fell by six per cent from the previous year. The fall in ***emissions*** was most influenced by the decreased use of coal and peat. ***Emissions*** not included in the EU ***Emissions*** Trading System fell by one per cent but exceeded the annual ***emission*** allocation set by the EU by 0.6 million tonnes of CO2 equivalent. The net sink of the ***land*** use, ***land*** use change and forestry (LULUCF) sector, that is, the sum of ***removals*** and ***emissions***, amounted to −14.7 million tonnes CO2 equivalent in 2019, but these data are not included in total ***emissions***. The data published are based on the preliminary report to be submitted by Statistics Finland to the European Commission by 15 January 2021 concerning ***emissions*** in 2019.

Finland's greenhouse gas ***emissions*** and ***removals*** by sector and the sum of all sectors, where the net sink of the LULUCF sector is deducted from the combined ***emissions*** of other sectors

\*Preliminary data.LULUCF refers to the ***land*** use, ***land*** use change and forestry sector. Negative figures are ***removals*** of greenhouse gases. The sector does not come under the scope of the EU ***Emissions*** Trading System or the reduction ***targets*** of EU's Effort Sharing Decision. The figures for the latest years will become revised as the source data are updated (e.g growing stock and surface areas).

According to the preliminary data, total ***emissions*** in 2019 fell by close to six per cent compared with the previous year. The sum of ***emissions*** and ***removals*** in the LULUCF sector, or the net sink are not included in the total ***emissions***. In the energy sector, ***emissions*** fell by seven per cent, the fall was most affected by lower consumption of coal and peat (link to the energy release ). ***Emissions*** from industrial processes and product use decreased by six per cent and those from the waste sector by one per cent from 2018 to 2019, while those from ***agriculture*** grew by two per cent. The net sink of the ***land*** use, ***land*** use change and forestry sector (LULUCF), that is, the sum of ***emissions*** and ***removals*** was -14.7 million tonnes of CO2 eq. in 2019, or 79 per cent higher than in the year before. Especially the six per cent reduction in fellings compared to the top year of fellings, 2018, increased the net sink of the ***land*** use sector. Calculation of the net sink becomes revised yearly for the penultimate years. This is due to utilisation of new data, e.g national ***forest*** inventory data, in the calculation. New data affect, e.g the areas and growing stock which, in turn, affect the litter input to the soil and thus the soil carbon storage (see the review (in Finnish)).

The complete document can be viewed at this link:[*http://www.stat.fi/til/khki/2019/khki\_2019\_2020-12-21\_tie\_001\_en.html*](http://www.stat.fi/til/khki/2019/khki_2019_2020-12-21_tie_001_en.html)

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[***The carbon opportunity cost of animal-sourced food production on land***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:671W-P2M1-JCWX-C29S-00000-00&context=1516831)

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**Body**

Main

Restoration of native ecosystems, including ***forests***, is a ***land***-based option for atmospheric carbon dioxide (CO2) ***removal***. Ecosystem restoration is constrained largely by ***land*** requirements of food production, the largest human use of ***land*** globally. Food production therefore incurs a ‘carbon opportunity cost’, that is, the potential for natural CO2 ***removal*** via ecosystem restoration on ***land***,. This cost can vary greatly depending on the ‘potential’ or ‘native’ vegetation of a given region and types of food produced. Animal-sourced foods such as meat and dairy have large ***land*** footprints because animals typically consume more food macronutrients than they produce. Quantifying the spatial distribution of ***agriculture***’s cumulative carbon opportunity cost within this century can inform efforts to limit global warming to 1.5 °C.

Ongoing ***agricultural*** ***emissions*** can be abated by shifts to less-resource-intensive, plant-based diets,, but the potential for cumulative CO2 ***removal*** from native vegetation regrowth in areas occupied by animal ***agriculture*** has not previously been calculated in a spatially explicit manner. Here we quantify the total carbon opportunity cost of animal ***agricultural*** production to be 152.5 (94.2–207.1) gigatons of carbon (GtC) in living plant biomass across all continents and biomes (Fig. and Supplementary Table ).

Distribution of carbon in potential vegetation in areas of present-day animal feed croplands and pastures combined for each 5 arcmin grid cell.

Colour corresponds to the product of ***land*** area presently under cultivation multiplied by the potential vegetation carbon density, minus the quantity presently stored in ***agricultural*** vegetation.

We approximated the potential for CO2 ***removal*** in soil and litter as an additional 63 GtC (Supplementary Table ). This estimate is associated with large but unknown uncertainty because of a deficit of data and the complexity of dynamics of non-living carbon pools in restored ecosystems.

Pastures for ruminant meat and dairy production represent the majority of the total carbon opportunity cost—72%—compared with animal feed croplands, which suppress the remaining 28% of native vegetation carbon (Supplementary Table ). Potential productivity on remaining cropland is sufficient to supply the current global population with 78 g capita−1 day−1 of protein (after factoring losses from both storage and consumer waste), an amount exceeding dietary recommendations, accounting for variation in nutritional requirements among demographic groups and for disparities in food availability.

The cumulative potential of CO2 ***removal*** on ***land*** currently occupied by animal ***agriculture*** is comparable in order of magnitude to the past decade of global fossil fuel ***emissions***. The largest potential for negative ***emissions***—74 GtC or 48% of the global total—lies in upper-middle-income countries (Fig. ), which will further increase as meat and dairy production expand. This is approximately equal to the past 19 years of fossil fuel ***emissions*** in these countries. In high-income countries, in which animal-sourced food demand is high but plateauing, the total carbon opportunity cost of animal-sourced food production is 32 GtC, approximately equal to the past 9 years of their domestic fossil fuel ***emissions***.

Carbon opportunity cost of animal ***agriculture*** and atmospheric CO2 ***emissions*** grouped by national income tiers.

CO2 ***emissions*** include fossil fuel and cement (grey bars). Carbon opportunity costs are disaggregated by present-day ***agricultural*** ***land*** type and potential vegetation biomes: croplands in native grassland areas (dark brown), croplands in native ***forest*** areas (light brown), pastures in native grassland areas (light green) and pastures in native ***forest*** areas (dark green). Error bars are combined 95% confidence intervals for the total carbon opportunity cost across all production categories and biomes in each income category.

Present-day pasturelands exist in areas of both native ***forests*** and grasslands within all continents (Supplementary Table ). Pastures in native ***forest*** areas displace 72 GtC—accounting for 68% of pastures’ carbon opportunity cost but only 22% of total pasture area (Supplementary Table and Supplementary Fig. ). In native grasslands, vegetation may be partially restored by improved grazing management, rather than ***removing*** animals altogether, although trade-offs remain with respect to non-CO2 ruminant ***emissions***. In addition, optimal grazing does not always promote restoration because ruminants selectively browse native species and translocate nutrients.

To understand the potential future consequences of animal-sourced food consumption on global CO2 budgets, we modelled ***land*** use of three global dietary scenarios to the year 2050 relative to the present day (base year 2015). The net CO2 balance was calculated for a business-as-usual (BAU) diet following economic trends, a healthier diet with approximately 70% meat reduction globally relative to BAU (the EAT-Lancet Commission or ELC diet) and a vegan (VGN) diet with no animal-sourced foods.

The BAU diet results in ***land*** clearing, with ***land***-use-change ***emissions*** of 86 (68–105) GtCO2 (Fig. ) because optimistic future improvements in yields are insufficient to meet expected animal feed demands.

Cumulative changes in terrestrial carbon from three dietary scenarios in 2050: BAU, ELC and VGN.

Scenarios do not include abated ***emissions*** associated with ***agricultural*** production (for example, ref. ). Positive CO2 indicates a loss of ecosystem vegetation carbon and ***emissions*** to the atmosphere; negative indicates CO2 ***removal*** via vegetation growth. Error bars are 95% confidence intervals, reflecting various estimates of potential vegetation and distributions of cropland ***removal*** from low- and high-carbon biomes.

The ELC and VGN diets result in 332 (210 to 459) and 547 (358 to 743) total GtCO2 ***removal***, respectively, approximately equal to the past 9 and 16 years of fossil fuel ***emissions***. Ecosystem soil and litter could ***remove*** an additional 135 and 225 GtCO2 for ELC and VGN, respectively (Supplementary Table ), but this estimate is highly uncertain.

Smaller future increases in crop yields would result in less ***land*** sparing and CO2 ***removal*** from ELC and VGN diets compared with present day: 199 and 424 GtCO2, respectively (Supplementary Table ). However, plant-rich diets would permit even greater mitigation compared with BAU; lower yields result in greater ***land***-clearing ***emissions*** of 247 GtCO2.

Ceasing fossil fuel use is necessary to limit global warming, but CO2 ***removal*** following plant-rich dietary shifts could substantially contribute to international greenhouse gas reduction ***targets***. Cumulative CO2 ***emissions*** (anthropogenic ***emissions*** minus ***removal***) must remain below 335 GtCO2 after 2019 to limit warming to 1.5 °C at a 66% likelihood level. CO2 ***removal*** from terrestrial vegetation following ELC or VGN dietary shifts would increase permissible CO2 ***emissions*** by 99% (63%–137%) or 163% (107%–222%), respectively. Adding net CO2 uptake by native ecosystem soil and litter to this total increases the 1.5 °C budget by 139% or 230%, respectively. By contrast, most future scenarios of 1.5 °C warming rely on nascent bioenergy carbon capture and storage technology to ***remove*** 151 to 1,191 GtCO2 from the atmosphere—an amount of CO2 comparable to plant-rich diets.

Across all scenarios, additional system-wide improvements in waste and efficiency are possible, including using crop residues and waste for animal feed. We do not model these interventions explicitly; previous analyses demonstrate that they could provide some additional ‘cropland-free’ animal food or spare additional ***land*** for ecosystem restoration,.

The likelihood of limiting warming to 1.5 °C without overshoot is improved by reaching carbon neutrality before 2050. Carbon uptake saturates after around 25 years for tropical ***forests*** and around 30 years for temperate ***forests***. Changes in diets and ***agricultural*** ***land*** use within the next two decades could contribute substantially toward carbon neutrality by 2050. Overshooting 1.5 °C warming poses substantial risks to human and natural systems, including a weakened terrestrial ecosystem carbon sink. However, even in high-***emission*** pathways, terrestrial ecosystems are expected to act as a net carbon sink through 2100, although the precise magnitude is subject to ongoing investigation. In addition, temperate reforestation can lead to local warming effects due to albedo changes—impacts that warrant further analysis—although temperate reforestation would still result in net cooling globally.

Our results do not reflect additional non-CO2 greenhouse gases and their respective twenty-first-century ***emissions*** budgets. Dietary shifts could mitigate 49% to 70% of annual BAU food system ***emissions*** (4.8 to 6.6 GtCO2-equivalent yr−1 of predominantly non-CO2 gases) in 2050,. This non-CO2 mitigation further improves the likelihood of remaining under 1.5 °C warming.

Our estimates of CO2 ***removal*** differ from prior approaches, which have been calculated on an annual basis,, and therefore depend on rates of hypothetical dietary transitions and ecosystem regrowth; modulating these rates produces different estimates. Such rate dependencies are complex, or derived from process-based models; fully reconstructing these assumptions for direct comparison with our results was outside of our scope. Our approach avoids temporal dependencies, directly addressing the cumulative twenty-first-century potential for CO2 ***removal***. One previous study has reported a cumulative potential of 30 GtC or 110 GtCO2 via dietary shifts; this analysis used a single native vegetation dataset at a coarser spatial resolution.

Changes to global ***agricultural*** production would be economically disruptive and could incur sociocultural costs, which must be compared with the costs of climate warming from unabated ***agricultural*** ***emissions***. Restoration efforts could minimize trade-offs by ***targeting*** the highest-carbon areas (Fig. and Supplementary Figs. and ). Financial incentives to restore high-carbon ***forests*** may come from higher-income, higher-emitting nations, providing investments to protect livelihoods, strengthen food security and improve ***agricultural*** productivity. Our analysis also reveals substantial opportunities for CO2 ***removal*** in high-income countries and temperate ecoregions that are often neglected in scientific and policy conversations (Fig. and ).

This analysis uses the most up-to-date and high-resolution data to map ecosystem carbon trade-offs associated with animal-sourced food production. Our results demonstrate substantial carbon opportunity costs incurred by resource-intensive diets, comparable to the remaining carbon budget to 1.5 °C. Animal ***agriculture*** across all continents and income categories represents a profound trade-off when compared with potential GHG mitigation. If future dietary shifts do not occur, carbon trade-offs are expected to grow, even with large improvements in yields and optimized cropland distribution. Our carbon accounting approach illuminates areas where policies could prioritize ecosystem restoration and CO2 ***removal***, including but not limited to tropical Latin American ***forests*** outside of the Amazon basin and temperate ***forests*** in Western Europe and East Asia, where carbon trade-offs are largest.

Methods

The carbon opportunity cost of present-day animal ***agriculture*** (Fig. and Supplementary Table ) was calculated as the difference between carbon stocks in potential vegetation (that is, vegetation following human abandonment) and vegetation carbon stocks in animal feed croplands and permanent pastures,,, all at 5 arcmin spatial resolution. Cropland carbon stocks were assumed equal to carbon in annual maximum biomass, estimated from harvested yields, per West et al.. This produces a conservative estimate for the difference between cropland and native biomass. Animal feed fractions for crops were taken from a previous analysis, which used data consistent with our analysis.

Carbon in potential vegetation was taken from six datasets, and carbon in present-day pastures from seven datasets (), at 5 arcmin, the highest-resolution global estimates available. We refer to potential vegetation as ‘native vegetation’ interchangeably, although restored vegetation may consist of non-native species. We do not consider ***forest*** plantations representative of commercial forestry, or tree planting.

In native ***forest*** areas, we assumed pastures exist on cleared ***land*** (Supplementary Fig. ). In native grasslands areas (including savannas of sufficiently low tree density <75 MgC ha−1), we assumed pastures exist on managed ***lands*** (Supplementary Fig. ), where carbon was assumed equal to that in present-day vegetation, which is lower than carbon in potential vegetation in most areas. Our soil and litter carbon estimates are described in .

For 2050 dietary scenarios, we developed a low-parameter, top-down representation of ***land*** use that adopts literature BAU estimates (). This flexible approach is used to parsimoniously calculate the fraction of literature BAU ***agricultural*** ***land*** that ELC and VGN diets could spare for ecosystem restoration, provided key parameters reflecting production, consumption and feed allocation are available.

In the 2050 BAU scenario in the main text, we used cropland expansion within each continent directly from Alexandratos and Bruinsma. We assumed a global pasture expansion of 6% by 2050, consistent with a literature estimate that assumes optimistic grazing improvements. Pasture expansion was distributed proportionally over the same distribution potential vegetation biomes as the present day, a conservative assumption because expansion is presently occurring disproportionately in carbon-rich tropical areas.

In the VGN scenario, all permanent pastureland was taken out of production, as well as feed croplands minus ***land*** necessary to provide macronutrients of removed animal-sourced foods (with approximately 25% excess after wastes and losses; Supplementary Table ). ELC requirements were derived from recent guidelines. We calculated fractions of feed cropland and pastureland necessary for each animal-sourced food category in ELC relative to BAU diets, using crop and forage and pasture allocation parameters from the literature.

Alternatively, we adopted a pessimistic BAU projection (), which assumes relatively lower crop yields and pasture productivity, in contrast to the more optimistic assumptions in the BAU scenario in the main text (Supplementary Table ).

All errors and ranges presented are 95% confidence intervals calculated over all combinations of carbon estimates and area distributions: carbon in potential vegetation from six spatial datasets, carbon in present-day pasturelands from seven spatial datasets and simulations wherein crops are removed from areas of highest versus lowest carbon in potential vegetation (Supplementary Figs. and ). For other assumptions, we were not able to calculate uncertainties; we therefore used the most conservative data or parameter estimates available in the literature for crop plant biomass, biomass in artificial pastures (areas of native ***forest***) and spatial estimates of pasture area,.

**Acknowledgements**

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**Notes**

Supplementary informationSupplementary information is available for this paper at [*https://doi.org/10.1038/s41893-020-00603-4.Publisher’s*](https://doi.org/10.1038/s41893-020-00603-4.Publisher’s) note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

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[***Bioenergy with carbon capture 'will not deliver negative emissions'***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:628J-6221-JBNF-W28P-00000-00&context=1516831)

utilityweek.co.uk

March 23, 2021 Tuesday 12:01 AM GMT

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**Section:** BIOMASS,CARBON CAPTURE AND STORAGE,GENERATION,POLICY,POLICY & REGULATION; Version:1

**Length:** 1129 words

**Byline:** Tom Grimwood

**Body**

Environmental groups have warned that bioenergy with carbon capture and storage (BECCS) will not deliver the "negative ***emissions***" touted by advocates, whilst also being expensive and damaging to the environment.

Organisations including Friends of the Earth, WWF and Greenpeace expressed their opposition to the technology in an open letter to the Department for Business, Energy and Industrial Strategy (BEIS) written as part of their response to a consultation on potential options for ***removing*** greenhouse gas from the atmosphere.

Drax recently revealed it was [*applying for planning permission*](https://utilityweek.co.uk/drax-plans-to-equip-two-biomass-units-with-ccs/) to install carbon capture and storage equipment on the two of the four biomass units at its power station in Selby. The company claimed this would allow it to become the world's first "negative ***emissions***" power station.

"BECCS relies on the premise that because ***forests*** and other plants absorb carbon as they grow, bioenergy is carbon neutral," the letter explained. "Proponents argue that when biomass is burned to fuel a power station, capturing and sequestering the smokestack CO2 ***emissions*** would thus make the process carbon negative."

However, putting aside the ***emissions*** created in processing and transporting the wood pellets burnt at Drax, most of which are sourced from the US, the letter said it was wrong to consider biomass generation as being carbon neutral. In addition to the ***emissions*** produced during combustion, carbon dioxide trapped in the soil is also released during harvesting.

It said even in the best-case scenario, in which trees are replanted and regrow immediately, replacing older trees with saplings reduces the amount of carbon stored in the ***forest***, and that carbon capture and storage can never mitigate this "foregone sequestration", which has often been "neglected" in carbon accounting.

"Together, this means that ***forest*** biomass harvest for energy, even under BECCS, has a negative impact on the climate, with consequences that can persist for decades or more-far outside Paris Agreement timeframes," it stated. "This holds true even under the industry's definition of sustainable biomass sourcing of thinnings from managed ***forests***."

The letter said pellets produced using "damaging logging practices" such as the clear-felling of mature hardwood ***forests***, "routinely enters the UK energy market", warning: "This biomass is high-carbon and its sourcing contributes to ***forest*** degradation, yet it takes place under existing governmental and corporate sustainability standards."

It said any attempts to produce the fuel domestically will have "serious implications" for ***land*** use, ***agriculture*** and biodiversity in the UK: "Reducing the ***land*** available for food production risks either greater intensification of ***agriculture*** or a reduction in ***agricultural*** output. If biomass production has to rely on ***agricultural*** intensification in combination with monoculture biomass plantations, it risks damaging biodiversity if ***forests*** are converted to plantations heavily reliant on agrochemicals.

"Once the carbon costs of pesticide use, fertiliser use, harvesting and transportation are factored in, any climate mitigation that is realised may be lower than if the same ***land*** was used for another carbon-absorbing activity, such as native tree-planting," it added.

Furthermore, the letter said biomass generation is a "hugely expensive and inefficient source of power", with recent figures from the think tank Ember putting the subsidies to Drax in 2020 at £832 million, including £258 million in tax breaks: "Rather than prioritising additional subsidies to run BECCS at Drax, a high priority from a climate perspective would be to replace Drax and other industrial scale bioenergy with low-carbon renewables."

It said BECCS "sacrifices genuine opportunities" to ***remove*** carbon dioxide from the atmosphere: "Protecting and restoring natural carbon sinks, including ***forests***, peatlands, grasslands and wetlands are the most effective and proven ways of sequestering carbon and are thus critical. In addition to pulling CO2 out of the air and storing it in organic materials, these approaches can secure food supplies, improve the resilience of ecosystems and communities, and enhance biodiversity."

Drax has previously said it is aiming to be able to generate power from biomass without subsidies by the time its current Contracts for Difference expire in 2027, but that it would be seeking subsidies to capture and store the ***emissions***.

In a report published in 2017, Chatham House claimed that biomass is a more carbon intensive source of power than gas or even coal. The think tank did not sign the letter but expressed its support for its message. Daniel Quiggin, senior research fellow for its energy, environment and resource programme, said: "It's an incredibly risky bet for the government to overly rely on bioenergy with carbon capture and storage.

He continued: "Government attention needs to focus primarily on low-carbon technologies that are affordable now and balance some of the risks of BECCS by separating the net-zero ***target*** into a decarbonisation ***target*** and a separate CO2 ***removal*** ***target***."

Jonathan Marshall, head of analysis at the Energy and Climate Intelligence Unit, commented: "These warnings come amid concerns that energy and climate models are over-egging the potential of BECCS. The heavy reliance on a technology that is facing increasing questions over its true sustainability is likely to cause concern for policy makers, especially in sectors where decisions are being delayed today on the back of expectations that negative ***emissions*** technologies will come to the rescue.

"The government is currently making big calls on the future of greenhouse gas ***removals***, at the same time as stalling on actions that can cut carbon now. Pushing this dangerous mindset has been a long-term strategy of oil and gas companies; we should expect our policy makers not to fall into the same trap."

A spokesperson for Drax said: "Climate change experts and scientists at the UN's IPCC and the UK's Climate Change Committee have stated sustainable biomass is critical to reach global climate ***targets*** - both in generating renewable electricity and in delivering negative ***emissions*** with bioenergy with carbon capture and storage.

"BECCS is the most cost-effective negative ***emissions*** technology available now. It has been proven to work at Drax - the first unit could be operational as soon as 2027, permanently ***removing*** millions of tonnes of CO2 from the atmosphere every year.

"Drax is committed to ensuring best practice in health and safety, operational efficiency and sustainability across the group and intends to invest accordingly to deliver this outcome."

The post [*Bioenergy with carbon capture 'will not deliver negative* ***emissions****'*](https://utilityweek.co.uk/bioenergy-with-carbon-capture-will-not-deliver-negative-emissions/) appeared first on [*Utility Week*](https://utilityweek.co.uk).

**Load-Date:** March 22, 2021

**End of Document**



[***Farmers stumped as hold-ups in licensing stop them felling timber; Ministry bottlenecks and environmental rule changes halt planting of trees to trap carbon, writes Valerie Flynn***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:6341-NGR1-JCBW-N11M-00000-00&context=1516831)

The Sunday Times (London)

July 11, 2021 Sunday

Edition 1, Ireland

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**Section:** NEWS; Pg. 20

**Length:** 982 words

**Body**

Jason Fleming's late father planted Sitka spruce on part of the family farm in Co Kerry in the early 2000s. Over two years ago, he applied for a felling licence to thin the crop, an important element of forestry management that involves harvesting the weaker trees so the rest get enough light and space to reach maturity. However, a backlog of 6,000 applications at the Department of ***Agriculture*** means Fleming is still waiting.

"There are other farmers who have their licence for clear-fell to take the crop out, but they haven't a licence for a road, so they can't get at it," he said. "It's absolutely and utterly frustrating."

The delays cause other problems.

Glennon Brothers, a timber company mostly supplying the construction industry, says the licence backlog has forced it to import logs from Scotland. Mike Glennon, managing director, said: "We can't supply our customers for six to eight weeks. There are others in the timber industry in the west who can't import, and we are all scrambling for logs."

The Climate Change Advisory Council has recommended that suckler-beef farmers diversify out of unprofitable, subsidised activities into forestry, reducing the national herd and greenhouse gas ***emissions***. The government set a ***target*** of 8,000ha of ***forest*** a year, and wants "all farmers" to give "serious consideration" to planting some of their ***land***.

Would Fleming, a suckler farmer, consider converting some of his ***land*** to forestry now? "Not a hope. I won't plant another acre," he said. "As farmers, we've been left behind. The applications are all tied up ... it's a mess. There's no demand for planting because you couldn't advise any farmer to plant under the current circumstances."

The amount of ***land*** planted with forestry is now in decline. Just 2,400ha were afforested last year, the lowest level since 1936. In the early 2000s, when Fleming's father planted his trees, the equivalent figure was 15,000ha, but it peaked above 20,000ha in the mid 1990s.

What changed? Pippa Hackett, the Green Party junior minister for ***agriculture***, notes that environmental rules were less stringent back then, with fewer areas deemed ineligible for planting. Fleming's trees were planted on boggy ***land*** that would not get permission today. Draining peat releases massive amounts of carbon dioxide into the atmosphere. Unlike in the 1990s, Coillte, the state's forestry body, is "no longer planting new ***forests*** to any great degree", Hackett added. The decline is storing up an environmental problem for Ireland, just as the Climate Bill comes into force. Recent amendments to the bill allow "***removals***" of CO2 from the atmosphere, such as through afforestation, to be offset against ***emissions*** from ***agriculture***. The issue is there may not be enough trees for this to work.

John Sweeney, a climate scientist who has contributed to the Intergovernmental Panel on Climate Change, said: "We're going to be felling more than we're planting for the next decade. ***Emissions*** from grassland at the moment are twice the level of sequestration from ***forests***."

Together, ***land*** use and forestry caused net ***emissions*** of 4.4 million tonnes of

CO2 in 2019. Hackett said that "projections show a decline in the national ***forest*** sink", with forestry to become a net emitter in about ten years from now as trees planted in earlier decades are harvested.

Sweeney points out that there is a difference between carbon storage and carbon sequestration, with only the latter representing meaningful climate action. "The rules for sequestration are laid down by the UN Framework Convention on Climate Change. It's something that adds to the carbon pool year by year. It's not giving credit for something in position from time immemorial," he said.

Tim Lombard, the Fine Gael senator who tabled the "***removals***" amendment, believes there should be more generous crediting of carbon stored by ***forests*** or hedgerows, even if they pre-date 2018, the baseline year against which the Climate Bill's ***targets*** are measured.

"My view is that [farmers] should get an acknowledgement for all their hedgerows, rather than just new hedgerows or new growth on hedgerows. We need to acknowledge the capability ***agriculture*** has to ***remove*** carbon," Lombard said.

Last Friday the government amended the Climate Bill to allow separate regulations setting out how ***removals*** will be calculated and accounted.

Everyone involved in forestry agrees that the licensing problem must be solved if afforestation is to be revived. Fleming argues that farmers should be able to get one forestry licence that covers planting, thinning, clear-felling and other work.

Peter Sweetman, an environmentalist who has lodged several appeals against forestry licences, agrees that a licence to plant should carry through to harvesting and replanting. However, he argues that any change must strengthen the requirement for environmental impact assessments of new plantations. Under current law, they are not required for plantations under [*www.50ha.No*](http://www.50ha.No) application over 50ha has been made for ten years. Sweetman claims "project splitting" is being used to get around the stipulation.

Hackett said that the licensing system changed after EU and Irish court rulings related to European environmental law. "This has been challenging to implement, and resulted in a requirement for much greater ecological input into licensing," she said.

New procedures and resources to deal with the changes are now in place, and forestry licensing legislation will soon be reviewed, Hackett promises. She added that a new afforestation programme will begin in 2023 which will encourage a broader range of planting and the creation of woodland on public ***land***.

"Combining woodland creation with farming is the future," she said. "Although levels of afforestation have been below ***target***, forestry remains a crucial mitigation measure available to Ireland in achieving the goals of the Paris agreement."

@valerie\_flynn

**Graphic**

Logs leaving Scotland for Glennon Brothers' mill in Cork, as a result of a tree felling licence backlog

**Load-Date:** July 11, 2021

**End of Document**



[***Forestry's climate impact 'invisible' under UN rules, experts say***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:6141-6BG1-DYXB-V1SC-00000-00&context=1516831)

EurActiv.com

October 21, 2020 Wednesday

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**Length:** 1338 words

**Byline:** Frédéric Simon

**Highlight:** ***Forests*** are the planet's biggest carbon "sink" - absorbing more CO2 from the atmosphere than they emit - but their contribution to cooling the earth's climate are currently not fully accounted for under UN rules, experts point out.

**Body**

***Forests*** are the planet's biggest carbon "sink" - absorbing more CO2 from the atmosphere than they emit - but their contribution to cooling the earth's climate is currently not fully accounted for under UN rules, experts say.

The European Commission rang the alarm bell about the state of EU ***forests*** last month, saying their capacity to absorb carbon dioxide - the main greenhouse gas responsible for global warming - has been decreasing since 2013 and needs to be restored.

"The sink has to go back to its previous levels" if Europe wants to bring ***emissions*** down to net-zero, EU climate chief Frans Timmermans said as he presented the Commission's 2030 climate plan last month.

The Commission said in its 2030 climate proposals that "need a growing sink in order for the EU to achieve climate neutrality by 2050", calling for improved ***forest*** management as well as "re- and afforestation" initiatives to restore degraded ***land*** and preserve biodiversity.

***Forest***-based industries, for their part, have insisted on the need to take a comprehensive view of forestry activities in order to evaluate their real contribution to the fight against global warming.

Wood-based products such as paper or furniture store CO2 until it is eventually returned to the atmosphere when they are burned at the end of their life-cycle, forming a closed carbon loop, said [*Peter Holmgren*](https://en.wikipedia.org/wiki/Peter_Holmgren), a forestry expert who spoke at a [*Brussels event*](https://skogsindustrierna.confetti.events/woodbebetter-cepi/livestream) organised last month with the Swedish ***forest*** industries.

But this does not take into account the avoided ***emissions*** when wood fibres are used to replace plastics or other fossil-based materials, said Holmgren, who is former director-general at the [*Centre for International Forestry Research*](https://en.wikipedia.org/wiki/Center_for_International_Forestry_Research) (CIFOR), a non-profit research group.

"Some of that oil or coal stays in the ground," he said, underlining the "substitution effect" of biomass in relation to fossil fuels. "And this is an immediate effect that we need to take into account," he told the Brussels event.

**'Substitution effect' of forestry sector**

The Confederation of European Paper Industries (CEPI), which also supported the event, produced a [*study*](https://www.cepi.org/wp-content/uploads/2020/07/Cepi_-study.pdf) earlier this year to try and quantify the "substitution effect" of wood-based products.

"The results show that ***forests*** and ***forest***-based products ***remove*** a net of 806 million tons of carbon dioxide equivalents annually" - or the equivalent 20% of all fossil ***emissions*** in the EU, said Holmgren, who is the main author of the study.

But according to Holmgren, current rules at UN level do not take this into account.

While the "net sink" effect of ***forests*** is part of the annual reporting obligations of EU member states under the EU regulation on ***land*** use, ***land*** use change and forestry (LULUCF), this is currently not the case at the UN level, Holmgren pointed out.

"When the IPCC produces their global report, they do not include that net sink," Holmgren explained, saying "this is by and large invisible in current climate reporting" to the United Nations. "In the ***land*** report, for example, it is explicitly excluded, which means there is a dissonance" between the EU and UN reporting rules, he told participants at the event.

"So we don't have a good picture," he added.

Artur Runge-Metzger, a senior official at the European Commission's climate directorate, said the CEPI study was "100% in line" with the Commission's own climate policy proposals, which aim for a 55% reduction in greenhouse gas ***emissions*** by 2030.

"We recognise the value of ***forests*** and ***agriculture***" when it comes to climate change, Runge-Metzger told participants at the event, saying the so-called "invisible effect" of forestry "is fully captured" in the EU's carbon inventories.

"And I think there is a possibility to accelerate, otherwise, we wouldn't have put forward the 55% ***target***," he told the audience, saying the Commission "supports the bio-economy" as a way to substitute fossil-based materials.

[***Commission under fire for including 'carbon sinks' into EU climate goals***](https://www.euractiv.com/section/climate-environment/news/commission-under-fire-for-including-carbon-sinks-into-eu-climate-goals/)

The European Commission on Thursday (17 September) defended its plan to bring carbon ***removals*** from ***agriculture***, ***land*** use and forestry into the EU's updated climate ***target*** for 2030, saying this was in line with UNFCCC standards.

**'Carbon farming'**

However, forestry is not the only sector contributing to the "substitution effect," Runge-Metzger added, saying solar and wind energy also displace fossil fuels in their own way and could claim the same kind of recognition under the EU's carbon accounting rules.

"We have the same discussion with the steel industry," which claim to be displacing coal because wind turbines are made of steel, he said. "And you can do that across the entire economy," Runge-Metzger remarked.

What is currently not reflected in EU policy, however, is the "carbon sink" function of ***forests*** and ***agriculture***, Runge-Metzger pointed out, saying the Commission is currently looking into ways of rewarding farmers and ***forest*** owners for maintaining carbon sinks.

"At the end of the day, it's the farmer or the ***forester*** who will have to make a living," Runge-Metzger reminded. "If we don't value the sinks function of the ***forests*** and ***agriculture***, farmers and foresters will not care. And that's what we fear is happening," he warned.

"Let's be honest, the substitution effect works because we have a carbon price in Europe for the energy sector, which pushes out coal from the energy mix," Runge-Metzger remarked. "And the same is true for any other place where there is a carbon price - there is immediately a better fit for forestry and ***agriculture*** products" that can act as substitutes for fossil fuels, he said.

"So the question really is: how can we make sure that we count what's happening on the sink side" and "put a value" on carbon sinks, he continued. "And that is something we are exploring with the farmers" as part of a new EU "carbon farming initiative" which aims to reward farming practices that ***remove*** CO2 from the atmosphere.

The EU scheme will include new regulations to certify carbon ***removals*** based on a "robust and transparent" carbon accounting methodology to monitor and verify the authenticity of carbon ***removals***, the Commission said in its 'Farm to Fork' strategy presented in May.

"That will take us many years and it might not happen between now and 2025 or 2030," Runge-Metzger said. "But in 2050, we need to be in a better place."

[***Europe revives carbon farming but without access to carbon markets***](https://www.euractiv.com/section/agriculture-food/news/europe-revives-carbon-farming-but-without-access-to-carbon-markets/)

The concept of soil carbon sequestration, a cornerstone of regenerative farming, is regaining strength as a key measure in both climate mitigation and adaptation.

Jytte Guteland, a Swedish MEP who was the lead author of the European Parliament's position on the EU's 2030 climate proposal, said the Commission had "underestimated the potential" of ***forests*** to act as carbon sinks.

"I think there is a bigger potential," she told participants at the event, saying well-managed ***forests*** "will actually improve the carbon sink for Europe, not the opposite".

She also called out what she described as a frequent misconception among lawmakers in the European Parliament that ***forests*** should be ring-fenced in order to preserve their ability to absorb CO2.

"From the point of view of my own country, Sweden, we have a common understanding that when the tree is growing, it can have a bigger carbon uptake. So we need to have more sustainable management of ***forests***" to make sure new trees are planted in replacement of those that are harvested for the needs of the paper and wood-based industries, Guteland said.

Runge-Metzger agreed with Guteland that foresters need incentives for "active ***forest*** management" practices that preserve carbon sinks. However, he insisted that those incentives "won't come like manna from heaven," and that those "expenses" need to be covered somehow.

"So the question is: are we going to rely on subsidies to do this, or are we going to find other ways to do that? That is where we would like to see a debate among foresters, the ***forest*** industry, and farmers on how we can realise that potential".

*[Edited by Zoran Radosavljevic]*

**Load-Date:** October 21, 2020

**End of Document**



[***Field trial will see thousands of trees planted***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:62W6-XYF1-JCBW-N3P9-00000-00&context=1516831)

Carmarthen Journal

June 9, 2021 Wednesday

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**Section:** NEWS; Pg. 19

**Length:** 577 words

**Byline:** IAN LEWIS

**Body**

MORE than 25,000 new trees will be planted on 28 acres of ***land*** in north Carmarthenshire as part of a field trial combining two nature-based climate solutions never previously deployed together on such a large scale.

Over the first two years, the project - which is on ***land*** near the village of Cynghordy, north of Llandovery - will measure the carbon stored in the trees and soil, and the results will identify the combination of treatments where the most carbon has been sequestered. The Carbon Community aims to scale up this reforestation method to accelerate and enhance carbon ***removal*** from the atmosphere.

The Carbon Community is a new charity dedicated to creating ***forests*** and speeding up carbon ***removal*** with breakthrough science.

It creates new ***forest*** on its own ***land*** to ensure the trees that are planted will be there for generations. The charity is looking for funders and partners to scale up tree planting and help advance the research on carbon in trees and soil.

Charles Nicholls, co-founder of the Carbon Community, said: "Reforestation is one of the most powerful tools we have to combat climate breakdown, much of which will happen on ***agricultural*** ***land***.

"Intensively farmed ***land*** is often stripped of the native biodiversity and minerals needed for optimal tree establishment.

"With this unique project we aim to restore biodiversity, enhance tree survival and unlock huge potential to accelerate and enhance the carbon stored in trees and soil."

The Carbon Community field trial is the first of its kind and the results will be made freely available to other tree-planting projects and environmental scientists.

The trial will study two types of ***forests***: the first comprises native broadleaf species from Wales, including birch, alder, cherry, oak, aspen and rowan.

The second type is a monoculture conifer ***forest*** comprising sitka spruce, typical of commercial forestry plantations.

In the design of this experiment ETH Zurich's Crowther Lab is intentionally reintroducing soil from established ***forest*** ecosystems in an effort to jump start reforestation.

For this field trial, The Carbon Community sourced soils from nearby ***forests***.

Dr Colin Averill, senior scientist at the Crowther Lab, said: "This is an important world-first field trial which will measure carbon sequestered in trees and soil on a scope and scale not seen before.

"Studies continue to find that introduction of native soil communities can dramatically increase plant survival.

"How these fungi may in turn affect tree seedling growth and survival rates and ecosystem carbon sequestration at scale remains unknown, and is one example of how The Carbon Community is pushing the frontiers of naturebased climate solutions."

The second aspect of the project is enhanced rock weathering.

This is a natural geological process which ***removes*** carbon dioxide from the atmosphere.

The project will add basalt to the soil which has the potential to dramatically increase the carbon ***removal*** and accelerate the establishment of new ***forests***.

Professor David Beerling at the University of Sheffield, one of the project leaders, said: "Our recent research revealed that applying basalt to croplands could absorb up to two billion tonnes of CO2 from the atmosphere.

"This exciting new partnership with The Carbon Community enables us to understand basalt addition in a reforestation project.

"To avoid catastrophic climate change we need to urgently scale up carbon ***removal*** strategies, alongside deep ***emissions*** cuts."

**Graphic**

More than 25,000 new trees will be planted on 28 acres of ***land*** in Carmarthenshire near Cynghordy, north of Llandovery, as part of a field trial. PAUL BOX

**Load-Date:** June 9, 2021

**End of Document**



[***From tree planting to CO2-sucking machines: How could 'negative emissions' help to tackle the climate crisis?***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:61YW-6H41-DY4H-K4YD-00000-00&context=1516831)

The Independent (United Kingdom)

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**Section:** CLIMATE,NEWS; Version:1

**Length:** 1637 words

**Byline:** Daisy Dunne

**Highlight:** ***Removing*** CO2 from air will likely be needed if the world is to meet its climate goals, writes Daisy Dunne, but our options for achieving 'negative ***emissions***' each come with a unique set of challenges

**Body**

Just over five years ago, countries reached a deal to keep global warming to below 2C above pre-industrial levels under the historic Paris Agreement. But since then, global [***emissions***](https://www.independent.co.uk/topic/emissions) are yet to reach a peak and the path to reaching the Paris goals grows steeper year by year.

Cutting back on greenhouse ***emissions*** as fast as possible will be crucial to meeting the world's climate goals. But to have the greatest chance of meeting the Paris ***targets***, it is likely the world will also have to scale up techniques for ***removing*** [*CO2*](https://www.independent.co.uk/topic/co2) from the atmosphere, scientists say.

Methods for ***removing*** CO2 from the atmosphere range from "natural climate solutions", such as replanting lost ***forests*** and restoring ***land*** and ocean ecosystems, to emerging technologies, including the idea of using machines to suck CO2 directly out of the air.

Scientists use the term "negative ***emissions*** technologies" to describe the wide and varied group of methods available for ***removing*** CO2 from air. Many of these techniques are still in their infancy, and all come with risks and challenges.

"I think most people would agree we're going to need some level of negative ***emissions*** in order to deliver on our ***targets***," Dr Rob Bellamy, a scientist studying [*climate change*](https://www.independent.co.uk/topic/climate-change-1) technologies at the University of Manchester, tells The Independent.

In 2019, the UK set a legal ***target*** of reaching net-zero greenhouse gas ***emissions*** by 2050. And in a landmark report published in December, the UK's climate advisers laid out a detailed plan for how the country will need to change in the coming decades in order to meet its ***target***.

The report made clear that scaling up methods for ***removing*** CO2 from the atmosphere will be key to reaching the 2050 goal. For example, the report says that within just five years, the UK will need to plant 30,000 hectares of new ***forest*** every year to be in line with its net-zero goal - a ***target*** it is still a long way from achieving.

"In the UK, you can't actually reach net zero without using negative ***emissions*** because of certain sectors having either difficult-to-abate or impossible-to-abate ***emissions***," says Dr Bellamy. Such sectors include aviation, a particularly polluting form of transport for which there are currently few immediate low-carbon solutions on the horizon.

"Unless we completely shut down those sectors, we'll need negative ***emissions*** to get rid of the greenhouse gases that they are responsible for," he explains.

Looking to nature

"Natural" solutions for ***removing*** CO2 from the atmosphere, such as tree planting and restoring carbon-rich ecosystems, have seen a surge in popularity in recent months.

Boris Johnson has repeatedly promised to make natural solutions a key part of Cop26, a crucial round of global climate talks that will be held in Glasgow later this year. And at a summit held earlier this month, world leaders backed an ongoing project to create a Great Green Wall of new ***forest*** stretching across the width of Africa just south of the Sahara desert. When completed, it will be the world's largest living structure.

Research suggests natural climate solutions could potentially offset large amounts of the world's CO2 ***emissions*** while providing co-benefits for wildlife and people.

In addition, these techniques do not require new technological innovations, giving them an advantage over some of the other types of negative ***emissions*** technologies that are still in their infancy, such as using machines to suck CO2 from air.

Studies suggest solutions to the climate crisis that are perceived to be "natural" are also more likely to be favoured by the public, says Dr Bellamy.

"An extensive amount of research has taken place on public perceptions that shows that people consistently prefer things that are shown to be perceived to be 'natural'," he says.

Tree planting offers the largest potential for offsetting CO2 out of the proposed natural climate solutions, research suggests. However, relying on tree planting to offset large amounts of CO2 could come with risks.

A landmark report into limiting global warming to 1.5C, the most aspirational ***target*** of the Paris Agreement, warned that planting the number of trees required to meet the goal could take up large amounts of ***land***, potentially reducing the area available for food production and wildlife.

"[Tree planting] may compete with other ***land*** uses and may have significant impacts on ***agricultural*** and food systems, biodiversity and other ecosystem functions and services," the report says.

Another concern with "reforestation" is that its potential benefits depend greatly on what kind of trees are planted and how projects are managed, scientists have warned. "Monoculture plantations" - ***forests*** with just one tree species - have been likened to "green deserts" because they provide little suitable habitat for wildlife.

Some environmentalists have also pointed out that many countries are still grappling with deforestation and may not be able to protect new ***forests*** from destruction. A report released last month found 43m hectares of ***forest*** and other critical natural ecosystems were destroyed between 2004 and 2017.

Burning crops

Among scientists, there is one negative ***emissions*** technology that has been at the forefront of much debate and discussion known as "bioenergy with carbon capture and storage" (BECCS).

The first step of BECCS involves growing crops and then burning them to produce energy. This is the "bioenergy" step. The second step involves capturing the CO2 emitted by the crops as they are burned and then storing these ***emissions*** either underground or under the sea. This is the "carbon capture and storage" step.

Because crops naturally absorb CO2 as they grow, it is theorised that this process would lead to the net ***removal*** of CO2 from the atmosphere.

Many of the pathways that scientists have come up with to show how the world could limit global warming to 1.5C rely heavily on the use of this technology in the coming decades. And in their report setting out how the UK can meet net zero by 2050, the UK's climate advisers say that some use of BECCS will be necessary to meet the country's ***target***.

Despite this, BECCS is still in its early stages of development. A handful of projects have piloted the technology at a small scale. The Drax power station in North Yorkshire is among the first in Europe to be trialling BECCS.

Scientists have also raised a range of potential risks associated with the technology. Like large-scale tree planting, widespread deployment of BECCS would require huge amounts of ***land*** for the production of the energy crops, posing a potential threat to wildlife and food production.

"We're really talking about potentially planetary-scale engineering," Dr Zeke Hausfather, a climate scientist and director of climate and energy at the Breakthrough Institute, an environmental think tank in California, toldThe Independent.

Scientists have also questioned whether BECCS would truly be able to deliver "negative ***emissions***". This is because the technology might have hidden carbon costs that aren't taken into account, it is argued. For example, to create the space to produce energy crops, cultivators may have to clear trees from their ***land***, which would cause additional CO2 to be released into the atmosphere.

There are also issues associated with the "CCS" part of BECCS. Carbon capture and storage is currently costly and requires large amounts of energy to work.

Sucking CO2 from air

Sucking CO2 straight from the air may sound like science fiction, but is one of the negative ***emissions*** techniques being seriously discussed by scientists.

Though the technology has not yet been shown to work at a large scale, various start-ups across the world are developing different methods for how it might work.

This includes Climeworks in Switzerland, a company that aims to capture one per cent of global CO2 ***emissions*** by 2025 through the use of machines that are able to capture CO2 directly from the air.

This is Orca: Climeworks' new large-scale carbon dioxide ***removal*** plant. The new plant will be able to permanently ***remove*** 4000 tons of carbon dioxide from the air per year.Follow this space for further updates![*#Climeworks*](https://twitter.com/hashtag/Climeworks?src=hash&ref_src=twsrc%5Etfw) [*#Orca*](https://twitter.com/hashtag/Orca?src=hash&ref_src=twsrc%5Etfw) [*#CarbonDioxideRemoval*](https://twitter.com/hashtag/CarbonDioxideRemoval?src=hash&ref_src=twsrc%5Etfw) [*pic.twitter.com/QuAmOS0NVg*](https://t.co/QuAmOS0NVg) - Climeworks (@Climeworks) [*September 7, 2020*](https://twitter.com/Climeworks/status/1302948073304399872?ref_src=twsrc%5Etfw)

Advocates for "direct air capture" say that, unlike BECCS and large-scale tree planting, ***removing*** CO2 from the atmosphere with machines would require relatively little ***land***. In addition, CO2 captured from air could be reused in the production of goods such as fizzy drinks, it is argued.

But the main drawback of the technology is it currently comes with large costs and energy requirements. One study published in 2019 found that, if "direct air capture" were rolled out on a global scale, it could require up to a quarter of the global energy supply by 2100.

"It's got an economic hurdle to get over," says Dr Bellamy.

Some have also argued that further development of direct air capture - along with other negative ***emissions*** technologies - might lead to misconceptions about there being a "quick fix" to the climate crisis. This might, in turn, lead to countries stalling on their commitments to rapidly reduce their greenhouse gas ***emissions***.

It is clear that there is no one technology that can act as a silver bullet for solving the climate crisis, says Dr Bellamy.

"There is a bit of a debate about the degree to which we'll need negative ***emissions***," he says. But the "motivation for doing negative ***emissions*** - which is that efforts to reduce ***emissions*** haven't been going that well" remains the same, he says.

Read More

[*Could the climate crisis have played a role in the emergence of Covid-19?*](https://www.independent.co.uk/climate-change/news/covid-climate-china-wuhan-bats-b1798036.html)

**Load-Date:** February 10, 2021

**End of Document**



[***World's most comprehensive analysis of forest resources launched today in an innovative format***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:60DK-0KV1-JDG9-Y4KJ-00000-00&context=1516831)

Impact News Service

July 21, 2020 Tuesday

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**Length:** 960 words

**Body**

Rome, Italy: Food and ***Agriculture*** Organization has issued the following press release:

FAO launched today the most comprehensive forestry assessment to date in an innovative and easy-to-use digital format.

Available for public viewing, the Global ***Forest*** Resources Assessment report (FRA 2020) and its first-ever online interactive dissemination platform contain detailed regional and global analyses for 236 countries and territories.

Users can now consult a comparable and consistent set of more than 60 ***forest*** indicators across countries and regions and download the requested data in a non-proprietary digital format. Monitoring of change over time is also possible in parameters such as ***forest*** area, management, ownership and use.

'The wealth of information on the world's ***forests*** is a valuable public good for the global community to help facilitate evidence-based policy formulation, decision-making and sound investments in the ***forest*** sector,' said Deputy Director-General, Maria Helena Semedo, at the launch. 'These newly released tools will enable us to better respond to deforestation and ***forest*** degradation, prevent biodiversity loss and improve sustainable ***forest*** management.'

Millions of people around the world depend on ***forests*** for their food security and livelihoods. Protecting ***forests*** is also key to conserving natural resources, as they harbour most of the Earth's terrestrial biodiversity and help mitigate climate change impacts. According to the recently published the State of the World's ***Forests*** (SOFO) report, ***forests*** contain 60,000 different tree species, 80 percent of amphibian species, 75 percent of bird species, and 68 percent of the Earth's mammal species.

Therefore, it is crucial to turn the tide on deforestation and the loss of biodiversity which can be done by conserving and sustainably managing ***forests*** and trees within an integrated landscape approach - addressing forestry and food security challenges together. Reliable and comprehensive information on ***forests*** and other ***land***-uses plays a vital role in this process, FAO says.

In addition, the FRA 2020 data are used by FAO to estimate carbon ***emissions*** and ***removals*** from ***forests***, by country and at a global level. For instance, the new FRA-based estimates indicate that global ***emissions*** from ***forest*** loss decreased by about one-third since 1990. Figures on carbon ***emissions*** and ***removals***, based on the FRA data, are made available through the FAO statistics database FAOSTAT.

***Forests*** are at the heart of the 2030 Agenda. They have immense potential to support sustainable development pathways.

This platform makes a significant contribution to reporting on the ***forest***-related indicators of the Sustainable Development Goals (SDGs). These include the extent of ***forest*** resources, ***forest*** biomass, ***forests*** in protected areas, ***forest*** management plans and certifications. The new tools will also provide support for the Paris Agreement on climate change.

The FRA 2020 key findings:

The world has a total ***forest*** area of 4.06 billion hectares, which is about 31 percent of the total ***land*** area. Europe, including Russian Federation, accounts for 25 percent of the world's ***forest*** area, followed by South America (21 percent), North and Central America (19 percent), Africa (16 percent), Asia (15 percent) and Oceania (5 percent). The global ***forest*** area continues to decrease, and the world has lost 178 million hectares of ***forest*** since 1990. However, the rate of net ***forest*** loss decreased substantially over the period 1990-2020 due to a reduction in deforestation[1] in some countries, plus increases in ***forest*** area in others through afforestation and natural expansion of ***forests***. Africa has the largest annual rate of net ***forest*** loss in 2010-2020, at 3.9 million hectares, followed by South America, at 2.6 million hectares. The highest net gain of ***forest*** area in 2010-2020 was found in Asia. Since 1990 an estimated 420 million ha of ***forest*** has been lost worldwide through deforestation, conversion of ***forest*** to other ***land*** use such as ***agriculture***. However, the rate of ***forest*** loss has declined substantially. In the most recent five-year period (2015-2020), the annual rate of deforestation was estimated at 10 million hectares, down from 12 million hectares in 2010-2015 and 16 million hectares in 1990-2000. The area of ***forest*** in protected areas has increased by 191 million ha since 1990, and has now reached an estimated 726 million ha (18 percent of the total ***forest*** area of reporting countries). In addition, the area of ***forest*** under management plans is increasing in all regions - globally, it has increased by 233 million ha since 2000, reaching slightly over two billion hectares in 2020.

Top ten countries worldwide for average annual net losses of ***forest*** area between 2010 and 2020 are: Brazil, Democratic Republic of the Congo, Indonesia, Angola, United Republic of Tanzania, Paraguay, Myanmar, Cambodia, Bolivia (Plurinational State of), Mozambique. Top ten countries for average annual net gains in ***forest*** area in the same period are: China, Australia, India, Chile, Viet Nam, Turkey, United States of America, France, Italy, Romania.

Commenting on the FRA key findings, Senior Forestry Officer and FRA Coordinator Anssi Pekkarinen said: 'While the rate of deforestation decreased substantially during the last decades, it still remains a source of great concern. At the current pace we risk not meeting the 2030 SDG ***targets*** related to sustainable ***forest*** management. We need to step up efforts to halt deforestation in order to unlock the full potential of ***forests*** in contributing to sustainable food production, poverty alleviation, food security, biodiversity conservation and climate change while sustaining the production of all the other goods and services they provide.'

**Load-Date:** July 22, 2020

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[***To achieve climate-neutrality, the EU needs a carbon sink strategy. Here's why***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:61BK-J801-F0YC-N09M-00000-00&context=1516831)

Impact News Service

November 18, 2020 Wednesday

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**Length:** 1326 words

**Body**

Cologny: World Economic Forum has issued the following press release:

To achieve its goal of climate neutrality by 2050, the EU will have to build its carbon sink capacity in order to ***remove*** CO2 from the atmosphere. Natural methods such as ***forests*** and soil storage can be deployed, and there are potential technological approaches, too. First, however, we must expand our knowledge and develop structured processes and strategies in order to progress.

Climate neutrality means more than just reducing greenhouse gas ***emissions***. This became clear most recently when the European Commission suggested that ***emissions*** sinks should be included in its calculations for reaching a strengthened 2030 climate ***target***, by including the effects of afforestation measures.

Climate neutrality means net-zero ***emissions***. Not all ***emissions*** can be completely eliminated – for example, those caused by ***agriculture***, heavy industry or shipping. Some way of compensating for these must therefore be found. Anthropogenic sources of greenhouse gases rightfully occupy a central position in the roadmap towards achieving climate neutrality. However, we must also get serious about preserving and expanding CO2 sinks; in other words, about capturing CO2 from the atmosphere and storing it permanently.Have you read?

How a desert became a carbon sink zone The best way to restore our ***forests*** is to let nature take its course Is a regenerative economy the cure for Europe's wilting ***forests***?

Conventional mitigation measures, such as energy efficiency and renewable energy deployment, are widely discussed in society and are supported by a multitude of analyses, studies and strategies. But we know relatively little about sinks and their potential. This subject should be approached systematically and strategically. Therefore, the EU needs a carbon sink strategy, and an accompanying roadmap, with detailed ***targets*** and implementation programmes.

The key questions are: How much sink capacity do we need to become climate neutral by 2050 – and to remain so afterwards? What kinds of sinks do we want? And how do we organise all this so that it also pays off economically?

Even a question like ‘how much?’ is not that easy to answer. Nobody can say for sure what the amount of ‘hard-to-abate’ residual ***emissions*** from ***agriculture***, industry and aviation will be in the EU by mid-century. But even scenarios are lacking. To date, there is only one analysis available, published by the European Commission in 2018. Here, residual ***emissions*** reach 10% of 1990 values, while 90% of ***emissions*** can be mitigated using conventional ***emissions*** reduction measures. While 10% may not sound like a lot, it represents more than 500 million tonnes of CO2 equivalents annually. This is twice as much as is currently being removed from the atmosphere through afforestation and better ***forest*** management.A sector-by-sector illustration of pathways to net-zero ***emissions*** in the EUA sector-by-sector illustration of pathways to net-zero ***emissions*** in the EUImage: SWP Berlin

In the EU, there is a lot of experience with net CO2 ***removal*** through ***land*** use, ***land***-use change and forestry (LULUCF). However, this experience also tells us that the exact measurement of CO2 ***removals*** via LULUCF is fraught with great uncertainty. Furthermore, the ***forests*** that have formed the most important sinks to-date are vulnerable to disturbances like heat stress, fires and pests. There is a real danger that the CO2 bound in trees and soils might escape into the atmosphere again later on. It is precisely for this reason that the sink capacity of ***forests*** has not been included in calculations for achieving EU climate ***targets*** to-date. There are good reasons to change this as we proceed towards climate neutrality. But we also require greater efforts and new concepts in this sector. This includes, for example, the issue of storing more CO2 in ***agricultural*** soils, or finding ways to clear ***forest*** areas sustainably if trees are no longer growing and thus not storing additional CO2 anymore. The increased use of wood as a long-lasting building material might be one solution to this.

However, there are also technological methods of capturing CO2 from the atmosphere. The one best known is direct air carbon capture and storage; it filters CO2 out of ambient air and combines it with geological storage. This process requires relatively little ***land*** and affords great flexibility in the choice of location. However, it needs a lot of energy and is still very expensive. So far there have only been a few pilot installations, and it is hardly possible to predict whether a massive expansion would result in cost reductions as dramatic as those in solar and wind power. Only limited potential is attributed to other processes such as biochar burial or deploying crushed minerals on soil or in coastal waters. Some of these may also face acceptance problem, depending on countries and locations of deployment. But just like with conventional ***emission*** reductions, we should not rely on one single technology for creating and expanding our CO2 sinks.What’s the World Economic Forum doing about climate change?

Climate change poses an urgent threat demanding decisive action. Communities around the world are already experiencing increased climate impacts, from droughts to floods to rising seas. The World Economic Forum's Global Risks Report continues to rank these environmental threats at the top of the list.

To limit global temperature rise to well below 2°C and as close as possible to 1.5°C above pre-industrial levels, it is essential that businesses, policy-makers, and civil society advance comprehensive near- and long-term climate actions in line with the goals of the Paris Agreement on climate change.Global warming can be beaten thanks to this simple plan

The World Economic Forum's Climate Initiative supports the scaling and acceleration of global climate action through public and private-sector collaboration. The Initiative works across several workstreams to develop and implement inclusive and ambitious solutions.

This includes the Alliance of CEO Climate Leaders, a global network of business leaders from various industries developing cost-effective solutions to transitioning to a low-carbon, climate-resilient economy. CEOs use their position and influence with policy-makers and corporate partners to accelerate the transition and realize the economic benefits of delivering a safer climate.

Contact us to get involved.

What needs to be done? Expanding our knowledge base can help us to engage with this issue in a cool-headed manner – and only with structured processes and strategies we will be able to make adequate progress. In order to make sustainable use of ecosystem-based or technological sinks, we require ambitious projects. On the one hand, the EU has an obligation here – not just because of its own ***target*** of climate neutrality by 2050, but also for reasons of global and historical responsibility. On the other hand, there are also opportunities in establishing technologies and processes that serve new markets, thereby creating jobs and prosperity.

Although it is true that there is a growing number of research programmes on CO2 ***removal***, in climate policy the issue has been given hardly any consideration so far. If we intend to transform the EU’s economy into a climate-neutral one over the next three decades, we will very soon need an initial idea of CO2 ***removal*** goals that we want to achieve by 2030, 2040 and 2050. This would give more structure to the transformation process, in which ***emission*** reductions and sink enhancements face different challenges. The IPCC has repeatedly pointed to the necessity of expanding CO2 sinks. Individual countries like the UK and Switzerland, or US states like California, have already begun to formulate strategies and even fund demonstration plants. As an established climate policy leader, it should be the EU’s aspiration not to remain on the sidelines any longer.

**Load-Date:** November 21, 2020

**End of Document**



[***Critical adjustment of land mitigation pathways for assessing countries’ climate progress***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:671W-P2B1-JCWX-C2RF-00000-00&context=1516831)

Nature Climate Change

April 2021

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**Byline:** [*giacomo.grassi@ec.europa.eu*](mailto:giacomo.grassi@ec.europa.eu)

**Body**

Main

Changes in ***land*** use and ***land*** management contribute around 14% of the total global anthropogenic CO2 ***emissions***, mainly through deforestation. Simultaneously, terrestrial sinks—both natural and anthropogenic—absorb nearly a third of the total anthropogenic CO2 ***emissions***, mainly in ***forests***. ***Land*** use, ***land***-use change and forestry (LULUCF) measures represent about 25% of the ***emissions*** reductions pledged by countries in their National Determined Contributions (NDCs) to the Paris Agreement. ***Land***-based mitigation, is increasingly recognized as a key strategy to reach the Paris Agreement’s aim to “achieve a balance between anthropogenic ***emissions*** by sources and ***removals*** by sinks”,.

The Paris Agreement mandates a periodic global stocktake exercise, to assess countries’ collective progress towards meeting its long-term goals. This exercise will take place for the first time starting in 2022 and finishing in 2023. Any identified gap between the globally aggregated reported and pledged ***emissions*** and ***emission*** pathways consistent with the Paris Agreement is expected to motivate increased mitigation ambition in subsequent NDCs (Supplementary Section ). Monitoring of historical progress is based on national greenhouse gas inventories (NGHGIs), whereas the assessment of future actions is based on countries’ climate ***targets*** (NDCs in 2025 or 2030 and long-term strategies in 2050). Estimates of the appropriate level of mitigation are based on ***emission*** pathways consistent with limiting warming to 1.5 °C and well-below 2 °C, from models and scenarios developed by the scientific community–. This, however, requires that the estimates used to derive the ***emission*** pathways and the country data used to measure progress are comparable.

Countries report national historical anthropogenic ***land*** CO2 fluxes as part of the LULUCF component of the NGHGIs, which are periodically submitted to the United Nations Framework Convention on Climate Change (UNFCCC). Independent global estimates of anthropogenic ***land*** CO2 fluxes assessed by the Intergovernmental Panel on Climate Change (IPCC),, are from global-scale models. In global assessments, bookkeeping models and dynamic global vegetation models (DGVMs) are used to assess historical ***emissions***, and Integrated Assessment Models (IAMs) are used to explore scenarios and pathways of future changes,,.

Previous studies highlighted that NGHGIs report values of global anthropogenic net CO2 ***emissions*** from ***land*** (mostly from ***forest*** ***land*** and deforestation) that are 4–5 GtCO2 yr−1 lower than those estimated by bookkeeping models and DGVMs for the period 2005–2014 (refs. ,). Here we show that this large difference exists also between NGHGIs and IAMs, with an estimated 5.5 GtCO2 yr−1 gap for the period 2005–2015 (Fig. ). This gap represents a key barrier to the use of IAMs in helping to set adequate ***emission*** ***targets*** in the context of the Paris Agreement. This issue has been acknowledged at the highest levels, such as in the Summary for Policymakers sections of recent IPCC Special Reports (on global warming of 1.5 °C (ref. ) and on climate change and ***land***) and during a UNFCCC plenary. A viable solution is needed by both the IPCC and the policymakers.

Global net anthropogenic ***land*** CO2 fluxes estimated by global models and reported in NGHGIs.

a, Global net anthropogenic ***land*** CO2 flux from the IPCC Special Report on Climate Change and ***Land*** (IPPC SRCCL) (blue line, using two bookkeeping models), from IAMs (averages of five models for various SSP2 mitigation scenarios,, red lines, starting in 2005) and from the sum of LULUCF in the NGHGIs (grey line, mostly ***forest*** sink and deforestation). Fluxes from ***forest*** and deforestation in the NGHGIs are comparable with those reported by FAOSTAT (green dashed line, elaborated based on country reports to Food and ***Agriculture*** Organization’s ***Forest*** Resources Assessment (FAO-FRA) 2020 (ref. )). The sum of conditional and unconditional NDCs for the ***land***-use sector are shown as black lines. Positive fluxes indicate net ***emissions***, whereas negative fluxes indicate net ***removals*** of CO2 from the atmosphere. The gap between IAMs and NGHGIs is equal to 5.5 GtCO2 yr−1 for the period 2005–2015. b, Global anthropogenic ***land*** CO2 ***emissions*** (mainly from deforestation), ***removals*** (mainly ***forest*** sink) and net flux, as estimated in IAMs (average with minimum–maximum range) and by the sum of NGHGIs (surrounded by a 95% confidence interval) for the period 2005–2015. See for the details.

The inconsistency between NGHGI and IAM estimates is almost entirely due to a difference in anthropogenic CO2 ***removals*** (4.5 GtCO2 yr−1, Fig. ), which mostly occur in ***forests***. This difference is potentially a consequence of: (1) simplified and/or incomplete representations of ***land***-use change and management in global models,, which includes the role of ***forest*** management in promoting biomass expansions and thickening, and the impact of ***forest*** demography, (2) inaccurate and/or incomplete estimation of LULUCF fluxes in NGHGIs, especially in non-***forest*** ***land*** uses and in soils, and (3) conceptual inconsistencies between global models and NGHGIs in estimating ‘anthropogenic’ CO2 fluxes from ***land***, which mean the estimates are hardly comparable. The impacts of (1) and (2) are difficult to quantify, and result in uncertainties that will decrease slowly over time through improvements of both the models and NGHGIs. By contrast, the inconsistencies in (3) and their resulting biases can be assessed and addressed.

The purpose of this study is to provide a means to make IAM ***land***-use CO2 mitigation pathways more comparable with NGHGIs at the global and regional levels, with the aim to facilitate the assessment of collective progress against the Paris Agreement’s mitigation goals. Extending previous studies, we first show how the above-mentioned methodological inconsistencies cause differences in estimated global anthropogenic ***land*** CO2 fluxes. Then, we use results from five IAMs (AIM-CGE, GCAM4 (ref. ), IMAGE, MESSAGE-GLOBIOM and REMIND-MAgPIE ()) and one DGVM (LPJmL) to apply a new method that, by adjusting the IAM results, ensures comparability between the IAMs and NGHGIs. Without this adjustment, country climate ***targets*** (based on the approach of NGHGIs) cannot meaningfully be assessed using the ***land*** mitigation pathways from IAMs.

Different scopes led to different approaches to ***land***-use fluxes

The different scientific communities involved in global ***land***-flux modelling and NGHGIs have developed independent approaches to estimate anthropogenic ***land*** CO2 fluxes, and these have different purposes and scopes. Global models focus on producing globally consistent estimates, which are assessed in IPCC reports,,. Meanwhile, IPCC Guidelines for estimating NGHGIs focus on individual countries, aimed at pragmatic and consistent methodologies that are generally applicable. Approaches developed by both communities are valid in their own specific context. However, a meaningful comparison of anthropogenic ***land*** CO2 fluxes between them is hampered by conceptual differences in the estimation of: (1) the anthropogenic flux, which differs in whether or not it includes the indirect impact of human-induced environmental changes (Fig. ), and (2) the ‘managed’ area, especially for ***forest*** ***land*** (Fig. ).

Main conceptual inconsistencies between IAMs and NGHGIs in estimating what is considered the anthropogenic ***land*** CO2 flux, and proposed solution.

a, Differences in estimating the anthropogenic ***land*** CO2 flux by global models (***land*** use of bookkeeping models and IAMs (left) and LULUCF of NGHGIs (right), which include the attribution of effects that influence the ***land*** CO2 flux (as defined by the IPCC) in managed and unmanaged ***lands***. The anthropogenic ***land*** CO2 flux by global models typically includes only the CO2 flux due to direct human-induced effects (***land***-use change, harvest and regrowth), although system boundaries make this attribution uncertain. By contrast, NGHGIs consider anthropogenic all the fluxes that occur in areas defined as managed (Fig. ), and typically also include most of the sink due to indirect human-induced effects (climate change, atmospheric CO2 increase, nitrogen deposition and so on) and due to natural effects (climate variability and background natural disturbance regime). These indirect human-induced and natural effects are modelled by some IAMs (for example, via DGVMs), but are not included in the reported anthropogenic ***land*** use flux from IAMs and related IPCC Assessments. b, Proposed solution to the inconsistency, via disaggregation of the ***land*** sink flux from DGVMs (from indirect and natural effects) into the CO2 fluxes that occur in managed and in unmanaged ***lands***. The sum of the ***land*** use flux (IAMs) (left) and the ***land*** sink flux that occurs on managed ***land*** (DGVMs) (centre) produces an adjusted IAM CO2 flux that is conceptually more comparable with that of NGHGIs (right). This figure may be an oversimplification as, for example, not all NGHGIs include all indirect effects. DGVMs can also simulate CO2 flux due to ***land***-use changes, but it is not considered here. See for the details.

Inconsistencies between IAMs and NGHGIs in the ***forest*** areas that are considered managed, and proposed solution for their reconciliation.

a, ***Forest*** area considered managed by IAMs and NGHGIs. b–g, Areas of managed and unmanaged ***forest*** in 2010, from IAMs (average of five models with minimum–maximum range) and from NGHGIs, and area of intact ***forest*** in 2013 (ref. ) and non-intact ***forest*** (total ***forest*** area from Hansen et al. minus intact ***forest*** area), for the world (b) and the following regions: Developed Countries (c, OECD 90 countries (OECD, Organisation for Economic Co-operation and Development) and new EU member states and candidates), Reforming Economies of Eastern Europe and the Former Soviet Union (d, REF, excluding EU member states), Asia (e, ASIA, Asian countries with the exception of the Middle East, Japan and Former Soviet Union states), Latin America and Caribbean (LAM), and Middle East and Africa (f, MAF) and Latin America and the Caribbean (g, LAM). Given the good match between non-intact ***forest*** area and NGHGIs’ managed area (which is not available on maps), this study uses the non-intact ***forest*** area as a proxy to separate spatially the ***Land*** Sink (from DGVMs, due to indirect effects (Fig. )) into fluxes that occur in managed and unmanaged areas. At the global level, NGHGI data on total and unmanaged ***forest*** area match well with the FAO-FRA 2020 (ref. ) data on total ***forest*** (~4 × 109 ha) and primary ***forest*** (~1 × 109 ha), respectively. h, Illustrative map of intact ***forests***, non-intact ***forests*** and a recently harvested area from IMAGE for the year 2010. Deforested areas are not included in any of the panels. See for details.

To make the global model results and NGHGIs comparable, one can, in principle, either adapt the country model approach to the global model approach, or vice versa. Changing the country approach, which is based on several UNFCCC decisions and well-established IPCC guidelines (Supplementary Section ), is impractical in the short term. Therefore, we explore how global models’ output could be pragmatically adjusted to facilitate a like-with-like comparison. Specifically, we propose ways to reconcile different methods to estimate the ‘anthropogenic’ flux (Fig. ) and ‘managed ***forest***’ (Fig. ) between global models and NGHGIs. We subsequently illustrated how these solutions can be implemented concomitantly (Fig. ), show the impact (Fig. ) and discuss the implications (Fig. ).

Implementation of the proposed solutions to reconcile the inconsistencies between IAMs and NGHGIs in the ‘anthropogenic’ ***forest*** CO2 flux.

Currently (upper figures), most IAMs consider anthropogenic only the CO2 fluxes associated with direct effects (Fig. , left) on a small fraction of the total ***forest*** area (managed area in the original IAMs’ map (Fig. )), and indirect effects on either managed or unmanaged area are not considered anthropogenic (right). In this article (lower figures), we address the inconsistencies between IAMs and NGHGIs on direct versus indirect effects (Fig. ) and on the extent of managed ***forest*** area (Fig. ) by adding the CO2 fluxes due to indirect effects (estimated by DGVMs (Fig. )) in non-intact ***forest*** area (used as proxy of managed ***forest*** area in NGHGIs (Fig. )) to the original IAMs’ anthropogenic ***land*** flux. The resulting adjusted IAM results are expected to be more comparable with those of NGHGIs. In this study, the indirect effects are estimated with IMAGE/LPJmL, whose original ***forest*** map for the year 2010 is reclassified according to the intact/non-intact ***forest*** map (Fig. ) without changing the other ***land*** uses (for example, ***agriculture*** and urban). See Supplementary Sections and for details.

Adjustment of the IAMs’ anthropogenic ***land*** CO2 fluxes to derive NGHGI-comparable estimates.

a–c, Global ***land*** CO2 fluxes due to indirect and natural effects from IMAGE/LPJmL for SSP2-1.9 (a), SSP2-2.6 (b) and SSP2-6.0 (c) scenarios in the period 2005–2050. d–i, Global anthropogenic ***land*** CO2 fluxes, which include the original IAM results (d–f), adjusted IAM results (NGHGI comparable (g–i)), NGHGIs, and unconditional and conditional NDCs for 2030 for SSP2-1.9 (d,g), SSP2-2.6 (e,h) and SSP2-6.0 (f,i). The adjustment of IAM results (g–i) is done by adding the indirect human-induced sink of the non-intact ***forests*** (thick green line in a) to the original IAM results (d–f). j, Anthropogenic ***land*** CO2 fluxes in the period 2005–2015, comparing the original and the adjusted IAM results (minimum–maximum range among models) to the NGHGIs (±95% confidence interval), at the global level, for Annex I countries, non-Annex I countries and for the following regions: OECD 90 and EU, REF, ASIA, MAF and LAM. IAM data are from the SSP database. NDC data (from Grassi et al.) are illustrative and do not aim to assess the future ***emission*** gap in the ***land*** sector. See for details.

Impact of adjusting the IAMs’ ***land*** CO2 fluxes to the NGHGI approach on global CO2 fluxes and the GHG mitigation pathways.

a–d, Global carbon fluxes, with anthropogenic (a,b, average of five IAMs for scenario SSP2-2.6) and other CO2 fluxes (c,d, which include natural and atmospheric sinks), according to the global models’ approach (a,c) and adjusted to the NGHGI approach (b,d). This adjustment reallocates part of the ***land*** sinks considered natural by global models (due to indirect human-induced effects on non-intact ***forests***, dashed green area in c) to the anthropogenic component (b). This improves the comparability with NGHGIs, but does not change the CO2 expected to remain in the atmosphere (red lines in c and d) because changes in natural and anthropogenic ***land*** fluxes compensate. Grey areas in a and b can become negative as they can include bioenergy with carbon capture and storage. e–g, Global CO2 fluxes from SSP2 scenarios: original IAM mitigation pathways and NGHGIs for LULUCF (e), indirect effects from non-intact ***forests*** (f) and combination of panels e and f to obtain NGHGI-comparable anthropogenic LULUCF pathways (g, original IAM results adjusted to the NGHGI approach). The indirect effects in f decline over time with increasing mitigation ambition, mainly because of the weaker CO2 fertilization effect, and become more uncertain after 2050 (grey shading in f and g). h,i, Global anthropogenic GHG ***emissions*** without LULUCF (h, with no adjustment needed) and combination of g and h to obtain NGHGI-comparable pathways for global GHG ***emissions*** with LULUCF (i). NGHGI data are from PRIMAP HISTCR for non-LULUCF and from this study for LULUCF. j, Cumulated adjustment of IAM fluxes from 2021 until GHG neutrality or 2100 (whatever comes first). This represents the impact of our approach on the NGHGI-comparable remaining GHG budget (as GtCO2 or %) relative to the original budget. See Supplementary Section for regional adjustments and a version of h–j that covers CO2 only.

Inconsistencies in estimating the anthropogenic flux

Conceptually, ***land*** fluxes can be differentiated between those due to ‘direct human-induced effects’ (***land*** use and ***land***-use change, which includes harvest and regrowth), those due to ‘indirect human-induced effects’ (that is, human-induced environmental change, which includes CO2 concentration, temperature, precipitation and nitrogen deposition feedbacks) and those due to ‘natural effects’ (which includes climate variability and a background natural disturbance regime, whose contribution is assumed to even out over time). Direct effects occur only in managed ***lands***, whereas indirect and natural effects occur in both managed and unmanaged ***lands***.

The approach used by countries to estimate anthropogenic GHG fluxes follows the IPCC Guidelines,. As most NGHGIs are fully or partly based on direct observations (for example, national ***forest*** inventories), which cannot separate the direct human-induced effects from the indirect as well as natural effects, the IPCC Guidelines adopted all GHG fluxes on managed ***land*** as a pragmatic proxy to estimate anthropogenic ***land*** GHG fluxes, (Supplementary Section ). GHG fluxes from unmanaged ***land*** are not considered anthropogenic and thus are not reported in NGHGIs. However, the degree to which direct and indirect effects are included in NGHGIs depends on the estimation method used, of which the complexity varies among countries. An earlier study concluded that the estimated NGHGI flux from managed ***forests*** includes the impact of all direct effects and, in most cases, indirect and natural effects (Fig. , right column ()).

Different types of global models are used to quantify different ***land*** CO2 fluxes. DGVMs include a process description of ***land***-related carbon fluxes, and therefore also capture the natural response of ***land*** to human-induced environmental change (indirect effects). IAMs focus on the anthropogenic ***land*** CO2 fluxes, typically including only the direct effects (***land*** use, ***land***-use change, harvest and regrowth, Fig. , left) on ***land*** that is identified as managed in the model (). Some IAMs are linked to a DGVM and use this (or a similar) linkage to evaluate the consequences of future ***land***-use scenarios.

Here we propose (1) to disaggregate the ***land*** sink due to indirect effects from DGVMs into fluxes that occur in managed and unmanaged ***lands***, and then (2) to sum the fluxes from direct effects reported by IAMs with the fluxes from indirect effects estimated by DGVMs on managed ***land***, to obtain adjusted estimates more comparable with those of NGHGIs (Fig. ).

Inconsistencies in managed ***forest*** area

The NGHGIs cover all managed ***land***—***forest*** ***land***, cropland, grassland, wetlands, settlements and other ***land***. Although the relative importance of each ***land*** use varies between countries, fluxes from ***forest*** and deforestation typically comprise the vast majority of CO2 fluxes in NGHGIs (Supplementary Section ). Furthermore, as indirect effects on non-***forest*** ***lands*** are small compared with the effects in ***forest*** ***land*** (), we concentrate only on managed ***forest*** here, because this is where most of the conceptual inconsistency occurs between IAMs and NGHGIs. The IAMs typically consider managed ***forests*** to be those ***forest*** areas that contribute to commercial wood supply (Fig. ). In contrast, the IPCC Guidelines used by countries define managed ***forest*** as areas ‘where human interventions and practices have been applied to perform production, ecological or social functions’. Country definitions are therefore flexible, must be applied consistently over time and are typically much broader than the one used by IAMs. For example, managed ***forest*** in NGHGIs includes all kinds of silvicultural activities (clear-cutting, thinnings and so on) and may include parks and protection ***forests***, whereas IAMs include only those areas that are planted (afforestation) or subject to a (recent) wood harvest needed to fulfil timber demand, given rotation cycles and carbon densities ().

A consequence of these different approaches is that the area considered managed ***forest*** by countries—about three billion hectares globally—is much bigger than that used in IAMs, despite the total ***forest*** areas (that is, managed and unmanaged combined) being similar (Fig. ). When country data for unmanaged and managed ***forest*** area are compared with the areas of ‘intact ***forest***’—that is, ***forest*** areas characterized by no remotely detected signs of human activity ()—and ‘non-intact ***forest***’, respectively, a good match emerges (third column in Fig. ), both at global and regional levels. As only a few NGHGIs provide maps of their managed ***forests*** that can be used by IAMs, our method uses the non-intact ***forest*** map as a proxy for managed ***forests*** in NGHGIs. This map can then be used to spatially separate the ***land*** sink from DGVMs (Fig. ) into fluxes that occur in managed and unmanaged ***lands***.

Way forward to reconcile the inconsistencies

To reconcile ***land***-use CO2 estimates from IAMs and NGHGIs, we added fluxes estimated by DGVMs (indirect effects) in non-intact ***forest*** areas to the original IAMs’ anthropogenic ***land*** fluxes (direct effects). This approach (Fig. ) assumes that the IAMs’ original flux captures the impact of the more intensive management activities (direct effects) that occur on a subset of the NGHGIs’ managed area, whereas the DGVMs’ flux captures the indirect effects on all the NGHGIs’ managed area ().

In this study, we estimated the sink due to indirect effects in the non-intact ***forest*** area with LPJmL runs associated with IMAGE ( and Supplementary Section ). Given the large uncertainty of the future ***forest*** sink,, we tested the representativeness of our results, and concluded that the ***forest*** sink estimated by LPJmL is reasonably representative of the available data in the literature (Supplementary Section ).

A consistent comparison

In our proposed method, we first estimate the CO2 sink associated with indirect effects in non-intact ***forests*** (see Fig. for a selection of Shared Socio-economic Pathway 2 (SSP2) scenarios). This sink represents around 70% of the total ***forest*** sink and 50% of the total ***land*** sink in the period 2005–2050. It decreases over time in the stringent mitigation scenarios (SSP2-1.9 and SSP2-2.6), whereas it is relatively stable in a weak mitigation scenario, such as SSP2-6.0, mainly because of different CO2 concentrations and the resulting CO2 fertilization effects.

Comparing the original IAM results with the country LULUCF estimates of NGHGIs and the NDCs reveals a wide discrepancy (Fig. ). This discrepancy is largely resolved when the original IAM results are combined with the indirect human-induced sink from non-intact ***forests*** (Fig. ).

For the historical period (2005–2015), the proposed adjustment reconciles IAM results with NGHGI estimates (Fig. ) at the global level, for Annex I countries (advanced economies with annual GHG reporting commitments under the UNFCCC) and for non-Annex I countries (countries with less-stringent reporting commitments). The match between IAMs and NGHGIs improved in all the regions examined (Fig. ). This pattern is also largely confirmed at the level of large countries (Supplementary Section ), with almost full reconciliation of the estimates in European Union (EU), Russia, United States, Brazil and Indonesia, but not fully in Canada and China. This indicates that the gap between IAMs and NGHGIs is mostly a matter of the different areas considered and a different allocation of fluxes (Extended Data Fig. and Supplementary Section ). Our scenario-specific results can be directly used by other studies at the global and regional levels (Supplementary Section ), but additional analyses would be required for specific countries.

Our approach should not be seen as the only or the final method available to reconcile estimates between IAMs and NGHGI at the country level, but rather as a pragmatic short-term fix to ensure comparability between global models and the collective country efforts during the Global Stocktake, which is essential for the implementation of the Paris Agreement. Many aspects of our method are expected to improve in the future. First, updated projections on the ***forest*** sink with a model ensemble would allow for further evaluation of the uncertainty of this sink and provide more confidence when using our approach in policy contexts. Second, the method relies on information that is appropriate at the global level, but not necessarily fully valid at the country level, such as that the non-intact ***forest*** map is a proxy of managed ***forest***, and assumes that the NGHGI fully captures the recent indirect effects. More country-specific information, such as maps of managed ***forest*** and the extent to which indirect effects are included in the NGHGI, would help the implementation of our approach at country level. Third, the effective reconciliation between NGHGIs and IAMs shown in Fig. may hide underlying uncertainties and inaccuracies through other compensating factors, such as incomplete representations of ***land***-use processes, the absence of nitrogen fertilization and ***forest*** age-structure dynamics in IAMs, and inaccurate and/or incomplete NGHGIs.

In the medium term, countries should improve the accuracy, completeness and transparency of their NGHGIs—whenever possible also including estimates with and without the impact of indirect effects—and the clarity of the LULUCF’s role within their climate ***targets***, which currently is often ambiguous. In parallel, IAMs (and, in general, global models) should progressively improve the representation of ***forest*** management beyond ***land***-use changes, and age-structure dynamics. In this context, evidence from Earth Observation will play a key role both in supporting the countries’ reporting and verification needs under the Paris Agreement, and as a benchmark against which the ***land*** sink from global models might be evaluated,. Improvements on both sides (countries and global models) will raise confidence in ***land*** CO2 fluxes and support the implementation of our approach to assess collective progress.

Implications for comparing ***targets*** with mitigation pathways

The proposed approach to make the IAMs’ output more comparable with that of the NGHGIs does not imply changes in the understanding of the global carbon fluxes, but simply imposes a reallocation of part of the ***land*** sink (Fig. , for SSP2-2.6). This is done by adjusting downward the original total anthropogenic net CO2 ***emissions*** estimated by IAMs by the indirect CO2 uptake on non-intact ***forests*** (dashed black line in Fig. ). To avoid double counting, the natural net sink in the IAM pathways needs to be reduced (that is, adjusted upward, dashed green line in Fig. ) to compensate for the reallocation of the indirect CO2 sink to the anthropogenic net ***emissions***, and thus the total net flux of CO2 to the atmosphere remains unaltered (red lines in Fig. ). That is, we shift a portion of the IAMs’ net flux of CO2 from the natural sink to the anthropogenic component, to achieve comparability with the NGHGIs.

The implications when comparing climate ***targets*** with global mitigation pathways are illustrated in Fig. . Our solution focuses on LULUCF, where the mismatch exists (Fig. ); by adding the indirect effects from non-intact ***forests*** (Fig. ), we adjusted the original IAMs pathways to derive NGHGI-comparable pathways for LULUCF (Fig. ). These changes do not affect the non-LULUCF ***emissions*** (Fig. ). However, the sum of LULUCF and non-LULUCF ***emissions*** (‘economy-wide’ ***emissions***) then obviously also changes, and NGHGI-compatible mitigation pathways for economy-wide ***emissions*** are lower than the original ones (Fig. ).

Our approach does not imply modifications of the original decarbonization pathways. This is illustrated by the absence of change in the models’ estimates of ***emissions*** from fossil fuels and ***land*** use in the adjustment from Fig. to Fig. . It simply ensures that an appropriate like-with-like comparison is made. If country climate ***targets*** using the NGHGI approach (thus, with a larger ***forest*** sink than that of IAMs) are used together with IAM pathways to assess collective climate progress, adjustments have to be made. The same reasoning applies to the remaining GHG budget (that is, the allowable ***emissions*** until net-zero GHG ***emissions*** consistent with a certain climate ***target***). For example, for SSP2-1.9 and SSP2-2.6 (which represent pathways that keep warming to 1.5 and 2 °C, respectively), the NGHGI-comparable remaining GHG budget is 120–192 GtCO2 lower than the original remaining GHG budget (Fig. ). In the absence of these adjustments, collective progress would appear to be more on-track than it actually is.

Overall, there is no change in scientific understanding of the mitigation effort needed. However, for countries that did not account for the mismatches above when setting their ***targets***, which include net-zero ***targets***, correcting for this (that is, using NGHGI-comparable pathways as benchmark) will result in a perceived increase of the required mitigation effort. These implications should be urgently and clearly communicated.

The assessment of the global 2030 ‘***emission*** gap’ between aggregated country NDCs and specific ***target*** mitigation pathways—as published annually by the United Nations Environment Programme—is only affected to a limited degree. This is because some estimates of global ***land***-use ***emissions*** used in this assessment already use the same ***land***-use approach as that of the IAM mitigation pathways,, or because historical data of global NDC estimates is harmonized to the historical data of global mitigation pathways (for example, Rogelj et al.). The latter procedure, however, is agnostic to the reasons for the observed mismatch, and often uses a constant offset. The adjustment proposed in this article allows us to resolve this mismatch by drawing on an understanding of the underlying reasons, and thus provides a more informed and accurate basis for the estimation of the ***emission*** gap.

The inclusion of indirect effects in climate ***targets*** may raise questions of equity when countries with different levels of indirect ***forest*** sink are compared with each other or against IAMs. In both cases, equity may be enhanced when countries transparently identify the direct and indirect components in climate ***targets***, and factor out indirect effects as appropriate. If this is not possible or practical, our approach provides a pragmatic option to exclude the impact of indirect effects when a country’s climate efforts is assessed against IAM pathways (that is, the impact of indirect effects in climate ***targets*** would be counterbalanced by a similar impact in the adjusted IAM pathways). This does not suggest that indirect effects should or should not be included in climate ***targets***, but simply facilitates a like-with-like (and thus scientifically more accurate) comparison of different country climate ***targets*** against IAM pathways, irrespective of their level of indirect ***forest*** sink.

The future evolution of the ***forest*** sink is very uncertain. Depending on the scenario, the uncertain magnitude of the CO2 fertilization effect on ***forest*** growth,, uncertain spatial and temporal patterns of climate change and the possibility of tipping points, the global ***forest*** sink may continue at current levels, weaken or even turn into a carbon source. Nevertheless, the proposed adjustment does not bring additional uncertainty into the NGHGI-comparable pathways. Currently, all these uncertainties on the future carbon sink are taken into account via the use of simple climate models or emulators, such as MAGICC used in IAMs to evaluate whether a certain mitigation pathway is consistent with a specified climate ***target***. The behaviour of the more complex carbon cycle models that contribute to the C4MIP project is represented by these emulators. The uncertainty of the future ***forest*** sink is therefore always included, independently of whether these flows are labelled as anthropogenic (as countries do) or natural (as global models do).

In conclusion, the current 5.5 GtCO2 yr–1 mismatch between IAM outputs and NGHGIs on ***land***-related GHG fluxes means that countries cannot use the original IAM pathways as a benchmark for their collective economy-wide climate action (including LULUCF). This gap is mostly caused by differences in how the anthropogenic ***forest*** sink is assessed. In this article, we describe and apply a ‘Rosetta stone’ solution that translates the IAM results into the country approach and reconciles the mismatch at global and regional levels. Our scenario-specific adjustments, which can be used in other studies and refined with improved estimates of the future ***forest*** sink, offer NGHGI-comparable ***land***-use pathways. Our solution does not change the original decarbonization pathways, but it reduces the perceived amount of allowable economy-wide cumulative net ***emissions*** for a given warming limit, relative to the original IAM pathways and related IPCC publications. Although further work is required to develop country-specific adjustments, countries that had previously used an incomparable benchmark may eventually need to update their ***target***. The NGHGI-comparable ***emission*** pathways presented here, and the associated impact on the remaining GHG budget perceived by countries, provide essential information for the IPCC Sixth Assessment Report and the Global Stocktake and will enable a more accurate assessment of the adequacy of countries’ mitigation pledges under the Paris Agreement.

Methods

Country data submitted to UNFCCC

In this study, we use the term national greenhouse gas inventory (NGHGI) in a broad sense, which includes anthropogenic historical GHG data within any country GHG report submitted to UNFCCC. Although the Paris Agreement ***removes*** the previous distinction between Annex I and non-Annex I countries in terms of ***targets*** and reporting (retaining some flexibility in GHG reporting for developing countries), we use this distinction here because it still reflects relevant differences in historical GHG data (see below). A general description of NGHGI estimation, reporting, accounting and review under the UNFCCC is included in Supplementary Section .

The global historical (2000–2017) LULUCF country CO2 dataset used here (Fig. ) is an update to February 2021 of the dataset in Grassi et al.. It includes data from all Annex I countries (for which a complete time series, 1990–2018, is available) and from most non-Annex I countries (incomplete time series, here gap filled for the period 2000–2017). To date, this dataset is the most comprehensive collection of the available country LULUCF estimates (Supplementary Section ).

In principle, LULUCF includes all ***land*** uses (***forest*** ***land***, cropland, grassland, wetlands, settlements and other ***land***). In practice, although almost all Annex I countries report all ***land*** uses, many non-Annex I countries report only on ***forest*** ***land*** and deforestation (that is, ***forest*** converted into other ***land*** uses). When splitting the net LULUCF flux into the three categories ‘***forest***’, ‘deforestation’ and ‘other’ (which includes peat decomposition in Indonesia), ***forest*** and deforestation represent more than 95% of the sum of absolute fluxes from the three categories in both Annex I and non-Annex I countries (Supplementary Section ). This does not mean that other fluxes are unimportant—for example, ***emissions*** from ***agricultural*** organic soils or ***removals*** from grasslands may be relevant in some countries—but simply that at the global level their net sum is close to zero in NGHGIs. In Fig. , ‘***emissions***’ include fluxes from deforestation and, for Indonesia, peat fires; ‘***removals***’ include fluxes from ***forest*** ***land*** and from ‘other’.

In terms of gases, although the information sources used (see below) include reporting for all GHGs, in this article we consider only CO2 to allow comparability with IAM data. Exceptions are a few non-Annex I countries for which it was not possible to separate CO2 from non-CO2 ***emissions*** (mainly CH4 and N2O from ***forest*** fire). However, this contribution is assumed to be relatively small, for example, for Annex I countries, the non-CO2 ***emissions*** are around 6% of the total CO2-equivalent net LULUCF GHG flux, but for Brazil they are 10%.

In terms of carbon pools, the ***forest*** biomass is always reported and typically represents the vast majority of LULUCF fluxes. Dead organic matter and mineral soils are reported by most Annex I countries and by the biggest non-Annex I countries for conversions between ***land*** uses, but these pools are often assumed to be in equilibrium for ***forest*** ***land*** that remains ***forest*** ***land***. ***Emissions*** from organic soils and peatland are typically reported when relevant. As most of the IAMs do not include carbon stock changes in harvested wood products (HWP), country data on HWP are not included here. Based on the information reported in the NGHGIs (mostly from Annex I countries), HWP represents a global sink of about −0.2 GtCO2 yr–1 (average 2005–2015), therefore its omissions here does not substantially affect our analysis.

The key statistics on the information sources used are illustrated in Supplementary Table . A summary of the most relevant historical data used in this study (area of managed ***forest*** and LULUCF CO2 ***emissions*** and ***removals***) is presented in Supplementary Tables and for all Annex I and for the main non-Annex I countries, respectively.

For Annex I countries (43 countries with advanced economies and annual NGHGI reporting commitments under the UNFCCC), the 2000–2017 time series of LULUCF CO2 estimates used in this study is taken from the National Inventory Submissions submitted in 2020, and in most cases includes all ***land*** uses, most carbon pools (except HWPs) and CO2 ***emissions*** from fires

For non-Annex I countries (152 countries with less stringent reporting commitments to UNFCCC), the data for periodicity, accuracy, transparency and completeness of NGHGI reporting vary considerably. For this reason, where necessary, we applied filters and gap filling for the period 2000-2017.

For these countries, a priority hierarchy of data sources was established. First, only post-2015 country submissions to UNFCCC were considered, generally prioritizing the more recent one: NDCs (typically submitted in 2015), National Communications or Biennial Update Reports and REDD+ submissions (if covering the entire country territory). This filter restricted the LULUCF CO2 data to 106 countries, which represent 98% of the ***forest*** area of all non-Annex I countries (Supplementary Table ). This number is larger than those in similar recent analyses, a witness to the relatively rapid improvement in the quantity (and in some case quality) of NGHGI information from non-Annex I countries. Data from non-Annex I countries includes mostly ***forest***-related CO2 fluxes (including deforestation and fires), with only few countries that also report cropland and grassland. In a few cases, additional criteria were used to exclude data that was considered not plausible (Supplementary Table ).

For the remaining 46 non-Annex I countries (typically small countries), either the information submitted to UNFCCC was considered old (<2015) or was not available. In this case, data on ***forest***-related CO2 fluxes were obtained based on the country reports to FAO-FRA 2015, as elaborated by Federici et al.. To approximate what the countries will likely submit under the Global Stocktake, in this article we focus only on CO2 information directly provided by the countries to UNFCCC or elaborated based on country data reported to FAO-FRA. Non-***forest*** GHG data reported in the FAOSTAT database, although potentially valuable to gap fill incomplete country GHG data, are not used here because they are not directly based on country data.

Second, as many non-Annex I countries do not report a complete times series, any missing data between 2000 and 2017 was obtained by linear interpolation of the available data (if the gap was between two data) or by backward or forward extrapolation of the closest data.

Use of the managed ***land*** proxy

The vast majority of countries that submitted GHG data to UNFCCC implicitly use the ‘managed ***land***’ proxy (that is, that all GHG fluxes from managed ***lands*** are anthropogenic) following either the 2003 IPCC Good Practice Guidance or the 2006 IPCC Guidelines; however, only a minority explicitly report information on the implementation of this proxy,. Although the lack of such information is often associated with the assumption that most or all ***land*** is managed, there is a clear need for greater transparency by countries on this issue.

All Annex I countries use the 2006 IPCC Guidelines. Most of these countries consider all ***land*** as managed (many EU countries), but some countries (for example, the United States, Canada and Russia) specifically report the area of unmanaged ***lands*** (for ***forest*** ***land***, grasslands and wetlands, without estimating the corresponding GHG fluxes, consistent with IPCC Guidelines).

The vast majority of the 106 non-Annex I countries for which GHG data submitted to UNFCCC is used in this paper implicitly use the managed ***land*** proxy,. However, an explicit separation of managed and unmanaged areas is reported only in a few cases (for example, Brazil). When available, here we considered as managed ***forest*** the area of ***forest*** used to compute the GHG fluxes reported to UNFCCC. Where this information was not available, we used the area of secondary ***forests*** and plantations from the country reports to FAO-FRA 2015 (ref. ) as a proxy of managed ***forest***.

Although the direct effects are, in principle, always fully included in the NGHGIs, the inclusion of indirect effects depends on the estimation methods used, which differ in approach and complexity among countries. Especially for non-Annex I countries, these methods are not always reported in a transparent way. Previous studies concluded that the impact of recent indirect anthropogenic effects is included in the NGHGIs of the vast majority of Annex I countries (with a few exceptions, for example, Australia, Canada and Japan) and at least in the most important non-Annex I countries (in terms of ***forest*** CO2 sinks: China, Brazil, Malaysia, Mexico and India) (Supplementary Table ).

The values of NGHGI uncertainty in Figs. and are based on information from countries’ reports to UNFCCC, complemented by expert judgement (see the Supplementary Information of Grassi et al.) and then aggregated at regional and global levels. Overall, the uncertainty on the net LULUCF CO2 flux is estimated to be around 35% for Annex I countries and 50% for non-Annex I countries. Given the incomplete information on the uncertainty of NGHGIs (especially for non-Annex I countries), these values should be considered as order-of-magnitude estimates.

For the projections up to 2030, here we use the data from NDCs as extracted by Grassi et al., for both Annex I and non-Annex I countries, normalized with the here-updated data for the five-year average around 2010. Despite the considerable uncertainty in the ***land***-use contribution to the NDCs, the trends found by Grassi et al. are consistent with other independent assessments (for example, Fyson and Jeffery and Forsell et al.). In the context of this article, these trends (as shown in Figs. and ) are illustrative and do not aim to quantify the future ***emissions*** gap in the ***land*** sector.

Other datasets

The ***forest***-related FAO data in Fig. are from FAOSTAT. They refer to ***emissions*** and ***removals*** in biomass from ***forest*** ***land*** and deforestation, computed by Tubiello et al. as the change in carbon stock using data in country reports to FAO-FRA 2020. Although in these country reports the ***forest*** carbon stock values, in principle, refer to the entire ***forest*** ***land*** area reported to FAO (that is, without differentiating between primary, naturally regenerated and planted ***forest*** categories), in most cases it can be noted that the dynamics of the carbon stocks in ***forest*** ***land*** are those typical of managed ***forest*** only. Overall, although ***forest***-related FAOSTAT estimates are not always fully comparable with NGHGIs, because of the possible differences in the pools and, in a few cases, in the area included (some NGHGIs may include less area than that in FAO-FRA 2020, but they often include non-biomass pools), the net global impact of these differences is considered to be small.

The PRIMAP-hist dataset (Fig. ) combines several published datasets to create a comprehensive set of GHG ***emission*** pathways for every country and Kyoto gas, and all UNFCCC member states. In the PRIMAP-HISTCR dataset used here, country-reported data submitted to UNFCCC is prioritized over third-party data.

IAMs

All the IAM scenario data we used in this study is based on SSP2 (ref. ). The SSPs depict five different global futures (SSP1–SSP5) with substantially different socio-economic conditions that aim to reflect different socio-economic challenges to mitigation and adaptation. SSP2 describes medium challenges of both kinds and is intended to represent a future in which development trends are not extreme in any of the dimensions, but rather follow middle-of-the-road pathways. The SSPs can be combined with different climate policy assumptions. Here, we use the results of SSP2 combined with different end-of-century radiative forcing levels, namely 1.9, 2.6, 3.4, 4.5, 6.0 and baseline. These scenarios were derived by five different IAMs with global coverage,: AIM, GCAM, IMAGE, MESSAGE-GLOBIOM and REMIND-MAgPIE. The vast majority of IAM data used here were taken from the public SSP web database hosted by the International Institute for Applied System Analysis ([*https://tntcat.iiasa.ac.at/SspDb/dsd?Action=htmlpage&page=welcome*](https://tntcat.iiasa.ac.at/SspDb/dsd?Action=htmlpage&page=welcome)), with the rest directly from the modelling teams (from IMAGE and LPJmL).

All the IAMs have in common that they contain ***land***-use modules, which differ, however, in their representation and parametrization of biogeochemical, biophysical and socio-economic processes as well as in their spatial resolution. All the IAMs are driven by the same projections of economic growth and population, developed for the SSPs. For other characteristics of the storylines (such as yield increases, ***land***-use change regulation and trade), the modelling teams have made their own assumptions on how to best represent the described trends of these drivers. More detailed descriptions of the individual ***land***-use modules can be found in Supplementary Section and in the Supplementary Material of Popp et al..

Although IAMs differ in how they calculate the area of managed ***forest***, in principle they all base it on following elements: (1) ***forest*** product demand (mostly based on FAO statistics and then projections into the future), (2) carbon density of ***forests*** and/or timber that can be harvested per hectare increments and (3) estimates on length of rotation cycles and/or year to maturity. Consequently, the area of managed ***forest*** represents the area required to provided historic and future demand for wood products in continuous harvest rotations. The resulting area is substantially lower than both FAO’s non-primary ***forest*** (secondary ***forest*** and plantations) and NGHGIs’ managed area, as large ***forest*** areas are, in reality, multipurpose, not subject to clear-cuts only and have no or much longer rotation length (period from one harvest to the next) than assumed by IAMs (see Supplementary Section for more details).

The ***emissions*** from IAMs in Fig. are mostly from deforestation and partly from non-***forest*** ***land*** use.

Calculation of the adjustment factors

The adjustment of the IAM results presented here (Figs. and ) uses the ***forest*** sink due to indirect effects in non-intact ***forests***, as estimated by LPJmL in combination with IMAGE. LPJmL model 4.0 (ref. ) is fully coupled and an integral part of IMAGE. In this coupling, IMAGE provides gridded ***land*** use, climate and CO2 concentrations to LPJmL, and receives ***agricultural*** production, vegetation structure, carbon stocks and fluxes, and water fluxes, all on a spatial grid of 0.5° resolution and annual time steps. The gridded precipitation and temperature in IMAGE are derived from a change in global mean temperature calculated by the internally coupled MAGICC model, plus a pattern scaling based on IPCC’s AR5 climate model output. As 30-year averages are used from the climate model patterns, interannual variability is added within LPJmL. LPJmL coupled to IMAGE accounts for ***forest*** management, following IMAGE’s ***forest*** harvest and management module with three different management types and calibrated rotation cycles and harvest characteristics,. We derived the indirect effects by grid cell and time step via counterfactual LPJmL runs with and without climate change.

The intact ***forest*** map was produced by the Intact ***Forest*** Landscapes project ([*www.intactforest.org*](http://www.intactforest.org)). Intact ***forest*** landscapes (IFLs) are defined as areas within the current ***forest*** landscape extent characterized by no remotely detected signs of human activity or habitat fragmentation and large enough to maintain all native biological diversity. ***Forests*** are defined as areas with a tree canopy cover greater than 20%, as identified by the Global ***Forest*** Change dataset by Hansen et al., derived from Landsat imagery. In 2000, IFLs covered globally 30% of the total ***forest*** area over 65 countries. IFLs were identified based on the absence of settlements, infrastructures (roads, railways, pipelines, power transmission lines and waterways), ***agriculture*** or timber production, and industrial activities in the past 30–70 years, which include oil and gas exploration and extraction, and peat extraction. Human activity and disturbances were identified with moderate-resolution satellite imagery and existing settlements and infrastructure maps, and used to map altered and fragmented ***forest*** areas in the ***forest*** map and consequently the remaining intact areas. IFL maps are available for the years 2000, 2013 and 2016. In this work, non-intact ***forest*** was derived by spatially subtracting IFL areas from the same global ***forest*** maps of the Global ***Forest*** Change dataset, coherent with the approach used to identify intact ***forest*** landscapes. Although non-intact ***forest*** represents a good proxy for managed ***forest*** in NGHGIs at the global level and for individual regions (Fig. ), this is not necessarily valid for all individual countries.

To calculate the ***forest*** sink due to indirect effects in non-intact ***forests***, the original gridded map from IMAGE/LPJmL for the year 2010 was reclassified according to the satellite-derived intact and non-intact ***forest*** map from Potapov et al. and Hansen et al. for the year 2013 (Fig. ), without changing the other ***land*** uses (for example, ***agriculture*** and urban). The procedure is described in detail in Supplementary Section . For the future, any projected change in the original IMAGE managed ***forest*** area (due to afforestation, deforestation or new harvest in previously unmanaged ***forests***) is taken into account and the associated CO2 flux counted as ***land***-use flux (Supplementary Fig. ). The differences in future ***forest*** area changes between each IAM and IMAGE were also considered (Supplementary Section ).

In calculating the adjustment to IAMs, we considered only the impact of indirect effects in ***forest*** areas. The rationale for not considering the possible indirect effects on non-***forest*** areas include: (1) evidence from models that most of ***land*** sink occurs on ***forests*** (Fig. and Grassi et al.), as confirmed by inventory methods (for example, Pan et al.) and by the NGHGIs of Annex I countries (where the sink of non-***forest*** ***land*** categories is very small compared to the ***forest*** sink); (2) non-***forest*** ***land*** is scarcely reported in non-Annex I countries (for the purpose of this article, it is not meaningful to correct IAM results for something that is very partially reported by countries); (3) although most countries include most of the indirect effects on their ***forest*** CO2 estimates, it is more difficult to assess the extent to which the impact of indirect effects is captured for non-***forest*** ***land*** (when reported by countries) and (4) although ‘intact/non–intact ***forest***’ is a good proxy for ‘managed/unmanaged ***forest***’, no similar reliable proxy exists for other ***land*** uses (for example, grassland).

Our approach assumes that indirect effects estimated by LPJmL are additive to the direct management effects estimated by IAMs (no double counting is expected) because none of the current IAM models and scenarios include recent and future indirect effects (Supplementary Section and Popp et al.).

Representativeness of the ***forest*** CO2 sink from LPJmL

Given the data requirement for this study (for example, spatially gridded data from a DGVM linked to an IAM), only LPJmL is available as a model to estimate the indirect human-induced ***forest*** sink. However, as the future ***forest*** sink is known to be very uncertain,, we tested the representativeness of our results by comparing LPJmL results with comparable data from other models. Specifically, we compared the ***forest*** sink due to indirect effects from LPJ-mL with the results from eight DGVMs for the period 2005–2014 and with the latest available data in the ISIMIP database up to 2100 ([*https://www.isimip.org/*](https://www.isimip.org/)), and the whole ***land*** sink from LPJmL with comparable data in the IPCC Fifth Assessment Report. Based on these comparisons, we conclude that the ***forest*** and whole ***land*** sinks in LPJmL are reasonably representative of the available data in the literature (Supplementary Section ).

Online content

Any methods, additional references, Nature Research reporting summaries, source data, extended data, supplementary information, acknowledgements, peer review information; details of author contributions and competing interests; and statements of data and code availability are available at [*https://doi.org/10.1038/s41558-021-01033-6*](https://doi.org/10.1038/s41558-021-01033-6).

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**Notes**

Extended datais available for this paper at [*https://doi.org/10.1038/s41558-021-01033-6.Supplementary*](https://doi.org/10.1038/s41558-021-01033-6.Supplementary) informationThe online version contains supplementary material available at [*https://doi.org/10.1038/s41558-021-01033-6.Peer*](https://doi.org/10.1038/s41558-021-01033-6.Peer) review informationNature Climate Change thanks Claire Fyson and the other, anonymous, reviewer(s) for their contribution to the peer review of this work.Publisher’s note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

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[***EU mulls over plan to boost carbon-storage on farmlands***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:60W0-5671-JCF9-42HX-00000-00&context=1516831)

EurActiv.com

September 18, 2020 Friday

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**Length:** 754 words

**Byline:** Gerardo Fortuna

**Highlight:** Farmers and foresters need to be "directly incentivised" to put in practice carbon-capture crops and other measures intended to reduce net greenhouse gases (GHG), according to an update of the European Commission's Climate Law.

**Body**

The new communication presented on Thursday (17 September) aims at storing more carbon on European farmlands and ***forests*** through a "robust carbon ***removal*** certification scheme."

To do so, the EU executive plans to overhaul several pieces of legislation in 2021, such as the on ***Land*** Use, ***Land*** Use Change and Forestry regulation (LULUCF) and the Effort Sharing regulation.

The Commission also calls on member states to deploy carbon farming and certification of carbon ***removals*** in the run-up to 2030.

With around 51 billion tonnes of CO2-equivalent removed from the atmosphere and stored in the topsoil of ***agriculture*** ***land*** during the photosynthesis process, carbon sequestration is considered a key measure in both climate mitigation and adaptation.

Some of the most effective carbon sinks are grasslands and permanent pastures, as well as ***agricultural*** ***land*** located on peatland and other organic soils.

Good farming practices, such as crop rotation and afforestation, can also have a role in keeping farming carbon neutral.

However, the idea of carbon ***removals*** from ***agriculture***, ***land*** use and forestry has been criticised by several environmental NGOs.

[***Commission under fire for including 'carbon sinks' into EU climate goals***](https://www.euractiv.com/section/climate-environment/news/commission-under-fire-for-including-carbon-sinks-into-eu-climate-goals/)

The European Commission on Thursday (17 September) defended its plan to bring carbon ***removals*** from ***agriculture***, ***land*** use and forestry into the EU's updated climate ***target*** for 2030, saying this was in line with UNFCCC standards.

The core aspect of the Climate Law update is to scale up the EU's ambition for reaching the climate neutrality by 2050.

In order to do so, the Commission proposed to increase the 2030 ***target*** for ***emission*** reduction from 40% to 55% and vowed that all legislation will be revised to make it fit for the new ***target***.

According to the European Environment Agency (EEA), the ***agriculture*** sector produced around 10% of the EU's total greenhouse gases (GHG) ***emissions***, with 426,473 kilotonnes of CO2 equivalent produced in 2015.

"While these ***emissions*** can never be fully eliminated under existing technology and management options, they can be significantly reduced while ensuring food security is maintained in the EU," the Commission's impact assessment reads.

Efficient use of fertilisers, precision farming, a healthier herd and the deployment of anaerobic digestion producing biogas, as well as valorising organic waste are listed as examples of existing technologies that could help cope with ***emissions*** reduction.

The document also shows that by 2030 ***emissions*** reductions stemming from changing consumer choices towards healthy diets could be of the same order of magnitude as technical options available to reduce ***emissions*** in the sector.

In September 2019, EU farming ministers discussed how to best support carbon capture through the post-2020 Common ***Agricultural*** Policy (CAP), with the aim of bringing forward this tool as one of the best ways of cutting ***emissions***.

In that informal meeting, organised by the Finnish Presidency of the EU Council, ministers were unanimous in stressing that measures improving farming sustainability require both sufficient funding and the right incentives.

[***Carbon-capture crops need incentives through CAP, EU ministers said***](https://www.euractiv.com/section/agriculture-food/news/carbon-capture-crops-need-incentives-through-cap-eu-ministers-said/)

Soil carbon sequestration and other measures intended to reduce net greenhouse ***emissions*** in farming require proper funding and a degree of flexibility, EU ***agriculture*** ministers agreed at an informal meeting hosted by the Finnish Council presidency.

Last week, the European Parliament's ***Agriculture*** Committee (COMAGRI), voted on their opinion on the Climate Law, which included proposals for the possibility of soil carbon sequestration scheme.

Asger Christensen, the liberal MEP who drafted the opinion, believes it can be supported by establishing a separate trading scheme for negative ***emissions***.

The committee chair, centre-right German MEP Norbert Lins, welcomed that the Commission "is paving the way for new income opportunities through carbon farming for farmers."

However, he added that the devil is in the detail as farmers need market-based solutions for carbon farming and real incentives

"We don't want a bureaucratic monster, but a carbon sequestration certification system that works," he concluded.

[***Agrifood Brief: The agri-side of Europe's man on the moon moment***](https://www.euractiv.com/section/agriculture-food/news/agrifood-brief-the-agri-side-of-europes-man-on-the-moon-moment/)

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Once again, European Commission President Ursula von der Leyen has come under fire ...

*[Edited by Benjamin Fox]*

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[***U.S Nature4Climate Launches to Highlight Role of Natural Climate Solutions to Slow Climate Change***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:60XM-D1N1-F0YC-N3W9-00000-00&context=1516831)

Impact News Service

September 25, 2020 Friday

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**Length:** 875 words

**Body**

Arlington, Virginia: The Nature Conservancy has issued the following press release:

Today, the Nature4Climate initiative announced the launch of its U.S chapter to help put America’s natural and working ***lands*** to work in the effort to slow climate change. Since its launch in 2017, Nature4Climate has worked to incorporate Natural Climate Solutions into worldwide efforts to mitigate greenhouse gas ***emissions***, alongside the decarbonization of the energy sector. The new U.S Nature4Climate coalition will highlight the role Natural Climate Solutions can play in efforts to address climate change in the United States.

“The launch of our U.S chapter will help unleash the capacity of America’s farms, ranches, ***forests***, grasslands and wetlands to ***remove*** dangerous greenhouse gases from the atmosphere,” said Lucy Almond, the Global Director and Chair of Nature4Climate. “With the ever-increasing frequency of climate change-related disasters in the U.S and worldwide, this effort has taken on new urgency.”

Natural Climate Solutions are conservation, restoration and improved ***land*** management practices that reduce greenhouse gas ***emissions*** and help ***remove*** carbon from the atmosphere. These practices have the potential to contribute up to 30 percent of the solution to climate change in the U.S , and include activities ranging from cover cropping to tree planting and improved ***forest*** management to grassland and sea grass restoration. Private landowners play a key role in implementation of these strategies.

“America’s natural and working ***lands*** have the potential to store vast amounts of carbon,” said Catherine Macdonald, The Nature Conservancy’s North America Director of Natural Climate Solutions and Chair of the USN4C Steering Committee. “This coalition will help ensure that Natural Climate Solutions are recognized as an important part of our overall strategy to address climate change, supporting efforts to reduce greenhouse gas ***emissions*** in other sectors of our economy.”

As part of this effort, U.S Nature4Climate is launching a website, [*www.USnature4climate.org*](http://www.USnature4climate.org), to serve as a resource for news media and others interested in learning more about the role of Natural Climate Solutions in the United States. The website includes the latest science on the carbon reduction potential of these climate solutions, profiles of programs that are putting these solutions into action, and stories of farmers, ***forest*** owners and communities reaping the economic and environmental benefits delivered by these strategies.

The U.S Nature4Climate Steering Committee is comprised of a diverse coalition of conservation, sustainability-focused businesses, forestry and ***agriculture*** leaders working together to ensure Natural Climate Solutions are integrated into national, state and corporate efforts to combat climate change.

The Nature Conservancy: Catherine Macdonald, North America Director of Natural Climate Solutions American ***Forests***: Jad Daley, President & CEO Ceres: Alli Gold-Roberts, Director – State Policy ***Land*** Trust Alliance: Kelly Watkinson, ***Land*** & Climate Program Manager Outdoor Industry Association: Amy Horton, Senior Director, Sustainable Business Innovation Theodore Roosevelt Conservation Partnership: Christy Plumer, Chief Conservation Officer U.S Climate Alliance: Jennifer Phillips, Senior Policy Advisor U.S Farmers & Ranchers in Action: Erin Fitzgerald, Chief Executive Officer Wildlife Conservation Society: Melanie Stansbury, Policy Advisor World Resources Institute: Alexander Rudee, Associate – Carbon ***Removal*** Nature4Climate: Lucy Almond, Director

In addition to their climate benefits, Natural Climate Solutions offer a wide array of complimentary economic and environmental benefits, many of which were highlighted by U.S Nature4Climate Steering Committee members:

“America’s farmers and ranchers have been and continue to be part of the solution to climate change. That’s why many are voluntarily adopting climate-smart farming and ranching techniques that store carbon and improve soil health –making our ***land*** more productive and our communities more vibrant.” – Erin Fitzgerald, Chief Executive Officer, U.S Farmers & Ranchers in Action

“Businesses are deploying and investing in Natural Climate Solutions because they play a key role in capturing carbon, increasing our resilience to climate change, and helping companies meet their ambitious sustainability goals.” – Alli Gold-Roberts, Director of State Policy, Ceres

“Trees are natural carbon-***removing*** machines. By protecting ***forests***, planting trees and changing the way we manage forestland, we can kick that machine into high gear, while also creating thousands of jobs. That is why policy makers across the aisle are embracing the role ***forests*** can play in our climate change strategy.” – Jad Daley, President & CEO, American ***Forests***

“America’s outdoor playgrounds — and the jobs and revenue generated by the $887 billion outdoor recreation economy — are at risk from climate disruption. In addition to driving down the outdoor industry’s greenhouse gas ***emissions***, protecting our ***forests*** and grasslands can mitigate climate change while also preserving the outdoor experience,” said Amy Horton, the Outdoor Industry Association’s Senior Director of Sustainable Business Innovation

**Load-Date:** September 28, 2020

**End of Document**



[***European Green Deal: Commission proposes transformation of EU economy and society to meet climate ambitions***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:634X-WX21-F0YC-N27R-00000-00&context=1516831)

Impact News Service

July 14, 2021 Wednesday

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**Length:** 1217 words

**Body**

Brussels, Belgium: European Commission has issued the following press release:

Today's proposals will enable the necessary acceleration of greenhouse gas ***emission*** reductions in the next decade. They combine: application of ***emissions*** trading to new sectors and a tightening of the existing EU ***Emissions*** Trading System; increased use of renewable energy; greater energy efficiency; a faster roll-out of low ***emission*** transport modes and the infrastructure and fuels to support them; an alignment of taxation policies with the European Green Deal objectives; measures to prevent carbon leakage; and tools to preserve and grow our natural carbon sinks.

The EU ***Emissions*** Trading System (ETS) puts a price on carbon and lowers the cap on ***emissions*** from certain economic sectors every year. It has successfully brought down ***emissions*** from power generation and energy-intensive industries by 42.8% in the past 16 years. Today the Commission is proposing to lower the overall ***emission*** cap even further and increase its annual rate of reduction. The Commission is also proposing to phase out free ***emission*** allowances for aviation and align with the global Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) and to include shipping ***emissions*** for the first time in the EU ETS. To address the lack of ***emissions*** reductions in road transport and buildings, a separate new ***emissions*** trading system is set up for fuel distribution for road transport and buildings. The Commission also proposes to increase the size of the Innovation and Modernisation Funds. To complement the substantial spending on climate in the EU budget, Member States should spend the entirety of their ***emissions*** trading revenues on climate and energy-related projects. A dedicated part of the revenues from the new system for road transport and buildings should address the possible social impact on vulnerable households, micro-enterprises and transport users. The Effort Sharing Regulation assigns strengthened ***emissions*** reduction ***targets*** to each Member State for buildings, road and domestic maritime transport, ***agriculture***, waste and small industries. Recognising the different starting points and capacities of each Member State, these ***targets*** are based on their GDP per capita, with adjustments made to take cost efficiency into account. Member States also share responsibility for ***removing*** carbon from the atmosphere, so the Regulation on ***Land*** Use, Forestry and ***Agriculture*** sets an overall EU ***target*** for carbon ***removals*** by natural sinks, equivalent to 310 million tons of CO2 ***emissions*** by 2030. National ***targets*** will require Member States to care for and expand their carbon sinks to meet this ***target***. By 2035, the EU should aim to reach climate neutrality in the ***land*** use, forestry and ***agriculture*** sectors, including also ***agricultural*** non-CO2 ***emissions***, such as those from fertiliser use and livestock. The EU ***Forest*** Strategy aims to improve the quality, quantity and resilience of EU ***forests***. It supports foresters and the ***forest***-based bioeconomy while keeping harvesting and biomass use sustainable, preserving biodiversity, and setting out a plan to plant three billion trees across Europe by 2030. Energy production and use accounts for 75% of EU ***emissions***, so accelerating the transition to a greener energy system is crucial. The Renewable Energy Directive will set an increased ***target*** to produce 40% of our energy from renewable sources by 2030. All Member States will contribute to this goal, and specific ***targets*** are proposed for renewable energy use in transport, heating and cooling, buildings and industry. To meet both our climate and environmental goals, sustainability criteria for the use of bioenergy are strengthened and Member States must design any support schemes for bioenergy in a way that respects the cascading principle of uses for woody biomass. To reduce overall energy use, cut ***emissions*** and tackle energy poverty, the Energy Efficiency Directive will set a more ambitious binding annual ***target*** for reducing energy use at EU level. It will guide how national contributions are established and almost double the annual energy saving obligation for Member States. The public sector will be required to renovate 3% of its buildings each year to drive the renovation wave, create jobs and bring down energy use and costs to the taxpayer. A combination of measures is required to tackle rising ***emissions*** in road transport to complement ***emissions*** trading. Stronger CO2 ***emissions*** standards for cars and vans will accelerate the transition to zero-***emission*** mobility by requiring average ***emissions*** of new cars to come down by 55% from 2030 and 100% from 2035 compared to 2021 levels. As a result, all new cars registered as of 2035 will be zero-***emission***. To ensure that drivers are able to charge or fuel their vehicles at a reliable network across Europe, the revised Alternative Fuels Infrastructure Regulation will require Member States to expand charging capacity in line with zero-***emission*** car sales, and to install charging and fuelling points at regular intervals on major highways: every 60 kilometres for electric charging and every 150 kilometres for hydrogen refuelling. Aviation and maritime fuels cause significant pollution and also require dedicated action to complement ***emissions*** trading. The Alternative Fuels Infrastructure Regulation requires that aircraft and ships have access to clean electricity supply in major ports and airports. The ReFuelEU Aviation Initiative will oblige fuel suppliers to blend increasing levels of sustainable aviation fuels in jet fuel taken on-board at EU airports, including synthetic low carbon fuels, known as e-fuels. Similarly, the FuelEU Maritime Initiative will stimulate the uptake of sustainable maritime fuels and zero-***emission*** technologies by setting a maximum limit on the greenhouse gas content of energy used by ships calling at European ports. The tax system for energy products must safeguard and improve the Single Market and support the green transition by setting the right incentives. A revision of the Energy Taxation Directive proposes to align the taxation of energy products with EU energy and climate policies, promoting clean technologies and ***removing*** outdated exemptions and reduced rates that currently encourage the use of fossil fuels. The new rules aim at reducing the harmful effects of energy tax competition, helping secure revenues for Member States from green taxes, which are less detrimental to growth than taxes on labour. Finally, a new Carbon Border Adjustment Mechanism will put a carbon price on imports of a ***targeted*** selection of products to ensure that ambitious climate action in Europe does not lead to ‘carbon leakage'. This will ensure that European ***emission*** reductions contribute to a global ***emissions*** decline, instead of pushing carbon-intensive production outside Europe. It also aims to encourage industry outside the EU and our international partners to take steps in the same direction.

These proposals are all connected and complementary. We need this balanced package, and the revenues it generates, to ensure a transition which makes Europe fair, green and competitive, sharing responsibility evenly across different sectors and Member States, and providing additional support where appropriate.

**Load-Date:** July 15, 2021

**End of Document**



[***Irish forestry is 'net emitter of greenhouse gases'***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:615V-WN41-DYS1-053C-00000-00&context=1516831)

The Irish Times

October 30, 2020 Friday

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**Section:** IRELAND; Pg. 4

**Length:** 287 words

**Byline:** Kevin O'Sullivan and Sean McCarthaigh

**Body**

SEÁN McCÁRTHAIGH Ireland's forestry is a growing source of greenhouse gas ***emissions*** rather than acting as a carbon sink absorbing them, according to a report produced for the Department of ***Agriculture*** .

The finding contradicts the Government's position that "Irish ***forests*** are a significant sink and carbon store", Friends of the Irish Environment (FIE) said in response to the findings, which have been submitted to the European Commission

The ***emissions*** imbalance could leave ***forest*** owners subject to carbon tax payment demands when they had envisaged they could claim carbon credits, said FIE spokesman Tony Lowes.

The report, entitled FRL 2021-2015: Ireland, a National Forestry Accounting Plan, has been reviewed extensively by the European Commission, and is due to be adopted by delegated Act by the end of October.

Under EU legislation member states must ensure greenhouse gas ***emissions*** from ***land*** use, ***land***-use change or forestry are balanced by at least an equivalent ***removal*** of CO2 from the atmosphere in the period 2021 to 2030.

The report concludes Ireland's ***forest*** estate transitioned from a sink - capturing CO2 - to a source during the 2012 to 2017 period, with indications of likely increases in greenhouse gas ***emissions*** from 420 gigatons in 2018 to 2,161 gigatons CO2 equivalent by 2025.

While growing trees absorb greenhouse gases, disturbance to soil - drainage, and disruption through afforestation and at clear-felling stage - all release carbon from the soil, confirmed climate scientist Prof John Sweeney.

"Any hope that new afforestation can miraculously be counted to meet short-term carbon budgets is misplaced," said Prof Sweeney. "The present forestry model grows the wrong trees in the wrong places."

**Load-Date:** October 31, 2020

**End of Document**



[***EU drafts plan to grow 'carbon sinks' in climate change fight***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:633D-V981-F03R-N28J-00000-00&context=1516831)

Newstex Blogs

EU Reporter

July 8, 2021 Thursday 5:45 AM EST

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**Body**

Jul 08, 2021( EU Reporter: [*http://www.eureporter.co*](http://www.eureporter.co) Delivered by Newstex)

The European Union has drafted plans to build up ***forests***, grasslands and other natural "carbon sinks" that absorb carbon dioxide from the atmosphere to help curb climate change, according to a draft document seen by Reuters on Tuesday (6 July), writes Kate Abnett.

Carbon sinks have gained in importance as countries strive to reach "net zero" ***emissions*** by 2050, the goal scientists say the world must meet to avoid the worst impacts of climate change. Net zero ***emissions*** means emitting no more greenhouse gases than can be balanced by ***removing*** gases from the atmosphere.

EU ***forests***, grasslands, croplands and wetlands altogether removed a net 263 million tonnes of CO2 equivalent (CO2e) from the atmosphere in 2018, according to the European Commission. That tally also accounts for the amount of CO2 released when trees were cut down or wildlands burned.

The Commission will next week propose a ***target*** to expand the EU's sink to absorb 310 million CO2e per year by 2030 by giving each member state a legally binding goal, according to the draft.

The proposal would require better protections for ***forests*** and wildlands, which have shrunk due to logging, demand for biomass energy and threats worsened by climate change such as wildfires and pests.

The draft did not define the national ***targets***, which would replace a current requirement to ensure that CO2 sinks do not shrink this decade.

From 2031, the EU would would also begin accounting for ***agricultural*** ***emissions*** of gases including methane - another potent greenhouse gas - in its net carbon sink tally. EU ***agriculture*** ***emissions*** have not decreased since 2010.

The proposal is due to be published on July 14 as part of a broader package of climate policies whose main thrust will be cutting CO2 ***emissions*** from sources such as vehicles, factories and power plants.

The policies will then be negotiated by member states and the European Parliament, a politically delicate process that could take up to two years.

The EU also plans to establish a system of carbon ***removal*** certificates, according to the draft proposal, which farmers and foresters could sell to polluters needing to balance their ***emissions*** - creating a financial incentive to store carbon.

**Load-Date:** July 8, 2021

**End of Document**



[***Constraints and enablers for increasing carbon storage in the terrestrial biosphere***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:693W-H851-F129-P0J8-00000-00&context=1516831)

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**Body**

Introduction

Rapid cuts to global carbon dioxide (CO2) ***emissions*** are needed to meet the Paris Agreement goal of limiting anthropogenic warming to well below 2 °C. Stabilizing climate change will eventually require net-zero ***emissions***. Slow progress towards decarbonization has increased the emphasis on negative ***emissions*** in meeting long-term temperature aims,.

Negative ***emissions*** describe intentional efforts to ***remove*** CO2 ***emissions*** from the atmosphere. Examples include direct air capture and bioenergy with carbon capture and storage (BECCS), both of which are in the early stages of technological development and cannot currently operate at scales relevant for global mitigation. Other negative ***emissions*** technologies include human interventions that seek to increase carbon sequestration in the ocean (including coastal vegetation restoration, enhanced ocean productivity and enhanced weathering) and on ***land*** (including reforestation, biochar and some improved ***forest*** management actions). Natural, unmanaged ***land*** and ocean CO2 uptake that make up background sinks are not negative ***emissions*** because they do not contribute additional CO2 ***removal***. The CO2 uptake of these unmanaged sinks is very important in both global and jurisdictional carbon budgets, and their future is uncertain, especially for ***land***. But assumptions about their continued uptake are embedded in calculations of remaining CO2 ***emissions*** budgets and negative ***emissions*** needs,.

Whereas negative ***emissions*** technologies such as direct air capture and BECCS remain in early stages of technological development and are not currently available at scales relevant for global climate mitigation, CO2 ***removal*** via the terrestrial biosphere already operates on these scales. Increasing carbon storage in the terrestrial biosphere has been proposed as a climate change response since at least 1990 (ref.), but has been the subject of increased interest in policy and management spheres as nature-based solutions or natural climate solutions (hereafter referred to as nature-based climate solutions (NbCS) to circumvent defining what ‘natural’ is).

NbCS include ***land*** management actions, such as conservation, restoration and improved management in ***forests***, wetlands, grasslands and ***agricultural*** fields, that contribute to climate change mitigation. They comprise both avoided ***emissions*** and negative ***emissions***. Some important NbCS, in particular, avoided deforestation and avoided ***forest*** degradation, both of which are valuable conservation and climate mitigation interventions, do not contribute to negative ***emissions***, even though they facilitate the perpetuation of unmanaged sinks.

Four main interventions, avoided deforestation, reforestation, (improved) ***forest*** plantations and soil carbon sequestration, can be used to represent the diversity of NbCS interventions and their associated challenges (Table ). For example, avoided deforestation and reforestation have higher potential environmental co-benefits, such as biodiversity protection, than ***forest*** plantations. Intermediate strategies include some improved ***forest*** management actions, which can simultaneously increase carbon storage in ***forests*** and still provide economic benefits from occasional lumber harvest, and proforestation, which can maximize carbon storage in intact ***forests*** and encourage the growth of large, old trees. Soil carbon sequestration can be done on the same ***land*** as ***agricultural*** production and, thus, has relatively low opportunity costs. The situation is similar for ***forest*** plantations, which can provide their own economic benefits via the sale of timber products. By contrast, durable climate mitigation from avoided deforestation and reforestation requires the ***land*** be allocated permanently (at least timescales ~100+ years) to the NbCS intervention. These timescales and opportunity costs lead to differing amounts of coordination required for successful implementation. Ability to measure the additional carbon storage is a persistent problem. It is especially acute for soil carbon sequestration, (Table ).

Characteristics of different mechanisms and measures through which carbon is stored in the terrestrial biosphere

| **Characteristic** | | **Unmanaged fertilization** | **Unmanaged regrowth** | **Avoided deforestation** | **Reforestation** | ***Forest* plantations** | **Soil carbon** |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Carbon storage category | Terrestrial carbon storage? | Yes | Yes | Yes | Yes | Yes | Yes |
| Nature-based climate solution? | No | No | Yes | Yes | Yes | Yes |  |
| Negative ***emissions***? | No | No | No | Yes | Yes | Yes |  |
| Intervention required? | No | No | Yes | Yes | Yes | Yes |  |
| Total potential contribution to negative ***emissions*** needs | Low | Low | None | Medium | Medium | Medium/high |  |
| Stability | Medium | High | Medium | Medium | Low | Medium |  |
| Level of management | ? | ? | Medium | Medium | High | Medium/high |  |
| Environmental co-benefits | ? | ? | High | Medium/high | Low | Medium |  |
| Technological readiness | ? | ? | High | High | High | Medium/low |  |
| Opportunity costs | ? | ? | High | High | Medium | Low |  |
| Ability to measure | Medium | Medium | Medium | Medium | Medium | Low |  |
| Coordination required | ? | ? | High | High | Medium | Low |  |

Estimates for NbCS potential cover a wide range,–, spanning ~100 to ~1,200 GtCO2. Given the potential value of NbCS, policy and management interest in them has also increased. For instance, several non-governmental organizations focused on climate and conservation have initiated or expanded ‘Trillion Tree’ and other NbCS programmes. Moreover, the ‘Trillion Trees Act’ was introduced in the United States House of Representatives (H.R. 5859) in February 2020. Of course, tree planting is just one example of the kinds of NbCS interventions that have seen large increases in attention and ambition. NbCS have featured prominently in many nationally determined contributions to the Paris Agreement and are expected to have a large platform at the 2021 United Nations Climate Change Conference, also known as COP26, in Glasgow.

Yet, despite increasing emphasis on NbCS, ***land*** use and ***land*** cover change remain a source of 4–7 GtCO2 per year, mainly from tropical deforestation,. Current efforts to prevent or offset these losses through NbCS, while increasing, remain limited. A broad suite of NbCS and related interventions have resulted in cumulative ***emissions*** reductions of 1.1 GtCO2 from 2006 to 2018 (ref.). More specifically, ***forest***-based net ***removals*** (including afforestation, reforestation, agroforestry, improved ***forest*** management and avoided deforestation) resulted in a cumulative total of 0.365 GtCO2 over 2010–2016 (ref.). The 67 afforestation or reforestation projects that were part of the Kyoto Protocol’s Clean Development Mechanism represent ***emission*** reductions of 0.002 GtCO2 per year (ref.). With cumulative negative ***emissions*** of 550–1,017 GtCO2 likely needed through 2100 to limit anthropogenic warming to 1.5 °C (ref.), it is important to ask how much can come from NbCS, which can provide a relatively small but important contribution to overall carbon ***removal***–. If NbCS do not meet the total need, a portfolio approach will be required.

In this Review, we develop safe, grounded estimates for NbCS potential contribution to negative ***emissions*** by assessing the wide range of existing estimates. We focus our discussion on four main NbCS interventions, avoided deforestation, reforestation, (improved) ***forest*** plantations and soil carbon sequestration, collectively representing the diversity of NbCS and their associated challenges. NbCS are especially critical based on availability and cost, but availability and cost-effectiveness have not, so far, driven implementation at scale. To this end, we explore interacting barriers that limit the practically implementable potential of NbCS — including net climate effects, socio-economic constraints, impacts on ecosystem service and governance — concluding that NbCS can provide significant negative ***emissions***, but that additional negative ***emissions*** technologies are likely to be necessary to achieve ambitious limits on warming.

Terrestrial biosphere carbon capacity

The ability to increase carbon storage in the terrestrial biosphere can be conceptualized as a spectrum from a ‘silo’ — wherein the capacity for increasing carbon storage is limited to refilling past losses from ***land*** use change or ***land*** management and is, hence, ‘bounded’ — to a ‘haystack’ — wherein carbon storage can increase beyond historical limits and is ‘unbounded’ (Fig. ). To a first approximation, silo conceptualizations of terrestrial carbon storage centre on refilling past carbon losses from ***land*** use change and ***land*** management,; in contrast, haystack conceptualizations centre on photosynthesis and large-scale management intervention, including fire suppression, the addition of compost or biochar, and shifting vegetation patterns, each with significant risks. Of course, these characterizations fall at the end points of the spectrum, with most lying somewhere in between.

Silo versus haystack.

A conceptual spectrum of carbon storage in the terrestrial biosphere ranges from a silo (carbon storage potential strictly limited to refilling past losses) to a haystack (ability to increase terrestrial carbon storage beyond historical levels). Both have underlying assumptions and conditions in regards to biogeography, biogeochemistry and management choices.

Traversing the spectrum from silo to haystack is moving from a conception of carbon storage capacity that envisions potential natural vegetation as setting a cap to progressively more latitude for factors such as CO2 fertilization, nutrient availability, climate effects and management choices to increase carbon storage capacity, as adding hay to a haystack changes its capacity (Fig. ). Climate changes could also decrease carbon storage capacity, resulting in a shrinking silo or haystack,. NbCS research and policy planning to date have involved implicit silo or haystack conceptions of carbon storage capacity without explicit recognition of the distinction or its implications.

Constraints related to past losses and subsequent refilling

With the silo conception, the available carbon capacity is determined by past losses related to human actions. Thus, understanding past carbon losses from ***land*** use and ***land*** management can represent a starting point for understanding unfilled silo potential.

Published estimates of these losses exhibit marked variability (Fig. ), with an interquartile range of 680–880 GtCO2. For example, a bookkeeping approach to track deforestation estimates a loss of 530 GtCO2 since 1850 (ref.); a combination of models and remote sensing calculates a cumulative loss from human activities of 666–729 GtCO2 (ref.); a spatially explicit bookkeeping approach indicates a loss of 956 GtCO2 since 1850 from ***land*** use and ***land*** cover change; the difference between actual and potential biomass defines a loss of 1,650 GtCO2 (ref.). Modelling quantifies a loss of 425 GtCO2 from soil degradation over the past 12,000 years of human ***land*** use. The highest estimates of biomass and soil loss are difficult to reconcile with the history of atmospheric CO2 (refs,). The highest estimates of biomass loss are highly uncertain, based on the poorly constrained nature of potential biomass.

Estimates for unfilled sink potential and increases in carbon storage from nature-based climate solutions.

a | Previously published estimates of carbon lost from the terrestrial biosphere owing to human activities (red; N = 13), the cumulative ***land*** sink since 1850 (green; N = 1) and potential increases in carbon storage via nature-based climate solutions (NbCS, blue; N = 42). See Supplementary Table for data sources,,,–,,,,,–,–. The boxplots show the first and third quartlies, the median (thick line), values within 1.5 times the interquartile range (vertical lines), the outliers (circles) and all data points (circles). b | The estimates of the carbon gain potential of NbCS in panel a by magnitude. To estimate total carbon gain, rates of carbon gain (light blue) were multiplied by the implementation years in the original publication; if implementation years were not provided, 54.5 years were used following ref.. Where necessary, carbon storage related to avoided deforestation (grey dots) were subtracted. The shaded band highlights the interquartile range of negative ***emissions*** needed through 2100 to limit anthropogenic warming to 1.5 °C in integrated assessment model scenarios from ref.. Estimates for the potential increases in carbon storage from NbCS span a wide range and high-end estimates would require increases in carbon storage greater than historical losses.

Some past carbon losses have already been refilled by recent sinks. The extent of refilling is handled inconsistently across various estimates, challenging the quantification of unfilled carbon potential; estimates based on potential versus actual vegetation, for example, arguably do not need to account for refilling, whereas those based on bookkeeping models account for some of the refilling but only for recently deforested sites.

The background terrestrial biosphere (not accounting for net deforestation) has operated as a consistent carbon sink since at least the 1950s. For example, it is estimated that 2–15 GtCO2 per year were sequestered over 1959–2018, representing a cumulative sink of 475 GtCO2 (ref.) (Fig. ). If the terrestrial carbon sink was taking space in a silo of fixed capacity, losses of ~730 GtCO2 (mean of all loss estimates; Fig. ) would be partially refilled by 475 GtCO2 gains, leaving ~255 GtCO2 unfilled.

While some of the terrestrial carbon sinks do not refill past ecosystem losses (including carbon in long-lived products or reservoir sediments), others do, especially ***forest*** regrowth. If the terrestrial biosphere operates like a silo for carbon, then regrowth of previously harvested ***forests*** should be a major factor in carbon sinks. Indeed, ***forest*** regrowth, particularly in eastern North America, southern-eastern Europe and southeastern temperate Eurasia, from 1990 to 2007 offset more than half of the annual tropical deforestation ***emissions*** and represents more than half of the ***land*** carbon sink from the period 2001–2010 (refs,,,). However, despite the robust ***land*** sink over the past few decades, there are early signs of sink saturation in some ecosystems–, suggesting that the rate of carbon storage might slow as the silo approaches capacity.

NbCS and the background terrestrial ***land*** sink

The expectation of continued operation of the background ***land*** sink is built into the calculation of remaining carbon budgets for stabilizing warming at any given level above pre-industrial; NbCS must contribute carbon storage additional to the background sink to be effective as negative ***emissions***,, (Table ).

Uncertainty in the future of the background terrestrial sink introduces major uncertainty in future needs for negative ***emissions***. The magnitude of this uncertainty is captured in the observation that, based on results from 11 Earth system models forced by RCP8.5 (ref.), modelled annual air-to-***land*** carbon fluxes at the end of the twenty-first century range from +36 to −30 GtCO2 per year. The range between the largest estimated average sink and source is more than the current total of annual anthropogenic greenhouse gas release.

An additional source of uncertainty relates to the ***land*** sink response as ***emissions*** approach net zero or net negative. As atmospheric CO2 stops increasing, incremental effects of CO2 fertilization will disappear, along with the fraction of the sink due to CO2 fertilization. At the same time, any increase in carbon loss from the biosphere via increased disturbance erodes both the background sink and the negative ***emissions*** potential of the terrestrial biosphere.

Ecosystem models run using ***land***-based mitigation scenarios (afforestation and/or avoided deforestation and BECCS) from two integrated assessment models generally failed to achieve the carbon uptake suggested by the integrated assessment models. Uptake uncertainty was driven by uncertainty in bioenergy crop yields, soil carbon response to ***land*** use change, ***forest*** biomass and the rate of ***forest*** regrowth. Earth system models show significantly weakened ***land*** and ocean carbon sinks at the end of the twenty-first century under the rapid mitigation pathway, RCP2.6, and indicate that the ***land*** and ocean will likely become a weak source of CO2 into the atmosphere in the twenty-third century. This reduction in the background sinks might mean that increased deployment of negative ***emissions*** technologies will be necessary to achieve desired climate mitigation goals. More modelling work is needed to understand the ***land*** sink dynamics under future mitigation scenarios where CO2 ***emissions*** go to net zero or net negative,. This work will be critical to inform a ‘right-timed’ approach to interventions seeking to increase the carbon storage of the terrestrial biosphere.

Increasing carbon storage beyond historical bounds

The haystack view of NbCS is rooted in the concept that past carbon stocks do not constrain future potential storage. As such, it underlies higher-end estimates of NbCS (Figs ,). Increasing carbon storage beyond historical limits (for example, if NbCS are used to achieve the 500–1,000 GtCO2 of negative ***emissions*** likely needed to limit warming to 1.5 °C (ref.)), however, requires several preconditions: continuation of CO2 fertilization effects outweighing decreases in productivity from warming; continuation of the effects of nitrogen and phosphorus fertilization; and large-scale implementation of management-intensive NbCS, such as ***forest*** plantations and afforestation.

Afforestation of grasslands and disturbance exclusion provide examples of haystack NbCS that could increase carbon storage above previous and historic levels. However, there are major questions about the ability to implement these interventions, especially in a non-stationary climate,. Even where implementation of these strategies is technically possible, it could be limited by conflict with priorities for conservation and disaster risk reduction priorities–, and by questions about whether they are sufficiently natural. Large-scale implementation of soil carbon sequestration via regenerative ***agriculture***, biochar or other interventions could also represent a pool of carbon that might have potential to increase beyond historical levels (for example, as proposed by Indigo ***Agriculture***’s Terraton Initiative), but there are significant questions about achievable rates and permanence.

Estimates of NbCS potential

Forty-two estimates of NbCS potential compiled from the literature (see ) indicate potential cumulative negative ***emissions*** during the twenty-first century from less than 100 GtCO2 to more than 1,000 GtCO2 (Fig. ), with a mean of ~400 GtCO2. The spread of the estimates is not explained by the geographic extent or the diversity of interventions considered in the estimates (Fig. ,).

Parsing natural climate solutions estimates by constraints considered.

Estimates of the carbon gain potential of nature-based climate solutions (NbCS) by intervention type (panel a; All, multiple NbCS interventions; AR, afforestation and/or reforestation; Soil, soil-based NbCS), geographic scope (panel b), consideration of net climate effects (panel c) and carbon price (panel d). The shaded band highlights the interquartile range of negative ***emissions*** needed through 2100 to limit global warming to 1.5 °C in integrated assessment model scenarios from ref.. In all panels, the boxplots show the first and third quartiles, the median (thick line), values within 1.5 times the interquartile range (vertical lines) and all datapoints (circles). See Supplementary Table for data sources. Consideration of additional constraints generally lowers the estimated potential for increased carbon storage via NbCS.

Overall, there is clear capacity for increases in carbon storage in the terrestrial biosphere to contribute to CO2 ***removal***. However, there are uncertainties related to the magnitude of the potential and to the response of both NbCS and the background ***land*** sink to future climate change and climate action. Furthermore, if 500–1,000+ GtCO2 of negative ***emissions*** are needed over the twenty-first century to meet ambitious climate goals, it is unlikely that even maximum biogeochemical capacity would be sufficient to meet these needs. Fewer than one-third of the 42 existing estimates are in this range (Figs ,).

Factors influencing NbCS feasibility

In converting the biogeochemical potential of NbCS to grounded estimates of implementable potential, many constraints must be considered. These constraints include the effects of net climate forcing, economics, ecosystem services, socio-political realities and governance (Fig. ), many of which are difficult to quantify or ignored in previous analyses. Each of these constraints is now considered, with discussion primarily focused on the full suite of NbCS interventions simultaneously, but, of course, individual interventions have unique characteristics (Table ).

Summary of constraints and judgement of near-term and long-term likelihood to be limiting.

Present constraints on forestry-based and soil-based climate solution implementation (low, medium or high), and the importance of these constraints in the future as implementation scales up (arrows and question marks). Upward-facing and downward-facing arrows indicate, respectively, increasing and decreasing importance of that constraint in the future, and question marks indicate uncertain changes in importance. Currently, governance and implementation constraints limit nature-based climate solutions implementation, but, in the future, biogeochemical and economic constraints will likely become more important.

Net climate effects

Net climate effects describe the balance between global cooling associated with increased carbon storage and the local biophysical effects or release of other greenhouse gases. While these net climate effects do not change the carbon storage capacity of the biosphere, they importantly modify calculations of the ultimate benefit of some NbCS interventions, as illustrated by the contrasting biophysical effects of afforestation at different latitudes. In middle to high latitudes, for example, afforestation can cause net warming, owing to a reduction in albedo–. In the tropics, by contrast, afforestation tends to increase albedo, amplifying the cooling effect of carbon sequestration, which can be further enhanced via increases in evapotranspiration. Climate effects of temperate afforestation or reforestation are mixed, sometimes promoting net local cooling. As a result of these net climate effects, afforestation-based NbCS efforts should generally avoid boreal regions. Indeed, NbCS estimates that incorporate this constraint generally find smaller potential increases in terrestrial carbon storage (318 GtCO2 compared with 591 GtCO2; Fig. ). To date, consideration of albedo and associated net climate effects have not been included in protocols for crediting increased carbon storage,.

The release of greenhouse gases other than CO2 is also an important net climate effect to be considered, especially in peatland restoration. In these interventions, increased long-term carbon storage arising from NbCS interventions can be partially offset by short-term release of methane due to anaerobic conditions. However, this effect is uncertain and peatland-specific. Nevertheless, while peatlands contain very high carbon density per unit of ***land*** area, the potential to increase their carbon storage is relatively low compared with other NbCS interventions.

Economic constraints

Economic costs represent another quantifiable constraint on NbCS implementation. Economy-wide pricing of carbon at around 100 USD per tCO2 appears to make a number of NbCS cost-effective (Fig. ). Of the 42 NbCS carbon gain estimates (Fig. ), only seven include a price. All seven of these indicate NbCS potential of less than 500 GtCO2, and stricter constraints (lower prices) generally result in reduced potential (Fig. ). These analyses implicitly assume that cost-effective potential is financially viable and can be implemented immediately if funds are available. However, cost-effectiveness does not imply that NbCS interventions are the most cost-efficient or profitable ***land*** use (especially given the opportunity costs of ***land*** being committed to forestry for 100+ years). Thus, even economy-wide carbon pricing might be insufficient to result in implementation.

From a techno-economic standpoint, NbCS fare well relative to other negative ***emissions*** technologies. Major NbCS categories such as avoided deforestation and afforestation or reforestation require almost no technological innovation. These are technologies that have existed for many years and, in some cases, can happen without dedicated intervention (for example, the reforestation of abandoned ***agricultural*** ***lands*** in the northeast United States over the twentieth century). Initial projects might be relatively inexpensive, but complexity and costs will likely increase if NbCS are to scale up, especially to the high range of haystack levels,. Other NbCS interventions, such as biochar and other soil carbon sequestration, will require some technological development. A complete analysis of technological readiness for negative ***emissions*** technologies can be found in ref.. Overall, this techno-economic-readiness analysis suggests that modest levels of deployment might be feasible, but high opportunity costs and lack of on-the-ground capacity have limited deployment to date (Fig. ). If higher haystack levels of implementation are to be achieved, costs and social resistance are likely to increase (Fig. ).

Effects on other ecosystem services

NbCS interventions, especially reforestation and avoided deforestation, are often well aligned with broader conservation goals, establishing them as win-win–. Yet, trade-offs between carbon storage and maintenance of other ecosystem services (including preservation, restoration and biodiversity) might emerge as NbCS deployment scales up to billions of tons of carbon ***removal*** in a haystack world (Fig. ).

Avoided deforestation, natural regrowth and reforestation with high-diversity native ***forests***, for example, support biodiversity conservation and enhanced ecosystem services. However, reforestation and afforestation with plantations might result in increased carbon storage without the conservation co-benefits. In fact, there could be adverse side effects. For instance, afforestation in ecosystems such as native grasslands might increase above-ground carbon but result in a substantial loss of below-ground carbon and increased susceptibility to disturbance, in addition to the displacement of species native to the grassland. Carbon sequestration is not the only reason to protect and restore ***forests***, and, for all interventions, it will be important to quantify the ecosystem services gained or lost, as well as the carbon sequestration.

Competition for ***land***

Scaling up NbCS to the levels needed to achieve climate mitigation goals requires huge amounts of ***land***; for example, ***removing*** 1 GtCO2 per year via afforestation or reforestation would need 70–90 Mha, roughly twice the size of California,. Scenarios for scaling forestry-based NbCS are often categorical, including: complete reforestation of all current ***agricultural*** ***land***, reforestation of marginal ***agricultural*** ***land***, constraining tree restoration potential to natural ranges or excluding developed ***land***,, or unconstrained tree restoration, and do not yet incorporate the kind of site-by-site analysis that will underlie any real large-scale deployment.

These ***land*** requirements for NbCS will need to compete with urban development, ***agricultural*** production and other negative ***emissions*** technologies. Large-scale BECCS implementation, for instance, would also require a vast scale-up in the ***land*** devoted to bioenergy crops–. Abandoned ***agricultural*** fields would, therefore, be in high demand for both reforestation and bioenergy crop production, with degradation limiting productivity and increasing the ***land*** area required for any total yield,. As ***agricultural*** expansion constitutes the dominant driver of deforestation and pressure on ***forests***,, increasing soil carbon sequestration might represent a potential win-win solution for meeting the world’s growing food needs and ***removing*** additional CO2 from the atmosphere. Determining ‘optimal’ ***land*** allocation requires analysis that goes far beyond simple carbon and energy accounting, and is strongly shaped by subjective priorities.

Socio-political contexts

Social and political realities, such as on-the-ground perceptions, cultural impacts, support and capacities, can hinder the implementation of biologically and economically viable interventions. However, public inclination towards natural solutions, especially those that feature diverse native ***forests*** and increases in crop yields, can facilitate their implementation. Modest levels of deployment are, therefore, likely feasible from a socio-political context. Yet, with increasing ambition about the level of deployment, the range of projects will need to broaden to include activities that are less natural and, thus, might receive less public support.

Social, cultural and political constraints are often cross-cutting in their overarching categories but require context-specific, local and heterogeneous solutions. General issues include ***land*** tenure–, weak institutions, and entrenched interests,. These constraints do not change the capacity of the terrestrial biosphere to uptake more carbon but they slow the implementation and complicate the maintenance of NbCS (Fig. ).

Analyses of NbCS potential to date have included relatively little consideration of social, cultural and political barriers. One potentially relevant metric is the ratio of cost-effective NbCS potential relative to gross domestic product (GDP). This ratio points to likely financing opportunities and challenges: countries with significant potential that can be achieved for a small fraction of GDP can likely finance the implementation, whereas countries where the costs are a large fraction of the GDP will require international financing. Relatively few tropical countries have both strong governance and large cost-effective potential relative to GDP; these include Indonesia, Brazil and India. Countries with below-average strength of governance and significant financial need include, most notably, the Democratic Republic of the Congo and the Central African Republic.

Financing for NbCS implementation

Several existing bilateral and multilateral agreements related to deforestation and ***forest*** degradation might be leveraged for NbCS capacity building, including REDD+ (ref.), the Convention on Biological Diversity and the Bonn Challenge. Carbon offset programmes have also provided financing for NbCS interventions. California’s Tropical ***Forest*** Standard and Norway’s International Climate and ***Forest*** Initiative represent rigorous examples for national and subnational financing mechanisms via ***forest*** carbon offsets.

Financing mechanisms based on the non-carbon benefits of NbCS interventions might represent an enabler for NbCS implementation. Some key examples of additional financing could include conservation easements and payment for ecosystem services–. Local initiative and capacity building are critical for the long-term success of these conservation-based mechanisms. Ideally, these financing mechanisms are coupled with a full livelihood development initiative aligned with sustainable economic development.

Investment in ***agriculture***, forestry, ***land*** use and natural resource management is a small but increasing part of overall climate finance,. Specifically, funding for the category has risen from 4 billion USD-equivalent in 2015–2016 to 11 billion USD-equivalent in 2017–2018 (ref.). In 2018, transactions totalled 98.4 MtCO2 for 295.7 million USD, an average price of 3.01 USD per ton (ref.). If NbCS are to scale up to billions of tons of carbon ***removal***, this funding flow will need future increases of approximately 65 billion USD per year. As a rough estimate, achieving 100 GtCO2 of negative ***emissions*** from NbCS at 10–100 USD per tCO2 would require a total funding flow on the order of 1 trillion USD.

In contrast with ***forest***-based solutions and existing institutions supporting them, ***agriculture*** and soil-carbon-based NbCS interventions have unique challenges relating to the smaller scales of deployment. Implementation of these technologies will likely be motivated by increased yield or other valued co-benefits on short timescales (on the order of one year), while the increased carbon storage accumulates over longer timescales. These projects also pose significant measurement and verification challenges that feed back into cost-efficiency: the costs for quantifying changes in soil stocks are very large relative to the value of the stock changes at reasonable carbon prices.

Governance and implementation

Successful NbCS implementation also requires robust governance mechanisms to coordinate the full range of public and private institutions and actors, and make NbCS rigorous enough for effective climate policy. Prime challenges in this arena are measurement, reporting and verification, methods to ensure permanence and additionality, and leakage avoidance. These needs highlight the interconnection between implementing NbCS and actually knowing whether the atmosphere ‘sees’ benefits.

First, advances in the technologies and methods supporting measurement and evaluation are needed to ensure transparent understanding and accountability for the climate effects of implemented NbCS projects. New data products and satellites such as OCO-2 and GEDI provide an unprecedentedly detailed look at carbon storage and ***emissions*** of the terrestrial biosphere, yet, stocks and fluxes are still uncertain and variable, increasingly so at small scales,. Interannual variability and periodic disturbance make it particularly challenging to establish a baseline to assure fair accounting of carbon storage, especially at the project level,. There will be intrinsic incentives to take credit for interannual variability that results in increases in carbon storage, while disregarding variability and disturbance that results in carbon losses; policy design must ensure that these incentives are minimized, so as to ensure fair and accurate accounting. If implementation increases to higher-range haystack levels, measurement and evaluation will become easier because the changes will be larger relative to the background (Fig. ).

In order for the long-term climate benefits of NbCS to be achieved, the increased carbon storage must be permanent on 100+-year timescales (although renting and trading carbon offsets could partially alleviate these problems,,). Furthermore, carbon sequestration can be undermined by leakage, that is, follow-on increases in ***land***-sector greenhouse gas ***emissions*** outside the governance system’s boundaries. Lastly, understanding the natural carbon sequestration in the absence of the NbCS intervention is important for assessing the additionality of NbCS implementation. Mechanisms to manage the risks of leakage and reversal cut into economic and financial viability, potentially enough to make many projects non-viable.

Taken together, these challenges are both central and substantial in making NbCS financial mechanisms and policies rigorous in their contributions to climate change mitigation. Policy implementation is slow and iterative: it can often take a decade or more to develop useful policy architecture. First rounds of implementation are not instantaneous and are usually imperfect. New policies shift dynamics among stakeholders, and policy learning through time is critical.

Governance lessons from the long-term effort to reduce deforestation provide a useful starting point for understanding some on-the-ground challenges that NbCS implementation will encounter. A summary of 152 case studies found that “no universal policy for controlling tropical deforestation can be conceived. Rather, a detailed understanding of the complex set of proximate causes and underlying driving forces affecting ***forest*** cover changes in a given location is required prior to any policy intervention”. A similarly detailed, project-by-project understanding will be required for successful NbCS implementation.

Creating rigorous and workable governance mechanisms is likely to be one of the key near-term barriers for robust implementation of NbCS (Fig. ). They are central to investments that can increase carbon storage in the terrestrial biosphere and make meaningful progress towards meeting international climate goals.

NbCS contributions to negative ***emissions***

Quantifying the effects of the full range of constraints is difficult at a global scale. At the regional scale, however, on-the-ground social, ***land*** use and economic constraints reduced the mitigation potential of degraded ***lands*** in Southeast Asia to less than 20% of the biogeochemical potential. This estimate provides one starting point for estimating likely implementable potential for NbCS contributions to negative ***emissions***.

Maximum estimates of NbCS potential are ~1,000 GtCO2 (Fig. ). The average of global estimates is ~400 GtCO2. There are relatively few estimates that identify the cost-constrained potential (Fig. ), but those that do suggest that there is around 100 GtCO2 low-cost NbCS (~10–20 USD per tCO2), and around 400 GtCO2 could be possible at carbon prices of around 100 USD per tCO2. These estimates do not include consideration of governance, financing and socio-political constraints, and, thus, the implementable capacity is likely significantly less. High quality, highly constrained global estimates (for example, refs,,) are generally around 200 GtCO2 or less. Based on all of these lines of evidence, a conservative, grounded potential for NbCS contributions to negative ***emissions*** is 100–200 GtCO2 during the remainder of the twenty-first century.

Summary and future perspectives

Carbon storage in the terrestrial biosphere is a key global ecosystem service and has already offset hundreds of billions of tons of ***emissions*** from fossil fuel combustion and ***land*** use change. NbCS have potential to increase terrestrial carbon storage with important co-benefits in many parts of the world over the next 20–50 years, but there are a number of near-term barriers that will slow implementation. Some constraints change the capacity for increases (for example, ***land*** availability and ecosystem services), while others make it more challenging or slow to increase carbon storage (for example, governance). Both types of constraints limit the potential effectiveness and implementation of NbCS. Future research should seek to map and quantify the full range of constraints and evaluate the outcomes and impacts of implemented projects. These analyses should particularly identify who benefits and who bears the costs and side effects.

Natural climate solutions are solutions at risk from the problem they are attempting to solve. Unabated warming might lead to future increases in atmospheric CO2 due to carbon release and a loss of NbCS investments from disturbance and mortality,. This potential carbon loss from ***forests*** becomes particularly problematic in an all-in ‘haystack’ implementation, where reversals could cause significant future warming. NbCS in the absence of broader climate action, notably, rapid decarbonization, are guaranteed to be ineffective. Understanding and quantifying the risks from climate change, carbon cycle feedbacks, policy change and socio-political dynamics is a key avenue for future research.

NbCS implementation should focus on projects with clear and significant co-benefits, and must not come at the expense of decarbonization and technological innovation on bioenergy (especially using waste products) and direct air capture, both with safe, long-term geologic storage. Rapid deployment of a broad portfolio of climate solutions with a focus on decarbonization and reduction of ***land*** use ***emissions*** decreases the risk that we enter a climate regime where NbCS implementation does not work,. There is clearly potential for the terrestrial biosphere to contribute additional CO2 ***removal***, but the first billion tons are more difficult and slower than sometimes assumed and the ultimate total less than we likely need.

**Acknowledgements**

This research was supported by the Climate and ***Land*** Use Alliance.

**Notes**

Supplementary informationThe online version contains supplementary material available at [*https://doi.org/10.1038/s43017-021-00166-8.Peer*](https://doi.org/10.1038/s43017-021-00166-8.Peer) review informationNature Reviews Earth & Environment thanks Richard Houghton and the other, anonymous, reviewer(s) for their contribution to the peer review of this work.Publisher’s noteSpringer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

**Load-Date:** September 6, 2023

**End of Document**



[***Welcome clarification from Climate Change Committee - Barton***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:62D9-2361-F15H-216W-00000-00&context=1516831)

Farming Life

April 10, 2021

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**Section:** FARMINGFARMING

**Length:** 295 words

**Highlight:** Ulster Unionist spokesperson on ***Agriculture***, Environment & Rural Affairs has welcomed the letter of information from the Climate Change Committee (CCC) to the DAERA Minister.

**Body**

Mrs Barton said: “The letter of 1st April 2021 from the CCC, which is chaired by Lord Deben clarifies recommendations for Northern Ireland, these include:

- That any climate legislation for Northern Ireland include a ***target*** to reduce all greenhouse gas (GHG) ***emissions*** by at least 82% by 2050;

- That Northern Ireland’s position as a strong agri-food exporter to the rest of the UK, combined with more limited capabilities to use ‘engineered’ greenhouse gas ***removal*** technologies, means that it is likely to remain a small net source of greenhouse gas ***emissions*** – almost entirely from ***agriculture***;

- That a Net Zero ***target*** covering all GHGs cannot credibly be set for Northern Ireland. ***Targets*** should be ambitious, but must be evidence-based and deliverable with a fair and equitable route map to achieving them.

“This is very useful information and clarification. It provides a practical plan for a way forward in this debate, we should not set unrealistic ***targets*** that are impossible to meet,” she added.

“To simply close down up to 50% of Northern Ireland’s ***agricultural*** ***land*** production would potentially result in us importing ***agricultural*** products from countries like Argentina and Brazil, which have much weaker food quality standards, are ***removing*** large areas of rain ***forests*** and have the consequence of significantly increasing food miles to Northern Ireland.

“Northern Ireland produces food with excellent animal health and welfare standards, we should not subject our local consumers to much inferior food products, just in an attempt to reach an unrealistic ***target***.

“Climate Change is something that impacts on everyone, including the ***agricultural*** sector.

“Farmers will play their part in a positive manner to help reduce greenhouse gas ***emissions*** in a practical way.”

**Load-Date:** April 9, 2021

**End of Document**



[***Eating lentils, beans and nuts instead of 'land-hungry meat and dairy' could remove up to 16 years' worth of CO2 emissions by 2050, scientists say***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:60SM-DPD1-JCJY-G103-00000-00&context=1516831)

MailOnline

September 7, 2020 Monday 3:58 PM GMT

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**Section:** SCIENCE; Version:5

**Length:** 935 words

**Byline:** Ian Randall For Mailonline

**Body**

* US experts mapped out ***land*** where meat/dairy farming pushed out native plants

1. They considered what would happen if the natural ecosystems were restored
2. This revealed how much carbon could be stored by the reverted ***land*** usage
3. Restoring native vegetation is the 'safest option' for tackling CO2, the team said

Switching from eating '***land***-hungry' meat and dairy produce to foodstuffs like beans, lentils and nuts could ***remove*** 16 years' worth of CO2 ***emissions*** by 2050.

Researchers from the US calculated that broad uptake of such plant-based protein alternatives could free up ***land*** to support more ecosystems that absorb carbon.

At present, around 83 per cent of the world's ***agricultural*** ***land*** is given over to meat and dairy-based production - much of which only produce low yields.

Reducing this figure, the team said, is a better way to combat climate change than waiting for 'unproven' large-scale technologies like atmospheric CO2 extractors.

'The greatest potential for ***forest*** regrowth, and the climate benefits it entails, exists in high- and upper-middle income countries,' said paper author and environmental scientist Matthew Hayek of New York University,

These, he added, are 'places where scaling back on ***land***-hungry meat and dairy would have relatively minor impacts on food security.'

In the study, Professor Hayek and colleagues mapped out the areas of the globe where ***land*** use for animal-sourced food production has squeezed out native vegetation, such as ***forests***.

This allowed the team to determine where a shift in our diets to more plant-based foodstuffs could allow natural ecosystems to be restored - helping to offset global carbon dioxide ***emissions*** in the process.

'We only mapped areas where seeds could disperse naturally, growing and multiplying into dense, biodiverse ***forests*** and other ecosystems that work to ***remove*** carbon dioxide for us,' Professor Hayek said.

'Our results revealed over 7 million square kilometres where ***forests*** would be wet enough to regrow and thrive naturally, collectively an area the size of Russia.'

The team concluded that - if the demand for ***land*** for meat production could be drastically lowered - vegetation regrowth in these locations could help to sequester around 9-16 year's worth of fossil fuel ***emissions*** by the middle of century.

This would effectively double the planet's so-called 'carbon budget' - the amount of fossil fuels ***emissions*** we can afford to release before we reach the threshold temperature rise of 2.7°F (1.5°C) above pre-industrial levels.

Exceeding this limit is expected to result in a significant rise in the number of severe impacts from climate change - including droughts and sea level rise.

'We can think of shifting our eating habits toward ***land***-friendly diets as a supplement to shifting energy, rather than a substitute,' Professor Hayek said.

'Restoring native ***forests*** could buy some much-needed time for countries to transition their energy grids to renewable, fossil-free infrastructure.'

The findings could help locally ***targeted*** interventions as appropriate to help mitigate the effects of climate change, the team suggested.

'***Land*** use is all about trade-offs,' added fellow author and ecosystem scientist Nathan Mueller of the Colorado State University in Fort Collins.

'While the potential for restoring ecosystems is substantial, extensive animal ***agriculture*** is culturally and economically important in many regions around the world.'

'Ultimately, our findings can help ***target*** places where restoring ecosystems and halting ongoing deforestation would have the largest carbon benefits.'

Restoring natural ecosystems could have other benefits as well, said the team.

'Reduced meat production would also be beneficial for water quality and quantity, wildlife habitat and biodiversity,' explained paper author and ecologist William Ripple of the Oregon State University in Corvallis.

'We now know that intact, functioning ecosystems and appropriate wildlife habitat ranges help reduce the risk of pandemics,' added environmental social scientist and Helen Harwatt of the Harvard Law School, a co-author on the study.

'When coupled with reduced livestock populations, restoration reduces disease transmission from wildlife to pigs, chickens, and cows, and ultimately to humans.'

The full findings of the study were published in the journal Nature Sustainability.

HOW EATING MEAT AND DAIRY PRODUCTS CAN HURT THE ENVIRONMENT

Eating meat, eggs and dairy products hurts the environment in a number of different ways.

Cows, pigs and other farm animals release huge amounts of methane into the atmosphere. While there is less methane in the atmosphere than other greenhouse gases, it is around 25 times more effective than carbon dioxide at trapping heat.

Raising livestock also means converting ***forests*** into ***agricultural*** ***land***, meaning CO2-absorbing trees are being cut down, further adding to climate change. More trees are cut down to convert ***land*** for crop growing, as around a third of all grain produced in the world is used to feed animals raised for human consumption.

Factory farms and crop growing also requires massive amounts of water, with 542 litres of water being used to produce just a single chicken breast.

As well as this, the nitrogen-based fertiliser used on crops adds to nitrous oxide ***emissions***. Nitrous oxide is around 300 times more effective at trapping heat in the atmosphere. These fertilisers can also end up in rivers, further adding to pollution.

Overall, studies have shown that going vegetarian can reduce your carbon ***emissions*** from food by half. Going vegan can reduce this further still.

**Load-Date:** September 8, 2020

**End of Document**



[***How farmers will be paid to capture carbon***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:62PJ-6RH1-JC8V-431M-00000-00&context=1516831)

Irish Examiner

May 6, 2021 Thursday

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**Section:** FARMING; Pg. 3

**Length:** 982 words

**Body**

Never waste a good crisis may be the motto of the promoters of a climate-friendly milk now marketed to UK consumers, from cows fed Mootral, one of the many products that cuts cattle greenhouse ***emissions***.

The feed supplement, with extracts of garlic and citrus, has been proven to cut methane ***emissions*** as much as 38%), thus helping in the fight against the climate crisis.

If Mootral can get enough supermarkets and other outlets to stock the milk, and enough environmentally conscious consumers to pay a premium price for it, it will be able to get more farmers feeding the supplement to their cows, ideally at no cost.

The milk is already used by the London-based Gail's bakeries chain, and can also be bought from the Butlers' Larder specialist online grocery store.

Part of the marketing message is that if all 1.5bn cows in the world ate Mootral Ruminant for a year, the reduction in methane ***emissions*** would be equivalent to taking 330m cars off the road (17% more than the number of cars in the EU).

Another reason the company hopes to eventually provide Mootral Ruminant at no cost to farmers is that it has become one of the first companies to generate and sell credits eligible for Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA).

Businesses across the globe can purchase these "CowCredits" to offset their ***emissions***.

A CowCredit equals an ***emissions*** reduction of one tonne of carbon dioxide equivalent, based on ***emissions*** from cattle.

Mootral plans to turn their attention next to the climatefriendly beef market.

Along the way, the company seeks help from ethical investors in their mission to make the feed supplement available at no cost to all cattle farmers.

It's a British company, and CowCredits methodology was approved by Verra, a Washington, DC-based nonprofit organisation that manages standards for reducing ***emissions***.

It will be quite a while before the EU has a regulatory framework for certifying carbon (or methane) ***removals***, which will open the way for carbon farming as a new green business model that creates a new source of income.

It was only last week that the European Commission published the final report of a two-year study on how to set up and implement carbon farming in the EU.

Building on this study and other preparatory work, the commission plans to publish an EU carbon farming action plan by the end of 2021.

It will primarily promote nature-based solutions that ***remove*** carbon from the atmosphere, to help the EU achieve climate neutrality. Such solutions should be rewarded, says the EU.

But certifying carbon ***removals*** must be based on robust and transparent carbon accounting to monitor and verify authenticity.

The study concluded that carbon farming brings benefits such as carbon sequestration and storage and increased biodiversity and preservation of eco-systems.

The commissions's executive vice-president for the European Green Deal, Frans Timmermans, said: "Our climate action must first and foremost reduce humanmade ***emissions***.

"But we also need to restore and protect natural carbon sinks, so that we can capture carbon dioxide from the atmosphere and store it in our soils and ***forests***.

"Carbon farming offers new income opportunities for farmers."

Ireland should be well-placed to take advantage, because we have experience since 2014 of beef carbon schemes, and the Burren Project's role in managing soil organic carbon in grasslands, and result-based payment schemes for biodiversity such as the Co Leitrim species-rich grassland and marsh fritillary butterfly habitat scheme and the Shannon Callows speciesrich flood meadow and wet grassland suitable for breeding waders schemes.

These were included in the commission's two-year study as case studies of how to operate carbon farming.

One of the lessons learned is that any scheme where the intention is to sell carbon credits will need a system of carbon audits for integrity.

As well as maintaining and enhancing soil organic carbon on mineral soils, and livestock farm carbon audits, other promising carbon farming area relevant to Ireland include peatland restoration and rewetting, and agroforestry.

Enhancing soil organic carbon in depleted arable ***land*** not only helps climate action; it also improves the productivity and resilience of farming activities, of great importance in continuous tillage soils across vast areas of the continent.

The same end result comes from protecting existing carbon-rich soils, such as grasslands and peatlands, with appropriate management techniques.

Planting new ***forests***, restoring degraded ***forests***, and improving the management of existing ***forests*** also help climate action. Supplying biomass for production of long-lasting bio-based products is another carbon farming possibility.

The European Commission says pilot initiatives should be developed at local or regional level in order to gather experience to upscale carbon farming, and expand farmers' knowledg e and understanding of the potential benefits for them.

The EU offers financial support for pilot initiatives on carbon farming through the LIFE programme and the European Regional Development Fund, among others.

Then Member States can accelerate the roll out of carbon farming practices in the new 2023 Common ***Agricultural*** Policy, the main finance source for carbon farming initiatives, along with State aid, private initiatives linked to carbon markets, or through a combination of the sefunding options.

The ***land*** sector is seen as key for reaching a climateneutral economy, because it can capture carbon from the atmosphere. However, to encourage the ***agriculture*** and forestry sectors to deliver on climate action and contribute to the European Green Deal, it is seen as necessary to create direct incentives for adoption of climate-friendly practices, as there is currently no ***targeted*** policy tool to significantly incentivise individual farmers to increase and protect carbon sinks.

**Graphic**

Picture, **The milk which a company hopes consumers will turn to, because the cows are fed a product which reduces their methane *emissions* 38%; if the milk sells well, and the company can sell carbon credits on its back, farmers will get the feed supplement free. It's an early form of the carbon farming which is on the way in the EU**.

**Load-Date:** May 18, 2021

**End of Document**



[***USDA Natural Resources Conservation Service Announces Signup for Funding to Remove Cogongrass Infestations in Florida***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:625T-7FK1-F0YC-N0BD-00000-00&context=1516831)

Impact News Service

March 9, 2021 Tuesday

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**Length:** 272 words

**Body**

Washington: US Department of ***Agriculture*** has issued the following news release:

Florida ***forest*** landowners in parts of Okaloosa and Santa Rosa counties can apply for financial assistance to manage invasive Cogongrass until March 26 from USDA’sNatural Resources Conservation Service(NRCS).

The U.S Department of ***Agriculture*** is investing $60,000 this fiscal year to ***remove*** the highly invasive Cogongrass in Florida. One of the world’s top-ten worst weeds, Cogongrass is threatening longleaf pine landscapes with its high-density growth, high burning intensity, poor value as wildlife habitat, and its difficulty to control.

Landowners will work with local NRCS staff and partners to apply ***targeted*** management practices on their ***land*** to meet the unique challenges in their areas. The following practices will be available for funding: brush management, herbaceous weed treatment, conservation cover, critical area planting, mulching, and pasture and hay planting.

Project partners are NRCS, USDA ***Forest*** Service, Florida ***Forest*** Service, and Florida Department of Transportation. The partners will ensure treatment control is implemented across boundaries of public and private ***land***, rights-of-way, and state lines.

The funding is through theJoint Chiefs’ Landscape Restoration Partnership, which allows NRCS and the ***Forest*** Service to collaborate with ***agricultural*** producers and ***forest*** landowners to invest in conservation and restoration at a large enough scale to make a difference. Working in partnership, and at this scale helps mitigate wildfire risk, improve water quality, and restore health ***forest*** ecosystems on public and private ***lands***.

**Load-Date:** March 10, 2021

**End of Document**



[***Leaving forests to regrow naturally 'could be better option than replanting'***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:60X2-FG11-JBNF-W1VC-00000-00&context=1516831)

The Guardian (London)

September 23, 2020 Wednesday 5:53 PM GMT

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**Section:** ENVIRONMENT; Version:1

**Length:** 506 words

**Byline:** Fiona Harvey Environment correspondent

**Highlight:** Study says potential for natural regrowth to absorb carbon has been substantially underestimated

**Body**

The costly and difficult work of replanting ***forests*** that have been cut down may not be the only way to restore the Earth's carbon-absorbing capacities, research has found, as allowing trees to grow back naturally without intervention could offer a cheaper alternative.

Keeping ***forests*** standing is still a better way to reduce the impact of the climate crisis, but in large areas of the world, ***forest*** and scrubland has already been cleared or degraded in some way, through deforestation, failed ***agriculture*** or some other exploitation. Often, the loggers, prospectors and ranchers quickly move on, leaving devastation in their wake.

Conventional thinking has been that replanting was the best way to restore the carbon balance, but a study published in the journal Nature shows that leaving ***forests*** to regrow naturally is cheaper and also allows native trees and wildlife to flourish.

Susan Cook-Patton, of the Nature Conservancy, lead author of the study, said natural regrowth was usually a simple option. "One would need to ***remove*** any disturbance or ***land*** use that prevented the ***forest*** from coming back - for example, if the ***land*** is grazed one might ***remove*** the cows or put up a fence," she told the Guardian. "But otherwise the ***forest*** is allowed to return without active planting."

The best regions in which to allow ***forests*** to regenerate naturally are in the tropical regions of west and central Africa. Regrowth takes longer in central Europe and the Middle East.

The study did not compare the rates of regrowth when ***land*** is left alone with the rates when there is intervention, or the costs of ***targeted*** intervention. Such intervention might be needed to help ***forests*** regrow to their maximum biodiversity, said Cook-Patton.

"If seed sources are nearby and the site isn't too degraded, then diverse ***forests*** can likely grow back by themselves," she said. "If the site is degraded and seed sources are far away, or if the only seed sources are from one or a few species, one might want to actively plant the whole site, or do some patch planting to foster recovery of a more diverse ***forest***. Active planting doesn't necessarily ensure a more diverse ***forest*** in the end, since often it can be hard to acquire diverse seedlings to plant."

Standing ***forests*** absorb about a third of the greenhouse gas ***emissions*** emitted by human activities each year. The study found that the potential for natural regrowth to absorb carbon had been substantially underestimated, by about a third overall and by about a half in the case of tropical ***forests***.

The paper provides a means of mapping where in the world natural ***forest*** regrowth is likely to be a good option.

"We know there is no single, one-size-fits-all solution for addressing climate change," said Nancy Harris, of the World Resources Institute, co-author of the study. "Our goal was to show where ***forests*** can capture carbon fastest on their own, a mitigation strategy that complements keeping ***forests*** standing. If we let them, ***forests*** can do some of our climate mitigation work for us."

**Load-Date:** September 23, 2020

**End of Document**



[***The race to net-zero is on. This is how we can cross the finish line***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:62T4-CJ81-JDG9-Y3J6-00000-00&context=1516831)

Impact News Service

May 28, 2021 Friday

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**Length:** 1582 words

**Body**

Cologny: World Economic Forum has issued the following press release:

Nature can play a fundamental role in achieving net-zero, with the capacity to deliver one third of cost-effective solutions to climate change. Delivering a sustainable net-zero future for ***land*** use will require a coordinated transformation. There needs to be a shift towards nature-positive, net-zero ***land*** use, which will require ongoing financial support and investment in Nature-based Solutions. Financial institutions should commit to become ‘nature-positive’ by 2030, including reversing biodiversity loss associated with investment and lending portfolios.

The world faces converging environmental crises that are inextricably linked: the accelerating destruction of nature and climate change, driven largely by unsustainable production and consumption. Science warns us that if we deviate from the Paris Agreement ***target*** to limit global warming to 1.5°C, the world could quickly find itself at a tipping point.

Nature underpins our global economy, generating approximately $44 trillion of global economic value. Nature will also play a fundamental role in achieving net-zero, with the capacity to deliver one third of cost-effective solutions to climate change.

Meanwhile, croplands account for 38% of the global ***land*** surface, and ***agricultural*** practices are a significant driver of tropical deforestation. Coupled with forestry and other ***land***-use activities, these account for 24% of total global ***emissions***, mainly from deforestation and ***agricultural*** ***emissions*** from livestock, soil and nutrient management. ***Agriculture*** alone is the largest driver of ***land*** use change and deforestation in the tropics accounting for >90% of the estimated ***forest*** loss in the last two decades.

We know that between 1990 and 2016, the world lost 130 million hectares of ***forest***. ***Agricultural*** commodities such as cattle, palm oil, soy, cocoa, rubber, coffee and plantation wood fibre, accounted for 26% of global tree cover loss from 2001 to 2015, replacing 71.9 million hectares of ***forest***, an area twice the size of Germany. The 2019 UN Intergovernmental Panel on Climate Change ***Land*** Use Report concluded that protecting and restoring ***forests*** and urgently revamping the global food system through dietary change are key solutions to the escalating biodiversity, climate, and food security crises.Have you read?

These are the breakthroughs we need to achieve a net-zero world 'Net-zero' ***emissions***: What is it and why does it matter so much?

***Agriculture***, forestry and ***land***-use is a unique sector as it provides food that feeds the Earths’ population of around 7.6 billion, livelihoods for billions of people worldwide, and is a critical resource for sustainable development in many regions. ***Land***-use is then both a source and sink of CO2 ***emissions***, playing a crucial role in combating climate change.The race to zero

Delivering a sustainable net-zero future for ***land*** use will be challenging and will require a coordinated transformation. Policymakers, businesses, investors, innovators, and citizens must all come together to trigger this transformation and agree on the next steps. With the United Nations Climate Change Conference (COP26) in Glasgow the vital milestone later this year, the promises and pledges made by governments must be converted into meaningful action, starting today.

The calls for change have also been accompanied by the arrival of initiatives that can accelerate change in the ***land***-use sector. One example is the FACT (***Forest***, ***Agriculture*** and Commodity Trade) Dialogue launched by the COP26 Presidency and supported by Tropical ***Forest*** Alliance (TFA) to accelerate the transition towards more sustainable ***land***-use practices in a way that opens up new opportunities for investment and jobs.

Although the net-zero finish line feels far off in the distance, the good news is that we can get there, and do so in a way that is good for business and promises a resilient future that vastly justifies taking action. —Justin Adams & Gonzalo Muñoz

But even with change underway, the world must quickly achieve breakthroughs in every sector of the global economy. Race to Zero is a global campaign to rally leadership and support from businesses, cities, regions and investors for a healthy, resilient, zero-carbon recovery that prevents future threats, creates decent jobs and unlocks inclusive, sustainable growth. To win the race to net-zero ***emissions*** by 2050 (at the very latest) means we must collectively halve current ***emissions*** by 2030, and then again by 2050. There is no time to waste.

Going one step further, the Race to Zero Breakthroughs offer a set of roadmaps to achieving the Paris Agreement ***targets*** of 1.5°C across all sectors. For Nature-Based Solutions (NbS) and the ***land***-use sector, the ambition is to have 20% of the food supply industry adopt a science-based ***target*** aligned with the Paris Agreement by no later than COP26, commit to deforestation-free supply-chains by 2023, adopt a science-based net-zero ***target*** to reverse biodiversity loss and enhance regenerative ***agriculture*** by 2023.What can companies do?

Although the net-zero finish line feels far off in the distance, the good news is that we can get there, and do so in a way that is good for business and promises a resilient future that vastly justifies taking action. Exponential Roadmap research is consistent with this, indicating that nature can help us to reduce and ***remove*** as much as 98GT CO2e from the atmosphere by as early as 2030. The World Economic Forum’s Nature and Net Zero report, meanwhile, estimates that natural climate solutions, including cover crops, can deliver up to 7Gt CO2 per year and at a lower cost than other forms of CO2 ***removal***. In most cases, prices are between $10-40 per tonne of CO2 with variations between geographies and project types.Image: Nature and Net Zero Report

The world can feel encouraged even in the face of COVID-19; during the pandemic, net-zero commitments have roughly doubled. Corporate commitments alone under the Race to Zero campaign now cover over 12% of the global economy and USD$ 9.81 trillion in revenue. We also know that a 55% decarbonization of the global food supply chain is viable through nature.

To join the movement for a net-zero, nature-positive economy, companies are expected to integrate the full value of ecosystem services from ***forests*** and other natural landscapes into all business decisions by 2025. In addition, businesses can also deliver on commitments to end losses to primary ***forests*** and to other natural ecosystems such as mangroves, peatlands, grasslands and savannas, so that by 2030 nature’s loss has been reversed.

But breakthroughs cannot happen if we all work in isolation. The challenges of competition and inertia often lower our ambitions. There needs to be a shift towards nature-positive, net-zero ***land*** use, which will require ongoing financial support and investment in NbS.Financing the nature-positive race to zero

Facilitating this move towards net-zero ***land*** use will need ongoing financial support and require a shift in negative financial flows. The newly-published State of Finance for Nature report states that approximately US$133 billion a year currently flows into nature, with public funds making up 86% and private finance 14%. The report also says that investment in NbS ought to at least triple in real terms by 2030 and increase four-fold by 2050 if the world is to meet its climate change, biodiversity and ***land*** degradation ***targets***.

However, current investments and capital flows can have a negative impact on nature. Countries that produce two-thirds of the world's ***agricultural*** output provided US$600 billion per year in ***agricultural*** financial support on average from 2014 to 2016. Only 5% of this funding supports any kind of conservation or climate objective, and only 6% supports research and technical assistance. Governments should create economic and regulatory incentives to scale up nature-positive investments.Image: World Resources Institute

Given its critical role in both mitigation and adaptation, it is fundamental that financial institutions commit to become ‘nature-positive’ by 2030, including reversing biodiversity loss associated with investment and lending portfolios. Financial institutions should design and deliver innovative financial products that promote climate-smart, agro-ecological practices, and work with governments and funders to design appropriate financial mechanisms to the same end, with the aim of halving ***emissions*** and reversing nature loss by 2030.

Financial alliances like the Glasgow Financial Alliance for Net Zero, which brings together leading net-zero initiatives from across the financial system to accelerate the transition to net-zero ***emissions*** by 2050 at the latest, and the Net Zero Asset Managers Initiative, will be instrumental in delivering on these financial and business opportunities. This coordination among financial institutions should promise that 20% of major asset owners, asset managers, and banks commit to ***land***-conversion free investment portfolios by 2025.

With five months to go until COP26, and as we enter the UN Decade for Ecosystem Restoration, we have arrived at a critical moment to avoid a climate and ecological breakdown. Together the world must race towards a resilient, healthy and zero carbon world. Rather than reaching a tipping point, 2050 could be a world where decarbonized industries are coupled with fertile ***forests*** and restored ***land***.

The nature-positive race is on.

**Load-Date:** May 30, 2021

**End of Document**



[***NGOs attack plans to include carbon offsets into EU climate goals***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:60YP-K7N1-JCF9-417P-00000-00&context=1516831)

EurActiv.com

October 1, 2020 Thursday

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**Length:** 579 words

**Byline:** Frédéric Simon

**Highlight:** Environmental campaigners have condemned proposals to include carbon credits from projects in developing countries when the European Parliament votes on the EU's proposed climate law next week.

**Body**

The Parliament will hold a plenary vote next Tuesday (6 October) on the draft European Climate Law, which seeks to enshrine into hard legislation the EU's goal of reaching "climate neutrality" by 2050.

Ursula von der Leyen, the president of the European Commission, [*tabled a proposal on 16 September*](https://www.euractiv.com/section/climate-environment/news/we-can-do-it-eu-chief-announces-55-emissions-reduction-target-for-2030/) to reduce the bloc's ***emissions*** by 55% by 2030 - an objective that will now be inserted into the draft climate law so that it can be made a legally-binding obligation on the 27 EU member states.

But campaigners have raised the alarm about proposals mooted in the European Parliament to also include international carbon offsets in the EU's 2030 ***targets***.

"The Commission shall set out how the use of international market mechanisms can contribute to the cost-effective achievement of the objectives," says an amendment to the draft climate law, tabled by the centre-right European People's Party (EPP), the largest political group in the European Parliament.

"The contribution of projects in least developed countries and selected developing countries should be counted towards the ***targets*** of the Union and the member states," the amendment adds.

In a bid to fend off criticism, the amendment also insists that carbon offsets should meet the "highest quality standards such as environmental integrity and additionality" and avoid "double counting" of ***emissions***.

But that was not enough to allay fears from environmental groups.

"The EPP's 2030 climate ***target*** is desperately trying to dress up a license for Europe to pollute by relying on already vulnerable ***forests*** and shifting the responsibility for carbon offsetting to poorer countries," said Sebastian Mang from Greenpeace.

"Pushing developing countries to plant trees just so that dirty corporations can continue polluting and Europeans can keep driving SUVs is wrong and won't stop climate breakdown," he told EURACTIV.

[***Commission under fire for including 'carbon sinks' into EU climate goals***](https://www.euractiv.com/section/climate-environment/news/commission-under-fire-for-including-carbon-sinks-into-eu-climate-goals/)

The European Commission on Thursday (17 September) defended its plan to bring carbon ***removals*** from ***agriculture***, ***land*** use and forestry into the EU's updated climate ***target*** for 2030, saying this was in line with UNFCCC standards.

Campaigners have previously condemned EU Commission proposals to include carbon ***removals*** from forestry and ***agriculture*** - so-called "carbon sinks" - into the bloc's 2030 ***target***, saying this would effectively dilute the bloc's climate objectives.

"We already know that the Commission's 55% net ***target*** with carbon sinks actually works out at 50.5-52.8% in terms of actual ***emission*** cuts in polluting sectors. We also know that the EU is currently expected to achieve 46% cuts in ***emissions*** by 2030 (under existing legislation). That makes the EPP 2030 ***target*** utterly laughable," Mang said.

In Parliament, the battle lines are already drawn. The socialists, greens and leftists are pushing for a 65% ***emissions*** cut, saying this is the only ***target*** that is consistent with science and the 2°C warming objective of the Paris Agreement.

The Liberals will defend a 60% cut, while the EPP seems ready to abandon its traditionally conservative stance on climate policy to support a 55% ***target***.

[***Europe's centre-right rallies behind 55% EU climate goal for 2030***](https://www.euractiv.com/section/energy-environment/news/europes-centre-right-rallies-behind-55-eu-climate-goal-for-2030/)

Europe's largest and most influential political faction, the European People's Party (EPP), has rallied behind an EU objective of curbing greenhouse gas ***emissions*** 55% by 2030, anticipating an announcement next week by the European Commission.

*[Edited by Zoran Radosavljevic]*

**Load-Date:** October 1, 2020

**End of Document**



[***McSally Moves to Prevent Catastrophic Wildfires with New Bill***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:60W4-SDV1-JDG9-Y1HV-00000-00&context=1516831)

Impact News Service

September 18, 2020 Friday

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**Length:** 690 words

**Body**

Washington: Office of the MP Martha McSally has issued the following news release:

U.S Senator Martha McSally (R-AZ) this week introduced a bill to restore Arizona’s ***forests*** by incentivizing the ***removal*** of dangerous overgrowth.

The ***Forest*** Health and Biomass Energy Act would advance ***forest*** restoration by incentivizing biomass energy development as a method to reduce hazardous fuel build-up in fire-prone ***forests***.

During a U.S Senate Subcommittee on Public ***Lands***, ***Forests***, and Mining yesterday, McSally discussed her new bill and the catastrophic wildfires raging across the West.

“One of the biggest challenges we’ve had in ***forest*** restoration in Arizona is the crushing expense of ***removing*** low-value biomass like branches, slash, and undergrowth from the ***forest***,” McSally said. “That’s why this week I’m introducing my bill, the ***Forest*** Health and Biomass Energy Act. My bill will accelerate ***forest*** restoration by reducing the cost and regulatory barriers to clearing out dangerous overgrowth and utilizing that material for carbon neutral biomass electricity. My bill complements the ***forest*** management policies included in the Emergency Wildfire and Public Safety Act, which I’ve cosponsored with Senator Daines and we’re considering in the hearing today. Together, our bills offer practical, cost-effective solutions to ***target*** the real root causes of these catastrophic wildfires while also supporting low carbon energy.”

During the hearing, McSally called out the U.S ***Forest*** Service for delaying Arizona’s single most important ***forest*** fire prevention project—the Four ***Forest*** Restoration Initiative (4FRI).

“While I am glad to see the ***Forest*** Service adopted many of the proposals in my [2019] bill, more work needs to be done to make 4FRI a success and reduce wildfire risk. Unfortunately, 4FRI has encountered delay after delay. And even though this is the single most important project underway to reduce the risk of wildfire in Arizona, the ***Forest*** Service recently pushed back Phase 2 even further. This is unacceptable.”

Two of McSally’s natural resources bills were discussed at the subcommittee hearing yesterday including her MAPLand Act to enhance access to public recreation areas through map digitization, and the La Paz County Solar Energy and Job Creation Act she introduced with Senator Kyrsten Sinema (D-AZ) to support renewable energy development in La Paz County.

Background:

On September 16, 2020, McSally introduced the ***Forest*** Health and Biomass Energy Act of 2020, which would: advance ***forest*** restoration and fire resilience by incentivizing biomass energy development as a method to reduce hazardous fuel build-up in fire-prone ***forests***. direct the Administration to assess the biomass energy fuel potential in U.S ***forests*** with a focus on identifying the most viable sources for energy use such as ladder fuels and by-products of ***forest*** restoration including branches, slash and other low-value biomass. establish a fund using a percentage of timber sale revenues to assist timber operators and biomass energy producers with the collection, harvesting and transportation of biomass material out of high hazard areas. On July 9, 2020, McSally pressed the U.S ***Forest*** Service on its wildfire prevention efforts given increased traffic to public ***lands*** during the pandemic. On June 18, 2019, McSally asked Department of Interior and U.S ***Forest*** Service officials about the backlog of multiple maintenance projects on federal ***land*** in Arizona. On June 13, 2019, McSally introduced the Accelerating ***Forest*** Restoration Act to expedite Arizona’s Four ***Forest*** Restoration Initiative (4FRI) and help the ***Forest*** Service ***remove*** the low or no-value ***forest*** byproducts that can cause ***forest*** fires. On April 9, 2019, McSally pressed the U.S Department of ***Agriculture*** (USDA) about the timeline of Arizona’s Four ***Forest*** Restoration Initiative (4FRI). On March 22, 2019, McSally visited Coconino County during her 15-county tour and heard from community leaders about the state of the ***forests***. On February 12, 2019, McSally helped pass the Bipartisan Natural Resources Management Act, which included important provisions to modernize wildfire technology.

**Load-Date:** September 19, 2020

**End of Document**



[***USDA awards new partnership projects in Washington to help mitigate climate change and protect natural resources while supporting America’s producers***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:62JP-43F1-F0YC-N1BK-00000-00&context=1516831)

Impact News Service

April 29, 2021 Thursday

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**Length:** 299 words

**Body**

Washington: US Department of ***Agriculture*** has issued the following news release:

USDA’s Natural Resources Conservation Service will invest $14,404,762 in 3 locally driven, public-private partnerships in Washington to the following projects:

Middle Columbia Steelhead Partnership (Awarded $6,781,670)The Yakama Nation and 14 non-governmental, state and federal partners propose working with producers and landowners to restore Mid-Columbia Steelhead habitat with ***forest*** stand improvements, invasive weed ***removal*** and native species plantings, and the replacement of inefficient irrigation systems. The project will ***target*** farm operators whose property contains riparian, wetland or floodplain habitat that impact this Steelhead species, which is of cultural and ecological importance to the Yakama Nation.

Nooksack Watershed Restoration (Awarded $4,827,100)The Lummi Nation proposes to partner with the Nooksack Tribe to support recovery of two native chinook salmon populations essential to the recovery of the threatened Puget Sound chinook species. The project will increase key habitat quality and diversity by creating pools with innovative, engineered logjams; increase the length of secondary and side channels; increase the availability of cold-water refuges; increase rearing habitat; and improve riparian ***forest*** conditions.

Fuel Break & ***Forest*** Resilience Partnership (Awarded $2,795,992)The Fuel Break & ***Forest*** Resilience Partnership proposes to accelerate ***forest*** restoration efforts in Eastern Washington's Wenatchee Watershed, building on many years of planning and complementary public and private investments. Project partners will ***target*** funding to high priority ***lands*** and leverage RCPP flexibilities to increase incentives for participating landowners and streamline technical assistance.

**Load-Date:** April 30, 2021

**End of Document**



[***Planting 20% more trees throughout Europe could not only help climate change, but it could boost rainfall during the summer by nearly 8%***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:6331-MM11-JBNF-W2H1-00000-00&context=1516831)

MailOnline

July 6, 2021 Tuesday 1:44 PM GMT

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**Section:** SCIENCE; Version:3

**Length:** 996 words

**Byline:** Chris Ciaccia For Dailymail.Com

**Body**

* Planting 20 percent more trees throughout Europe could help stave off the effects of climate change

1. Rainfall patterns would also rise by an average of 7.6 percent in the summer
2. Changes to ***land*** cover can have a 'substantial' impact on dry conditions associated with changing weather patterns
3. Rainfall might increase because of the way trees interact with cloudy air
4. Some of the trees would be planted on ***agricultural*** ***land***

Planting 20 percent more trees throughout Europe would not only help stave off the effects of climate change, but it would boost the continent's rainfall too, a new study suggests.

Changes to ***land*** cover - by adding ***forests*** - can have a 'substantial' impact on the dry conditions that are associated with changing weather patterns, while also changing rainfall patterns by an average of 7.6 percent in the summer, researchers say.

'We conclude that ***land***-cover-induced alterations of precipitation should be considered when developing ***land***-management strategies for climate change adaptation and mitigation,' the authors wrote in the study published in Nature.

Trees store carbon and an increase of this magnitude on the continent could ***remove*** a significant portion of the nearly 43 billion tons of carbon dioxide that humans emit annually, according to 2019 data.

'***Forestation***-induced precipitation changes appear to be subject to spatial trade-offs due to downwind effects,' the authors added.

'While we find a local increase in precipitation due to ***forestation*** across Europe, ***forestation*** might reduce precipitation further downwind in winter. However, ***forestation*** increases precipitation downwind in summer, probably due to higher moisture supply by ***forests*** than by [***agricultural*** ***land***].'

They continued: 'Overall, our results highlight that [***land***-cover changes], such as ***forestation***, can considerably alter precipitation in the mid-latitudes, both locally and further downwind. Hence, the consequences of human ***land*** use for water availability should be considered alongside biogeochemical effects and the biogeophysical alteration of temperatures.

'As droughts are projected to become more severe with changing climate in Europe, the interplay between [***land***-cover] and water availability deserves more attention.'

The researchers acknowledge that not every European country can realistically increase its ***forest*** ***land*** by 20 percent, pointing out some countries are better suited than others.

As such, the researchers looked at the potential according to the Global Reforestation Map and found that 14.4 percent of ***land*** surface is suitable for ***forestation***, specifically in the British Isles, western and southern France, Portugal, Italy and Eastern Europe.

The researchers are not yet certain why planting more trees would increase rainfall, but it could be due to the way they interact with cloudy air, according to the BBC.

One of the study's co-authors, Ronny Meier from ETH Zurich, said areas like the Mediterranean need an increase in tree population the most.

'Probably the most threatening climate change signal that we expect in relation to precipitation, is this decrease in summer precipitation that is expected in the southern parts of Europe like the Mediterranean,' he told BBC News.

'And there, according to our study, ***forestation*** would lead to an increase in precipitation. So the ***forestation*** would probably be very beneficial in terms of adapting to the adverse effects of climate change.'

In May, the UK said it would boost the number of trees it plants every year until 2035 to 143 million per year to meet climate ***targets***.

That would double the planting of woodland to almost 80 million in the next four years, with the initial focus being on cities and towns.

Woodland covers 13 percent of the UK landmass, compared with 31 percent in France and 30 percent in Germany.

In October 2020, the Trump administration signed an executive order that reiterated its efforts to help the World Economic Forum's One Trillion Trees Initiative, growing and conserving one trillion trees worldwide by 2030.

The new study is not without its criticism, given that there is an inevitable impact converting some ***agricultural*** ***land*** into ***forests***.

In 2019, DailyMail.com reported on a separate study that said taking ***agricultural*** ***land*** and turning them into ***forests*** could lead to starvation of the human population, as population numbers continue to rise around the world.

However, the new study notes that 20 percent is the right figure to impact climate change, while not negatively impacting ***agricultural*** ***land***.

'***Foresting*** 20% of the ***land*** surface decreases winter downwind precipitation over northern Europe, exhibits a weak signal in central and eastern Europe and increases precipitation in coastal areas of western and southern Europe,' the researchers added in the study.

It's also possible that the increased rainfall could have negative side effects, given that ***forests*** are a 'much rougher surface than ***agricultural*** ***land***,' Meier added to the BBC.

'So, it induces more turbulence at the ***land***-atmosphere interface, and also, the ***forest*** exerts more drag on to the atmosphere than ***agricultural*** ***land***.'

'We think that this drag, this higher turbulence over the ***forests*** is probably the main reasons for the fact that we find more precipitation in regions with more ***forests***.'

Free University of Brussels Belgium professor Wim Thiery said planting trees is not the sole solution to help countries stay under the 2015 Paris Climate Agreement mandate of an increase 1.5 degrees Celsius, but it can help.

'But cutting back on our ***emissions*** won't be enough: we will also need to actively ***remove*** carbon from the atmosphere should we wish to stay below 1.5C of warming,' Thiery told the BBC.

'From that perspective, tree planting emerges as a potential candidate for generating these negative ***emissions***, but planting trees should never be an excuse for not acting on reducing our carbon ***emissions*** by all means possible.'

The new study was published in the scientific journal Nature Geoscience.

**Load-Date:** July 6, 2021

**End of Document**



[***EU climate plan blows hot and cold on forestry, biomass***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:60X0-TSP1-JCF9-42DR-00000-00&context=1516831)

EurActiv.com

September 23, 2020 Wednesday

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**Length:** 1552 words

**Byline:** Frédéric Simon

**Highlight:** While recognising the positive role of ***forests*** in mitigating global warming, the European Commission has riled the agroforestry and biomass industries by stating its intention of limiting growth in the sector.

**Body**

Will the EU impose a cap on the number of trees that can be felled in Europe each year? Judging by the Commission's 2030 climate plan, presented last week, this is now looking like a distinct possibility.

The capacity of ***forests*** to act as a "carbon sink" - absorbing more CO2 than they emit - is decreasing and needs to be reversed, the Commission said in its new climate plan for 2030.

The EU executive argues that "we need a growing sink in order for the EU to achieve climate neutrality by 2050" and calls for improved ***forest*** management as well as "re- and afforestation" initiatives to restore degraded ***land*** and preserve biodiversity.

"We really have to take care of our ***forests***," said Frans Timmermans, the EU executive vice-president in charge of climate action. "We need to make sure our ***forests*** stay healthy and this is going to be a momentous task," he told journalists.

***Forest*** owners wouldn't contradict the Commission on this point. Time and again, they have highlighted the role of "sustainable ***forest*** management practices" in environmental conservation and how those can support the EU's biodiversity and climate objectives.

However, they say the Commission's 2030 climate plan places too much emphasis on the role of ***forests*** as carbon sinks.

"This approach is rather unfortunate as it omits two other major climate benefits provided by ***forests***: carbon storage in EU ***forests*** and wood products and carbon substitution with wood replacing fossil-based products and energy," said Fanny-Pomme Langue, secretary-general of the Confederation of European ***Forest*** Owners (CEPF).

For ***forest*** owners, the key is to maintain ***forests*** as "productive" economic tools providing them with the revenues necessary to take care of their ***land***. And that implies planting, thinning, harvesting and replanting trees as part of "active" management of ***forests***.

"***Forest*** owners are custodians of ***forests***' future and their focus is to maintain productive, healthy and vital ecosystems," said Sven-Erik Hammar, board member of CEPF.

This was the view espoused by the European Parliament's ***agriculture*** committee, which [*backed a report earlier this month*](https://www.europarl.europa.eu/news/en/press-room/20200831IPR86011/eu-forest-strategy-ensuring-high-quality-management-of-eu-forests-and-woodlands) charting "the way forward" for the EU's upcoming ***forest*** strategy, expected to be published in the coming months.

**Carbon sink and carbon stock**

Ursula von der Leyen, the president of the European Commission, seemed to acknowledge the role ***forests*** can play for the climate. In her state of the union speech last week, she said Europe's buildings could be turned "from a carbon source into a carbon sink if organic materials like wood" are being used.

Because trees absorb CO2 as they grow, harvesting them to make wood products is indeed considered as a "climate positive" economic activity which sequesters carbon in the form of furniture or building materials.

More controversial however is when wood is burned in biomass plants to produce electricity, or as a way of heating people's homes.

Critics say burning wood immediately releases CO2 which took years or even decades to accumulate during the tree's growth phase. This, they argue, creates a "carbon debt" for future generations until new trees can grow back and suck an equivalent amount of CO2.

And since time is running out to meet the Paris Agreement goal of limiting global warming to 2°C, they argue that urgent action must be taken now to prevent a further increase in biomass burning for energy generation.

[***Scientists call on EU to 'correct' biomass carbon accounting rules***](https://www.euractiv.com/section/emissions-trading-scheme/news/scientists-call-on-eu-to-correct-biomass-carbon-accounting-rules/)

Europe's academies of science have called on EU lawmakers to introduce a "radically new standard" in the bloc's ***Emissions*** Trading Scheme (ETS) to ensure net carbon ***emissions*** from biomass power stations are "properly accounted for and declared".

The European Commission seemed to pay heed to those concerns when it placed the emphasis on the need to restore carbon sinks in Europe.

"Projected increases in bioenergy use by 2030 are limited compared to today," the Commission pointed out in its [*2030 climate plan*](https://ec.europa.eu/clima/sites/clima/files/eu-climate-action/docs/com_2030_ctp_en.pdf), guarding against any "further increases in harvesting" that could see the EU's carbon sink decline further.

"Any unsustainable intensification of ***forest*** harvesting for bioenergy purposes should be avoided," the EU executive warned, saying "the use of whole trees and food and feed crops for energy production - produced in the EU or imported - should be minimised" in order to limit the impact on climate and biodiversity.

Bioenergy producers dispute this, saying "active ***forest*** management" practices "will optimise the carbon flow" and promote carbon sinks in addition to providing much-needed jobs and economic activity for rural areas.

"It is important to stress that bioenergy is not a driving force of ***forest*** harvesting," said Bioenergy Europe, a trade association. In fact, ***forest*** cover in the EU increased by 5.8% in 1995-2015 while bioenergy consumption "more than doubled" during the same period, it points out.

"The increase in bioenergy has been possible thanks to a better use of residues from the ***forest***-based industries and increased synergies with the wood-based industry," said Jean-Marc Jossart, secretary-general of Bioenergy Europe.

Importantly, Jossart said a distinction should be made between "carbon sinks" - the capacity of ***forests*** to capture carbon - and the "carbon stock", which is the total amount of carbon stored in the ***forest*** at a certain moment in time.

"A ***forest*** management based on maximising the carbon stock will not deliver efficiently against climate change because of maturation of trees and carbon losses" due to fires and insects, which are becoming more frequent because of climate change, he argued.

In reality, "a better managed ***forest*** reduces the risks of ***forest*** fires as there will be less dead wood on the ground helping the propagation of fire," Jossart told EURACTIV in emailed comments, saying landowners need to be incentivised to take care of their ***land***.

"Planting, thinning, harvesting and replanting are part of virtuous operations of climate-friendly ***forests***, as well as taking infected trees out of the ***forests***," he said.

**Incentives for 'sustainable' biomass**

The Commission does not dispute this, saying "the promotion of sustainable ***forest*** management" combined with strict enforcement of EU green criteria for biomass will help make the sector more sustainable.

And it keeps the door open to bioenergies in general, saying "a shift towards growing woody biomass on cropland in a sustainable manner, including as a feedstock for advanced biogas and biofuels, could alleviate the situation" and help restore healthy ***forests***.

"Bioenergy production should come from better use of biomass wastes and residues and sustainable cultivation of energy crops, rather replacing the production of first-generation food-crop-based biofuels," the EU executive says.

If those solutions are implemented swiftly in the coming years, "this could already reverse the current trend of a diminishing EU ***land*** carbon sink by 2030, increasing it again to levels above 300 million tons CO2eq," the Commission says.

[***EU plans sweeping bioenergy review by end 2020***](https://www.euractiv.com/section/biomass/news/eu-plans-sweeping-bioenergy-review-by-end-2020/)

The European Commission intends to push a "transformative approach" to all forms of bioenergy - including biofuels and woody biomass - as part of a biodiversity strategy due to be unveiled on Wednesday (20 May).

By the end of the year, the Commission is expected to publish an extensive review of biomass policies. And much of the debate from now on is expected to focus on the incentives that are needed to support sustainable forestry practices and carbon ***removals***.

"Definitely, we want to recognise the ***removals*** that are being done in ***agriculture*** and forestry more strongly than what we did in the past," said a senior EU official who was briefing journalists after the Commission presented its 2030 climate plan last week.

"That will require incentives for those who are responsible - and that's the farmers and the foresters," the official said.

In Germany, the government is currently debating a "[*tree premium*](https://www.euractiv.com/section/biomass/news/berlin-and-brussels-mull-forest-protection-as-climate-change-takes-its-toll/)" of (EURO)125 per hectare as a way to reward ***forest*** owners for reducing carbon ***emissions***. The premiums would be linked to the EU carbon market, meaning that if CO2 prices rise, the tree premium would also increase.

Another option is to bring ***agriculture*** under an EU regulation dealing with ***land*** use, ***land***-use change, and forestry (LULUCF).

"For somebody who is responsible for ***agriculture*** and forestry, it's probably much easier to handle that as a policy field and to make the right trade-offs within the sector," the official explained, saying any EU proposal on the matter would need to be backed by a cost-benefit analysis and fall in line with the Common ***Agricultural*** Policy.

For the bioenergy sector, incentives are fine as long as they allow foresters to "actively manage their ***forests*** through planting, thinning, harvesting and replanting".

"If conversely, these subsidies are there to leave the ***forests*** untouched, this will have the adverse effects of reducing their resilience," it argues.

[***Berlin and Brussels mull forest protection as climate change takes its toll***](https://www.euractiv.com/section/biomass/news/berlin-and-brussels-mull-forest-protection-as-climate-change-takes-its-toll/)

The German ***Forest*** Days, which started on Friday (18 September), are intended to draw attention to the fact that ***forests*** are threatened by climate change. At the same time, Berlin and Brussels are developing strategies to protect them. EURACTIV Germany reports.

*[Edited by Zoran Radosavljevic]*

**Load-Date:** September 23, 2020

**End of Document**



[***Tree Seedlings Available Nov 2-6***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:616H-BV31-JDG9-Y2H7-00000-00&context=1516831)

Impact News Service

October 31, 2020 Saturday

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**Length:** 736 words

**Body**

Saanich:BC, District of Central Saanich, British Columbia has issued the following news release:

The District of Central Saanich, thanks to the generous donation of Mosaic ***Forest*** Management, will be giving out 100 Douglas Fir seedlings the week of November 2 to 6, 2020. The seedlings will be available outside Municipal Hall, at 1903 Mt Newton Cross Road, from 9 am to 4 pm, and available to any Central Saanich resident (one per person).

Typically, the District's Tree Appreciation Day takes place in early November with a tree planting event open to the public, but this year's seedling giveaway will allow all to celebrate safely.About Douglas Firs

Douglas firs are evergreens, and can add privacy and shade to a property year-round. Once the tree is established, care is minimal. The tree is drought-tolerant. In 10 years’ time, a Douglas fir seedling may grow to 12-15 feet tall. They will ultimately be large trees and can grow to 120 feet and live hundreds of years. In ***forests***, Douglas firs drop their lower branches, but in the open, their spread can exceed 20 feet.Planting tips

Pick a good spot

Pick an area on your property with excellent drainage, room to grow, sunlight and shade (lots of shade is okay). You will want your tree to grow for years to come so allow a clearance of 20-30 feet away from buildings, fences, driveways, utilities and neighbouring properties. You can visit [*www.bc1c.ca*](http://www.bc1c.ca) to identify underground utility lines. Be certain the soil is deep, moist and well drained; they do poorest on gravelly soils.

Prepare the hole

Dig a hole about inches wider in diameter and 3 inches deeper than the root ball. Place the seedling in. Backfill with good soil and gently press down the soil around the seedling with your foot. Water the seedling and, if possible, place a small amount of wood chips around it to retain moisture.

Ongoing careDuring the first summer water weekly, depending on rainfall and how the soil holds water.Related: The District of Central Saanich is updating the Tree Protection Bylaw

The impacts of climate change are increasingly apparent and the role of tree preservation is a recognized climate mitigation measure. While trees are key to carbon sequestration, they can also play a significant role in storm water management, reducing the urban heat island effect, providing habitat and enhancing biodiversity, and their inherent aesthetic and cultural value reflect the importance of a healthy urban ***forest***. Within the District, preservation of the urban ***forest*** is particularly challenged by the size of our ***agricultural*** ***land*** base and the cumulative impacts resulting from development, including infill developments and infrastructure improvements (roads, sewer, water, etc.).

Therefore, Council identified a Tree Protection Review in the 2019 Strategic Plan. Staff initiated a review of the current Tree Bylaw and, with the help of a consultant, drafted a new Tree Management Bylaw. In October, Council endorsed the next step of the project, community engagement. In this phase, the District is asking for input on the draft bylaw.

Highlights of the new bylaw include:

Introducing a Tree Density ***Target*** of 50 trees per hectare Tree ***removal*** requires 3 replacement trees to be planted per tree removed, up to the lot achieving the Tree Density ***Target*** Tree retention is incentivized by giving credit for retention of trees Trees with a Diameter at Breast Height of 20 cm or more are considered ‘permit’ trees and require a permit for ***removal*** or pruning A cash-in-lieu option of $500 per tree would be available in cases where replacement trees cannot be accommodated on site Security of $250 per tree for the planting and maintenance (one year) of replacement trees would be required For permit trees located in the Erosion District, only one permit would be required Tree ***removal*** on ***lands*** within the ***Agricultural*** ***Land*** Reserve (ALR) remains exempt from the requirement for a permit, however, a written statement from the owner declaring that the trees are to be removed for an ***agricultural*** use is required. ***Removal*** of trees on municipal ***land*** requires 3 replacement trees for each tree to be removed, and a contribution of $750 per replacement tree toward a Tree Planting Reserve Fund An increase of application fees to recover District costs. There would be no cost to ***remove*** hazardous trees, a $75 base fee plus $25 per tree to a maximum of $200, and a fee of $75 to amend a permit.

**Load-Date:** November 2, 2020

**End of Document**



[***Corporate-led $1bn forests scheme is ‘just the beginning’***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:62T4-RNH1-F039-608B-00000-00&context=1516831)

FT.com

May 30, 2021 Sunday

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**Length:** 1056 words

**Byline:** Chelsea Bruce-Lockhart and Steven Bernard

**Body**

Amazon, Boston Consulting, McKinsey, Unilever, Salesforce, Airbnb, GSK, and Nestlé in April threw their weight behind a  [*$1bn scheme*](https://www.aboutamazon.com/news/sustainability/amazon-joins-global-initiative-to-protect-tropical-rainforests) aimed at tackling deforestation that now faces the challenge of establishing which countries will receive funds.

The Lowering ***Emissions*** by Accelerating ***Forest*** Finance (Leaf) venture was launched just as new data showed greenhouse gas ***emissions*** from the loss of previously untouched tropical ***forests*** had exceeded the combined ***emissions*** from Europe’s five-largest economies.

Under the proposed scheme, companies would in effect pay countries such as Brazil, Indonesia and the Democratic Republic of Congo for carbon credits linked to the avoidance of deforestation.

The organisations can then use those credits to compensate for their own ***emissions***. Since trees absorb carbon, cutting them down counts as a source of ***emissions***.

Leaf has proposed voluntary contributions of at least $10 per tonne of CO2 ***emissions*** avoided, or almost double what is presently offered in the voluntary carbon market.

“We’ve announced the call for proposals of $1bn — 100m tonnes at $10 per tonne. But that’s just the beginning. We know that that’s not enough,” said Eron Bloomgarden, executive director of Emergent, a US-based non-profit that will facilitate the transactions.

Globally, more than 4.2m hectares of humid primary tropical ***forest***, or an area similar to the size of Switzerland, were lost in 2020, mainly to ***agriculture***, commodity production and wildfires.

An equivalent of 2.65bn tonnes of CO2 were released into the Earth’s atmosphere as a result, according to data from the World Resources Institute’s  [*Global* ***Forest*** *Watch*](https://www.globalforestwatch.org/dashboards/global/?category=summary&dashboardPrompts=&location=WyJnbG9iYWwiXQ%3D%3D&map=), based on the estimates of carbon stored in the destroyed vegetation and root structures.

Humid tropical ***forest*** loss rose 12 per cent in 2020, despite the global economic slowdown brought on by the pandemic. It also flew in the face of commitments by large multinationals to prevent deforestation in their supply chains caused by the production of soy, palm oil, timber and beef.

Primary tropical ***forests*** are particularly important since they are not fully recoverable, and can take centuries to regenerate. Their ***removal*** results in a huge loss of biodiversity.

Elizabeth Dow Goldman, GIS research manager for Global ***Forest*** Watch, said: “We were all hoping [2020] would be the year where things turned around. Yet [primary ***forest*** loss] went up . . . it’s disappointing to see that.”

“Across the tropics, ***agriculture*** is such a big driver of primary ***forest*** loss,” said Goldman. Being intentional about how and where ***agriculture*** expanded could have a big impact, she added. “There needs to be a focus on improving output from the ***land*** that’s already under cultivation.”

Under Leaf’s scheme, Brazil could theoretically receive about $1bn if its deforestation of primary tropical ***forests*** were reduced by just 10 per cent.

But there are many other countries seeking financial support, where the effect would also shift their economies.

Malaysia is  [*one of only four*](https://www.nature.com/articles/s41558-020-00976-6) countries where ***forests*** emitted more carbon than was captured over the past two decades, turning them into a carbon source from a typical carbon “sink”. In the period from 2001 to 2020, close to 17 per cent of Malaysia’s tropical primary ***forests*** were lost, mainly to palm oil plantations and timber trade.

Yet Malaysia has managed to reduce deforestation for each of the past four years after bringing in caps on palm plantation areas and harsher punishments for illegal logging. Humid primary ***forest*** loss reduced from 185,000 hectares in 2016 to 73,000 hectares in 2020, GFW figures show.

If Malaysia reduced its deforestation rate of primary tropical ***forests*** by a further 10 per cent from current rates, in theory Leaf’s voluntary carbon credit scheme, if scaled, could provide about $60m in financial support.

In the Democratic Republic of Congo, deforestation is mostly caused by ***agricultural*** demands as smallholder farmers clear space to grow staple foods such as cassava and maize, for an increasing population.

A  [*study*](https://www.globalforestwatch.org/blog/data-and-research/new-map-helps-distinguish-between-cyclical-farming-and-deforestation-in-the-congo-basin/) by the University of Maryland found that more than 90 per cent of overall tree cover loss in the Democratic Republic of Congo was because of “slash and burn” ***agricultural*** techniques where ***forest*** ***land*** is burnt for cultivation and then left to regenerate. Deforestation in the DRC has resulted in about 480,000 hectares of primary humid tropical ***forest*** being lost each year, over the past five years.

If deforestation rates in DRC for humid primary tropical ***forests*** alone were reduced by just 10 per cent, its jurisdiction could receive almost $350m from Leaf’s scheme.

[*Credits linked to avoided deforestation*](https://www.ft.com/content/522e9f1e-711d-40c0-b265-2998c9194fd3) are not new and have caused controversy: critics have said it is difficult to ensure that the protection of one area does not lead to deforestation in another. Also, some “avoided deforestation” credits are generated from schemes in areas of woodland that were not genuinely at risk of being cut down.

Under the Leaf plan, tropical ***forest*** countries would not receive financing until a third party had checked that deforestation was reduced across the “jurisdiction” — the nation, state or province.

Leaf advocates argue that the jurisdictional approach will avoid protecting one area while deforestation shifts next door, creating “islands of green”.

***Emissions***-reduction purchase agreements are expected to be signed with tropical countries by the end of the year, but countries will not start receiving financing until the projects have begun generating credits.

“These countries need to find the right equilibrium between ***forest*** protection . . . and food production,” said Emergent’s Bloomgarden.

The scheme is underwritten by the governments of the UK, US and Norway.

“Protecting tropical ***forests*** is really a global imperative,” said Ruben Lubowski, chief natural resource economist at the Environmental Defense Fund, a US non-profit environmental advocacy group. “There’s no pathway to meeting the Paris ***targets*** without rapidly reducing deforestation. It’s mission critical,” he added.

“Right now, the economic development model only puts a value on trees when they are cut down,” Lubowski said. “Leaf aims to create durable finance for a model that is consistent with standing ***forests*** and sustainable livelihoods for indigenous and local communities.”

*Additional reporting Billy Nauman and Camilla Hogdson*

**Load-Date:** October 13, 2021

**End of Document**



[***How to save the world's forests with carbon credits***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:62VM-J6K1-F0YC-N239-00000-00&context=1516831)

Impact News Service

June 5, 2021 Saturday

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**Length:** 1263 words

**Body**

Cologny: World Economic Forum has issued the following press release:

The Verified Carbon Standard can unlock the power of carbon credits to halt deforestation. By the end of last year, 185 million carbon credits had been issued under this programme for ***forest*** preservation. Now we need to scale this up – and that will require investment from the public and private sectors.

A decade ago, a stretch of ***land*** in Kenya became the foundation for a new source of finance with the potential to save the world’s ***forests***: carbon credits.

The premise is simple. ***Forest*** countries and communities have historically faced intense economic and political pressure to cut down trees for logging, mining and industrial ***agriculture***, releasing millions of tonnes of CO2 into the atmosphere in the process. They need an alternative – more specifically, a tangible incentive – to preserve and restore their ***forests*** instead of cutting them down.

Enter the Verified Carbon Standard (VCS). Under the VCS, proponents can propose and implement a project to protect a ***forest***: for example, hiring community members to patrol it, building fire lines to prevent the spread of wildfires, and working with farmers to enhance ***agricultural*** productivity, which reduces pressure on the ***forest***. The impact is compared against what would have happened in the absence of the project, and carbon credits are issued: one for every tonne of CO2 that would have otherwise been released.Have you read?

Climate change could be making ***forests*** shorter – this is how Why we can’t afford to dismiss carbon offsetting in a climate crisis

These carbon credits can be sold to governments, companies or individuals seeking to complement their internal ***emission*** reductions and to further decrease their carbon footprints. Finance from the sales is channeled to ***forest*** countries and communities, providing alternative livelihoods for people who until then had relied on depleting the ***forest*** cover. This finance also supports new jobs, wildlife protection, education, clean water and other initiatives that seek to transform the local economy away from reliance on the ***forest***.

The results speak for themselves. Keeping carbon in the ***forest*** becomes an economically attractive option. By the end of 2020, 77 projects for “reducing ***emissions*** from deforestation and ***forest*** degradation” (REDD) were registered under the VCS and 185 million credits were issued.

But with a football field of tropical ***forest*** being lost every six seconds, the results to-date remain a mere drop of rain in an otherwise empty bucket.Halting deforestation would go a long way towards meeting the Paris climate goalsHalting deforestation would go a long way towards meeting the Paris climate goalsImage: World Resources Institute

Programs to stop deforestation need to be drastically scaled up. The current decline in tropical ***forest*** cover needs to be quickly turned around if we are to reach the Paris Agreement’s goal of keeping global warming to below 1.5°C. The ***emission*** pathways set out by the IPCC for this goal are already challenging enough: meeting the 1.5°C ***target*** requires reducing deforestation by 77%.

Scaling up requires sufficient and ongoing finance from multiple sources over multiple years. The incentive to preserve ***forests*** can be effective when the prospect of funds is real and when payment is contingent on demonstrating that ***forest*** carbon stocks are being properly preserved. The incentive to clear ***forests*** can outlive these other incentives if the funding source runs dry.

Public and private sector investment needs to move more firmly into this space. Corporates, propelled by fresh commitments to carbon neutrality and net-zero ***emissions***, need to source credits on the voluntary market to compensate for whatever low levels of internal ***emissions*** remain or for upstream and downstream ***emissions*** they cannot fully control. Some regulatory markets are now also allowing companies to use carbon credits from REDD projects to meet their compliance obligations.

At Verra, we believe that the future of REDD+ (the '+' stands for 'conservation of ***forest*** carbon stocks, sustainable management of ***forests***, and enhancement of ***forest*** carbon stocks') lies in integrated systems that leverage the strengths of jurisdictional and project-based approaches.

Governments are best placed to create enabling environments and to implement policy measures to protect ***forests***. These can establish a baseload of conditions for private sector investment to support specific projects within these jurisdictions. Project developers can be nimbler and more effective in delivering services to local communities and actors and in addressing local drivers of deforestation, while building resilient alternative livelihoods that don’t rely on cutting down the ***forest***.

We have spent the last two years revising—and just published—the Jurisdictional and Nested REDD+ (JNR) framework to enhance ambition while harmonizing the accounting of ***emission*** reductions at the project level with government accounting. This 'nesting' of REDD+ projects into jurisdictional accounting means that they can be integrated into government programmes while using jurisdictional deforestation rates for the broader area to determine project baselines. This not only eases the accounting of project-specific impacts; it also enhances consistency by ensuring the same data and methods are used across the region, and by dealing with the real risk that ***emissions*** may 'leak' from one project area to other ***forests*** in the same jurisdiction.What is the WEF doing on natural climate solutions?

The world faces converging environmental crises: the accelerating destruction of nature, and climate change.

Natural climate solutions (NCS) – investment in conservation and ***land*** management programmes that increase carbon storage and reduce carbon ***emissions*** – offer an important way of addressing both crises and generate additional environmental and social benefits.

Research conducted for the Forum’s Nature and Net Zero report confirms estimates that NCS can provide one-third of the climate mitigation to reach a 1.5° and 2° pathway by 2030—and at a lower cost than other forms of carbon dioxide ***removal***. This report builds on the recommendations from the Taskforce for Scaling Voluntary Carbon Markets, and identifies six actions to accelerate the scale-up of high-quality NCS and unlock markets through the combined efforts of business leaders, policymakers and civil society.

To foster collaboration, in 2019 the Forum and the World Business Council for Sustainable Development came together to establish the Natural Climate Solutions Alliance to convene public and private stakeholders with the purpose of identifying opportunities and barriers to investment into NCS.

Get in touch to join our mission to unleash the power of nature.

Ten years in, REDD+ crediting has proven its worth in harnessing finance to tackle one of the most intractable climate problems we face while making real progress on sustainable development at the local level. But we remain far from the scale and investment we need to turn this problem around and make the fight against deforestation help usher in the global net-zero ***emissions*** by 2050 that the Paris Agreement demands.

At Verra, we are busy creating the conditions to rally investment in this fight and the voluntary carbon market. We are forging a path toward credible and achievable opportunities to impact on deforestation and ***forest*** degradation, working hand-in-hand with local ***forest*** communities, jurisdictions and donor governments. One decade old, much growth still remains.

**Load-Date:** June 6, 2021

**End of Document**



[***EU countries clinch new mandate for talks on climate law, raising hopes of a deal***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:62FS-1RM1-DYXB-V2NY-00000-00&context=1516831)

EurActiv.com

April 16, 2021 Friday

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**Length:** 1518 words

**Byline:** Kira Taylor

**Highlight:** EU member states have adopted a revised mandate for negotiating the European climate law, including a new stance on the 2030 ***target*** that retains the net 55% reduction objective but limits the role of carbon sinks, according to documents seen by EURACTIV.

**Body**

Lawmakers are now hoping that the next round of negotiations on the climate law next Tuesday (20 April) will be the last, allowing European countries to attend the US climate summit on Thursday with a deal on the EU's 2030 ***target***.

"The negotiations are ongoing with a full package view of the several main elements in the Climate Law, where nothing is agreed until everything is agreed," according to an EU source.

"Options are being explored by both parties to bridge the gaps in the remaining issues and the scrutiny of the possible shared compromises will occur in due time," the source added.

**2030 *target***

Tabled one year ago by the European Commission, the climate law is the centrepiece of the Green Deal. Its main objective is to enshrine the bloc's 2050 climate neutrality goal into hard legislation while incorporating the EU's 2030 climate ***target***, which is still the subject of intense negotiations.

While EU member states painfully agreed on the Commission's proposal to cut greenhouse gas ***emissions*** by at least 55% by 2030, the Parliament has voted a 60% reduction compared to 1990 levels. All three now need to come to an agreement during so-called "trilogue" talks.

Portugal, which currently holds the six-month rotating presidency of the EU Council of Ministers, has been trying to find consensus among the EU's 27 member states. With a revised mandate, it is now hoping to clinch a deal ahead of the climate summit organised by US President Joe Biden on 22 April.

[***Deal on European climate law is 'big priority' for Portugal at EU helm***](https://www.euractiv.com/section/energy-environment/news/deal-on-european-climate-law-is-big-priority-for-portugal-at-eu-helm/)

Negotiations on the European Climate Law - including the bloc's proposed 55% greenhouse gas reduction ***target*** for 2030 - are expected to wrap up before the end of June as Portugal makes a climate agreement the "big priority" of its six-month EU presidency, which started on 1 January.

There is still no deal on the 2030 ***target***, but this week saw movement in the position of EU member states when the Portuguese Presidency presented two options for compromise at a meeting of national ambassadors on Wednesday (14 April).

These options kept the existing text, and crucially the "net" ***target*** for 2030 which takes into account carbon ***removals*** from ***agriculture*** and forestry. However, it offered clarification on the inclusion of carbon sinks, a proposal which was contested by Parliament.

The first option was to set a cap on the contribution of sinks: "The contribution of ***removals*** to this ***target*** shall be limited to the volume of ***removals*** under existing commitments pursuant to Article 4 of the LULUCF Regulation," the EU Council Presidency proposal said.

LULUCF stands for ***land*** use, ***land*** use change and forestry, which makes the biggest contribution to carbon ***removals***. According to EU calculations, the current LULUCF sink capacity is 225 million tonnes of CO2. This could either increase or decrease depending on whether policies are put in place to protect Europe's ***forests***.

The second option was to establish a discount on the contribution of sinks up to 2030: "However, when calculating the contribution of ***removals*** for achieving the 2030 climate ***target***, every ton of reported net ***removals*** from the EU-wide LULUCF sector, as long as it remains a net sink, shall be discounted by XX%," the proposal said.

Room documents from the ambassador's meeting, seen by EURACTIV, suggest that the first option has been selected. This would mean that the EU's 55% "net" greenhouse gas reduction ***target*** for 2030 would be equivalent to a 52.8% gross reduction, without carbon sinks.

"For me, this is much too little," said Michael Bloss, the Parliament negotiator for the Greens, who points out that carbon sinks can be difficult to calculate.

"There are a lot of big promises like the Green Deal and then basically we settle with real ***emission*** reductions of only 52.8%. We can never call ourselves climate champions if we do that," he told EURACTIV.

Others point out that 52.8% is still much higher than the EU's current official ***target*** of 40%.

"The proposed ***target*** of net 55% is very ambitious," said Peter Liese, a German MEP who is lead negotiator for the centre-right European People's Party (EPP), the largest political group in Parliament.

"From 1990 until now, we only reduced 25% which means that in 9 years we have to do a bigger step than in the last 30 years. This is necessary and the EPP supports it but it will only be achieved if we use all the necessary tools, including carbon sinks, through sustainable ***forest*** management and modern technology," Liese said.

**2050 *target***

While the 2050 net-zero ***emission*** ***target*** has been less controversial, there are still discussions as to whether it should be enforced by each country individually or whether the ***target*** applies to the EU as a whole, allowing laggards to surpass it if other meet the objective earlier.

For Richard Brabec, the Czech environment minister, [*it is clear that the objective should be a collective one*](https://www.euractiv.com/section/climate-environment/news/eu-countries-dig-in-heels-over-55-climate-target-for-2030/). But Leonore Gewessler, the Austrian environment minister, contradicted this, saying, "Austria is in favour of reaching climate neutrality at 2050, at member state level as well. We would welcome it if we could make concessions to the European Parliament."

[***EU countries dig in heels over 55% climate target for 2030***](https://www.euractiv.com/section/climate-environment/news/eu-countries-dig-in-heels-over-55-climate-target-for-2030/)

Environment ministers from the 27 EU member states confirmed they would continue to push for a 55% net greenhouse gas reduction ***target*** by 2030 during a meeting of the environment council on Thursday (18 March), despite calls from Parliament to increase the EU's ambition.

**Scientific advisory body**

Elsewhere, there is now broad agreement on proposals to establish a new scientific advisory body whose role will be to assess the alignment of EU policies with the bloc's climate neutrality objective, an idea introduced by Parliament.

However, the exact wording still needs to be fleshed out. The Presidency's revised proposals include a compromise on this, based on suggestions from Jytte Guteland, the lead rapporteur on the climate law in the European Parliament.

The new compromise, confirmed in the room documents from Wednesday's ambassador meeting, would see 13-15 members from different EU countries serve for three years on an independent scientific "board", nominated by the European Environment Agency (EEA).

The Portuguese EU Presidency has worked hard to bring in elements added by Parliament, including on the role of science, and engaging "with determination and the aim of making progress", according to an EU source.

However, conservation group WWF criticised the compromise proposal for replicating the EEA's role.

"We mustn't reinvent the wheel: we already have climate scientists in the form of the IPCC and EEA. What the EU needs is assessment and recommendations by experts from various backgrounds on the consistency of our policies with climate science," said Romain Laugier, policy officer at the WWF European Policy Office.

**Greenhouse gas budget**

A related proposal defended by the Greens is to introduce a greenhouse gas budget defining how much CO2 the EU can produce before 2050 in order to stay within the 1.5°C warming limit of the Paris Agreement.

Originally introduced by Parliament, that proposal eventually won support in the Council of Ministers, notably from France and Nordic countries.

According to the Presidency's revised proposals, the Presidency would accept part of its proposal for a carbon budget, in exchange for Parliament sacrifices on demands related to access to justice and phase-out of fossil fuel subsidies.

The idea is that the Commission would publish a legislative proposal to set out the 2040 ***target*** and a separate, indicative greenhouse gas budget for the EU between 2030 and 2050, six months after the first global stock-take in 2023 to measure progress under the Paris Agreement.

**Sectoral decarbonisation roadmaps**

Finally, negotiators are close to an agreement on sectoral decarbonisation roadmaps for sectors like buildings, transport, cement, steel or chemicals, which are considered hard to abate.

While these sectoral roadmaps won't be mandatory as the Parliament wanted, MEPs obtained commitments that the Commission will regularly monitor developments and facilitate dialogue and sharing of best practices. On climate adaptation, the Commission will also produce guidelines to ensure public works and construction projects follow EU-wide standards related to aspects like flood resilience.

Alongside this, Article 5 of the European Climate Law stipulates that any proposal coming out of the European Commission must be in line with the bloc's climate neutrality objective. If it chooses to deviate from that goal, the EU executive will need to justify its decision either because the socio-economic costs are too high or because there is no technology available yet to reach the climate neutrality objective in that particular sector of economic activity.

Parliament negotiators from the different political groups will meet on Monday to exchange views on the Council's revised proposal. The sixth and possibly final trilogue on the European climate law is scheduled for Tuesday afternoon (20 April).

[*Revised four column document*](https://www.euractiv.com/wp-content/uploads/sites/2/2021/04/Revised-four-column-document.pdf)

*[Edited by Frédéric Simon]*

**Load-Date:** April 16, 2021

**End of Document**



[***EU Commission clashes with Parliament over 'net' 2030 climate target***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:624T-DRR1-JCF9-42Y7-00000-00&context=1516831)

EurActiv.com

March 5, 2021 Friday

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**Length:** 996 words

**Byline:** Kira Taylor

**Highlight:** Lawmakers have denounced a "loophole" in the European Commission's proposed climate ***target*** for 2030 and pointed the finger at the EU executive for its hard negotiation style over the EU climate law.

**Body**

MEPs from across the political spectrum turned up the heat on Frans Timmermans, the executive vice-president of the European Commission, during a heated [*exchange of views with the bloc's climate chief on Thursday (4 March)*](https://multimedia.europarl.europa.eu/en/committee-on-environment-public-health-and-food-safety_20210304-1645-COMMITTEE-ENVI_vd).

Lawmakers raised concerns about the Commission's "net" greenhouse gas reduction ***target*** for 2030, which includes carbon ***removals*** from ***agriculture***, ***land*** use and forestry - so-called "carbon sinks".

Carbon sinks weren't included in the EU's previous climate objectives, something which MEPs said creates a loophole meaning the actual greenhouse gas reductions will be lower than the 55% advertised by the EU executive.

"I must say that we have serious doubts about the nature of the Commission's proposed net ***target*** for 2030," said Jytte Guteland, a Swedish MEP from the socialists and democrats who is the Parliament's rapporteur on the 2030 proposal.

"The Commission's own impact assessment makes clear that there is in fact no certainty how big this will be and what the reduction will be for 2030 with this net approach, so it could be under the 'at least 55%'," Guteland said.

The Swedish MEP criticised the current calculation of "carbon sinks", saying the ***target*** failed to take into account ***forest*** fires and storms that could reduce the ability of trees to absorb CO2.

To address the issue, many MEPs suggested creating a separate ***target*** for sinks, in order to keep track of the EU's natural carbon stock.

Timmermans defended the proposed net ***target***, saying it is in line with methodologies applied at UN level. He referred to the Commission's impact assessment, saying it shows that achieving a 55% net reduction in ***emissions*** by 2030 is in line with a 1.5°C pathway advocated by the  International Panel on Climate Change.

"We believe this to be a fair ***target*** also taking account of our historic responsibilities as the EU," Timmermans said.

But MEPs cited the European Commission's own estimates to argue that a net ***target*** would in fact mean ***emissions*** are only reduced by around 53% instead of 55%.

Others, meanwhile, have said that using 1990 as a baseline for calculating the EU's 2030 objective is misleading because ***emissions*** rapidly decreased in the 1990s after the Soviet Union broke up. [*A 55% reduction compared to 1990 is in fact equivalent to a 42% reduction on 2018 levels,*](https://gretathunberg.medium.com/the-eu-is-cheating-with-numbers-and-stealing-our-future-1aca3e9a295f) warned climate activist Greta Thunberg.

[***Commission under fire for including 'carbon sinks' into EU climate goals***](https://www.euractiv.com/section/climate-environment/news/commission-under-fire-for-including-carbon-sinks-into-eu-climate-goals/)

The European Commission on Thursday (17 September) defended its plan to bring carbon ***removals*** from ***agriculture***, ***land*** use and forestry into the EU's updated climate ***target*** for 2030, saying this was in line with UNFCCC standards.

**Climate law**

MEPs also criticised the Commission's approach to negotiations over the EU's climate law, which seeks to make the bloc's climate neutrality goal a legally-binding objective.

The Commission is supposed to act as an honest broker during three-way talks with the European Parliament and the EU Council of Ministers, but lawmakers argued that it is failing in this task.

Moreover, MEPs blamed the EU executive for ignoring the Parliament's call for a 60% ***target*** in its cost-benefit analysis on the 2030 ***target***.

The possibilities are there because the impact assessment does not include all the more ambitious scenarios like on transport and other sectoral policies, but the Commission has deliberately not explored these, said Green MEP, Bas Eickhout.

"We in the parliament agreed on 60% as our climate ***target*** as democratically elected representatives and you're ignoring this when you are making your calculations," said Michael Bloss, a German MEP from the Green party.

"We have been waiting for constructive proposals from the Council and Commission, but they have refused to acknowledge the need to compromise. This take it or leave it attitude must change if a deal on the climate law is to be achieved," he said.

"I'm not ignoring your position," Timmermans replied. "I just don't agree with it," he added, saying the Commission would do its best to find a compromise.

The issue of ***forests*** as an economic resource, a carbon sink and home for biodiversity was also the subject of intense discussions, with Timmermans defending a balanced approach on the matter.

The Commission will soon put forward a legislative proposal in response to the [*Parliament's call for mandatory due diligence*](https://www.euractiv.com/section/energy-environment/news/europe-needs-laws-to-stop-import-of-deforestation-linked-products-lawmakers-say/) when it comes to EU consumption and deforestation, he said.

[***Greens frustrated with slow pace of talks on European climate law***](https://www.euractiv.com/section/energy-environment/news/greens-frustrated-with-slow-pace-of-talks-on-european-climate-law/)

European countries are delaying negotiations on the EU's 2030 climate ***target***, according to Michael Bloss, a Green MEP from Germany who briefed the press after the third round of talks on the European climate law.

**ETS revision**

One of the most highly anticipated pieces of legislation in the upcoming June package is the revision of the ***emissions*** trading scheme (ETS). The Commission is currently running an impact assessment on extending this to cover more sectors, possibly maritime and road transport as well as buildings.

However, road transport is already covered by CO2 ***emission*** standards and there are concerns that adding it to the ETS' remit could have a direct impact on consumers, including an increase in fuel prices.

"While the S&D group welcomes the introduction of the maritime transport to the ETS, we cannot say the same for the road transport," said Guteland. "While we currently do not have any major reduction ***targets*** for shipping, we actually already have in place decent CO2 standards for road transport," she remarked.

Timmermans has said earlier that he was personally against including road transport in the ETS. But he declined to confirm what was being considered, saying only that the social aspect of the ETS reform will be looked at.

[***EU carbon market not the right policy for cars, says Timmermans***](https://www.euractiv.com/section/transport/news/eu-carbon-market-not-the-right-policy-for-cars-says-timmermans/)

Road transport should not be top of the list when the European Union expands its carbon market into new sectors, the bloc's climate policy chief said on Tuesday (8 September).

*[Edited by Frédéric Simon]*

**Load-Date:** March 5, 2021

**End of Document**



[***Carbon uptake in re-growing Amazon forest threatened by climate and human disturbance***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:62B9-0GS1-JDG9-Y4W1-00000-00&context=1516831)

Impact News Service

March 30, 2021 Tuesday

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**Length:** 792 words

**Body**

London: University of Bristol has issued the following news release:

Large areas of ***forests*** regrowing in the Amazon to help reduce carbon dioxide in the atmosphere, are being limited by climate and human activity.

Large areas of ***forests*** regrowing in the Amazon to help reduce carbon dioxide in the atmosphere, are being limited by climate and human activity.

The ***forests***, which naturally regrow on ***land*** previously deforested for ***agriculture*** and now abandoned, are developing at different speeds. Researchers at the University of Bristol have found a link between slower tree-growth and ***land*** previously scorched by fire.

The findings were published today [date] in Nature Communications, and suggest a need for a better protection of these ***forests*** if they are to help mitigate the effects of climate change.

Global ***forests*** are expected to contribute a quarter of pledged mitigation under the 2015 Paris Agreement. Many countries pledged in their Nationally Determined Contribution (NDC) to restore and reforest millions of hectares of ***land*** to help achieve the goals of the Paris Agreement. Until recently, this included Brazil, which in 2015 vowed to restore and reforest 12 million hectares, an area approximately equal to that of England.

Part of this reforestation can be achieved through the natural regrowth of secondary ***forests***, which already occupy about 20% of deforested ***land*** in the Amazon. Understanding how the regrowth is affected by the environment and humans will improve estimates of the climate mitigation potential in the decade ahead that the United Nations has called the “Decade of Ecosystem Restoration”.

Viola Heinrich, lead author and PhD student from the School of Geographical Sciences at the University of Bristol, said, “Our results show the strong effects of key climate and human factors on regrowth, stressing the need to safeguard and expand secondary ***forest*** areas if they are to have any significant role in the fight against climate change. ”

Annually, tropical secondary ***forests***, which are growing on used ***land***, can absorb carbon up to 11 times faster than old-growth ***forests***.

However, there are many driving factors that can influence the spatial patterns of regrowth rate, such as when ***forest*** ***land*** is burned either to clear for ***agriculture*** or when fire elsewhere has spread.

The research was led by researchers at the University of Bristol and Brazil’s National Institute for Space Research (INPE) and included scientists from the Universities of Cardiff and Exeter, UK.

Scientists used a combination of satellite-derived images that detect changes in ***forest*** cover over time to identify secondary ***forest*** areas and their ages as well as satellite data that can monitor the aboveground carbon, environmental factors and human activity.

They found that the impact of disturbances such as fire and repeated deforestations prior to regrowth reduced the regrowth rate by 20% to 55% across different areas of the Amazon.

“The regrowth models we developed in this study will be useful for scientists, ***forest*** managers and policy makers, highlighting the regions that have the greatest regrowth potential. ” Said Heinrich.

The research team also calculated the contribution of Amazonian Secondary ***Forests*** to Brazil’s net ***emissions*** reduction ***target*** and found that by preserving the current area, secondary ***forests*** can contribute to 6% of Brazil’s net ***emissions*** reduction ***targets***. However, this value reduces rapidly to less than 1% if only secondary ***forests*** older than 20 years are preserved.

In December 2020, Brazil amended its pledge (NDC) under the Paris Agreement such that there is now no mention of the 12 million hectares of ***forest*** restoration or eliminating illegal deforestation as was pledged in Brazil’s original NDC ***target*** in 2015.

Co-author Dr Jo House, University of Bristol said “The findings in our study highlight the carbon benefits of ***forest*** regrowth and the negative impact of human action if these ***forests*** are not protected. In the run up to the 26th Conference of the Parties, this is a time when countries should be raising their climate ambitions for protecting and restoring ***forest*** ecosystems, not lowering them as Brazil seems to have done. ”

Co-author Dr Luiz Aragão, National Institute of Space Research in Brazil, added “Across the tropics several areas could be used to regrow ***forests*** to ***remove*** CO2from the atmosphere. Brazil is likely to be the tropical country with the largest potential for this kind of Nature-based solution, which can generate income to landowners, reestablish ecosystems services and place the country again as a global leader in the fight against climate change. ”

The team will now focus their next steps on applying their methods to estimate the regrowth of secondary ***forest*** across the tropics.

**Load-Date:** March 31, 2021

**End of Document**



[***Boris Johnson’s climate plan missing nature-based solutions, campaigners say***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:61B0-MY11-JBNF-W093-00000-00&context=1516831)

The Independent (United Kingdom)

November 18, 2020 Wednesday 5:58 PM GMT

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**Section:** ENVIRONMENT,CLIMATE CHANGE; Version:2

**Length:** 851 words

**Byline:** Daisy Dunne

**Highlight:** The protection and restoration of ***forests*** and peatlands will be crucial for the UK to meet its climate goals, environmentalists say

**Body**

New commitments to tackle the climate crisis through nature-based solutions are missing from Boris Johnson’s new 10-point plan to reach net zero carbon ***emissions***, campaigners have warned.

Mr Johnson set out his long-awaited climate plan yesterday evening. It included some [*strong new environmental measures*](https://www.independent.co.uk/environment/climate-change/boris-johnson-climate-change-plan-b1724555.html) , including an earlier ban on the sale of new petrol and diesel vehicles, a boost for electric cars and more funding to tackle ***emissions*** from Britain’s homes.

However, Mr Johnson’s plan only made a vague reference to nature and the role that it could play in helping the country to reach its ***target*** of net zero ***emissions*** by 2050.

Point number nine in Mr Johnson’s plan was dedicated to “nature” and the “protecting and restoring our natural environment”.

But little information was given on how this might be achieved. The plan made reference to a pledge to plant 30,000 hectares of new ***forest*** every year. However, this is a repeat of a promise [*first made*](https://www.independent.co.uk/environment/climate-change/boris-johnson-climate-change-plan-b1724555.html) by Mr Johnson in the 2019 general election.

“If we look at an overview of this plan, what it looks like is a big shiny metal lump of technology, with a little clump of trees planted alongside,” Green Party peer and former leader Natalie Bennett told The Independent.

“The government talks a good game on nature-based solutions, particularly in an international context, but what we have here is something that lacks nature, and also people.”

[*Research*](https://www.independent.co.uk/environment/climate-change/boris-johnson-climate-change-plan-b1724555.html) has shown that protecting and restoring the UK’s remaining ***forests*** and peatlands will key to reducing its greenhouse gas ***emissions***, along with other needed changes such as a transition away from fossil fuels in the power and transport sectors.

This is because both types of ecosystems store large amounts of carbon. ***Forests*** hold carbon in their trees, which absorb CO2 from the air during photosynthesis and then use it to build new leaves, roots and shoots.

Peatlands, meanwhile, are able to store high amounts of carbon in their dense waterlogged soils. Across the world, peatlands cover just 3 per cent of the ***land***’s surface, but store [*one-third*](https://www.independent.co.uk/environment/climate-change/boris-johnson-climate-change-plan-b1724555.html) of the Earth’s soil carbon.

If these ecosystems were given a boost, they could absorb more CO2 from the atmosphere, helping to reduce the UK’s overall ***emissions***, explains Dr Nem Vaughan, a senior lecturer in climate change at the University of East Anglia.

“Establishing more woodlands and changing how we manage our ***land*** are likely to be needed to compensate for difficult to decarbonise sectors like ***agriculture*** and aviation,” she told The Independent.

It will be tricky to reduce ***emissions*** from aviation because possible future technologies such as electric air travel are still a long way away from being reality, scientists say.

***Agriculture***, too, poses a particular challenge because the production of some foods, such as meat and dairy, is particularly polluting, and there are currently very few “techno-fixes” in the pipeline. (Scientists [*have found*](https://www.independent.co.uk/environment/climate-change/boris-johnson-climate-change-plan-b1724555.html) that the easiest way to reduce ***emissions*** from meat and dairy would be to eat less of it.)

“We are one of the worst states for nature in the world,” said Baroness Bennett.

“Trees are not the only solution to that, it has to be the right tree in the right place. But restoring those natural environments is absolutely crucial for carbon storage and for protecting the natural world, and it will actually produce a much nicer local environment for people.”

A [*report*](https://www.independent.co.uk/environment/climate-change/boris-johnson-climate-change-plan-b1724555.html) released by the RSPB earlier this week found that the poor condition of the UK’s peatlands results in the release of carbon equivalent to 5 per cent of total UK greenhouse gas ***emissions*** every year.

“The UK has got to come up with a plan under the Paris Agreement to say how it’s going to meet its obligations under net zero, and, of course, it can now show off about some of the energy revolutions measures [it has announced],” Martin Harper, director of conservation at the RSPB, told The Independent.

“But it ought to be more explicit about what percentage contribution nature-based solutions will make as part of that plan.”

The UK is due to submit an updated climate plan in the coming months, ahead of its role of host of the UN climate talks, known as COP26, which are to be held in Glasgow next year.

“As well as including ***emissions*** reductions ***targets*** for energy and transport, they need to be thinking about ***emissions*** reductions ***targets*** and potentially greenhouse gas ***removals*** from ***land***,” Mr Harper added. “And at the moment they don’t think about this in a very sophisticated way.”

Earlier this week, the UK government [*announced*](https://www.independent.co.uk/environment/climate-change/boris-johnson-climate-change-plan-b1724555.html) that it would create new national parks as part of its 25-year environment plan. The plan ultimately aims to protect 30 per cent of the UK’s natural spaces.

However, the RSPB said this “barely scratches the surface of what is needed”.

“Designating more ***land*** for nature looks good on paper, but this won’t make any real impact if landscapes remain as poorly managed for nature as many are now,” said Beccy Speight, chief executive at the RSPB.

The Independent approached a government spokesperson for comment.

Read More

[*Just £4bn of new money for climate emergency plan, minister admits*](https://www.independent.co.uk/environment/climate-change/boris-johnson-climate-change-plan-b1724555.html)

**Load-Date:** November 18, 2020

**End of Document**



[***Methods for removing carbon dioxide from the air***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:60VG-B4F1-JBK9-2387-00000-00&context=1516831)

Die Welt (English)

September 16, 2020 Wednesday

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**Section:** SCIENCE; Pg. 20; No. 217

**Length:** 575 words

**Body**

***Agriculture***

In fields, CO2 can accumulate when farmers work crop residues into the soil, plough less, or sow catch crops. The process could be used at any time, it could also improve the fertility of the soil, but storing the CO2 would not be very safe, and if ***land*** use changed, it would possibly be released again.

Afforestation

Plants bind CO2 by photosynthesis. The expansion of ***forests*** and plantations would therefore ***remove*** CO2 from the air. However, after a hundred years at the latest, when ***forests*** have reached maturity, they do not bind additional CO2. Trees could then be transformed into building material and furniture to prevent rotting and the associated release of CO2. Problems are: Competition with food production, high water consumption and storage uncertainty due to pests and weather.

Researchers have just calculated what contribution ***forests*** could make. After a few decades, ambitious global reforestation could ***remove*** all the CO2 from the air each year that all countries in the world together currently release annually with fossil fuels, researchers from the Netherlands report in the journal "Nature Climate Change ".

The study confirms the theoretical potential of CO2 ***removal***, says Oliver Geden, climate protection expert from the German Institute for International and Security Affairs (Stiftung Wissenschaft und Politik). However, the question is rather how conflicts of objectives can be solved: For example, which countries would take over reforestation, or how overlaps with other types of ***land*** use such as food production could be avoided.

Use of biomass with CO2 storage (BECCS)

Fast-growing plants bind CO2 - and they can supply energy by combustion. The CO2 produced in the process should be stored, so that ultimately "negative ***emissions***" would be produced. Problems are the high demand for cultivable ***land***, water and fertilization, as well as the required infrastructure and storage capacity. The process is considered to be well researched, but is hardly ever operated.

Capture of CO2

By means of chemical filters CO2 can be extracted from the air and stored underground. The advantage would be the relatively small area of the filters, which could be operated for a long time.

Storage of CO2 (CCS)

Researchers favour emptied gas or oil reservoirs as storage for captured CO2. Problem: The method itself requires energy and large storage facilities. Plants are already in operation in the USA, Italy, Switzerland, Canada and Iceland. Germany has tested CCS on a small scale, but has imposed high hurdles on the method following protests.

Ocean fertilization

Iron is used to stimulate the growth of plankton in the sea, the plants bind CO2. However, there is a danger of over-fertilization, with risks for the marine environment. The method is criticized.

Rocks bind CO2

Rocks weather, they discolour and thereby bind CO2. Small rasped rock, spread out on fields or in the sea, would extremely accelerate the process, which is a long one in nature, because many small particles offer the air a larger surface to attack. The rock flour could even be used to cultivate ***agricultural*** ***land*** and counteract ocean acidification. However, the method is still under development.

Vegetable carbon

If plant remains are heated in the absence of oxygen, they form vegetable carbon without releasing the CO2 that they had absorbed during their growth. The coal is stable, but the process has not yet been tested on a large scale.

Document original

**Load-Date:** September 16, 2020

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[***Climate change: Are forests carbon sinks or carbon sources?***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:620X-DMM1-F0YC-N32G-00000-00&context=1516831)

Impact News Service

February 13, 2021 Saturday

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**Length:** 1304 words

**Body**

Cologny: World Economic Forum has issued the following press release:

***Forests*** are an important asset in the fight against climate change. New research has found that they sequester around twice as much carbon dioxide as they emit, classifying them as a carbon sink. ***Forests*** emitted on average 8.1 billion metric tonnes of carbon dioxide and absorbed 16 billion between 2001 and 2019.

The world is getting a better understanding of just how important ***forests*** are in the global fight against climate change.

New research, published in Nature Climate Change and available on Global ***Forest*** Watch, found that the world’s ***forests*** sequestered about twice as much carbon dioxide as they emitted between 2001 and 2019. In other words, ***forests*** provide a “carbon sink” that absorbs a net 7.6 billion metric tonnes of CO2 per year, 1.5 times more carbon than the United States emits annually.Have you read?

5 things you might not know about ***forests*** – but should These 5 countries are home to more than half the world’s ***forests*** How a desert became a carbon sink zone

Unlike other sectors, where carbon makes a one-way trip to the atmosphere, ***forests*** act as a two-way highway, absorbing CO2 when standing or regrowing and releasing it when cleared or degraded.

Before now, scientists estimated these global “carbon fluxes” from the sum of country-reported data, creating a coarse picture of the role ***forests*** play in both carbon ***emissions*** and sequestration. With these new data that combine ground measurements with satellite observations, we can now quantify carbon fluxes consistently over any area, from small local ***forests*** to countries to entire continents.

Using this more granular information, we found that the world’s ***forests*** emitted an average of 8.1 billion metric tonnes of carbon dioxide into the atmosphere each year due to deforestation and other disturbances, and absorbed 16 billion metric tonnes of CO2 per year.a diagram showing how ***forests*** can both absorb and produce carbonForests are capable of both producing and absorbing carbon.Image: World Resources Institute

Here’s a look at what else the new maps tell us about ***forests*** and carbon:

Only one major tropical rainforest remains a strong carbon sink

Tropical rainforests are far and away the most important ecosystems for mitigating climate change. Tropical rainforests collectively sequester more carbon from the atmosphere than temperate or boreal ***forests***, but they’re also increasingly destroyed for ***agricultural*** expansion. The world’s three largest tropical rainforests are located in the Amazon, Congo River basin and Southeast Asia.

Over the past 20 years, ***forests*** across Southeast Asia have collectively become a net source of carbon ***emissions*** due to clearing for plantations, uncontrolled fires and drainage of peat soils.

The Amazon River basin, which stretches across nine countries in South America, is still a net carbon sink, but teeters on the edge of becoming a net source if ***forest*** loss continues at current rates. The Amazon basin has experienced heightened deforestation in the last four years due to clearing for cattle pasture and degradation from fires.

Of the world’s three largest tropical rainforests, only the Congo has enough standing ***forest*** left to remain a strong net carbon sink. The Congo’s tropical rainforest sequesters 600 million metric tonnes more carbon dioxide per year than it emits, equivalent to about one-third of the CO2 ***emissions*** from all U.S transportation.

Protecting the remaining ***forests*** in all three regions is critical to mitigating climate change.a diagram showing how much carbon different ***forests*** absorb and produce.Different ***forests*** absorb and emit different amounts.Image: World Resources Institute

Protected areas help conserve ***forest*** carbon sinks

The precarious state of the Amazonian carbon sink highlights the need to protect the ***forests*** we have left in this region and elsewhere around the world. Protected areas and indigenous reserves are some of our most valuable tools in the climate action toolbox, combined with command-and-control policies.

The new map reveals that 27% of the world’s net ***forest*** carbon sink falls within protected areas. Looking at individual areas demonstrates just how effective these designations can be in keeping CO2 in ***forests***.

For example, in Brazil, a stark contrast in carbon ***emissions*** is evident between the protected Menkragnotí indigenous reserve and the surrounding unprotected ***forest***. ***Forests*** in the reserve continue to absorb approximately 10 million metric tonnes of carbon dioxide more from the atmosphere than they emit every year — equivalent to the annual carbon ***emissions*** from more than 2 million cars. The area surrounding the Menkragnotí indigenous reserve has become a net carbon source due to clearing for mining, pasture and soy.

Recognizing Indigenous Peoples and local communities as owners of their ***lands***, and enforcing those rights, is a proven strategy to protect standing ***forests*** and enhance carbon stored in them.a map of showing the carbon absorption of the amazon rainforestThe Amazon rainforest absorbs lot carbon.Image: World Resources Institute

Forestry carbon flux varies based on management practices

Nowhere is the bidirectional nature of carbon flux more apparent than in the world’s managed ***forests***, which are cut and regrown to produce timber and concentrated mainly in the United States, Canada, China, Europe and Russia. In these managed ***forest*** areas, some patches of trees are harvested or thinned at planned intervals, leading to carbon ***emissions***, while others are left to regrow and absorb carbon.

Ultimately, whether managed ***forests*** are carbon sources or sinks depends on how they’re managed — how much time elapses between harvest cycles, how much ***forest*** is cut, the age of the trees, and, importantly, the total area over which fluxes are calculated.

Zooming in on individual clear-cuts in the new map shows CO2 ***emissions*** from the abrupt loss of tree cover during harvest. But at the landscape scale, forestry becomes a patchwork of both CO2 ***emissions*** from harvest and carbon ***removals*** from previously harvested ***forests*** growing back. On the whole, most well-managed ***forests*** are net carbon sinks.

Logging in pristine primary ***forests***, however, still represents a concern with respect to both climate and biodiversity. Unlike secondary ***forests*** or fast-rotation pine or eucalyptus plantations, harvesting in old-growth ***forests*** releases CO2 that has taken centuries to accumulate — carbon that, once lost, is irrecoverable in our lifetime.a map showing how ***emissions*** are produced from ***forest*** harvestingForest harvesting is big contributour to ***emissions***.Image: World Resources Institute

Protecting standing ***forests*** is critical for climate mitigation

Overall, the data show that keeping existing ***forests*** standing remains our best hope for maintaining the vast amount of carbon ***forests*** store and continuing the carbon sequestration that, if halted, will worsen the effects of climate change.

While planting new trees (the right way) or letting them regrow naturally can play a role in mitigating climate change (and helping communities adapt to its effects), the new data show that ***forests*** that have sprouted up in the past 19 years represent less than 5% of the current global ***forest*** carbon sink.

Although important to give these young ***forests*** the chance to grow into old ones, protecting primary and mature secondary ***forests*** today is most important for curbing climate change.

With these new maps, we can identify with unprecedented detail those ***forests*** that are capturing and emitting the most carbon. The maps can also be continually improved as better data become available. This gets us one step closer to tracking progress toward reducing ***emissions*** from deforestation and identifying where ***forests*** are being successfully managed — and where they need more protection.

**Load-Date:** February 15, 2021

**End of Document**



[***Green Climate Fund approves new projects***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:60NK-WHN1-JDG9-Y0S1-00000-00&context=1516831)

Impact News Service

August 22, 2020 Saturday

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**Length:** 852 words

**Body**

Italy: Food and ***Agriculture*** Organization has issued the following press release:

The Board of the Green Climate Fund today approved several new projects, including one for Côte d'Ivoire that marks the first time the Food and ***Agriculture*** Organization of the United Nations has helped an African country obtain a grant from the international entity.

Along with the $11.8 million approval for Côte d'Ivoire, other two FAO-led projects in Armenia and Colombia, for a total amount of $58.5 million, including $10.5 million in cofinancing, received approval from the Green Climate Fund, a unique global platform mandated to invest in low-***emission*** and climate-resilient development.

'These approvals show that FAO is a strong partner for Members looking to meet their climate goals with inclusive rural growth strategies,' said Maria Helena Semedo, FAO Deputy Director-General, Climate and Natural Resources. 'Africa has a lot of need, and a lot of potential, in this area, so we commend the Green Climate Fund for approving that project and look forward to helping implement it.'

Côte d'Ivoire

The funds will help Côte d'Ivoire's Promire project - Promoting zero-deforestation cocoa production for reducing ***emissions*** in Côte d'Ivoire -upscale a pilot project which supported a local cooperative of organic cocoa producers in La Mé amplify their access to fair-trade markets while reducing loss of ***forest*** cover.

The enlarged project will implement low-carbon ***emission*** agroforestry practices on 3 650 hectares in a way designed to nudge changes by and for the benefit of 600 000 smallholder farmers in the southeastern regions around Agnéby-Tiassa, La Mé and Sud-Comoé.

Côte d'Ivoire has one of the world's fastest rates of ***forest*** loss and almost no pristine ***forest*** remains outside its national parks.

***Agriculture*** contributes to almost two-thirds of the deforestation, with a third due to cocoa production - exacerbated by ***land*** clearing to grow 'full-sun' cocoa, a strategy favoured by unorganized smallholders who often lack secure ***land*** tenure, rather than 'shaded' cocoa which is associated with lower short-term yields but is better for biodiversity, water management and environment sustainability.

On the ground, the project also focuses on diversified use of farmland beyond cash crops to include food crops - such as plantain and cassava - and renew coffee plantations as well as the planting of trees with other uses. Partnerships will be sought with investors who are increasing their commitment to sustainability, not least as the larger cocoa business sector risks sharp output reductions from the world's largest cocoa producing country if climate change is not addressed.

This approval marks the first time a REDD+ project is approved in Africa and globally under the Fund's Simplified Approval Process (SAP). The new project is expected to reduce carbon ***emissions*** by 5.5 million tCO2 equivalent over a 20-year span, making a significant contribution to the country's Nationally Determined Contribution pledge to reduce its GHG ***emissions*** by 28 percent by 2030. That goal is linked to an ambitious REDD+ mechanism which the government has committed to implement with the technical assistance of FAO.

ArmeniaThe Green Climate Fund Board approved a $10 million grant for a project on rural green growth and ***forest*** resilience focused on 207 rural communities in Lori Marz and Syunik Marz.

Activities range from provision of energy-efficient fuel-wood stoves - expected to reduce wood consumption by 30 percent and reduce energy poverty in ***forest*** areas - to a broad tree-planting programme that will also increase the ***forest*** cover of the country increasing carbon ***removals*** from ***forests*** by at least 7 percent.

Finally, the project will create new job opportunities for rural households and reduce indoor air polluting increasing the overall resilience of rural households to external shocks. The project is also being financed by the Austrian Development Agency, the Autonomous Province of Bolzano (Italy), the Government of Armenia and WWF- Armenia.

Colombia

In Colombia, the Green Climate Fund is offering $28 million to help finance the existing REDD+ programme, which led to 31.5 million tCO2 equivalent of carbon mitigation in 2015 and 2016. In lieu of active carbon markets, the Fund is making a payment for some of the results achieved.

By utilising funds received through the results based payments scheme, the project will foster green economic growth and development and will enhance the sustainable and inclusive governance of natural resources. The proceeds will be primarily invested in projects involving indigenous peoples and community-based forestry initiatives.

Addressing climate change is a cornerstone of FAO's work, as effective climate action across the ***agricultural*** sectors will promote livelihood resilience and reduce poverty for vulnerable rural communities while conserving the environment and biodiversity.

Last month, FAO Director-General QU Dongyu and Yannick Glemarec, Executive Director of the Green Climate Fund, met to discuss ways to further expand collaboration in the wake of the COVID-19 crisis.

**Load-Date:** August 24, 2020

**End of Document**



[***Is carbon offsetting really helping the planet?; sustainability carbon offsetting Nick Hughes BrewDog, Accolade Wines and Cranswick are just some of the big names using offsetting to reach net zero goals. But is it effective - or simply detracting from the bigger picture?***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:62B9-3CV1-DYTY-C2MY-00000-00&context=1516831)

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**Section:** BUSINESS; Pg. 30,31,32,33

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**Body**

D

rink a glass of wine this weekend and you might be helping fund clean cookstoves in South Africa. Enjoy it with some sausage and mash, and you could be contributing towards a geothermal energy investment in Indonesia.

The reason is carbon offsetting. A tool long used by airlines and oil giants, it enables companies to mitigate carbon debts in their own operations by funding environmental projects on the other side of the globe.

Now it's gaining popularity in grocery. Cranswick, Accolade Wines, BrewDog and Morrisons are just some of the big names using offsetting to reach carbon goals.

Yet the practice is attracting scrutiny from experts, who say it is a distraction from the structural changes organisations need to make. In certain cases, they claim offsetting could even have a negative effect by giving implicit permission to continue high-emitting activities like flying or eating large amounts of meat.

So can carbon offsetting form part of a credible net zero strategy for food and drink businesses? Or is it a 'get out of jail free' card that enables companies to carry on with unsustainable business as usual?

"Offsetting substitute reductions. or misleading claims will

Offsetting is simple enough to do. The voluntary carbon market, which governs offsetting, allows companies to purchase carbon credits from verified suppliers. The revenues are used to finance carbon reduction projects like tree planting and renewable energy generation.

It's becoming an increasingly common practice as the UK strives to become a net zero economy by 2050. Indeed, the Institute for Government says the ***target*** would be "not realistic" without the use of offsetting.

Against this backdrop, "we're seeing a big increase in demand for carbon offsetting from food and beverage companies and the reason for that is there's a big emphasis on how we are going to achieve net zero," says Oliver Forster, director of business development at ClimateCare, which helped create the voluntary carbon market and delivers some of the largest offsetting programmes in the world. "Carbon offsetting is one of the tools in the box."

A tool in the box it may be, but it's not a solution in itself. "The critical thing about offsetting is it's definitely not a silver bullet and it must be part of a broader climate strategy," Forster adds. "For most companies that means measure, reduce, and then offset is the third part."

The sentiment is echoed by Food Ethics Council executive director Dan Crossley, who stresses that offsetting "is not a substitute for ***emissions*** reductions".

That's at least something that both proponents and critics of the method can agree on. Before paying for third-party offsets, it is widely accepted that businesses must look to reduce their own direct ***emissions*** and those right across their value chain.

BrewDog is one example of how offsetting can work within a wider strategy. The brewer proudly declares it is now "carbon negative", meaning it takes twice as much carbon out of the air as it emits.

Offsetting has a role to play, but COO David McDowall stresses that reducing its own ***emissions*** is a "top priority". BrewDog estimates it has achieved around a 30% fall in ***emissions*** versus 2019 and is ***targeting*** a further 40% reduction this year with new initiatives, which include taking power directly from three wind turbines situated near its Scotland brewery and establishing an EV fleet.

is not a for ***emissions*** Making false net zero not wash"

The concern among critics is that businesses are putting too many eggs in the offsetting basket - especially amid pressure to commit to net zero ***targets***. Shell, for example, has faced a backlash from campaigners for its "drive carbon neutral" campaign, which offers customers the opportunity to offset their fuel purchases by funding the protection and development of ***forests***. The argument is that it essentially gives a free pass on fuel consumption, making businesses and shoppers less likely to take alternative action.

That hasn't stopped some food businesses following a similar approach. A case in point is meat supplier Cranswick, which announced in November its Milton Keynes cooked meats plant had become its first facility to be awarded carbon neutral status - a ***target*** achieved in part by purchasing "high-quality offsets". A message of permissibility was key here. Commercial director Jim Brisby noted "customers still want to eat meat, so the best thing we can do is allow them to continue and look at how we can reduce the impact".

This argument doesn't wash with campaigners like Greenpeace chief scientist Doug Parr, though. "The idea that offsetting a flight or consumption of meat makes it somehow OK is wrong," he says. "There is no pathway to zero ***emissions*** in developed countries that doesn't go through rapid decarbonisation of our energy and ***land*** use systems."

The issue facing food businesses is that total decarbonisation of their supply chains is near impossible. Food production relies on biological processes that produce greenhouse gases like carbon dioxide, methane and nitrous oxides.

"Aside from radical new technologies and innovations, the only way to eliminate those ***emissions*** is to stop doing the activity in the first place, or balance those ***emissions*** with commensurate reductions and ***removals*** elsewhere," explains Eli Mitchell-Larson, an advisor to Carbon Direct and researcher at the University of Oxford. So he believes "there is absolutely a role for offsets" in the food and drink sector - "the question then becomes which offsets are we talking about?"

The current way of doing things is unlikely to cut it, in his opinion. Mitchell-Larson was part of a team of academics who last year drew up the Oxford Principles for Net Zero Aligned Carbon Offsetting. The authors said current approaches "are unlikely to deliver the types of offsets needed to achieve global climate goals".

They stressed that offsets must be additional, meaning the ***emissions*** saving would not have happened were it not for the carbon credit being purchased.

Offsets should also focus on ***removing*** carbon from the atmosphere rather than simply reducing ***emissions***.

Mitchell-Larson notes the majority of credits are still issued for avoiding deforestation or funding renewable energy projects, which are reductions rather than ***removals***. This is especially problematic since "when an offset does nothing it actually does worse than nothing, it does harm, because it ate up real corporate ambition and willingness to pay for climate action".

Offsets should also deliver long-lived rather than short-lived carbon storage and have a low risk of reversal. This is especially relevant to nature-based offsets such as tree planting and peatland restoration, which promise to sequester millions of tonnes of carbon in the future. Those gains risk being reversed if the ***forest*** or landscape is destroyed or degraded years from now.

This brings up the issue of the quality of offsets, which can vary substantially across different companies. Ice cream brand Jude's found that out in its work to become carbon negative, which included some offsetting. "It's hard to find really good projects," MD James Wright told The Grocer conference on sustainabilty this week.

Five businesses using offsets to achieve net zero

Accolade Wines In November, Accolade Wines announced that its Europe branded wine portfolio, which includes the Hardys and Echo Falls brands, had been certified carbon neutral.

To achieve that goal, Accolade has partnered with ClimateCare to offset ***emissions*** it can't yet reduce by investing in projects such as afforestation in Chile, clean cookstoves in South Africa and renewable energy in the US and China. "Right now, there is no way for us to conduct our business without creating some ***emissions***," says Caroline Thompson-Hill, MD for Europe at Accolade Wines.

BrewDog The Scottish brewer has gone a step beyond carbon neutrality and claims the business is now carbon negative.

In practice, this means it ***removes*** twice as much carbon from the air each year as it emits. BrewDog currently purchases carbon credits. However, future carbon ***removals*** will come from its 2,050-acre 'BrewDog ***Forest***' in Scotland, where it plans to create native woodlands and peatland.

"The beauty of the multi-use approach is areas that cannot be planted with trees are generally suitable for peatland restoration," says BrewDog COO David McDowall.

Bulldog Skincare In February, Bulldog Skincare announced its full range of moisturisers was carbon neutral.

Caroline Mallet, general manager of Bulldog Skincare, says efforts to reduce direct operational and supply chains ***emissions*** have been prioritised. This includes a switch to using sugarcane plastic instead of a standard fossil fuelbased plastic.

"We would love to be carbon neutral without the use of offsetting in the future but that isn't yet possible," Mallet says. "Some ***emissions*** remain unavoidable and will rely on the complete decarbonisation of the entire global economy."

Cranswick Cranswick claimed a milestone achievement when its Milton Keynes cooked meats plant became the first factory of its kind in the UK to be certified carbon neutral in November. It's all part of a its bid to achieve net zero by 2040.

Alongside investments in more efficient machinery and a switch to 100% renewable electricity at the site, Cranswick has used what it refers to as verifiable "high-quality carbon offsets", through initiatives including the restoration of Doddington North Moor in Northumberland and a geothermal energy investment in Indonesia.

Morrisons Earlier this month, Morrisons pledged to become the first supermarket to be completely supplied by net zero carbon British farms by 2030. It expects its eggs to reach net zero carbon status by 2022, which will be followed by lamb, fruit, vegetables, pork and beef.

Farms will implement a series of measures to become net zero, including offsetting carbon ***emissions*** via planting trees and hedgerows and improving soil health.

"It's years ahead of industry expectations - and an ambitious ***target*** - but it's our duty to do it," said CEO David Potts.

Crossley argues you get what you pay for. The price of carbon credits mostly falls within a £3-£5 per tonne range at the lower end of the quality spectrum and around £25 at the higher end. "If an offset is cheap, it's cheap for a reason," he added at the conference.

So it can be worth paying more. Companies such as ClimateCare, which promises the "highest standards" in its offsets, are confident their projects will make a genuine difference. Although Forster accepts the risk

of long-term reversal is "a challenge we face", he says there are various ways risk is accounted for.

"What we're always looking for with nature-based projects is the strength of the counterparty we're working with on the ground and resilient projects that have multi-stakeholder engagement," he explains. Suppliers also have to assess permanence risk and put carbon credits into a buffer pool to protect for risk of reversal.

To further ensure quality, some companies only pay on a results basis. "The onus is on the projects to prove they have delivered carbon reductions and for this to be independently verified before we pay," says Caroline Thompson-Hill, MD for Europe at Accolade Wines. New carbon technologies Still, there's no denying that popular nature-based solutions like tree planting are unlikely to deliver net zero alone. For a start, there is only so much ***land*** available to plant trees. And if that ***land*** could otherwise have been used for food production it raises complex questions around food security.

Over time, experts believe offsets will need to shifttowards projects that capture carbon directly from the air and store it permanently underground. The challenge is such technologies are at a nascent stage and therefore hugely expensive - sometimes costing upwards of £500 for each carbon credit, according to Mitchell-Larson.

Some, like Greenpeace's Parr, are sceptical such technologies will ever be viable at a large scale. "It's not possible to rule it out but we certainly shouldn't be depending on it. The brutal truth is there isn't a way of buying your way out of this."

Mitchell-Larson, meanwhile, is challenging food and drink businesses to look more closely at ways to balance their own biological ***emissions***. "If you are a company like BrewDog and have high-purity CO2 literally bubbling out of your fermentation process, why not capture that CO2 and find some use for it?" he suggests.

It's an example that could soon become a reality. As part of its strategy, BrewDog is looking to invest in CO2 recovery projects with the aim of being able to capture all the gas emitted in the fermentation process, which will be used downstream to carbonate its beers.

In the meantime, offsetting will continue to play a role. BrewDog recently purchased 2,050 acres of ***land*** in the Scottish Highlands, on which it plans to plant over a million trees. But will that, along with other offsetting initiatives, fulfil the promise of keeping future greenhouse gas ***emissions*** in check? By the time we find out the answer, it might be too late.

Watch our webinar on 'The Path to Net Zero' from this week's How to Build a Sustainable Brand broadcast conference at [*www.thegrocer-conferences.co.uk*](http://www.thegrocer-conferences.co.uk)

How Nestlé is doing it differently

In February, Nestlé published a roadmap that sets out how the global food and beverage giant intends to achieve net zero ***emissions*** by 2050. On paper, the timeline looked conservative compared with some of its sector peers, but there was a catch: Nestlé does not allow offsetting to contribute towards its corporate ambition.

"The guiding principles for us were about authenticity and the most important element of our net zero strategy was actively working on absolute ***emissions*** reductions. Offsetting does not play a role," says Emma Keller, head of sustainability at Nestlé UK & Ireland.

Plans to reduce direct

***emissions*** include a switch to 100% renewable electricity in all Nestlé sites by 2025; making all packaging recyclable or reusable by the same date; and increasing the proportion of plant-based foods across its portfolio.

To balance the vast majority (around 80%) of ***emissions*** that occur within its supply chain, Nestlé is investing billions in what Keller describes as "climatesmart and regenerative ***agricultural*** practices" such as agroforestry systems. These could include tree planting, but Keller suggests there is a clear distinction between offsetting, which happens outside of a business' sphere of influence, and

insetting, which takes place within its own value chain and is a form of carbon ***removal***.

Nestlé will, however, allow individual brands to offset their ***emissions*** to declare themselves net zero ahead of the 2050 corporate ***target***.

Keller says this allows brands such as Nespresso, which has committed to be carbon neutral by 2022, provide "climate-smart choices people can find on supermarket shelves in the short to medium term". She adds, however, over time "we believe those offsets will become less necessary as we start being able to deliver on low-carbon, no-carbon or even carbon-positive solutions".

"Offsetting is not a substitute for ***emissions*** reductions. Making false or misleading net zero claims will not wash" "The brutal truth is there isn't a way of buying your way out of this"

**Load-Date:** April 28, 2021

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[***Green recovery post-COVID-19: Promoting healthy and restored forests***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:60YG-C941-JDG9-Y2H7-00000-00&context=1516831)

Impact News Service

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**Length:** 1195 words

**Body**

Nairobi, Kenya: United Nations Environment Programme has issued the following press release:

Prepared for delivery at the webinar organized by the UN Forum on ***Forests*** Secretariat, UN DESA on the margins of the 75th Session of the United Nations General Assembly, titled “***Forests*** at the heart of a green recovery from COVID-19.”

Liu Zhemin, Under-Secretary-General for Economic and Social Affairs, UNDESAMunir Akram, President of the UN Economic and Social Council and Permanent Representative of Pakistan to the United NationsKitty Sweeb, Chair of the UNFF16/17 and Permanent Representative of the Republic of Suriname to the United NationsElizabeth Mrema, Executive Secretary of the Convention on Biological Diversity

Excellencies, ladies and gentlemen

At this time, most of us are well aware of the situation we find ourselves in: The three planetary crises impacting all life on earth as we know it. The climate change crisis, nature and biodiversity crisis and the pollution and waste crisis. These three crisis, caused by our unsustainable consumption and production are undermining the natural foundations of human existence. The devastating COVID-19 pandemic, is obviously closely linked to these crises.

I think that by now, we are also all aware that we have a window of opportunity for a green recovery from the pandemic. We simply cannot go back to our pre-pandemic nature and climate destructive practices. We need the stimulus packages to have green strings attached. But there is much we can do and many measures that governments can take to stimulate a green recovery. Promoting healthy and restored ***forests*** will have to feature strongly.

This is because without halting and reversing deforestation, climate, biodiversity and sustainability goals cannot be met.

***Land*** conversion due to deforestation, ***agricultural*** practices and other ***land*** use activities causes approximately 23 per cent of global greenhouse gas ***emissions***[1].

IPBES estimates that deforestation and other ***land*** degradation costs the world 10 per cent of global GDP every year in lost ecosystems services such as preventing harmful nutrient run-off into streams or decreasing the effects of floods.

Healthy ***forests*** reduce the risk of future pandemics by creating buffer zones that reduce human-wildlife interactions and conflicts.

Despite the widely known benefits, ***forest*** cover is still declining.

Yes, while the rate of deforestation has slowed in recent years, we are still moving in a negative direction and between 2015-2020, a ***forest*** area the size of Portugal was still lost every year.

To reverse this trend, the recovery from the pandemic must support the transition laid out in the Convention on Biological Diversity’s Global Biodiversity Outlook: Conserving intact ecosystems, restoring ecosystems, reversing degradation, and employing landscape level spatial planning.

But how, specifically, do we do this? We need to take three policy steps with determination:

First, we need to reform ***agriculture***, the largest cause of deforestation.

***Agriculture*** subsidies and other public support runs at over USD 700 billion a year, with only around 15 percent ***targeted*** at public goods. A shift in policy priorities could move ***agriculture*** away from deforestation and into restorative and regenerative ***agriculture***, nature-positive ***agriculture*** and therefore towards the restoration of degraded ***lands***.

The UNEP and Rabobank AGRI3 fund, with USD 1 billion available in loans to farmers, is supporting COVID-19 economic recovery by accelerating shifts towards sustainable ***agriculture***. But this needs to be scaled up and replicated on a massive scale.

A shift towards regenerative ***agriculture*** is possible. It is already beginning. For example, India plans to move to a new system called ‘Zero Budget Natural Farming’ which has been successfully introduced in Andhra Pradesh State. With over 260,000 ha farmed under this approach so far, it has had remarkable returns, accompanied by increases in small-holder farmer income, while phasing out synthetic pesticides and fertilizers.

Secondly, we must find ways to unlock private sector investments to fund ***forest*** conservation and restoration.

***Forests*** and other nature-based solutions represent one-third of the solution to climate change but receive less than three per cent of climate finance. Large amounts have of course been invested in new technologies and new energy infrastructure.

However, it is important that we get carbon markets moving and that we send a strong signal to incentivize a first gigatonne in private-sector ***forest*** investments, through a combination of ***emission*** reductions from avoided deforestation and carbon ***removals*** from ***forest*** restoration.

Unlocking a first green gigatonne requires USD 10 to 15 billion of investments. To get there, performance-based payments for ***forest*** conservation and restoration should be scaled up and the price of ***forest*** carbon through REDD+ should obviously reflect the costs of policies and other measures for avoided deforestation.

UNEP is a proud partner of the UN-REDD Programme, the UN Flagship programme on ***forest*** action, helping 65 developing countries to better conserve, manage and restore their ***forests***. A global carbon market combined with a sustainable and fair price for ***forest*** carbon would make a massive difference to these countries’ efforts.

We at UNEP, together with our FAO colleagues and crowding in many partners from across the world, look forward to the launch of the UN Decade on Ecosystem Restoration (2021-2030) as the Decade will provide us a global platform to spur investment.

And thirdly, we absolutely must back multilateralism to boost action.

Next year gives us an opportunity to join the biodiversity and climate agendas under the umbrella of the SDGs. The post-2020 global framework for biodiversity, and nature-based climate solutions like REDD+ in the Paris Agreement, are starting to get the attention they deserve. If we harness political will, investments will follow.

We need to aim for nothing less than a multi-billion USD annual flow of investments into ***forest*** conservation and restoration.

If this sounds too ambitious, it is not.

In the 1930s, Franklin D. Roosevelt deployed hundreds of thousands of unemployed American to plant billions of trees. In the 1950s, South Korea responded to famine and a refugee crisis by restoring ***forests*** and landscapes. Massive restoration is underway today with the Great Green Wall, an 8,000-kilometer long ecosystem innovation along the southern edge of the Sahara Desert.

This is the scale we must aim for.

The difference between the right and wrong policies is huge.

The Food and ***Land*** Use Coalition found that 1.2 billion hectares of ***land*** used for ***agriculture*** could be freed up for restoration by 2050 with the right incentives and signals. If we follow current ***agricultural*** practices and trends, however, a further 400 million hectares of natural ecosystems will be converted from ***forest*** ***lands*** to ***agricultural*** ***lands***. This is simply unsustainable.

Put bluntly, either we get it wrong and push the world deeper into trouble, or we get it right and deliver benefits for biodiversity, the climate, jobs, economies and human health.

The choice is clear.

**Load-Date:** September 30, 2020

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[***Ask an Expert The Green Glacier: What is Conifer Encroachment and Why is it Bad?***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:631X-HKW1-F0YC-N4TP-00000-00&context=1516831)

Impact News Service

June 28, 2021 Monday

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**Length:** 2137 words

**Body**

Washington: US Department of ***Agriculture*** has issued the following news release:

As a general rule, humans love trees. It’s not surprising; there’s a lot about trees to like. Trees help clean our air, pull carbon dioxide from the atmosphere, and help provide clean water. Studies show that people prefer living and shopping along tree-lined streets. No doubt, a big part of our collective appreciation of trees is their beauty. It’s hard to walk through a shady ***forest*** and not be captivated by the simple beauty it provides.

But trees don’t belong everywhere. Across the globe, vast swaths of the landscape are naturally treeless, and they make up 40% of all terrestrial ecosystems. They’re not barren landscapes, devoid of life. Rather, they’re some of our most productive and important ecosystems. These areas – known as grasslands, shrublands, prairies, steppes, pampas, or more generally, rangelands – are dominated by native grasses, wildflowers, and shrubs. They play a critical role in providing society with food and fiber, clean water supplies, and support a remarkable diversity of unique wildlife that don’t live in ***forests***.

In the U.S , one-third of the country was once virtually treeless, including iconic regions like the Great Plains and sagebrush country in 13 western states. But these landscapes are changing. From Nebraska to Oregon, rangelands are slowly transitioning to woodlands, dominated by eastern redcedar, pinyon pine and juniper, Douglas fir, mesquite, and other trees. Of course, these tree species always existed adjacent to rangelands but were confined to higher elevations, fuel limited places, and along creeks and rivers where fire didn’t spread. As landscapes transition from rangeland to woodland, we stand to lose the critical services and values they provide.

For the last decade, the Sage Grouse Initiative has worked with private landowners, public ***land*** managers, and NGOs to help maintain and restore rangelands impacted by woodland expansion. This work, grounded in science and focused on improving priority wildlife habitat, has become a hallmark of our efforts in the West.

We sat down with Jeremy Maestas, a sagebrush ecosystem specialist at the NRCS’ West National Technology Support Center in Oregon to learn more about the impact encroaching trees, and specifically the conifer trees that grow in the Intermountain West, are having on our sagebrush and grassland landscapes.

Can you tell us about the conifer expansion issue in the Intermountain West?

Sure. Extensive research shows us that native conifer trees, primarily juniper and pinyon pine, but also other conifers, have been increasing their footprint on the landscape at an unprecedented rate over the last 150 years or so, especially in places like the Great Basin. This is part of a global phenomenon of trees encroaching into and replacing adjacent grasslands and shrublands.

Some of that change is expansion in the traditional sense, that is, trees moving from higher elevations or fuel-limited sites protected from fire where they historically existed into areas where they never grew before. But much of the change is what we call ‘infill,’ which is what happens after trees colonize and continue to populate previously tree-less landscapes, turning them from sagebrush or grasslands with just a few trees per acre into closed-canopy woodlands – what you might think of as a ***forest***.

I’ve always thought more trees is a good thing. Why is that not the case?

Trees are good! But context is everything. It’s important to acknowledge that pinyon-juniper woodlands and other conifer ***forests*** are incredibly important native ecosystems in their own right. They’ve been here for millennia and they provide valuable habitat and ecosystem services that are worth conserving too.

But, here’s the rub: their continued expansion is coming at a cost to imperiled ecosystems. In fact, 90% of tree expansion in the Intermountain West has occurred in sagebrush steppe – a habitat type that has already been reduced by half due to a wide variety of threats.

This transition from sagebrush and grassland ecosystems to woodlands and ***forests*** has consequences for things we care about as a society, such as, unique wildlife, functioning watersheds, and productive grazing ***lands***. Species like sage grouse, found nowhere else in the world, are particularly sensitive to tall structures, like trees, and will abandon breeding habitats when there are just a few trees per acre. Conifer expansion also sucks up precious soil moisture needed on arid ***lands*** to grow other native plants, which means less food and cover not only for wildlife but livestock that sustain rural ***agricultural*** economies in the West.

What’s driving the expansion?

Unfortunately, the causes aren’t well understood but the evidence points to climate and reduced fire. The western U.S experienced a favorable climate (cooler and wetter) in the late 1800s through the early 1900s that likely helped trees begin their accelerated march into new habitats. However, the effects of climate cannot be separated from other factors like Euro-American settlement and heavy livestock grazing of the region that occurred during the same time. The reduction of grasses through grazing is thought to have reduced natural wildfires. Later in the century, active fire suppression also allowed trees to expand and infill areas where they would have been burned historically.

What is being done to address this problem? Is it enough?

***Land*** managers use a variety of techniques including mechanical tools, like chainsaws or heavy machinery, and prescribed fire to ***remove*** expanding conifers. While pinyon-juniper management has been occurring for decades for many different purposes, ***removal*** has really been ramped up in strategic places over the last decade to save sage grouse and sagebrush habitats. This has been a top priority for Sage Grouse Initiative partners on private and public ***lands*** in places like Oregon, Idaho, and Utah.

Your question about the scale of management is timely. We recentlypublished a studythat used satellite remote sensing data to quantify the extent of conifer reduction in sagebrush country. We found that total footprint of conifers in the region actually decreased by 1.6% over the last several years, with about two-thirds of that due to management and the other third due to wildfire. So, the short answer is we are making progress.

However, the sobering news is that researchers estimate pinyon-juniper trees continue increasing at a rate of between 0.4% and 1.5% annually. In the Great Basin alone, that has resulted in 1.1 million acres transitioning to ***forests*** since 2000, just 20 years. While the scale of conifer management may sound like a lot, it may just be keeping up with the current rate of expansion and infill. More needs to be done in priority watersheds.

What outcomes have you seen from this type of restoration work so far?

Well, thanks to some long-term research, we now know sage grouse are benefiting. Along-term study in Oregonshowed that sage grouse population growth rates increased 12% following the strategic ***removal*** of conifer trees when compared to a nearby area where no trees were removed. This is one of the only habitat restoration techniques that has actually been scientifically proven to work for grouse, so these findings are huge.

Other sagebrush-dependent wildlife benefit as well. Studies have shown that in Colorado, mule deer fawn survival during the winter increased by 15% following conifer ***removal***. The abundance of Brewers sparrow, a sagebrush-dependent songbird, doubled following conifer ***removal*** in another Oregon-based study.

Several other studies have shown two-to-twenty-fold increases in wildflowers and native grasses following conifer ***removal***, improving forage for wildlife, pollinators, and livestock.

What’s the downside to ***removing*** conifer trees?

That’s a great question. For me, the effect of conifer ***removal*** (positive or negative) comes down mostly to where on the landscape the treatment is being done. In other words, it’s context dependent. There are some places, like in the middle of a historic pinyon-juniper woodland, where ***removing*** all the trees isn’t appropriate. That’s why we use what we call Ecological Site data, derived from the soils, to help tell us which sites were historically grasslands and shrublands versus woodlands and ***forests***. Sage Grouse Initiative partners focus on ***removing*** encroaching conifer trees from former sagebrush sites in priority habitats for sage grouse. We work hard to ensure our treatments are highly ***targeted*** and designed to improve the health and resilience of places that used to be treeless sagebrush rangelands.

Obviously, there are a suite of wildlife that use, and depend on, conifer woodlands and ***forests*** so there is some concern about the impacts of ***removal*** on them. As you might expect, though, many of these species are also increasing as the footprint of trees grows. For example, many migratory songbirds that rely on pinyon-juniper woodlands, such as, the ash-throated flycatcher, juniper titmouse, gray vireo, and gray flycatcher, actually have stable-to-increasing population trends according to long-term monitoring data. One notable exception is the pinyon jay, which has experienced steep declines despite having more woodland habitat available. The causes of this are not well understood, but we suspect declines may be more related to the overall health and structure of historic pinyon-juniper stands than to the ***removal*** of trees from sagebrush habitats. Pinyon jay nesting is closely linked to the health of pinyon pine trees which has been declining as woodlands get thicker and suffer from prolonged drought.

The bottom line is that we need to take a holistic view the of landscape, from ridge top to valley bottom, in order to ensure restoration addresses the health of all ***lands*** including pinyon-juniper woodlands and ***forests***. We’re not picking winners and losers; we’re just balancing the tables to ensure we don’t lose imperiled ecosystems and the species that rely on them.

Cheatgrass and other invasive annual grasses are also major threats to sagebrush country. Does ***removing*** conifer trees lead to cheatgrass invasion?

Unfortunately, cheatgrass is present throughout much of our sagebrush country and therefore is a new reality that must be considered in every management decision we make. Conifer ***removal*** doesn’t cause cheatgrass to invade, per se. Cheatgrass doesn’t just appear out of thin air. If cheatgrass increases following conifer ***removal***, that’s because it was therebeforethe conifers were removed. Like any vegetation, it’s simply taking advantage of the increases in sunlight, water and nutrients that stemmed from ***removing*** the conifers in the first place.

We know the risk of cheatgrass getting worse depends upon the site conditions, so we are using that knowledge to mitigate potential problems. For example, sites that are warmer and drier pose a higher risk. Also, maintaining healthy perennial bunchgrasses is key to resisting spread of cheatgrass. Managers use this information to plan follow-up weed control, seeding, and grazing management to keep invasive annuals at bay.

It’s important to note that doing nothing also poses risks. As shrublands transition to woodlands, fuel loads increase dramatically and perennial grasses decrease which sets us up for disaster when wildfire strikes. Hotter canopy fires in woodlands with a poor understory are ripe for wholesale cheatgrass conversion. Through conifer ***removal*** during early phases of woodland development, we’re actually trying to prevent a more catastrophic scenario from playing out.

What’s the most important thing you want readers to know about conifer ***removal*** in sagebrush country?

That’s easy: it works. It’s one of the few restoration practices for which we have the science showing a host of benefits, from water to wildlife. You can’t say that for some of the other restoration practices in sagebrush country. Do we need to continue monitoring and refining our treatments? Absolutely. But the weight of evidence suggests this is an important practice if we’re going to maintain sagebrush habitats that are under threat from many factors.

I’d also say this isn’t just a problem in the past. Conifer encroachment continues today, as shown by the satellite data. Conservation partners are going to need to band together in priority watersheds and accelerate management in order to get ahead of the rate of expansion and infill.

Keep in mind that this also isn’t just a local problem; it’s part of a larger phenomenon impacting grasslands and shrublands around the world. It’s easy to underestimate the scale of change and impacts of conifer encroachment, but the consequences are truly on par with human-caused losses of rangelands like cropland conversion and development.

**Load-Date:** July 1, 2021

**End of Document**



[***Plans submitted for solar power site***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:615H-CWR1-F0JC-M15K-00000-00&context=1516831)

Salisbury Journal

October 28, 2020 Wednesday

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**Length:** 360 words

**Byline:** [*Katy Griffin*](http://Katy Griffin)

**Body**

Plans have been submitted to build a solar power site on ***land*** at Hamer in Somerley.

The "renewable led energy generating station" comprises a 23MW ground-mounted solar photovoltaic solar array with substation and inverter/transformer.

A design and access statement submitted with the plans said: "The proposed development responds to the government's support for solar energy by providing a greater renewable energy supply that would reduce carbon ***emissions*** and assist in establishing a diversity of energy sources in the UK. The biodiversity of the site would also be significantly improved."

The site is made up of four parcels of ***agricultural*** ***land***, which are currently used for grazing, and is accessed from Harbridge Drove.

The statement says that the development is "anticipated to generate approximately 23,566 MWh per year (after anticipated system losses)" and adds: "This is the equivalent of 5,802 New ***Forest*** district homes (4,062kWh/pa/household) and displacement of 8,436 t/CO2 compared with conventional fossil fuel generation sources."

The site would have rows of solar photovoltaic panels. There will be inverter and transformer stations within shipping containers, as well as one substation and one switchroom, connected by underground cables. The statement also said that the design would "respect the character of the landscape and use the strong field boundaries to integrate the scheme into the landscape as far as practicable" and existing landscape features would be "protected and strengthened."

It adds that "all trees and hedgerows on/around the site would be retained and additional planting provided, where necessary, to fill gaps in the existing boundary planting".

The design, the plans say, would also allow for the option of "low intensity grazing" of livestock.

It also said: "Following decommission of the modules, the proposal is fully reversible and as there are no significant changes made to the ***land*** in terms of earth ***removal*** or levelling, there will be no constraints on returning the site to its current condition."

To view or comment on the plans go to New ***Forest*** District Council website, newforest.gov.uk (reference 20/11073).

**Load-Date:** October 28, 2020

**End of Document**



[***Forest planting falls 70pc short of Government target for 2020***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:632Y-YX51-JCBW-N1TW-00000-00&context=1516831)

Irish Independent

July 6, 2021 Tuesday

Edition 1, National Edition

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**Section:** FARMING;NEWS; Pg. 6

**Length:** 768 words

**Byline:** Claire Mc Cormack

**Body**

Just 2,434ha of new ***forests*** were created in the country last year - only 30pc of the Government's annual planting ***target*** of 8,000ha, a new report has confirmed.

The news comes as farm leaders continue to put pressure on the Department of ***Agriculture*** over the ongoing forestry licensing crisis - around 1,500 new licences have been issued for 2021, just over 30pc of the Department's ***target*** of 4,500 by the end of the year.

According to the Department's newly published annual ***Forest*** Statistics Report, Cork had the highest afforestation area last year at 293ha, followed by Kerry at 289ha.

Farmers It says 50.8pc of ***forests*** are in public ownership, with the remainder in private ownership. Farmers accounted for 81pc of private ***lands*** afforested between 1980 and 2020.

Nationally, it says, conifer species are "the dominant species present", representing 71pc of ***forest*** area, while broadleaved species accounted for 29pc. The proportion of broadleaves in new ***forests*** created during 2020 is 34pc, an increase of nine per cent on 2019.

Native woodlands established as part of the afforestation scheme in 2020 represented 19pc of the total area, up 10pc on 2019.

Other findings of the report, which is prepared annually by the Department, include: ¦ in 2020, total expenditure was (EURO)79.2m, which includes afforestation grants, annual premium payments and grants for ***forest*** road infrastructure; ¦ since 1980, over 23,000 private ***land*** owners have received grant aid to establish ***forests***. The average size of private grant-aided afforestation since 1980 is 8.6ha; ¦ the construction of nearly 100km of private ***forest*** roads was funded in 2020. This, the report says, reflects the projected increase in timber and wood to be harvested, which is expected to double by 2030; ¦ felling licences were issued during 2020 for the thinning of 7,605ha and the clearfelling of 11,870ha; ¦ according to the State of Europe's ***Forests*** 2020 report,

Ireland has one of the highest annual rates of change in ***forest*** area in Europe, expressed as a percentage of total ***forest*** area; ¦ in 2019, Ireland's ***forests*** removed close to five million tonnes of carbon dioxide.

Minister of State at the Department, Senator Pippa Hackett, said: "The decreasing trend in the area being afforested annually is something that needs to be addressed. Objectives "New forestry is essential to meeting not only our economic objectives, but also our climate-change ***targets*** and our aims in terms of enhancing biodiversity.

"Therefore, the immediate priority is to address the current licensing difficulties and deliver on the objectives set out in Project Woodland. My Department is also examining ways of promoting tree planting on farms on a smaller scale than our existing afforestation schemes for inclusion in the next CAP under agri-environment schemes.

"The primary aim of these measures is to promote and enhance biodiversity, by protecting important environmental resources and generating carbon sinks."

Meanwhile, IFA farm forestry chairman Vincent Nally said farmers "need clarity" on when the licensing backlog will be cleared.

He said improvements to the appropriate assessment procedures and the ***removal*** of the need to submit a Natura Impact Statement in order for a felling and road application to be prioritised were "positive developments". "We need to see new ***targets*** and increased output of licences associated with these improvements," he said. "Farmers have heard similar promises from the Department in the recent past, but the increased output never materialised.

"The Department issued a circular to the industry notifying them of changes to private tree-felling licence (TFL) applications following an internal review of the system and appropriate assessment procedures.

"These changes are very much tinkering around the edges of a system that does not work for farmers.

"We are waiting on Project Woodland, which will hopefully lead to a complete overhaul of the ***forest*** licensing system, to deliver a new and improved system that will support farmers to plant more trees on farms.

"Each of these licences represents a ***forest*** owner who wants to manage their ***forest***. Every additional week limits their management options and potentially reduces the value of their timber crop."

He stressed that a Natura Impact Statement may still be requested by the Department and under these circumstances, it was vital that an environmental planning grant was introduced to support farmers with the cost.

There are around 6,000 ***forest*** licences in the system, of which 1,860 are privately held and for afforestation. Road and felling are with the ecology section.

**Graphic**

Backlog: Just 2,434ha of new ***forests*** were created in the country last year

**Load-Date:** July 6, 2021

**End of Document**



[***Climate and nature crises: solve both or solve neither, say experts***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:62WG-20D1-DY4H-K341-00000-00&context=1516831)

The Guardian (London)

June 10, 2021 Thursday 2:00 PM GMT

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**Section:** ENVIRONMENT; Version:1

**Length:** 855 words

**Byline:** Damian Carrington Environment editor

**Highlight:** Restoring nature boosts biodiversity and ecosystems that can rapidly and cheaply absorb carbon ***emissions***

**Body**

Humanity must solve the climate and nature crises together or solve neither, according to a report from 50 of the world's leading scientists.

Global heating and the destruction of wildlife is wreaking [*increasing damage on the natural world*](https://www.theguardian.com/environment/2019/may/06/human-society-under-urgent-threat-loss-earth-natural-life-un-report) , which humanity depends on for food, water and clean air. Many of the human activities causing the crises are the same and the scientists said increased use of [*nature as a solution*](https://www.theguardian.com/environment/2020/oct/14/re-wild-to-mitigate-the-climate-crisis-urge-leading-scientists) was vital.

The devastation of [***forests***](https://www.theguardian.com/environment/2021/mar/31/destruction-of-worlds-forests-increased-sharply-in-2020-loss-tree-cover-tropical) , peatlands, [*mangroves*](https://www.theguardian.com/environment/2019/oct/03/shocked-scientists-find-400km-of-dead-and-damaged-mangroves-in-gulf-of-carpentaria) and other ecosystems has decimated wildlife populations and released huge amounts of carbon dioxide. Rising temperatures and extreme weather are, in turn increasingly damaging biodiversity.

But restoring and protecting nature boosts biodiversity and the ecosystems that can rapidly and cheaply absorb carbon again, the researchers said. While this is crucial, the scientists emphasise that rapid cuts in fossil fuel burning is also essential to ending the climate emergency.

They also warned against action on one crisis inadvertently aggravating the other, such as creating monoculture tree plantations that store carbon but are wildlife deserts and more vulnerable to extreme weather.

"It is clear that we cannot solve [the global biodiversity and climate crises] in isolation - we either solve both or we solve neither," said Sveinung Rotevatn, Norway's climate and environment minister.

The [*peer-reviewed report*](http://www.ipbes.net/biodiversityclimatescience) was produced by the world's leading biodiversity and climate experts, who were convened by the Intergovernmental Panel on Climate Change and the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services, both which report to the world's political leaders.

The report identified actions to simultaneously fight the climate and nature crises, including expanding nature reserves and restoring - or halting the loss of - ecosystems rich in species and carbon, such as ***forests***, natural grasslands and kelp ***forests***.

"It's very disturbing to see the impacts over recent years," said Prof Alex David Rogers, of conservation group REV Ocean and the University of Oxford, and a report author. "Between 1970 and 2000, mangrove ***forests*** have lost about 40% of their cover and salt marshes an estimated 60%. We've also lost half of coral cover since Victorian times."

Food systems cause a third of all greenhouse gas ***emissions***, and more sustainable farming is another important action, helped by the ending of destructive subsidies and rich nations eating less meat and cutting food waste.

"Animal ***agriculture*** not only emits 10 to 100 times more greenhouse gases per unit product than plant-based foods, they also use 10 to 100 times more ***land***," said Prof Pete Smith, of the University of Aberdeen. "So [*more plant-based diets*](https://www.theguardian.com/environment/2018/may/31/avoiding-meat-and-dairy-is-single-biggest-way-to-reduce-your-impact-on-earth) would mean more environmentally friendly farming and then there would be more ***land*** on which to apply nature-based solutions."

The scientists also warned against actions that tackled one crisis but worsened the other. "When I went for a walk in a plantation ***forest*** in England, it was sterile. It was a single, non-native species of tree," said Prof Camille Parmesan, of the University of Plymouth. "There was nothing else there, no insects, no birds, no undergrowth. You might as well have built a concrete building."

Past tree planting on carbon-rich peatlands that had never been ***forested*** was another example, said Smith. "That was an epic fail for the climate and for biodiversity."

Planting very large areas with single crops to burn for energy was also problematic, even if the CO2 was captured and buried, Smith said: "To get the billions of tonnes of carbon ***removal*** that has been proposed in some scenarios for global stabilisation of climate, you would need thousands of millions of hectares - an area twice the size of India."

Protecting and restoring natural ecosystems was the fastest and cheapest way to ***remove*** CO2 from the atmosphere, the scientists said. Cutting fossil fuel ***emissions*** was essential, but not enough at this point in the climate crisis, said Parmesan. "We cannot avoid dangerous climate change without soaking up some of the carbon that we've already put into the atmosphere and the best way to suck up carbon is using the power of plants," she said.

"The science of restoration of ecosystems has really blossomed over the last 40 years. We are now able to efficiently and effectively restore complex systems, tropical rainforest, coastal wetlands, kelp ***forests*** and seagrass meadows, natural American prairie, and UK meadows back to their near historical diversity."

Prof Mark Maslin, of University College London, said the report was seminal: "The science is very clear that climate change and biodiversity are inseparable. To stabilise climate change we need massive rewilding and reforestation."

The UK environment minister, Zac Goldsmith, said: "This is an absolutely critical year for nature and climate. With the UN biodiversity [and climate summits], we have an opportunity and responsibility to put the world on a path to recovery. This hugely valuable report makes it clear that addressing biodiversity loss and climate change together offers our best chance of doing so."

**Load-Date:** June 10, 2021

**End of Document**



[***FIT FOR 55 LEGISLATIVE PACKAGE***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:634G-2K11-F0YC-N4YC-00000-00&context=1516831)

Impact News Service

July 12, 2021 Monday

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**Length:** 2413 words

**Body**

Brussels, Belgium: Association of Accredited Public Policy Advocates has issued the following press release:

Fit for 55 is a mammoth collection of policy measures aimed at enabling the EU to cut ***emissions*** by at least 55 percent by 2030. Massive changes are in store for everyone: people, businesses, governments.

The Commission is looking to revise existing proposals, from ***emission*** standards for cars to new renewable energy and efficiency ***targets***, as well as come up with a whole new levy for polluting imports and a social fund to shield poor and vulnerable households from rising fuel prices

Revision of the EU ***Emissions*** Trading System (ETS): The cornerstone of Europe’s climate policy, the ETS is a market-based mechanism that puts a price on each tonne of carbon emitted by around 10,000 installations in the power sector and manufacturing industry, as well as intra-EU flights. The current scheme covers around 40% of the EU’s total greenhouse gas ***emissions***, the remaining 60% being covered by the effort sharing regulation, which addresses ***emissions*** from transport, industry and ***agriculture***. The system works by setting a cap of total ***emissions*** that decreases over time. Companies can then buy and trade emitting permits. The current cap was designed to enable ***emissions*** reductions of 40% by 2030. With the reform, the European Commission aims to adjust the cap to the EU’s new ***target*** of cutting ***emissions*** by 55%. Environmental groups, like Climate Action Network Europe, have urged the EU to ***remove*** 450 million allowances from the market as quickly as possible in order to prop up the carbon price. NGOs have also criticised the practice of distributing allowances to some industries free of charge, saying it goes against the polluter pays principle. EU auditors found that these have hampered the EU’s attempt to decarbonise. As part of the revision, the Commission plans to expand the ETS to cover the maritime sector. A separate sytem would be created covering buildings and road transport. This has caused concern among countries like Poland and some EU lawmakers because of its possible impact on Europe’s poorest households. But some, like industry body Eurogas and the think tank Agora Energiewende support the move.Climate action social facility: To tackle the potential social impact of the new ETS, the European Commission is planning to introduce a climate action social fund. At least 50% of revenues generated by the ETS would l be earmarked to the new fund. Part of the revenues generated from ***emissions*** trading in road transport and buildings could be put into a dedicated fund, so that member states can use those revenues to compensate the cost of this transition to vulnerable citizens.Revision of the Effort Sharing Regulation (ESR): Working in tandem with the ETS is the effort sharing regulation, which covers ***agriculture***, transport, buildings and waste – or around 60% of Europe’s ***emissions***. The regulation covers the sectors left out by the ETS, and sets binding ***targets*** for each EU country, depending on their GDP. It is unclear yet how the updated regulation will work with the new ETS for buildings and transport. According to EU officials, buildings and transport will remain covered by national-level ***targets*** while the new ETS will come on top, acting as a price signal to incentivise decarbonisation. WWF, a green NGO, has warned against completely scrapping the regulation, saying this would ***remove*** incentives for climate action at the national level. “Repealing the effort sharing regulation is completely unacceptable. It is Europe’s most significant climate regulation and is a key driver of both national measures and member state support for EU measures,” it said.Revision of the Regulation on the inclusion of greenhouse gas ***emissions*** and ***removals*** from ***land*** use, ***land*** use change and forestry (LULUCF). Adopted in 2018, it sets a binding requirement for each EU country to make sure that ***emissions*** from these sectors are compensated by CO2 ***removals*** – the ‘no debit’ rule. EU countries already had that commitment under the Kyoto Protocol – the predecessor to the Paris Agreement – but the regulation will see this brought into EU law for the first time for 2021-2030. More pressure is likely to be put on LULUCF now because of the inclusion of carbon sinks in the EU’s 2030 greenhouse gas reduction ***target***. During the negotiations on Europe’s climate law, the Commission said it would consider proposing a ***target*** of sequestering 300 million tonnes of carbon – up from the current aim of 225 million. The Commission is aiming for -310 million tonnes of carbon sequestration.Proposal for a carbon border adjustment mechanism: The carbon border adjustment mechanism, or CBAM is a measure that aims to protect European businesses from environmental dumping and prevent “carbon leakage” whereby industries relocate production or new factories abroad in search of lower production costs. It will take the form of a regulation, covering cement, fertilisers, iron & steel, aluminium, and electricity. Free allowances under the ETS would l also be phased out for sectors covered by CBAM, although it is not yet clear when. This will be crucial to determine whether CBAM is compatible with rules set out under the World Trade Organisation (WTO), which prohibit double compensation for industries. Brussels is walking on eggshells with the proposal, which has already raised concern from the US, China and other emerging economies. Recent plans show no exemptions for developing countries – instead, the Commission appears to be going for a system of climate finance for developing countries, funded by the measure. While the European Parliament has been strongly in favour of the idea and called for the mechanism to be in place by 2023, others have been more cautious. The European aluminium industry has already come out against it saying it would be preferable to keep free ETS allowances instead. The European Parliament also rejected plans to scrap free allocations to industry, which could become an issue for the scheme’s WTO compatibility.Revision of the renewable energy directive: The renewable energy directive performs two main roles: defining what energy sources are regarded as ‘renewable’ and setting out binding ***targets*** for renewables in Europe’s energy mix. The EU’s aim to hit net zero ***emissions*** by mid-century will require a huge increase in Europe’s renewable energy generation capacity. In 2018, the EU set a 32% ***target*** for renewable energy in Europe’s mix by 2030, up from around 20% currently. This will need to roughly double to 38-40% in order to reach the bloc’s updated climate ambition, according to the European Commission. The directive has met criticism over the role of bioenergy, with campaigners expressing concerns about the environmental impact of increased biomass production, and the forestry sector, which wants biomass sustainability criteria to remain unchanged from the 2018 version. There are also concerns that the European Commission could open the door to fossil gas through the inclusion of ‘low-carbon’ fuels in the EU’s renewable energy directive.Revision of the energy efficiency directive: Last revised in 2018, the energy efficiency directive aims to achieve savings of at least 32.5% by 2030. The ***target*** is currently non-binding but the European Commission now plans to make it a legal obligation. Energy efficiency and renewable energy will go hand in hand to ensure Europe reaches its goal of net zero ***emissions*** by 2050. Put simply, the more energy-efficient Europe is, the less renewable energy it will need.Campaigners have called for an energy savings goal of at least 45% and nationally binding ***targets*** to ensure accountability across EU countries. Renovation is also a core part of the directive. There is currently a 3% ***target*** for renovating publicly owned and occupied buildings, but this is tiny compared to the mass of European buildings that will need renovating before 2050. To tackle this, the ***target*** should be expanded to “all public buildings, prioritising schools, hospitals and social housing according to the Coalition for Energy Savings.Revision of the energy taxation directive: Last agreed in 2003, the energy taxation directive is in desperate need of an update. It sets minimum tax rates for energy products, like heating, transport fuels and electricity, but was never adjusted to inflation. Another issue is that, under the current system, oil and gas is taxed less than electricity, something that will need to change since the electrification of buildings, transport and industry is a key pillar of the green transition. There are also issues for road transport, where more-polluting diesel is taxed less than petrol, as well as in aviation where kerosene is entirely exempt from tax. Because of this, the revision could have a huge impact on the fossil fuel industry. Currently, fossil fuel sees exemptions and lower tax rates amounting to around €35 billion every year – nearly four times the tax expenditures for renewables. Any changes will need to be agreed with unanimity from EU countries. A previous attempt to revise the legislation started in 2011, but the European Commission withdrew the proposal in 2015 in the face of opposition from EU member states who stuck to the unanimity rule.New EU ***forest*** strategy: The Commission plans to adopt stronger and more transparent governance rules for forestry and reaffirm its commitment to strictly protect all primary and old-growth ***forests***, which would be defined at EU level. The draft is welcomed by environmental NGOs but criticised by the forestry industry, which says the plan ignores the economic role of ***forests***. In Parliament, the European People’s Party (EPP) has called on the European Commission to fix the imbalance between the role of ***forests*** in tackling climate change and their role in the economy. Countries with large ***forest*** industries, such as Finland and Sweden, are seen opposing the Commission’s plan and could receive backing from others like France.Revision of the directive on deployment of alternative fuels infrastructure: In updating the 2014 AFID directive, the EU executive aims to make it easier for alternatively powered vehicles to recharge and refuel across the bloc – a particularly pressing mission as consumers are increasingly turning to electric vehicles. In addition to facilitating recharging for electric cars and refuelling for hydrogen trucks, the revision seeks to end the current lack of transparency on pricing and facilitate cross-border payments when charging e-vehicles, an issue flagged by the European Court of Auditors in a recent report. The European Commission has already announced its ambition to increase the number of electric charging points to 1 million by 2025, rising to 3 million by 2030.Revision of the regulation setting CO2 standards for new cars and vans: A key part of the EU’s drive to cut road transport ***emissions***, the revised regulation is expected to impose CO2 performance standards requiring vehicles to be almost ***emissions***-free. Last updated in 2019 (and only in force since the start of 2020), the regulation allocates vehicle manufacturers a carbon budget based on the weight of vehicles registered in a given year. Should ***emissions*** exceed the CO2 ***target*** assigned, the manufacturer must pay a penalty on the excess ***emissions***. This carbon budget will likely be curtailed further in the revision, as the EU pushes to end tailpipe ***emissions***. Drafts of the regulation update require a 60% to 90% cut in ***emissions*** from new vehicles by 2030, with hefty penalties for carmakers who fail to meet the ***target***. The move is widely seen as laying the groundwork for an EU-wide switch to electric mobility. A related draft ***emission*** standard proposal called ‘Euro 7 has already drawn fire from the automotive industry, with some car manufacturers labelling it “a ban through the back door “” of the combustion engine.RefuelEU Aviation – sustainable aviation fuels : ReFuelEU Aviation aims to cut ***emissions*** in the notoriously carbon-intensive aviation sector by increasing the amount of green jet fuel used within the EU. To increase the supply of sustainable aviation fuels (SAFs), the EU is set to impose a blending mandate. All aircraft departing from EU airports will be required to refuel using green jet fuel. Sources with knowledge of the proposal indicate that there will be a 2% SAF requirement in 2025, moving to 5% in 2030, 20% in 2035, 32% in 2040, and 63% in 2050. In addition, a sub-mandate for e-fuels – such as hydrogen produced from electrolysis – is under discussion, potentially starting at 0.7% in 2030 and increasing to 25% by 2050. At present, SAFs, which are made from advanced biofuels and renewable electro-fuels, count for less than 1% of the aviation fuels used in the EU. This is partly due to SAFs being limited in supply and up to five times more expensive than kerosene. However, one big advantage of SAFs is that they can be mixed with kerosene without any changes to the aircraft engine – up to around 50%. This makes them an attractive means to decarbonise flights as low-carbon aviation technology comes to maturity.FuelEU Maritime – green European maritime space: Similar to its aviation counterpart, FuelEU Maritime aims to decarbonise the shipping industry by ramping up the use and production of sustainable alternative fuels. Ship traffic currently accounts for some 11% of EU transport ***emissions***, which is around 3-4% of total EU CO2 ***emissions***. However, decarbonising shipping is no easy task. As alternative fuels generally have a lower energy content than oil, ships will need bigger tanks to travel the same distance. Unlike in aviation, the Commission is not expected to mandate a certain share of green fuels used in shipping, such as renewable hydrogen or ammonia. Rather it will set “greenhouse gas intensity ***targets***” that will increase over time. This flexibility in fuelling options was strongly pushed for by industry during the legislative consultation period. Given the specific fuel needs of the shipping industry, the Commission is expected to back liquefied natural gas (LNG) in shipping’s fuel mix, on the grounds that LNG represents the cleanest fossil fuel available at scale. The legislation also includes the use of first-generation biofuels. The move has already been condemned by environmental groups, who say it will lock in fossil fuels and “unsustainable” biofuels for decades to come.

**Load-Date:** July 13, 2021

**End of Document**



[***The EU's imported deforestation problem - a closer look***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:619S-JV41-DYXB-V0C2-00000-00&context=1516831)

EurActiv.com

November 17, 2020 Tuesday

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**Length:** 861 words

**Byline:** Lucie Duboua-Lorsch

**Highlight:** Forestry policy was on the agenda for Europe's ***agriculture*** ministers on Monday, which made for a heated debate since Europeans are, through their lifestyles, contributing to massive deforestation worldwide. EURACTIV France reports.

**Body**

The European Green Deal unveiled with great pomp and circumstance last December includes the ambitious objective of making the EU the first climate-neutral region by 2050.

While the initiative has been welcomed, it remains to be seen how the European executive will put it into practice. Among the new measures to be adopted, one is particularly awaited: the "post-2020 EU forestry strategy" that the European Commission is expected to present by early 2021.

The EU's ***agriculture*** ministers called on the Commission to present a "reinforced forestry strategy", the impact of which would be felt in Europe and internationally, particularly since forestry is a cross-border issue.

In its 2020 report on the state of the world's ***forests***, the UN Food and ***Agriculture*** Organisation (FAO), points out that more than half of the world's ***forests*** are located in just five countries: Brazil, Canada, China, the United States and Russia.

[***Official: EU taking first steps to bring forestry into carbon market***](https://www.euractiv.com/section/energy-environment/interview/official-eu-taking-first-steps-to-bring-forestry-into-carbon-market/)

The first step to bring forestry under the EU's ***emissions*** trading scheme is to ensure that every tonne of carbon dioxide in the ***forest*** is counted so that a certification system for carbon ***removals*** can be put in place, Artur Runge-Metzger told EURACTIV.

**Imported deforestation**

Their diversity and richness make these ecosystems highly sought-after environments. However, as the timber trade continues to boom and ***land*** is cleared for ***agricultural*** purposes, ***forest*** areas are constantly shrinking. According to FAO estimates, 10 million hectares of ***forest*** area are lost each year, an area the size of Portugal.

While tropical ***forests*** are the most threatened, the EU is responsible for almost 10% of the world's ***forest*** destruction. Meat, dairy products, soya, rubber, and palm oil are produced at the expense of ***forest*** ecosystems.

According to the FAO, production-oriented ***agriculture*** remains one of the main causes of this phenomenon. The UN organisation estimates that between 2000 and 2010, "large-scale commercial ***agriculture*** was responsible for almost 40% of deforestation in the tropical world", notably through livestock breeding, soya cultivation and palm oil production.

[***Romania's forests - source of biodiversity, resource for 'wood mafia'***](https://www.euractiv.com/section/energy-environment/news/romanias-forests-source-of-biodiversity-resource-for-wood-mafia/)

Romania has the largest area of ​​virgin ***forests*** in the whole of the EU. Home to a large number of animal and plant species, they are endangered by illegal logging, as seen in a recent documentary starring ultramarathon runner Andrei Rosu.

**The French example**

In its 2018 report, [*French NGO Envol vert*](http://envol-vert.org/campagnes/lempreinte-foret/2018/11/lempreinte-foret-des-francais-352m2/#_ftn1) found that the production of soy, leather, palm oil, paper, coffee, rubber, cocoa and wood are - in that order - the main sources of deforestation and that a French person would "eat" an average of 352 m2 of ***forest*** each year to meet his or her needs.

Faced with this challenge, France's High Climate Council recently recommended that the French government accelerate the strategy to combat imported deforestation, because "while greenhouse gas ***emissions*** on the national territory are falling, imported ***emissions*** are continually increasing", according to its [*latest report*](https://www.vie-publique.fr/sites/default/files/rapport/pdf/276536.pdf).

[***Tackling the hidden cost of Europe's chocolate habit***](https://www.euractiv.com/section/energy-environment/news/tackling-the-hidden-cost-of-europes-chocolate-habit/)

Chocolate is a cheap treat in Europe, but beneath the wrapper, it is mired in the bitter issues of deforestation, biodiversity loss and child labour.

**A European project**

The High Climate Council is clear on this point: the fight against imported deforestation will primarily be played out at European level, and various EU bodies have started to tackle the matter. In addition to the Council of Ministers, the European Parliament called on the Commission on 22 October to present a European legal framework to stop global deforestation caused by the EU.

"No EU rules prohibit the placing on the European market of products that have contributed to the destruction of ***forests***", explained the Vice-President of the S&D Group and member of the Environment Committee, Eric Andrieu, in a statement. Andrieu hopes that sanctions are introduced against "companies that put products derived from raw materials that endanger ***forests*** and ecosystems on the European market."

The ball is now in the court of the Commission, which is due to present its new EU forestry strategy shortly. For the time being, the Commission is conducting a public consultation on deforestation lasting until 10 December, which is being promoted by the #Together4Forests campaign, led by nearly 150 NGOs.

"The European Commission must propose new legislation", said Anke Schulmeister-Oldenhove, head of forestry policy at the WWF's European Policy Office, in an interview with EURACTIV France. "If as many people as possible respond to the consultation, the EU will have no choice but to take ambitious measures against deforestation, biodiversity degradation and for the protection of human rights," she added.

Since the public consultation was launched on 3 September, it has received almost one million responses.

[***The answer to deforestation lies in space***](https://www.euractiv.com/section/biomass/opinion/the-answer-to-deforestation-lies-in-space/)

The use of satellite technology to track and halt real-time cases of deforestation in a country like Malaysia could become a "blueprint" for ending deforestation in the Amazon, writes Daniel Mackisack.

**Load-Date:** November 17, 2020

**End of Document**



[***Agrifood Brief: The agri-side of Europe's man on the moon moment***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:61VW-R821-JCF9-43YD-00000-00&context=1516831)

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**Length:** 1742 words

**Byline:** Gerardo Fortuna, Natasha Foote

**Highlight:** Welcome to EURACTIV's AgriFood Brief, your weekly update on all things ***Agriculture*** & Food in the EU. You can subscribe here if you haven't done so yet.   Once again, European Commission President Ursula von der Leyen has come under...

**Body**

**Welcome to EURACTIV's AgriFood Brief, your weekly update on all things *Agriculture* & Food in the EU. *You can subscribe*** [***here***](https://www.euractiv.com/agrifood-brief/) ***if you haven't done so yet.***

**3 - Carbon credits, meat alternatives, AGRIFISH agenda**

Once again, European Commission President Ursula von der Leyen has come under fire for having apparently forgotten farming in her maiden State of the Union speech and, in doing so, neglecting a key player in the Commission's vision for a greener future.

***Agriculture*** warranted only one passing mention in von der Leyen's hour-and-a-half speech on Wednesday (16 September).

The Commission chief already caught flak for not mentioning the farming sector in [*her first address*](https://euractiv.us15.list-manage.com/track/click?u=ec8c3035cd2e0ab2e3760549e&id=bb36eee424&e=00fd0e4e3d) to the European Parliament plenary in Strasbourg in July last year.

With the focus of her speech on the willingness to scale up the EU's ambition for reaching the climate neutrality by 2050, von der Leyen placed a new emphasis on the Green Deal architecture, which she herself once labelled as [*Europe's man on the moon moment*](https://euractiv.us15.list-manage.com/track/click?u=ec8c3035cd2e0ab2e3760549e&id=ba116388f4&e=00fd0e4e3d).

This included proposing an increase in the 2030 ***target*** for ***emission*** reduction from 40% to 55% and vowing that all climate and energy legislation will be revised to make it fit for the new ***target***.

But ***agriculture***'s role in the EU's green equation is often overshadowed by other environmental aspects, leaving farming on the dark side of the moon.

According to the European Environment Agency (EEA), the ***agriculture*** sector produced around 10% of the EU's total greenhouse gases (GHG) ***emissions***, with 426,473 kilotonnes of CO2 equivalent produced in 2015.

"Carbon must have its price because nature cannot pay this price anymore," von der Leyen stressed in her speech.

To make this happen, the new Climate Law indicates that farmers and foresters must be "incentivised" to store more carbon on their ***land***, including via a "robust carbon ***removal*** certification scheme."

But Pekka Pesonen, secretary-general of farmers' association Copa-Cogeca, has previously warned that this drive for carbon neutrality needs "sustainable financing in parallel with constant innovation of production tools and methods."

This is something that Asger Christensen, the liberal MEP who was the rapporteur on the opinion on the Climate Law in the Parliament's ***Agriculture*** Committee (COMAGRI), believes can be supported via the establishment of a separate trading scheme for negative ***emissions***.

"In order to stimulate the development of ***removals***, the Commission should explore the possible separate trading of ***removals*** or negative ***emissions*** on EU and global carbon markets," he said, adding that such trading of negative ***emissions*** might generate substantial climate finance.

In this way, farmers could be offered carbon credits in return for sequestering carbon, for example via tree growth or soil health improvements, which can then be sold to buyers as voluntary offsets for their ***emissions***.

Carbon credit schemes are also garnering their fair share of attention in research.

Most recently, the Grantham research centre experts published a new [*study*](https://euractiv.us15.list-manage.com/track/click?u=ec8c3035cd2e0ab2e3760549e&id=4c802fac3b&e=00fd0e4e3d) which suggests the UK and Europe should radically rethink sheep farming.

The research concludes that sheep farmers would not need government subsidies if they let native trees spread over part of their ***land*** instead of using it entirely for sheep pasture, and then sell credits for the carbon dioxide the new ***forests*** would absorb.

As everyone has heard at least once, ***agriculture*** is part of the problem but can offer solutions too.

*(N.F and G.F.)*

**Agrifood news this week**

**Every drop counts: Exploring innovative solutions for Europe's drought problem**A third consecutive year of drought shows that water scarcity is an increasingly frequent and widespread phenomenon in the EU, and one which holds enormous implications for the ***agricultural*** sector. [*EURACTIV spoke with Netafim*](https://euractiv.us15.list-manage.com/track/click?u=ec8c3035cd2e0ab2e3760549e&id=b2cb35791c&e=00fd0e4e3d), a specialist irrigation company, about the innovative solutions on offer to cope with this.

**MEPs want Commission to enter the veggie burger fray**European Parliament lawmakers are considering asking the European Commission to step in and help nix any doubts about the terminology used for plant-based meat substitutes, which are gaining in popularity across the EU. [*Gerardo Fortuna reports.*](https://euractiv.us15.list-manage.com/track/click?u=ec8c3035cd2e0ab2e3760549e&id=81ae6a538c&e=00fd0e4e3d)

**Germany well prepared to deal with African swine fever case, says farmers association**German ***Agriculture*** Minister Julia Klöckner confirmed a case of African Swine Fever (ASF) in a wild boar in Germany on Thursday (10 September), but the EU farmers association was quick to stress the country is well prepared to respond to the issue. [*Natasha Foote has the story.*](https://euractiv.us15.list-manage.com/track/click?u=ec8c3035cd2e0ab2e3760549e&id=333f1ab276&e=00fd0e4e3d)

**France unlocks (EURO)100 million to develop its plant-based protein production**The French government intends to allocate (EURO)100 million to develop the country's plant-based protein production. The decision, however, is based on commercial rather than environmental concerns. [*EURACTIV France reports.*](https://euractiv.us15.list-manage.com/track/click?u=ec8c3035cd2e0ab2e3760549e&id=742a8956af&e=00fd0e4e3d)

**"Our current levels of consumption of raw materials, energy, water, food and *land* use are not sustainable. We need to change how we treat nature, how we produce and consume, live and work, eat and heat, travel and transport"**

European Commission President Ursula von der Leyen during her first 'State of the Union' speech.

**News from the bubble**

**Climate Law:**In an [*amendment*](https://euractiv.us15.list-manage.com/track/click?u=ec8c3035cd2e0ab2e3760549e&id=cde5b06540&e=00fd0e4e3d) to the proposed European Climate Law, the Commission highlighted that "individual farmers or ***forest*** managers need to be directly incentivized to store more carbon on their ***land*** and their ***forests***." The communication presented on Thursday (17 September) also calls on member states to deploy carbon farming and certification of carbon ***removals*** in the run-up to 2030.

**EU-China trade:** The European Union and China signed [*a bilateral agreement*](https://euractiv.us15.list-manage.com/track/click?u=ec8c3035cd2e0ab2e3760549e&id=d32eac95d1&e=00fd0e4e3d) that will protect 100 European Geographical Indications (GIs) in China and 100 Chinese GIs in the European Union against usurpation and imitation.

**Compensation for farmers**: The Dutch and Danish ***agriculture*** sherpas have filed [*a proposal*](https://euractiv.us15.list-manage.com/track/click?u=ec8c3035cd2e0ab2e3760549e&id=c2eb17ce53&e=00fd0e4e3d)to compensate in the next Common ***Agricultural*** Policy (CAP) those farmers who implement the directive on nitrates, sustainable use of pesticides and reduction of national ***emissions***.

**PFAS in food:** On Thursday (17 September), the European Food Safety Agency (EFSA) published its [*final opinion*](https://euractiv.us15.list-manage.com/track/click?u=ec8c3035cd2e0ab2e3760549e&id=f3372946fe&e=00fd0e4e3d) on the risks to human health for the presence of perfluoroalkyl substances (PFAS) in food. PFAS are synthetic chemicals used in a wide variety of industrial and consumer products. EFSA has set a new safety threshold for main PFAS that accumulate in the body.

An updated version of a **map of the key players in DG AGRI**was published this week - [*you can find it here.*](https://euractiv.us15.list-manage.com/track/click?u=ec8c3035cd2e0ab2e3760549e&id=26ae8a607a&e=00fd0e4e3d)

**Agrifood news from the Capitals**

**IRELAND**The president of the Irish farmers association has expressed his disappointment at the lack of support European Commission President Ursula von der Leyen showed Irish citizens and farmers in her maiden State of the Union speech, saying that her comments about Brexit were "chilling" for Irish farmers. [*Natasha Foote reports.*](https://euractiv.us15.list-manage.com/track/click?u=ec8c3035cd2e0ab2e3760549e&id=83cbbc7d9a&e=00fd0e4e3d) ([*EURACTIV.com*](https://euractiv.us15.list-manage.com/track/click?u=ec8c3035cd2e0ab2e3760549e&id=9e9836699f&e=00fd0e4e3d))

**FRANCE**The Ministries of Ecological Transition, Economy and Finance, and ***Agriculture***, together with the Ademe (Ecological Transition Agency), launched a call on Thursday (10 September) for applications to develop a label that will inform consumers about the environmental impact of food. This experiment is part of "the framework of the law on the fight against waste and the circular economy". It is aimed at food producers, distributors, contract caterers, but also at players in the digital sector, research and the voluntary sector. This experiment is due to end in the autumn of 2021. ([*Anne Damiani*](https://euractiv.us15.list-manage.com/track/click?u=ec8c3035cd2e0ab2e3760549e&id=1e3d49702a&e=00fd0e4e3d)| [*EURACTIV.fr*](https://euractiv.us15.list-manage.com/track/click?u=ec8c3035cd2e0ab2e3760549e&id=3d5a870104&e=00fd0e4e3d))

**UK**Northern Ireland's Environment Minister Edwin Poots has said the UK government will be paying for work to expand post-Brexit control points at local ports, which are currently used for checks on agri-food products and animals. Carrying out the work on the facilities is seen as a crucial part of the preparations for the regulatory checks required in the UK and the EU's controversial Brexit protocol. ([*Natasha Foote*](https://euractiv.us15.list-manage.com/track/click?u=ec8c3035cd2e0ab2e3760549e&id=5b8e0c4bdc&e=00fd0e4e3d) | [*EURACTIV.com*](https://euractiv.us15.list-manage.com/track/click?u=ec8c3035cd2e0ab2e3760549e&id=563eee0734&e=00fd0e4e3d))

**BELGIUM**Belgium's increased use of pesticides and mechanical plowing in ***agriculture*** has caused over 60% of birdlife to disappear in the last 30 years, according to a new report by the World Wildlife Federation (WWF). ([*Natasha Foote*](https://euractiv.us15.list-manage.com/track/click?u=ec8c3035cd2e0ab2e3760549e&id=51daa0e1f0&e=00fd0e4e3d) | [*EURACTIV.com*](https://euractiv.us15.list-manage.com/track/click?u=ec8c3035cd2e0ab2e3760549e&id=d20fd95af2&e=00fd0e4e3d))

**CZECH REPUBLIC**The lower house of the Parliament of the Czech Republic has banned cages for laying hens from 2027, and also outlined a commitment of Czech policy-makers to push for an EU-level ban. The new ban will cover cages for both laying hens and laying breeders. ([*Natasha Foote*](https://euractiv.us15.list-manage.com/track/click?u=ec8c3035cd2e0ab2e3760549e&id=76b2192e64&e=00fd0e4e3d) | [*EURACTIV.com*](https://euractiv.us15.list-manage.com/track/click?u=ec8c3035cd2e0ab2e3760549e&id=489e96394c&e=00fd0e4e3d))

**On our radar**

On Friday (17 September), the European farmers' association COPA-COGECA will renew its highest positions, electing the president and 6 vice-presidents.

On Monday (21 September), there is an **EU** **AGRIFISH Council** to discuss some elements of the reform of the common ***agricultural*** policy (CAP) and trade-related issues in the ***agricultural*** sector. The meeting will be livestreamed. [*See here for more information*](https://euractiv.us15.list-manage.com/track/click?u=ec8c3035cd2e0ab2e3760549e&id=4e11b5fdef&e=00fd0e4e3d)

[*'any other business' request*](https://euractiv.us15.list-manage.com/track/click?u=ec8c3035cd2e0ab2e3760549e&id=2b606c9b21&e=00fd0e4e3d)And , due to be discussed at the AGRIFISH council, has been proposed by the Ministers of ***Agriculture*** of Bulgaria, Croatia, Cyprus, Czech Republic, France, Greece, Hungary, Italy, Latvia, Luxembourg, Poland, Romania, Slovakia, Slovenia and Spain on the need to develop plant proteins in European ***agriculture***.

**Upcoming events**

21 September- The 3rd **International Bioeconomy Congress**will take place, involving discussions on how innovative solutions can contribute to mitigating climate change, reducing pollution and other Sustainable Development Goals. [*More details here.*](https://euractiv.us15.list-manage.com/track/click?u=ec8c3035cd2e0ab2e3760549e&id=94bfdc4f85&e=00fd0e4e3d)

23 September - An **online event with Wolfgang Burtscher**, director general of DG ***Agriculture*** and Rural Development, will take place as part of a series of discussions entitled 'Talking Europe'. [*More information here.*](https://euractiv.us15.list-manage.com/track/click?u=ec8c3035cd2e0ab2e3760549e&id=530dc88037&e=00fd0e4e3d)

24 September- There is a webinar on **crop protection and studies on the future of *agriculture***in Europe, bringing together European researchers working on crop health and protection. For more information, [*see here.*](https://euractiv.us15.list-manage.com/track/click?u=ec8c3035cd2e0ab2e3760549e&id=5931a5e05d&e=00fd0e4e3d)

24 September - There is POLITICO's ***Agriculture* and Food Summit 2020,** where they will explore the new political reforms and innovative technologies that have the potential to shape Europe's ***agricultural*** and food industry into a greener, more innovative as well as globally competitive sector. [*See here for details.*](https://euractiv.us15.list-manage.com/track/click?u=ec8c3035cd2e0ab2e3760549e&id=446e3c123c&e=00fd0e4e3d)

**Don't miss**

Euractiv's upcoming [*event report*](https://euractiv.us15.list-manage.com/track/click?u=ec8c3035cd2e0ab2e3760549e&id=c4e6f07ea4&e=00fd0e4e3d) exploring sustainability in the livestock sector - what does sustainability in the sector should look like in the EU and how can this be achieved.

**Load-Date:** January 27, 2021

**End of Document**



[***Lab-grown 'chicken' meat made without slaughtering any animals will go on sale in Singapore after gaining world-first regulatory approval***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:61DY-K4J1-JBNF-W0GX-00000-00&context=1516831)

MailOnline

December 2, 2020 Wednesday 8:26 AM GMT

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**Section:** SCIENCE; Version:4

**Length:** 1002 words

**Byline:** Ian Randall For MailonlineAfp

**Body**

* The island city-state approved the use of the meat for making chicken nuggets

1. The cultured chicken fillets are the brainchild of the US-based start-up 'Eat Just'
2. Costs of the artificial meat are expected to start on a par with regular chicken
3. It is expected that the price will be able to be lowered over the coming years
4. The firm also plans to unveil other lab-grown chicken products soon, like breast

Restaurants in Singapore will be the first in the world to serve up lab-grown 'chicken', after the slaughter-free meat received regulatory approval.

US start up Eat Just revealed today that its artificial meat has been given the green-light in the Southeast Asian island city-state to be an ingredient in chicken nuggets.

As the world turns to more environmentally friendly and ethical ways of sourcing meat, the move marks a 'breakthrough for the global food industry', the firm said.

'I'm sure that our regulatory approval for cultured meat will be the first of many in Singapore and in countries around the globe,' said Eat Just CEO, Josh Tetrick.

Consumption of regular meat is an environmental threat, experts have warned, as cattle produce the potent greenhouse gas methane, while logging ***forests*** to make way for animals also serves to destroy natural barriers against climate change.

Pressure from consumers is increasing the availability of meat alternatives - but other products on the market are plant-based.

'Right from the start, we will be at price parity for premium chicken at a high-end restaurant,' a spokesperson for the firm told the AFP.

While Eat Just has not confirmed exactly how much the lab-grown chicken nuggets will cost, the firm did reveal plans to roll out similar products - including, for example, lab-grown chicken breasts.

It is anticipated that the cost of the artificial meat could be brought down to less than that of regular chicken in the coming years, the spokesperson added.

The company conducted over 20 production runs in 1,200 litre bioreactors to make the chicken alternative, and checks on safety and quality showed its 'cultured' product - the term for meat grown in labs from animal cells - met food standards.

Meat consumption is projected to increase by over 70 per cent by 2050, and lab-grown alternatives have a role to play in a safe, secure food supply, Eat Just said.

'Working in partnership with the broader ***agriculture*** sector and forward-thinking policymakers, companies like ours can help meet the increased demand for animal protein as our population climbs to 9.7 billion by 2050,' said Mr Tetrick.

The Singapore Food Agency - the city-state's regulator - confirmed it had approved the sale of Eat Just's lab-grown chicken in nuggets after concluding that the meat product was safe for consumption.

The agency said it had put in place a framework for 'novel foods' which do not have a history of being consumed by humans, as to ensure that safety standards are met before they go on sale.

The high-tech city-state has become a hub for the development of sustainable foods in recent years, with local start-ups concocting dishes suited to Asian palates.

These range from lab-grown 'seafood' to dumplings made with tropical fruit, instead of pork.

EATING LENTILS, BEANS AND NUTS INSTEAD OF MEAT AND DAIRY' COULD ***REMOVE*** 16 YEARS' WORTH OF CO2 ***EMISSIONS*** BY 2050

Switching from eating '***land***-hungry' meat and dairy produce to foodstuffs like beans, lentils and nuts could ***remove*** 16 years' worth of CO2 ***emissions*** by 2050, experts said.

Researchers from the US calculated that broad uptake of such plant-based protein alternatives could free up ***land*** to support more ecosystems that absorb carbon.

At present, around 83 per cent of the world's ***agricultural*** ***land*** is given over to meat and dairy-based production - much of which only produce low yields.

Reducing this figure, the team said, is a better way to combat climate change than waiting for 'unproven' large-scale technologies like atmospheric CO2 extractors.

'The greatest potential for ***forest*** regrowth, and the climate benefits it entails, exists in high- and upper-middle income countries,' said paper author and environmental scientist Matthew Hayek of New York University,

These, he added, are 'places where scaling back on ***land***-hungry meat and dairy would have relatively minor impacts on food security.'

In the study, Professor Hayek and colleagues mapped out the areas of the globe where ***land*** use for animal-sourced food production has squeezed out native vegetation, such as ***forests***.

This allowed the team to determine where a shift in our diets to more plant-based foodstuffs could allow natural ecosystems to be restored - helping to offset global carbon dioxide ***emissions*** in the process.

'We only mapped areas where seeds could disperse naturally, growing and multiplying into dense, biodiverse ***forests*** and other ecosystems that work to ***remove*** carbon dioxide for us,' Professor Hayek said.

'Our results revealed over 7 million square kilometres where ***forests*** would be wet enough to regrow and thrive naturally, collectively an area the size of Russia.'

The team concluded that - if the demand for ***land*** for meat production could be drastically lowered - vegetation regrowth in these locations could help to sequester around 9-16 year's worth of fossil fuel ***emissions*** by the middle of century.

This would effectively double the planet's so-called 'carbon budget' - the amount of fossil fuels ***emissions*** we can afford to release before we reach the threshold temperature rise of 2.7°F (1.5°C) above pre-industrial levels.

Exceeding this limit is expected to result in a significant rise in the number of severe impacts from climate change - including droughts and sea level rise.

'We can think of shifting our eating habits toward ***land***-friendly diets as a supplement to shifting energy, rather than a substitute,' Professor Hayek said.

'Restoring native ***forests*** could buy some much-needed time for countries to transition their energy grids to renewable, fossil-free infrastructure.'

**Load-Date:** December 2, 2020

**End of Document**



[***Annual Climate Report 2021: Emissions in Finland declined in the exceptional year***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:6314-6JG1-JDG9-Y4TS-00000-00&context=1516831)

Nordic Daily

June 23, 2021 Wednesday

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**Length:** 1255 words

**Body**

Helsinki: Government of Finland has issued the following press release:

The Government submitted its Annual Climate Report to Parliament on Wednesday 23 June. According to the report, Finland's ***emissions*** declined in the exceptional year, but achieving carbon neutrality by 2035 will require more and faster action also after the pandemic.

“We are going in the right direction, but new climate measures are needed. We are currently preparing our most important climate plans: the Medium-term Climate Change Policy Plan that extends until 2035, the Climate and Energy Strategy and the climate change plan for the ***land***-use sector. In this work, we must find measures that will enable us to achieve Finland's goal of being carbon neutral in 2035. It is also important to ensure that the climate measures are implemented in a way that is fair,” Minister of the Environment and Climate Krista Mikkonen says.

The Government’s objective is that Finland will be carbon neutral by 2035 and carbon negative shortly thereafter. Carbon neutrality means that ***emissions*** and the sinks that sequester carbon are in balance, i.e ***emissions*** caused by human activity are calculated to be as high as greenhouse gas ***removals***. Carbon negativity means a situation in which greenhouse gas ***removals*** are higher than greenhouse gas ***emissions***.

A key factor for the carbon neutrality ***target*** is the expected number of carbon sinks in 2035, which determines the magnitude of the required ***emissions*** reductions. If a net sink of 21 million tonnes is aimed for in the ***land*** use sector in 2035, ***emissions*** should likewise decrease from the current 48 million tonnes to 21 million tonnes. The current measures are estimated to cover about 16 million tonnes of the necessary ***emissions*** reductions of 27 million tonnes, which means that 11 million tonnes will remain as an ***emissions*** gap.Considerable reductions in ***emissions*** trading sector in 2020, small reductions in other sectors

According to the preliminary data of Statistics Finland, the total ***emissions*** in Finland declined by about 9% from the previous year. In the ***emissions*** trading sector the reduction was almost 16% and in the non-***emissions*** trading sectors the ***emissions*** decreased by 3%, which slightly exceeded the EU’s annual ***emission*** allocation for Finland in 2020.

The ***emissions*** trading scheme covers electricity production and the majority of district heat production, metal production, pulp and paper industry, chemical industry, construction industry and air transport. Sectors and operations not covered by the scheme include road transport, ***agriculture*** and heating of individual buildings.

The decrease in ***emissions*** was a result of the warm winter, recent structural changes in electricity production and a decrease in ***emissions*** from the transport sector. The ***land*** use sector’s carbon sinks increased while felling of ***forests*** declined, which was also relevant for the climate.Finns are consuming more

According to the calculations of the Finnish Environment Institute, ***emissions*** from household consumption declined between 2010 and 2015, but have remained at around the same level since then. Consumption-based ***emissions*** include ***emissions*** arising in Finland from the production of goods and services as well as overseas ***emissions*** from the production chains of imported goods. ***Emissions*** from export production chains are deducted in the calculation of consumption-related ***emissions***.

There has been an overall increase in ***emissions*** from consumption of 4% since 2000. The primary factor explaining this rise is income level: the more money people have, the more they usually consume. The increase in consumption expenditure has been partly compensated by lower-***emission*** products and services.Decline in transport sector ***emissions***

In 2020, ***emissions*** from the transport sector in Finland decreased by 6% from the previous year. The coronavirus pandemic, in particular, contributed to the decline in ***emissions*** from the transport sector as there was a decrease in driving distances.

The ***target*** set in the Government Programme is for transport sector ***emissions*** to be halved from 2005 levels by 2030. Transport sector ***emissions*** are declining too slowly in relation to the ***target***: the existing measures are expected to reduce ***emissions*** to 7.9 million tonnes, but ***emissions*** should decrease to 6.3 million tonnes. In May 2021, the Government adopted a resolution on a roadmap for fossil-free transport to achieve this ***target***.***Emissions*** from ***agriculture*** remain unchanged

According to preliminary data, ***emissions*** from ***agriculture*** in 2020 remained the same as the previous year. The current measures included in the Medium-term Climate Change Policy Plan are expected to lead to a slight downward trend in ***emissions*** from the ***agriculture*** sector.The EU Common ***Agricultural*** Policy is currently being revised for the next funding period. Measures to reduce ***emissions*** will be re-examined in connection with this. The EU’s obligation to Member States is to allocate 30% of rural development funds to environmental and climate measures at the national level.

Discontinuation of oil heating will drive down ***emissions*** caused by heating of individual buildingsEmissions from the heating of individual buildings have been on a downward trend in recent years due to the reduction of oil heating and improvement in the energy efficiency of buildings. ***Emissions*** from individual buildings are mainly caused by oil heating.

The action plan for phasing out fossil fuel oil in heating was on a consultation round in spring 2021. Newly introduced subsidies will be used to speed up discontinuation of oil use in residential properties.Adaptation measures need to be expedited

Accelerating global warming highlights the need to expedite the measures to prepare for change. An update to Finland’s National Climate Change Adaptation Plan will be launched under the leadership of the Ministry of ***Agriculture*** and Forestry in 2021. The aim of the implementation of the adaptation plan is to reduce the harmful effects of climate change on people’s safety, health and living conditions, nature and other environments, livelihoods, infrastructure and society’s important functions.

A knowledge base of the impacts and risks of climate change and methods to prepare for these are being developed in several currently ongoing research projects. Finland’s ability to prepare for climate change will improve by strengthening broad-based cooperation, forging partnerships and developing climate-resilient solutions.Annual Climate Reports are based on the Climate Change Act

The Annual Climate Reports are based on the Climate Change Act that entered into force in 2015. This is the third annual report.

The Annual Climate Reports follow the achievement of Finland's ***emission*** reduction ***targets***. They contain information on the trends in the ***emissions*** and sinks in Finland. They also deal with climate change adaptation and the impacts of the envisaged policy measures on ***emissions***. The reports also consider whether new measures are needed to achieve the objectives set.

To make it more comprehensive, the content of this Annual Climate Report has been developed on the basis of reports issued by Parliament and feedback received from various stakeholders. The Annual Climate Report provides extensive information on ***emissions*** trends and topical issues related to climate policy. In addition to the effort sharing sector, the ***emissions*** trading and ***land*** use sectors are also examined.

Parliament will start the discussions on the Annual Climate Report after the summer holidays.

**Load-Date:** June 27, 2021

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[***Reactions: Deal on EU's 2030 climate target is a big step, but won't close the gap to 2050***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:61HP-JN61-JCF9-432P-00000-00&context=1516831)

EurActiv.com

December 15, 2020 Tuesday

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**Length:** 1086 words

**Byline:** Kira Taylor

**Highlight:** EU heads of states have agreed on a 55% reduction ***target*** for greenhouse gas ***emissions*** by 2030, but the inclusion of carbon sinks and the choice of 1990 as the baseline year have led environmentalists to criticise the deal for lacking ambition.

**Body**

When EU leaders agreed a new climate goal for 2030 on Friday morning after a night of marathon talks, there was a smell of victory in the air.

"Kudos to the EU for pulling the future into the present, with huge benefits for people, planet and profit," said Christiana Figueres, former executive secretary of the UN Framework Convention on Climate Change (UNFCCC).

"I am very happy to be a European these days. Europe committed to climate neutrality by 2050, and now, just as importantly, to put climate and environment at the centre of its economy and society. It's no longer a climate goal - it's a societal goal for the EU," said Laurence Tubiana, CEO of the European Climate Foundation (ECF).

[***EU clinches hard-fought deal on 2030 climate target***](https://www.euractiv.com/section/energy-environment/news/eu-clinches-hard-fought-deal-on-2030-climate-target/)

European leaders haggled through the night to clinch a deal on the bloc's updated climate ***target*** for 2030 on Friday morning (11 December), agreeing an EU-wide goal of cutting net greenhouse gas ***emissions*** by 55% by 2030.

**Not sufficient**

Yet, environmental NGOs were quick to point out that the 55% ***emissions*** reduction goal, as ambitious as it seems, is insufficient to contain global warming to manageable levels.

Global ***emissions*** need to fall by 7.6% annually until 2030 to reach the 1.5°C ***target*** in the Paris Agreement, according to the United Nations' ***Emissions*** Gap report.

That would require a 65% ***emissions*** cut in Europe by 2030, something environmental NGOs were keen to highlight on Friday as EU leaders gave their blessing to the 55% goal.

"EU leaders may pat themselves on the back for finally agreeing a new climate ***target***, but this is still a far cry from the victory the climate needs," said Colin Roche from Friends of the Earth Europe. "Our leaders must go further to deliver Europe's fair share of global action to cut carbon and live up to the agreement they made in Paris five years ago," he added.

"Governments will no doubt call it historic, but the evidence shows that this deal is only a small improvement on the ***emission*** cuts the EU is already expected to achieve," said Sebastian Mang, climate policy adviser at Greenpeace. "It shows that political convenience takes precedence over climate science, and that most politicians are still afraid to take on big polluters".

Speaking on Monday, the EU's energy Commissioner, Kadri Simson, described the European Council's decision as a landmark event and responded to NGOs' criticism: "I think that it is always good when there is certain pressure to do even more, but only one year ago, when we were preparing the Green Deal, there was a scepticism if we would be able to achieve unanimity and this ambitious ***target*** seemed very difficult."

"The decision of the European Council confirms commitment across the EU and ensures we stay on track to deliver our green deal agenda and global commitments," she added.

In October, [*Poland and Hungary delayed a vote on the EU's 2030 climate* ***target***](https://www.euractiv.com/section/climate-environment/news/eu-leaders-to-decide-tougher-climate-goal-in-december/), asking for analysis into how it would impact member states.

"What was very impressive was to hear from the member states that despite all of their differences, their national specificities, despite the conditions in the Irish Sea, we can all make our contribution," said Peter Altmaier, the German energy minister, adding it would be a long and difficult path, but one they are determined to pursue.

[***EU leaders to decide tougher climate goal in December***](https://www.euractiv.com/section/climate-environment/news/eu-leaders-to-decide-tougher-climate-goal-in-december/)

EU leaders on Thursday (15 October) said they will decide on a more stringent climate ***target*** for 2030 at a summit in December, leaving more time to forge a united European response to climate change.

**'Net' *target***

Criticism has also been levelled at the 2030 ***target*** including carbon sinks, like ***forests*** and soil, which sequester carbon and make ***emission*** cuts easier. The EU's previous 2030 ***target*** did not include these.

The European Commission has estimated carbon sequestration means the actual reduction would be around 53% while climate scientist, Bert Metz, [*reckons it would effectively be less than 50%.*](https://www.euractiv.com/section/climate-environment/opinion/how-the-eu-could-snatch-defeat-from-the-jaws-of-victory-on-climate/)

"This is a bittersweet moment. More climate ambition is always welcome but the inclusion of sinks in the ***target*** waters it down and sets a dangerous precedent that ***removing*** carbon with trees and soil is equivalent to not emitting in the first place," said Mark Preston Aragonès, Policy Advisor at Bellona Europa, an international environmental NGO based in Norway.

Including sinks also makes the reduction hard to calculate and relies on methodologies not yet developed.

"Mixing carbon sinks and ***emission*** reductions is an irresponsible accounting trick and undermines the deal's credibility," said Sam Van den Plas, policy director at Carbon Market Watch, an international NGO.

[***Commission under fire for including 'carbon sinks' into EU climate goals***](https://www.euractiv.com/section/climate-environment/news/commission-under-fire-for-including-carbon-sinks-into-eu-climate-goals/)

The European Commission on Thursday (17 September) defended its plan to bring carbon ***removals*** from ***agriculture***, ***land*** use and forestry into the EU's updated climate ***target*** for 2030, saying this was in line with UNFCCC standards.

**1990 levels**

Basing reductions on 1990 levels also gives the EU more leeway, as ***emissions*** have decreased over the last thirty years, [*making a 55%* ***target*** *more like a 42%* ***target*** *on 2018 levels.*](https://gretathunberg.medium.com/the-eu-is-cheating-with-numbers-and-stealing-our-future-1aca3e9a295f)

"The EU's so called '55% reduction ***target*** by 2030' has got nothing to do with a real 55% ***emission*** reduction," teen activist Greta Thunberg, said on Twitter.

The ***target*** also does not include certain sectors, like aviation, shipping and goods manufactured outside the EU, critics point out.

"Our leaders must go further to deliver Europe's fair share of global action to cut carbon and live up to the agreement they made in Paris five years ago," said Colin Roche, climate justice coordinator for Friends of the Earth Europe.

**Unpredictability of climate change**

NGOs also say achieving ***emissions*** reduction will be made even harder by the increasing impacts of climate change.

***Forest*** fires caused by higher temperatures and more erratic weather release carbon into the atmosphere and destroy trees that could sequester carbon, they point out.

And so-called feedback loops create further complications as melting ice means less reflective surfaces for sunlight, allowing the sun's heat to be captured by darker seawater instead.

WWF has called on environment ministers meeting this week to "rescue some of the EU's reputation on climate" and ensure the EU's climate law includes a review of the ***target*** every five years.

The 2030 ***target*** will now go into final negotiations between the European Parliament, the Commission and Council and put down into the final text of the draft European Climate Law.

*[Edited by Frédéric Simon]*

**Load-Date:** December 15, 2020

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[***-University of Virginia: REMOVE CARBON DIOXIDE FROM THE AIR? DON'T BET ON IT BEFORE EXAMINING COSTS, RESEARCHERS SAY***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:60PG-C3J1-F0K1-N1M0-00000-00&context=1516831)

ENP Newswire

August 28, 2020 Friday

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**Length:** 918 words

**Body**

Ateam led by researchers at the University of Virginia cautions that when it comes to climate change, the world is making a bet it might not be able to cover.

The team's new paper in the journal Nature Climate Change explores how plans to avoid the worst outcomes of a warming planet could bring their own side effects.

The handful of models the United Nations Intergovernmental Panel on Climate Change and decision-makers around the world trust to develop strategies to meet carbon neutrality commitments all assume negative ***emissions*** technologies will be available as part of the solution.

Negative ***emissions*** technologies, often called NETs, ***remove*** carbon dioxide from the atmosphere. The three most widely studied approaches are bioenergy with carbon capture and storage, which entails growing crops for fuel, then collecting and burying the CO2 from the burned biomass; planting more ***forests***; and direct air capture, an engineered process for separating CO2 from the air and storing it permanently, likely underground.

'The trouble is, nobody has tried these technologies at the demonstration scale, much less at the massive levels necessary to offset current CO2 ***emissions***,' said Andres Clarens, a professor in UVA Engineering's Department of Engineering Systems and Environment and associate director of UVA's pan-University Environmental Resilience Institute. The institute partially funded the research leading to the Nature Climate Change paper.

'Our paper quantifies their costs so we can have an honest conversation about it before we start doing this on a large scale,' Clarens said.

Since the Paris Agreement to limit global warming to 1.5 degrees Celsius, hammered out by world leaders in 2015, a growing number of corporations such as BP and many institutions and governments - including UVA and the Commonwealth of Virginia - have committed to reaching zero carbon ***emissions*** in the next few decades. Microsoft has pledged to erase its carbon ***emissions*** since its founding in 1975.

To Clarens, an engineer who studies carbon management, and his fellow researchers, these are encouraging developments. Led by Clarens' Ph.D. student, Jay Fuhrman, the group also includes economist Haewon McJeon and computational scientist Pralit Patel of the Joint Global Change Research Institute at the University of Maryland; UVA's Joe D. and Helen J. Kington Professor of Environmental Sciences, Scott C. Doney; and William M. Shobe, research director at UVA's Weldon Cooper Center for Public Service and a professor in the Batten School of Leadership and Public Policy.

For the research, the team used an integrated model - one of those the United Nations relies on - called the Global Change Assessment Model. The model was developed at the University of Maryland, which partners with the Pacific Northwest National Laboratory to run the Joint Global Change Research Institute. They compared the effects of the three negative ***emissions*** technologies on global food supply, water use and energy demand. The work looked at the role having direct air capture available would have on future climate scenarios.

Biofuels and reforestation take up vast ***land*** and water resources needed for ***agriculture*** and natural areas; biofuels also contribute to pollution from fertilization. Direct air capture uses less water than planting biofuels and trees, but it still demands a lot of water and even more energy - largely supplied by fossil fuels, offsetting some of the benefits of carbon dioxide ***removal***. Until recently, direct air technologies also were considered too expensive to include in ***emissions*** reduction plans.

The team's analysis shows that direct air capture could begin ***removing*** up to 3 billion tons of carbon dioxide from the atmosphere per year by 2035 - more than 50% of U.S. ***emissions*** in 2017, the most recent year for which reliable data was available. But even if government subsidies make rapid and widespread adoption of direct air capture feasible, we'll need biofuels and reforestation to meet CO2 reduction goals. The analysis showed staple food crop prices will still increase approximately threefold globally relative to 2010 levels and fivefold in many parts of the world where inequities in the cost of climate change already exist.

'Direct air capture can soften - but not eliminate - the sharpest tradeoffs resulting from ***land*** competition between farmland and ***land*** needed for new ***forests*** and bioenergy,' Fuhrman and Clarens wrote in a blog accompanying the release of the paper.

The costs that remain increase with time, making determined, multipronged actions toward reducing carbon dioxide ***emissions*** and ***removing*** it from the atmosphere all the more urgent, the researchers argue.

'We need to move away from fossil fuels even more aggressively than many institutions are considering,' Clarens said. 'Negative ***emissions*** technologies are the backstop the UN and many countries expect will one day save us, but they will have side effects we have to be prepared for. It's a huge gamble to sit on our hands for the next decade and say, 'We've got this because we're going to deploy this technology in 2030,' but then it turns out there are water shortages, and we can't do it.'

'Before we bet the house, let's understand what the consequences are going to be,' Fuhrman added. 'This research can help us sidestep some of the pitfalls that could arise from these initiatives.'

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[***'Burn now and pay later': is net zero a dangerous trap?; ScientistJames Dyke believeshumanity has gambled its civilisation on no more than promises of future solutions***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:62VJ-FJ11-F072-44W1-00000-00&context=1516831)

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**Section:** THE NEW REVIEW; Pg. 41

**Length:** 3587 words

**Byline:** JAMES DYKE

**Body**

Sometimes realisation comes in a blinding flash. Blurred outlines snap into shape and suddenly it all makes sense. Underneath such revelations is typically a much slower-dawning process. Doubts at the back of the mind grow. The sense of confusion that things cannot be made to fit together increases until something clicks. Or perhaps snaps.

Collectively the authors of this article must have spent more than 80 years thinking about climate change. Why has it taken us so long to speak out about the obvious dangers of the concept of net zero? In our defence, the premise of net zero is deceptively simple - and we admit that it deceived us. The threats of climate crisis are the direct result of too much carbon dioxide in the atmosphere. So it follows that we must stop emitting more, and even ***remove*** some of it. This idea is central to the world's current plan to avoid catastrophe. In fact, there are many suggestions as to how to do this, from mass tree planting, to high tech direct air capture devices that suck carbon dioxide out from the air.

The current consensus is that if we deploy these and other so-called "carbon dioxide ***removal***" techniques at the same time as reducing our burning of fossil fuels, we can more rapidly halt global warming. Hopefully around the middle of this century we will achieve "net zero". This is the point at which any residual ***emissions*** of greenhouse gases are balanced by technologies ***removing*** them from the atmosphere.

This is a great idea, in principle. Unfortunately, in practice it helps perpetuate a belief in technological salvation and diminishes the sense of urgency surrounding the need to curb ***emissions*** now. We have arrived at the painful realisation that the idea of net zero has licensed a recklessly cavalier "burn now, pay later" approach which has seen carbon ***emissions*** continue to soar. It has also hastened the destruction of the natural world by increasing deforestation today, and greatly increases the risk of further devastation in the future.

To understand how this has happened, how humanity has gambled its civilisation on no more than promises of future solutions, we must return to the late 1980s, when climate change broke out onto the international stage.

Steps towards net zero

On June 22 1988, James Hansen was the administrator of Nasa's Goddard Institute for Space Studies, a prestigious appointment but someone largely unknown outside of academia. By the afternoon of 23 June he was well on the way to becoming the world's most famous climate scientist. This was as a direct result of his testimony to the US congress, when he forensically presented the evidence that the Earth's climate was warming and that humans were the primary cause: "The greenhouse effect has been detected, and it is changing our climate now."

If we had acted on Hansen's testimony at the time, we would have been able to decarbonise our societies at a rate of around 2 per cent a year to give us about a two-in-three chance of limiting warming to no more than 1.5C. It would have been a huge challenge, but the main task at that time would have been to simply stop the accelerating use of fossil fuels while fairly sharing out future ***emissions***.

Four years later, there were glimmers of hope that this would be possible. During the 1992 Earth Summit in Rio, all nations agreed to stabilise concentrations of greenhouse gases to ensure that they did not produce dangerous interference with the climate. The 1997 Kyoto Summit attempted to start to put that goal into practice. But as the years passed, the initial task of keeping us safe became increasingly harder given the continual increase in fossil fuel use.

It was around that time that the first computer models linking greenhouse gas ***emissions*** to impacts on different sectors of the economy were developed. These hybrid climate-economic models are known as Integrated Assessment Models. They allowed modellers to link economic activity to the climate by, for example, exploring how changes in investments and technology could lead to changes in greenhouse gas ***emissions***.

They seemed like a miracle: you could try out policies on a computer screen before implementing them, saving humanity costly experimentation. They rapidly emerged to become key guidance for climate policy. A primacy they maintain to this day.

Unfortunately, they also removed the need for deep critical thinking. Such models represent society as a web of idealised, emotionless buyers and sellers and thus ignore complex social and political realities, or even the impacts of climate change itself. Their implicit promise is that market-based approaches will always work. This meant that discussions about policies were limited to those most convenient to politicians: incremental changes to legislation and taxes.

Around the time they were first developed, efforts were being made to secure US action on the climate by allowing it to count carbon sinks of the country's ***forests***. The US argued that if it managed its ***forests*** well, it would be able to store a large amount of carbon in trees and soil which should be subtracted from its obligations to limit the burning of coal, oil and gas. In the end, the US largely got its way. Ironically, the concessions were all in vain, since the US senate never ratified the agreement.

Postulating a future with more trees could in effect offset the burning of coal, oil and gas now. As models could easily churn out numbers that saw atmospheric carbon dioxide go as low as one wanted, ever more sophisticated scenarios could be explored which reduced the perceived urgency to reduce fossil fuel use. By including carbon sinks in climate-economic models, a Pandora's box had been opened.

It's here we find the genesis of today's net-zero policies.

That said, most attention in the mid-1990s was focused on increasing energy efficiency and energy switching (such as the UK's move from coal to gas) and the potential of nuclear energy to deliver large amounts of carbon-free electricity. The hope was that such innovations would quickly reverse increases in fossil fuel ***emissions***.

But by around the turn of the new millennium it was clear that such hopes were unfounded. Given their core assumption of incremental change, it was becoming more and more difficult for economic-climate models to find viable pathways to avoid dangerous climate change. In response, the models began to include more and more examples of carbon capture and storage, a technology that could ***remove*** the carbon dioxide from coal-fired power stations and then store the captured carbon deep underground indefinitely.

This had been shown to be possible in principle: compressed carbon dioxide had been separated from fossil gas and then injected underground in a number of projects since the 1970s. These Enhanced Oil Recovery schemes were designed to force gases into oil wells in order to push oil towards drilling rigs and so allow more to be recovered - oil that would later be burnt, releasing even more carbon dioxide into the atmosphere.

Carbon capture and storage offered the twist that instead of using the carbon dioxide to extract more oil, the gas would instead be left underground and removed from the atmosphere. This promised breakthrough technology would allow climate friendly coal and so the continued use of this fossil fuel. But long before the world would witness any such schemes, the hypothetical process had been included in climate-economic models. In the end, the mere prospect of carbon capture and storage gave policy makers a way out of making the much needed cuts to greenhouse gas ***emissions***.

The rise of net zero

When the international climate change community convened in Copenhagen in 2009 it was clear that carbon capture and storage was not going to be sufficient for two reasons.

First, it still did not exist. There were no carbon capture and storage facilities in operation on any coal fired power station and no prospect the technology was going to have any impact on rising ***emissions*** from increased coal use in the foreseeable future.

The biggest barrier to implementation was essentially cost. The motivation to burn vast amounts of coal is to generate relatively cheap electricity. Retrofitting carbon scrubbers on existing power stations, building the infrastructure to pipe captured carbon, and developing suitable geological storage sites required huge sums of money. Consequently the only application of carbon capture in actual operation then - and now - is to use the trapped gas in enhanced oil recovery schemes. Beyond a single demonstrator, there has never been any capture of carbon dioxide from a coal fired power station chimney with that captured carbon then being stored underground.

Just as important, by 2009 it was becoming increasingly clear that it would not be possible to make even the gradual reductions that policy makers demanded. That was the case even if carbon capture and storage was up and running. The amount of carbon dioxide that was being pumped into the air each year meant humanity was rapidly running out of time.

With hopes for a solution to the climate crisis fading again, another magic bullet was required. A technology was needed not only to slow down the increasing concentrations of carbon dioxide in the atmosphere, but actually reverse it. In response, the climate-economic modelling community - already able to include plant-based carbon sinks and geological carbon storage in their models - increasingly adopted the "solution" of combining the two.

So it was that Bioenergy Carbon Capture and Storage, or Beccs, rapidly emerged as the new saviour technology. By burning "replaceable" biomass such as wood, crops, and ***agricultural*** waste instead of coal in power stations, and then capturing the carbon dioxide from the power station chimney and storing it underground, Beccs could produce electricity at the same time as ***removing*** carbon dioxide from the atmosphere. That's because as biomass such as trees grow, they suck in carbon dioxide from the atmosphere. By planting trees and other bioenergy crops and storing carbon dioxide released when they are burnt, more carbon could be removed from the atmosphere.

With this new solution in hand the international community regrouped from repeated failures to mount another attempt at reining in our dangerous interference with the climate. The scene was set for the crucial 2015 climate conference in Paris.

A Parisian false dawn

As its general secretary brought the 21st United Nations conference on climate change to an end, a great roar issued from the crowd. People leaped to their feet, strangers embraced, tears welled up in eyes bloodshot from lack of sleep.

The emotions on display on 13 December 2015 were not just for the cameras. After weeks of gruelling high-level negotiations in Paris a breakthrough had finally been achieved. Against all expectations, after decades of false starts and failures, the international community had finally agreed to do what it took to limit global warming to well below 2C, preferably to 1.5C, compared to pre-industrial levels.

The Paris Agreement was a stunning victory for those most at risk from climate change. Rich industrialised nations will be increasingly impacted as global temperatures rise. But it's the low-lying island states such as the Maldives and the Marshall Islands that are at imminent existential risk. As a later UN special report made clear, if the Paris Agreement was unable to limit global warming to 1.5C, the number of lives lost to more intense storms, fires, heatwaves, famines and floods would significantly increase.

But dig a little deeper and you could find another emotion lurking within delegates on 13 December. Doubt. We struggle to name any climate scientist who at that time thought the Paris Agreement was feasible. We have since been told by some scientists that the Paris Agreement was "of course important for climate justice but unworkable" and "a complete shock, no one thought limiting to 1.5C was possible". Rather than being able to limit warming to 1.5C, a senior academic involved in the IPCC concluded we were heading beyond 3C by the end of this century.

Instead of confronting our doubts, we scientists decided to construct ever more elaborate fantasy worlds in which we would be safe. The price to pay for our cowardice: having to keep our mouths shut about the ever growing absurdity of the required planetary-scale carbon dioxide ***removal***. Taking centre stage was Beccs because at the time this was the only way climate-economic models could find scenarios that would be consistent with the Paris Agreement. Rather than stabilise, global ***emissions*** of carbon dioxide had increased some 60 per cent since 1992.

Alas, Beccs, just like all the previous solutions, was too good to be true. Across the scenarios produced by the Intergovernmental Panel on Climate Change (IPCC) with a 66 per cent or better chance of limiting temperature increase to 1.5C, Beccs would need to ***remove*** 12 billion tonnes of carbon dioxide each year. Beccs at this scale would require massive planting schemes for trees and bioenergy crops.

The earth certainly needs more trees. Humanity has cut down some three trillion since we first started farming some 13,000 years ago. But rather than allow ecosystems to recover from human impacts and ***forests*** to regrow, Beccs generally refers to dedicated industrial-scale plantations regularly harvested for bioenergy rather than carbon stored away in ***forest*** trunks, roots and soils.

Currently, the two most efficient biofuels are sugarcane for bioethanol and palm oil for biodiesel - both grown in the tropics. Endless rows of such fast growing monoculture trees or other bioenergy crops harvested at frequent intervals devastate biodiversity. It has been estimated that Beccs would demand between 0.4 and 1.2 billion hectares of ***land***. That's 25 per cent to 80 per cent of all the ***land*** currently under cultivation. How will that be achieved at the same time as feeding 8-10 billion people around the middle of the century or without destroying native vegetation and biodiversity?

Growing billions of trees would consume vast amounts of water - in some places where people are already thirsty. Increasing ***forest*** cover in higher latitudes can have an overall warming effect because replacing grassland or fields with ***forests*** means the ***land*** surface becomes darker. This darker ***land*** absorbs more energy from the sun and so temperatures rise. Focusing on developing vast plantations in poorer tropical nations comes with real risks of people being driven off their ***lands***. And it is often forgotten that trees and the ***land*** in general already soak up and store away vast amounts of carbon through what is called the natural terrestrial carbon sink. Interfering with it could both disrupt the sink and lead to double accounting.

As these impacts are becoming better understood, the sense of optimism around Beccs has diminished.

Pipe dreams

Given the dawning realisation of how difficult Paris would be in the light of ever rising ***emissions*** and limited potential of Beccs, a new buzzword emerged in policy circles: the "overshoot scenario". Temperatures would be allowed to go beyond 1.5C in the near term, but then be brought down with a range of carbon dioxide ***removal*** by the end of the century. This means that net zero actually means carbon negative. Within a few decades, we will need to transform our civilisation from one that currently pumps out 40 billion tons of carbon dioxide into the atmosphere each year, to one that produces a net ***removal*** of tens of billions.

Mass tree planting, for bioenergy or as an attempt at offsetting, had been the latest attempt to stall cuts in fossil fuel use. But the ever-increasing need for carbon ***removal*** was calling for more. This is why the idea of direct air capture, now being touted by some as the most promising technology out there, has taken hold. It is generally more benign to ecosystems because it requires significantly less ***land*** to operate than Beccs, including the ***land*** needed to power them using wind or solar panels.

Unfortunately, it is widely believed that direct air capture, because of its exorbitant costs and energy demand, if it ever becomes feasible to be deployed at scale, will not be able to compete with Beccs with its voracious appetite for prime ***agricultural*** ***land***.

It should now be getting clear where the journey is heading. As the mirage of each magical technical solution disappears, another equally unworkable alternative pops up to take its place. The next is already on the horizon - and it's even more ghastly. Once we realise net zero will not happen in time or even at all, geoengineering - the deliberate and large scale intervention in the Earth's climate system - will probably be invoked as the solution to limit temperature increases.

One of the most researched geoengineering ideas is solar radiation management - the injection of millions of tons of sulphuric acid into the stratosphere that will reflect some of the Sun's energy away from the Earth. It is a wild idea, but some academics and politicians are deadly serious, despite significant risks. The US National Academies of Sciences, for example, has recommended allocating up to $200m (£141m) over the next five years to explore how geoengineering could be deployed and regulated. Funding and research in this area is sure to significantly increase.

Difficult truths

In principle there is nothing wrong or dangerous about carbon dioxide ***removal*** proposals. In fact developing ways of reducing concentrations of carbon dioxide can feel tremendously exciting. You are using science and engineering to save humanity from disaster. What you are doing is important. There is also the realisation that carbon ***removal*** will be needed to mop up some of the ***emissions*** from sectors such as aviation and cement production. So there will be some small role for a number of different carbon dioxide ***removal*** approaches.

The problems come when it is assumed that these can be deployed at vast scale. This effectively serves as a blank cheque for the continued burning of fossil fuels and the acceleration of habitat destruction. Carbon reduction technologies and geoengineering should be seen as a sort of ejector seat that could propel humanity away from rapid and catastrophic environmental change. Just like an ejector seat in a jet aircraft, it should only be used as the very last resort. However, policymakers and businesses appear to be entirely serious about deploying highly speculative technologies as a way to ***land*** our civilisation at a sustainable destination. In fact, these are no more than fairy tales.

The only way to keep humanity safe is to impose immediate and sustained radical cuts to greenhouse gas ***emissions*** in a socially just way. Academics typically see themselves as servants to society. Indeed, many are employed as civil servants. Those working at the climate science and policy interface desperately wrestle with an increasingly difficult problem. Similarly, those that champion net zero as a way of breaking through barriers holding back effective action on the climate also work with the very best of intentions.

The tragedy is that their collective efforts were never able to mount an effective challenge to a climate policy process that would only allow a narrow range of scenarios to be explored. Most academics feel distinctly uncomfortable stepping over the invisible line that separates their day job from wider social and political concerns. There are genuine fears that being seen as advocates for or against particular issues could threaten their perceived independence. Scientists are one of the most trusted professions. Trust is very hard to build and easy to destroy.

But there is another invisible line, the one that separates maintaining academic integrity and self-censorship. As scientists, we are taught to be sceptical, to subject hypotheses to rigorous tests and interrogation. But when it comes to perhaps the greatest challenge humanity faces, we often show a dangerous lack of critical analysis.

In private, scientists express significant scepticism about the Paris Agreement, Beccs, offsetting, geoengineering and net zero. Apart from some notable exceptions, in public we quietly go about our work, apply for funding, publish papers and teach. The path to disastrous climate change is paved with feasibility studies and impact assessments. Rather than acknowledge the seriousness of our situation, we instead continue to participate in the fantasy of net zero. What will we do when reality bites? What will we say to our friends and loved ones about our failure to speak out now?

The time has come to voice our fears and be honest with wider society. Current net zero policies will not keep warming to within 1.5C because they were never intended to. They were and still are driven by a need to protect business as usual, not the climate. If we want to keep people safe then large and sustained cuts to carbon ***emissions*** need to happen now. That is the very simple acid test that must be applied to all climate policies. The time for wishful thinking is over.

Additional reporting by Sir Robert Watson and Wolfgang Knorr

James Dyke is a senior lecturer in global systems at the University of Exeter. Robert Watson is Emeritus Professor in environmental sciences at the University of East Anglia. Wolfgang Knorr is a senior research scientist in physical geography and ecosystem science at Lund University. This article first appeared on The Conversation.

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[***New Study: U.S Needs to Double Nursery Production***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:624H-FGK1-F0YC-N33B-00000-00&context=1516831)

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**Length:** 1250 words

**Body**

Arlington, Virginia: The Nature Conservancy has issued the following press release:

In order to realize the potential of reforestation in the United States, the nation’s tree nurseries need to increase seedling production by an additional 1.7 billion each year, a 2.3-fold increase over current nursery production. Currently the nation produces 1.3 billion seedlings per year. These numbers, taken from a new study, show the promise of increased nursery output as a way to fight climate change, create jobs, and recover from uncharacteristically severe wildfires.

With more than 200,000 square miles in the United States suitable for reforestation, ramping up nursery production could offer big benefits for the climate. Restoring ***forests*** is an important nature-based solution to climate change and a complement to the critical work of reducing fossil fuel ***emissions***.

“To meet the need for reforestation, we’ll need to invest in more trees, more nurseries, more seed collection, and a bigger workforce,” said the study’s lead author, Joe Fargione of The Nature Conservancy. “In return we’ll get carbon storage, clean water, clean air, and habitat for wildlife. ”

The new study, published in the science journal Frontiers in ***Forests*** and Global Change, was co-authored by 18 scientists from universities, nonprofits, businesses, and state and federal agencies.

To illustrate the requirements for increasing reforestation capacity in the U.S , the researchers identified 64 million acres of natural and ***agricultural*** ***lands***, nearly half of the total reforestation opportunity. Accounting for different planting densities by region, it would require 30 billion trees to reforest these ***lands***. This equates to 1.7 billion more tree seedlings produced each year for this ***land*** to be reforested by 2040.

To achieve this large increase, investment is required across the entire reforestation “pipeline. ” Additional investment would be needed to expand capacity for seed collection and storage, tree nursery expansion, workforce development, and improvements in pre- and post-planting practices. To encourage nursery expansion, low-interest or forgivable loans in addition to long-term contracts, will be needed. Across the pipeline, achieving this scenario will require public support for investing in these activities, plus incentives for landowners to reforest. The investments will create jobs in rural communities, not only in nurseries but across the whole spectrum of reforestation activities- from seed collection, to preparing sites for planting, to post-planting management activities essential to growing healthy young stands.

There are several existing reforestation programs in the United States that could be scaled up to put the new study’s information to work. On public ***lands*** this includes the Reforestation Trust Fund, which can be enhanced via the soon-to-be-introduced federal REPLANT Act to fully fund reforestation of America’s national ***forests***. On private ***lands***, they include the U.S Department of ***Agriculture***’s Environmental Quality Incentives Program (EQIP) and Conservation Reserve Program (CRP), as well as state conservation agency cost-share programs.

Given the large opportunity for reforestation across the country, more funding will be needed, particularly for federal and state agencies that lack a stable, dedicated funding source for reforestation, such as the Department of the Interior.

In the United States, hundreds of millions of acres are potentially reforestable. Currently, most ***lands*** in need of reforestation are not being reforested. This problem is being exacerbated by the increasing need to reforest after fires – which are becoming increasingly large and severe due to a century of misguided fire suppression and climate change. Only by increasing our capacity to plant trees will this need be met.

Quotes from contributing co-authors:

“Nurseries are critical to our national carbon ***removal*** ambitions, but they face serious labor and funding shortfalls. New “green recovery” proposals from the Biden administration, such as the Civilian Climate Corps, could grow the country’s reforestation workforce. At the same time, ***removing*** the outdated cap on the Reforestation Trust Fund would free up more money for the U.S ***Forest*** Service to grow and plant trees. ”Brian Kittler, Senior Director of ***Forest*** Restoration, American ***Forests***, [*bkittler@americanforests.org*](mailto:bkittler@americanforests.org)

“The area burned each year in the western US is rapidly outpacing the capacity of government agencies to reforest these ***lands***. Each year the gap between what needs to be replanted and our capacity to do that work grows steadily into a chasm. ”Solomon Dobrowski, Professor, Franke, College of Forestry and Conservation, University of Montana, [*solomon.dobrowski@umontana.edu*](mailto:solomon.dobrowski@umontana.edu)

“Seed collection, seed handling and seedling production require specialized skills and training. Much of this expertise has been lost with the closing of nurseries and plant material programs over the last several decades, yet it is critical to reaching reforestation ***targets*** and protecting investments in the reforestation pipeline. Funding for programs that provide hands-on training for seed collectors, seed extractory personnel, and nursery growers is critical to ensuring that a trained workforce is available. Opportunities to integrate workforce training between the federal and private sectors also exist. ”Olga Kildisheva, Project Manager, The Nature Conservancy, [*olga.kildisheva@tnc.org*](mailto:olga.kildisheva@tnc.org)

“We are at a pivotal moment in time where we can make a huge impact on the battle against climate change. Sadly, the greatest tool we have to fight this battle is incomplete. Therefore, it is critical that we invest in the entire reforestation pipeline to address the urgency and scale of the climate problem while simultaneously supporting water resources, ***forest*** products, wildlife habitat, recreation, and many other valuable resources ***forests*** provide. ”Owen Burney, Director of Reforestation and Associate Professor, New Mexico State University, [*oburney@nmsu.edu*](mailto:oburney@nmsu.edu)

“Wildfires and insect outbreaks are being exacerbated by climate change and natural tree regeneration is being limited by the size of these disturbances. Planting is the only way we will reestablish ***forest*** cover in many of these areas and our lack of national nursery capacity is going to create a real bottleneck in seedling supply. ”Matthew Hurteau, Associate Professor, Department of Biology, University of New Mexico, [*mhurteau@unm.edu*](mailto:mhurteau@unm.edu)

“The reforestation challenge is really an economic and political challenge. Reforestation is one of the lowest cost options to deal with climate change and provide many other public benefits. How to translate these public goods benefits into private reforestation incentives is critical. ”Daowei Zhang, Professor and Associate Dean for Research, School of Forestry and Wildlife Sciences, Auburn University, [*zhangdw@auburn.edu*](mailto:zhangdw@auburn.edu)

“As director of the Southern ***Forest*** Nursery Management Cooperative, I knew that the southern US produces over a billion seedlings annually and that reforestation/afforestation could be one way to mitigate carbon sequestration, but there are unknowns. What is the US capacity for seedling production? What are the limitations and what is the available ***land*** base to do so? This research team has been effective in addressing those questions due to their diverse range of expertise. With this combined knowledge, the team was able to identify the pinch points and strategies that would allow the US to increase tree planting. ”

**Load-Date:** March 4, 2021

**End of Document**



[***How Nestlé is leveraging agriculture and forestry to fight climate change***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:62KM-7KD1-DYNP-M182-00000-00&context=1516831)

FoodNavigator.com

May 4, 2021 Tuesday 3:56 PM GMT+1

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**Section:** BUSINESS

**Length:** 1494 words

**Byline:** Katy Askew, , [*Katy*](mailto:Katy)

**Body**

Swiss food giant Nestlé has a carbon footprint that is twice the size of Switzerland’s ***emissions*** linked to fossil fuel use. The company has a ***target*** to reach net zero by 2050 – and it believes that the regenerative potential of ***agriculture*** and forestry will help it get there.

The food system sits at an unhappy intersection. It is both significantly exposed to, and a significant contributor to, climate change.

If both direct and indirect ***emissions*** are taken into account, over 30% of the European Union’s GHG ***emissions*** come from the food and drink sector, according to environmental campaign group Friends of the Earth.

Meanwhile, extreme weather events like droughts and flooding have the potential to disrupt the industry’s global supply chains, increasing volatility in commodities and potentially hitting the supply of raw materials.

As data from the Met Office and the World Food Programme reveal, areas across Africa, the Middle East, Asia and Latin America are already vulnerable to food insecurity. WFP reports that changes in climactic conditions have affected the production of some staple crops and ‘future climate change threatens to exasperate this’.

The integrated nature of global supply chains, which are reliant on internationally sourced crops like cocoa, coffee and palm oil, leave large food makers in Europe and North America – regions the WFP says food insecurity is negligible – exposed.

“This has consequences, this has business consequences,”​ Benjamin Ware, Nestlé Head of Sustainable Sourcing and Climate Diversity stressed.

Speaking to journalists at a recent workshop, Ware emphasised that taking action to mitigate the food industry’s climate impact is ‘truly a business matter for the survival of the economy at large’ and ‘not only a green thing’.

The Swiss food group has laid out its roadmap to net zero, including a series of important milestones. It aims to cut its GHG footprint by 20% by 2025; 50% by 2030 and 100% by 2050, in line with the Paris Agreement and the UN 1.5° pledge.

“We will achieve this through carbon reductions and ***removals***… and not so much through the use of offsets and carbon credits,”​ Ware predicted.

Nestlé has calculated its annual carbon footprint at 92m tonnes of CO2e. Seventy percent of this footprint lies in the raw materials it sources – 28m tonnes of ***agricultural*** materials a year from 86 countries.

While work is being undertaken to cut the footprint of the company’s own operations – switching to renewable energy for instance - success will ultimately depend on Nestlé’s ability to tackle scope 3 ***emissions***, those that originate in the supply chain.

Here, Nestlé believes that two approaches could prove particularly fruitful: the promotion of regenerative ***agricultural*** practices to build soil health and a ‘***forest*** positive’ ambition. “This is where the solutions are for us and this is where the focus is for us,​” Ware said.

Regenerative ***agriculture***: Building healthy soils

Alongside climate change, soil health also stands as a threat to ***agricultural*** yields. The UN’s Food and ***Agriculture*** Organization estimates that soil erosion can result in a reduction in crop yield of up to 50%. Degraded soils also increase exposure to other stressors, such as water insecurity.

FAO data suggest one-third of the planet’s soils are already eroded – and over 90% could become degraded by 2050. Currently, the equivalent of one soccer pitch of soil is eroded every five seconds.

One of the major causes of soil erosion – like climate change – is intensive ***agriculture***. The FAO reports that soil erosion on arable or intensively grazed ***lands*** is between 100 and 1000 times higher than natural erosion rates.

“We want to move from degraded soils to restoring fertility,”​ Pascal Chapot, Nestlé’s Group Head of Sustainable ***Agriculture*** revealed, pointing to the potential of regenerative ***agriculture***.

“The idea is to scale up practices that will contribute to soil fertility, which means restoring the organic matter in the soil,”​ he told the digital event. “All this revolves around soil. If we manage to restore soil fertility, we will have a lot of benefits… at a landscape level.”​

Soil organic matter (SOM) is primarily made up of carbon, hydrogen and oxygen and consists of plant and animal debris, soil microbes and the substances they synthesise. SOM improves soil structure and reduces erosion. It can work against drought by percolating and storing water, and can draw carbon down from the atmosphere into the earth.

This can, in turn, help address carbon ***emissions*** associated with production. “The soil can be a net emitter or a carbon sink,”​ Chapot explained.

While there is not currently a definitive definition of ‘regenerative ***agriculture***’, practices include minimum or no tillage, crop rotation, well-managed grazing versus industrial feed lots, and increasing soil fertility through biological means such as the use of cover cropping.

So what does regenerative ***agriculture*** mean for Nestlé? Chapot said that a ‘one size fits all’ approach ‘does not apply’. “Where you see a list of regenerative practices, do not think that a farmer has to apply all of them,”​ he said.

However, he highlighted the importance of covered soil, a reduction in tillage and a reduction in the use of chemicals and pointed to Nestlé projects that have increased the use of intercropping, supporting not only soil fertility but also building more resilient farmer incomes.

Nestlé’s approach will be both ‘pragmatic’ and ‘science-based’, he stressed.

“We will help farmers to change from conventional to regenerative… We need to be careful and localise our solutions,”​ the ***agricultural*** expert noted.

“It is important to see it as a journey, it’s not black or white, it will evolve over time and it’s a collaborative journey.”​

From deforestation-free to '***forest***-positive'

Deforestation and ***land***-use change are also big contributors to global heating. ***Forests*** store large amounts of carbon and the plants within them absorb carbon dioxide as they grow.

Research from the World Resources Institute, averaged over 2015-2017, concludes that global loss of tropical ***forests*** contributed about 4.8 billion tonnes of carbon dioxide per year.

***Forests*** cover about 30% of the planet’s landmass – but they are shrinking at an alarming rate. According to the World Bank, between 1990 and 2015 there has been a 3% decline ***forested*** ***land*** globally – that equates to 1.3 million square kilometres, or an area roughly the size of South Africa. Much deforestation has been driven by the growing demand for ***agricultural*** commodities, such as palm oil, soy and cocoa.

“Inaction is not an option. ***Forests*** are being cut, there are massive fires around the world… ***Forests*** are the lungs of the planet. We look on them not only as a solution for what we want to do with climate change, but as part of our body,​" Ware said.

When Nestlé thinks about ***forests***, he continued, it is through ‘many angles we don’t necessarily see when we think trees’, including the livelihoods supported by the agro-forestry landscape.

For the past decade Nestlé has been in a ‘race’ to achieve deforestation-free status for its key commodities. The company has taken a ‘tool kit’ approach that includes certification, collaboration with NGOs and other stakeholders, transparent reporting structures and developments like the use of satellite technology.

According to Emily Kunen, Global Sustainable Sourcing Leader, ***Forests***, this tech development – adopted in 2019 – has been a ‘gamechanger’ in supply chain monitoring.

Nestlé has, nevertheless, come short of its goal to be 100% deforestation-free by 2020. By the end of 2020, 90% of the group’s key commodities were verified deforestation-free, Kunen revealed. “We remain committed to achieving 100% deforestation-free by the end of next year,”​ she told event attendees. “We’ve learned a lot about what companies like Nestlé can do to protect ***forests***.”​

The company is already looking beyond this achievement to the next step. “We are in a position to evolve the term deforestation-free to ***forest***-positive… We know we don’t have all the answers but we have to be more forward looking.”​

Kunen illustrated her point by highlighting Nestlé’s involvement in a [*project to protect and restore the Cavally* ***forest*** *reserve in Côte d’Ivoire*](https://www.foodnavigator.com/Article/2020/08/19/Earthworm-Nestle-tie-up-tackles-deforestation-in-Cote-d-Ivoire-Cocoa-farming-in-the-Cavally-forest-reserve-is-illegal)​. A collaboration between Nestlé, NGO Earthworm and the Ivorian Ministry of Waters and ***Forests*** (MINEF), the national forestry agency (SODEFOR), the project is centred around farmer engagement rather than simply evicting smallholders operating illegally in the area.

The CHF2.5m scheme aims to ‘conserve and restore’ by ‘protecting’ existing ***forest***, ‘restoring’ degraded ***forest*** and, ultimately, ‘increasing resilience and improving livelihoods’, Kunen explained.

Bringing together issues around deforestation, human rights and livelihoods is an important unlock for Nestlé and its ‘***forest*** positive’ ambition. It is hoped that this in turn will help lower the carbon footprint of the world’s largest food maker.

**Load-Date:** May 4, 2021

**End of Document**



[***North Yorkshire energy boss says decarbonisation would support 17,000 local jobs***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:61W4-PSB1-F0JC-M0YW-00000-00&context=1516831)

York Press

January 28, 2021 Thursday

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**Length:** 872 words

**Byline:** [*Nadia Jefferson-Brown*](http://Nadia Jefferson-Brown)

**Body**

THE head of a UK and US sustainable energy company says 17,000 jobs would be supported by developing decarbonisation at its North Yorkshire plant.

Drax CEO Will Gardiner has spoken out about the need for nations to stand together against climate change, after Joe Biden became the 46th US president and re-joined the Paris Agreement.

Will, a US citizen, said the move had come ''at a crucial time to ensure global leadership and collaboration on climate change'.

"As a UK-US sustainable energy company, with communities on both sides of the Atlantic, we at Drax are keenly aware of the need for thinking that transcends countries and borders.

"Starting with re-joining the Paris Agreement, I am confident that the new administration can make a significant difference to this once-in-a-lifetime challenge.

"This is why Drax and our partners are mobilising a transatlantic coalition of negative ***emissions*** producers.

"This can foster collaboration and shared learning between the different technologies and techniques for carbon ***removal*** that are essential to decarbonise the global economy.

"Clear long-term policies that spur collaboration, drive innovation and enable technologies at scale are essential in achieving the UK and US' aligned ***targets*** of reaching net zero carbon ***emissions*** by 2050."

Climate change required collaboration on a scale like few other project, he added.

The Port of Baton Rouge, Louisiana

Will said that in the UK, delivering negative ***emissions*** using bioenergy with carbon capture and storage (BECCS) were essential in preventing the impact of climate change, but also a vital economic force in the recovery from the impact of Covid-19.

"Government and private investments in clean energy technologies can create thousands of well-paid jobs, new careers, education opportunities and upskill workforces.

"Developing BECCS at Drax Power Station, for example, would support around 17,000 jobs during the peak of construction in 2028, including roles in construction, local supply chains and the wider economy.

"Additional jobs would be supported and created throughout our international supply chain.

"The technology depends upon sustainable ***forest*** management in regions, such as the US South where our American communities operate. Carbon capture using sustainable bioenergy will help Drax to be carbon negative by 2030.

"Experts on both sides of the Atlantic consider BECCS essential for net zero. The UK's Climate Change Committee says it will play a major role in tackling carbon dioxide (CO2) ***emissions*** that will remain in the UK economy after 2050, from industries such as aviation and ***agriculture*** that will be difficult to fully decarbonise. Meanwhile, a report published last year by New York's Columbia University revealed that rapid development of BECCS is needed within the next 10 years in order to curb climate change.

"A variety of negative ***emissions*** technologies are required to capture between 10% and 20% of the 35 billion metric tonnes of carbon produced annually that the International Energy Agency says is needed to prevent the worst effects of climate change.

"We believe that sharing our experience and expertise in areas such as forestry, bioenergy, and carbon capture will be crucial in helping more countries, industries and businesses deploy a range of technologies.

"A formal coalition of negative ***emissions*** producers that brings together approaches including ***land*** management, afforestation and reforestation, as well as technical solutions like direct air capture (DAC), as well as BECCS, would offer an avenue to ensure knowledge is shared globally.

"It would also offer flexibility in countries' paths to net zero ***emissions***. If one approach under-delivers, other technologies can work together to compensate and meet CO2 ***removal*** ***targets***.

"I agree whole heartedly that a nation's economy and environment are intrinsically linked - something many leaders are now saying, including President Biden."

He added: "We are also partnered with 11 other organisations in the UK's Humber region to develop a carbon capture, usage and storage (CCUS) and hydrogen industrial cluster with the potential to spearhead creating and supporting more than 200,000 jobs around the UK in 2039.

"The expertise and equipment needed for such a project can be shared, traded and exported to other industrial clusters around the world, allowing us to help reach global climate goals and drive global standards for CCUS and biomass sustainability.

"Clear, long-term policies are essential here, not just to help develop technology but to mitigate risk and encourage investment. These are the next crucial steps needed to deploy negative ***emissions*** at the scale required to impact CO2 ***emissions*** and lives of people.

"At Drax we directly employ almost 3,000 people in the US and UK, and indirectly support thousands of families through our supply chains on both sides of the Atlantic.

"Drax Power Station is the most advanced BECCS project in the world and we stand ready to invest in this cutting-edge carbon capture and ***removal*** technology. We can then share our expertise with the United States and the rest of the world - a world where major economies are committing to a net zero future and benefitting from a green economic recovery."

**Load-Date:** January 28, 2021

**End of Document**



[***UK greenhouse gas emissions decreased by 2.8% in 2019***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:61XC-D5B1-JDGR-53T4-00000-00&context=1516831)

Bioenergy Insight

February 3, 2021 Wednesday 11:33 AM EST

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**Length:** 1039 words

**Body**

The UK's greenhouse gas (GHG) ***emissions*** decreased by 2.8% in 2019, according to the latest government figures.

In 2019, the UK's net territorial ***emissions*** (occurred within UK borders) of the basket of seven GHGs covered by the Kyoto Protocol (CO2, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, sulphur hexafluoride, and nitrogen trifluoride) were estimated to be 454.8 million tonnes of carbon dioxide equivalent (MtCO2e), a decrease of 2.8% compared to the 2018 figure of 468.1 million tonnes and 43.8% lower than they were in 1990.

Carbon dioxide made up around 80% of the 2019 total, with methane at 12%, nitrous oxide 5%, and fluorinated gases at 3%.

According to the Department for Business, Energy, and Industrial Strategy (BEIS), the decrease in GHG ***emissions*** from 2018 was mainly caused by reductions in ***emissions*** in the energy supply sector, down 8.1% (8.4 MtCO2e). This was driven by the continued decrease in power station ***emissions*** due to the change in the fuel mix for electricity generation, in particular a reduction in the use of coal. ***Emissions*** from energy supply are now 65.5% lower than they were in 1990.

**Transport *emissions***

***Emissions*** from transport fell by 1.8% (2.2 Mt CO2e) in 2019, their second year in decline having previously risen since 2013. Despite this, transport remains the largest emitting sector, responsible for 27% of all GHG ***emissions*** in the UK. Transport ***emissions*** are only 4.6% lower than in 1990, as increased road traffic has largely offset improvements in vehicle fuel efficiency.

Between 1990 and 2019, there has been relatively little overall change in the level of GHG ***emissions*** from the transport sector, according to the BEIS figures. Between 1990 and 2007 (when ***emissions*** peaked), there was a general increasing trend, with some fluctuations year-to-year. After this peak, ***emissions*** dropped each year until 2013, at which point the trend reversed to show small increases most years. The overall effects of these fluctuations over time means ***emissions*** are estimated to have been around 5% lower in 2019 than in 1990.

**Energy supply sector *emissions***

The UK's energy supply sector consists of ***emissions*** from fuel combustion for electricity generation and other energy production sources. It's estimated to have been responsible for 21% of UK GHG ***emissions*** in 2019, with CO2 being by far the most prominent gas for this sector at 94%. The main source of ***emissions*** from this sector is the combustion of fuels in electricity generation from power stations.

Figures show there was an 8% fall in ***emissions*** from the energy supply sector between 2018 and 2019, meaning that between 1990 and 2019, they have reduced by 66%. This decrease has resulted mainly from changes in the mix of fuels being used for electricity generation, including the growth of renewables, together with greater efficiency resulting from improvements in technology.

There was a 56% decrease in coal use for electricity generation between 2018 and 2019. This follows large falls in the previous three years, driven by the increase in the carbon price floor in April 2015, from £9 (€10.21) per tonne of CO2 to £18 (€20.42) per tonne of CO2, which led to a shift away from coal towards gas.

***Agriculture* *emissions***

The UK ***agriculture*** sector consists of ***emissions*** from livestock, ***agricultural*** soils, stationary combustion sources, and off-road machinery. It's estimated to have been responsible for 10% of GHG ***emissions*** in the UK in 2019. ***Emissions*** of methane (54%) and nitrous oxide (32%) dominate this sector.

The most significant sources here are ***emissions*** of methane due to enteric fermentation from livestock - particularly cattle - and nitrous oxide ***emissions*** related to the use of fertilisers.

Between 2018 and 2019 there was a 1% increase in ***emissions*** from the ***agriculture*** sector, largely due to an increase in CO2 ***emissions*** from liming. Between 1990 and 2019, GHG ***emissions*** in this sector decreased by around 13%, with a general downward trend in ***emissions*** since the late 1990s. This was driven by a fall in animal numbers and a decrease in synthetic fertiliser use.

**Waste management *emissions***

This sector consists of ***emissions*** from waste disposed of to landfill sites, waste incineration, and wastewater treatment. It's estimated to have been responsible for around 4% of GHG ***emissions*** in the UK in 2019, with methane being by far the most prominent gas (90% of ***emissions***). The vast majority of ***emissions*** came from landfill sites.

***Emissions*** from the waste management sector decreased by 1% between 2018 and 2019, mainly due to reduced landfill ***emissions***. Between 1990 and 2019, GHG ***emissions*** decreased by 71%, this was due to a combination of factors, including improvements in the standards of landfilling, changes to the types of waste going to landfill (e.g. reducing the amount of biodegradable waste), and an increase in the amount of landfill gas being used for energy.

***Land* use, *land*-use change, and forestry (LULUCF)**

The LULUCF sector consists of ***emissions*** and ***removals*** from ***forest*** ***land***, cropland, grassland, settlements, and harvested wood products. Following a major methodology change this year to better represent ***emissions*** from drained and rewetted inland organic soils (peatlands), the BEIS now estimates this sector to be a net source of GHG ***emissions*** in each year from the start of the data series in 1990.

In 2020, the government estimated it to be a net sink of GHGs in the UK throughout the series, meaning that it removed GHGs from the atmosphere. In general, settlements and cropland are the largest sources of CO2 ***emissions***, while ***forest*** ***land*** is the dominant sink. Following the peatlands methodology change, the government now estimates that grasslands have been a net source of ***emissions*** over most of the time series, before becoming a small net sink from 2013 onwards.

The LULUCF sector is estimated to have had net ***emissions*** of 5.9 MtCO2e in 2019. This has risen slightly in the last two years but is down from a total of 18 MtCO2e in 1990. This long-term fall has been driven by a reduction in ***emissions*** from cropland and grassland and an increase in the sink provided by ***forest*** ***land***, with an increasing uptake of CO2 by trees as they reach maturity, in line with the historical planting pattern.

**Load-Date:** February 3, 2021

**End of Document**



[***Opinion: The climate crisis can't be solved by carbon accounting tricks***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:6250-SKJ1-JDG9-Y2B4-00000-00&context=1516831)

Impact News Service

March 5, 2021 Friday

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**Length:** 950 words

**Body**

London: University College London has issued the following news release:

Disaster looms if big finance is allowed to game the carbon offsetting markets to achieve ‘net zero’ ***emissions***, says Professor Simon Lewis (UCL Geography).

An astonishing global shift is under way: 127 countries have now stated that by mid-century their overall ***emissions*** of carbon dioxide will be zero. That includes the EU, US, and UK by 2050 – and China by 2060. Companies are enthusiastically signing up to similar “net zero” goals. Finally the international community seems to have accepted the scientific fact that we need to stop adding greenhouse gases to the atmosphere to stabilise our climate. Dare we hope that the climate crisis can be brought under control?

Perhaps, but big problems remain. Long-term commitments have not resulted in sufficient near-term actions. The world is on track for ***emissions*** to be just 0.5% below 2010 levels by 2030, compared with the 45% needed on the road to net zero by 2050. The pivotal Glasgow Cop26 climate talks in November will need to tackle this. But a more insidious problem is emerging. Net zero increasingly involves highly questionable carbon accounting. As a result, the new politics swirling around net zero ***targets*** is rapidly becoming a confusing and dangerous mix of pragmatism, self-delusion and weapons-grade greenwash.

The science of net zero is simple: every sector of every country in the world needs to be, on average, zero ***emissions***. We know how to do this for electricity, cars, buildings and even a lot of heavy industry. But in certain areas, including air travel and some ***agricultural*** ***emissions***, there is no prospect of getting to zero ***emissions*** in the near future. For these residual ***emissions***, greenhouse gasses will need to be sucked out of the atmosphere at the same rate as they are added, so that, on average, there are net zero ***emissions***.

Making this work requires carbon ***removal***, also known as “negative ***emissions***”. This can be low-tech, like restoring ***forests***, as this takes carbon out of the atmosphere and stores it in trees. Or it can be hi-tech, like using chemicals to strip carbon dioxide from the atmosphere and then pumping it deep underground into safe geological storage. In theory this is all fine, as pragmatically some carbon ***removal*** is needed to balance hard-to-reduce ***emissions***: but negative ***emissions*** and offsetting alone are not a route to net zero.

In practice, by believing in the promise of these methods, we are too often deceiving ourselves, in three major ways. The first is an unrealistic overreliance on carbon ***removal*** to preserve the status quo. Shell recently published its net zero plan, that actually projects high oil and gas production through to 2050 and beyond, which voila, are magically removed with negative ***emissions***. Critically, there is far too little ***land*** to plant enough trees to counter today’s ***emissions***, and large-scale hi-tech methods do not yet exist.

The second deception is in offsetting against notional ***emissions*** trajectories instead of ***removing*** carbon from the atmosphere. Mark Carney, the ex-governor of the Bank of England and climate adviser to Boris Johnson, recently described his $600bn Brookfield Asset Management portfolio as “carbon neutral”, despite investing in fossil fuels. Carney said: “The reason we’re net zero is that we have this enormous renewables business. ” He went on to claim that renewables avoid carbon ***emissions*** that would otherwise have happened, so they “offset” his investments in fossil fuel ***emissions***. This is not net zero. It is an accounting trick. Emitting carbon at the same time as building solar capability does not equal zero ***emissions*** overall. Offsetting needs to be used to ***remove*** carbon dioxide from the atmosphere to counter difficult-to-***remove*** ***emissions***, and not just be an enabler of business-as-nearly-usual.

The third deception comes from not getting what you think you’re paying for in the self-regulated global carbon market. The commercial carbon offset concept relies on “additionality” – that money paid then reduces ***emissions*** or captures carbon that would not otherwise have happened. A recent report I advised on showed that the offsets market is awash with old legacy carbon credits where that assumption is violated, some 600m tonnes of these environmentally poor-quality credits are available to buy, six times the current size of the voluntary carbon market. These old credits come from projects that have already happened, meaning buying additional credits provides no additional climate benefit. Energy giant Total recently bought these near-worthless credits.

What is to be done? Negative ***emissions*** and offsets are here to stay. In a limited way, they are needed to stabilise the climate as they are the only way to tackle the hardest-to-eliminate ***emissions***. Urgent discussion is needed about what comprises a “residual ***emission***” that requires offsetting. In practical terms, making the carbon accountancy trustworthy will require truly independent regulation that is based on science. It is the only way to contain the bad actors and release the capital of good actors. Solving these carbon deceptions should be a core outcome of the Glasgow Cop26 climate summit.

If such deceptions remain, disaster looms. Big finance, led by Carney, is planning to massively expand carbon markets. Conceivably, new carbon-based financial products could boom, with little impact on ***emissions***. Just like the sub-prime crisis, few will understand what they bought, and another globe-spanning crash could sweep the world, compounding economic and climate crises causing mass suffering, as we realise again that the Earth owes us nothing. Nature doesn’t do bailouts.

**Load-Date:** March 6, 2021

**End of Document**



[***How the EU plans to reshape its economy to limit climate change***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:634S-82Y1-F039-6471-00000-00&context=1516831)

FT.com

July 14, 2021 Wednesday

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**Length:** 1253 words

**Byline:** Mehreen Khan in Brussels

**Body**

Brussels has laid out the path to the EU becoming the world’s first economic bloc to hit net zero greenhouse gas ***emissions*** by 2050 in an attempt to limit global warming.

The EU’s approach to the mammoth task of ending the economic reliance on fossil fuels involves three big policy levers: tougher regulation and ***emissions*** standards for industry; carbon pricing and taxes on polluters; and rules to promote investment in low-***emissions*** technology.

Brussels hopes the blitz of measures will ensure the 27-country bloc can reduce average ***emissions*** by 55 per cent by 2030, falling to net zero by 2050.

The EU has so far cut ***emissions*** by 24 per cent from 1990 levels, but will now take aim at some of the bigger sources, including power plants, factories, cars, planes, shipping and heating systems.

Here’s a breakdown of the new policies.

Carbon pricing

The centrepiece of the EU’s bid to sharply reduce ***emissions*** across the economy is a revamp of the bloc’s carbon market, known as the ***Emissions*** Trading System.

[*Set up in 2005*](https://www.ft.com/content/a4e3791b-9d9e-4bf9-ae74-fe1cf1980625), the ETS requires large industrial polluters such as steelmakers and power generators to buy carbon credits to cover the cost of their ***emissions***. These credits are traded on financial markets and have helped drive the cost of polluting to a recent high of more than €55 per tonne of carbon.

The European Commission now proposes to extend the scheme to cover the shipping industry for the first time.

At the same time it will phase out the free credits that many sectors have long benefited from, including airlines that must pay for ***emissions*** on flights inside the EU.

The phaseout ends in 2036, with the ETS designed to reduce ***emissions*** in the system by 61 per cent over the next decade.

Among the most contentious proposals is a plan to extend the system to transport and buildings — a reform that some EU governments argue will  [*drive up the heating and petrol bills*](https://www.ft.com/content/a4e3791b-9d9e-4bf9-ae74-fe1cf1980625) of consumers who cannot readily afford to switch to greener alternatives. Brussels aims to cushion the blow with a pot of €72bn to alleviate energy poverty.

Carbon border

The EU is planning on becoming the first big economic power to impose a levy on imports based on their carbon footprint.

The so-called carbon border adjustment mechanism is part of an attempt to prevent “carbon leakage”, where companies can move their operations to other jurisdictions to avoid being subject to green regulations.

European industry has demanded the CBAM as a way to ensure foreign competitors face the same costs. But attempts to impose border levies have been beset by legal difficulties, including abiding by World Trade Organization agreements.

The tool will be initially limited to products such as steel, cement, aluminium and fertilisers, with Russian and Turkish exporters expected to be hit hardest.

Under the system companies will have to buy carbon credits that mirror the prices paid by European industry. The commission has said it will only apply the levy on foreign businesses that do not abide by equivalent carbon pricing as their European rivals.

Rich vs poor

Business sectors not covered by the EU’s carbon market include ***agriculture***, waste and some parts of industry, and account for almost 60 per cent of total domestic EU ***emissions***. These will now be subject to binding ***emissions*** goals, set out in what it calls the Effort Sharing Regulation.

The legislation sets national ***targets*** for the 27 member states that translate ***emissions*** goals to their domestic economy in these sectors.

National ***targets*** have been revised after the EU agreed to accelerate carbon ***emission*** reduction from a ***target*** of 40 per cent to 55 per cent by 2030.

Brussels has also tweaked the criteria that determine member states’ ***targets***, which are based on their relative wealth. Poorer countries have had to do proportionally less than richer ones in the past, but western economies have called for a more equal distribution among the bloc. Poland, Lithuania, and Latvia will be among the countries with the greatest challenge.

Green taxes

Brussels aims to increase carbon taxes on dirty fuel by updating a 15-year-old rule book, known as the Energy Taxation Directive.

The commission wants to tax kerosene jet fuel used by airlines and polluting fuels in the shipping industry for the first time and close loopholes that have allowed EU governments to exempt fossil fuels.

Updating the directive will be the toughest political task set by the commission as taxation policy requires unanimous backing from all EU countries. Smaller states such as Greece, Cyprus and Malta are likely to resist taxing shipping, arguing they have been hit already by the pandemic and have fewer green alternative fuels to switch to.

Clean cars

Brussels wants to include carmakers in the ETS and set tougher ***emissions*** standards for new vehicles that are driven out of showrooms across Europe in order to cut 90 per cent of ***emissions*** from transport.

It proposes more stringent carbon ***emission*** standards for new passenger vehicles, setting a de facto date to ban the sale of new diesel and petrol in Europe from 2035. Automakers that cannot meet the standards, set every five years, will face fines.

EU clean car standards were first introduced in 2018 and the quick take-up of electric vehicles has emboldened Brussels to push for wider change. The end date for the combustion engine will be contested in the European Parliament, where there is a push for a date closer to 2030 at the same time as governments such as France want to give carmakers until 2040.

Green fuel

Brussels wants to assist industry to decarbonise by creating rules to promote the development of green fuels and accelerate the rollout of critical electric charging points.

It is aiming to ensure greater public access to charging points for cars by ensuring they are available within every 60km, and will require more hydrogen refuelling stations for vans and trucks.

Brussels also wants to encourage the development of sustainable fuels for planes and ships. The commission has proposed a blending ***target*** of 5 per cent for sustainable aviation fuels by 2030 — a relatively modest goal that reflects the difficulty in using green fuels to power long-haul flights.

Shippers will also have to begin reporting to the commission what type of vessels and fuels they use.

Renewable energy

The commission wants to raise the bloc’s renewable energy ***target*** to 40 per cent of the total energy mix by 2030, compared with a current ***target*** of 32 per cent.

Nearly two-thirds of the EU’s current renewable energy derives from  [*biomass*](https://www.ft.com/content/c3b00115-562e-4d06-bd11-f46a3f9366b1), which includes pellets made from organic waste being burnt for energy. The commission has been under pressure from environmental groups to ***remove*** woody biomass from its renewable energy definitions, arguing that use of trees for power is detrimental to the planet.

The commission will introduce stricter sustainability rules for biomass, curb the circumstances in which subsidies can be given to the industry, and exclude biomass from primary ***forests*** from counting towards green ***targets***.

Carbon sinks

Brussels is ***targeting*** natural carbon sinks, where soil and ***forests*** can absorb carbon dioxide from the atmosphere, to help meet its 2030 goals.

It proposes to expand the EU’s sequestration of carbon to 310m tonnes from a current ***target*** of 265m tonnes under its ***land*** use and forestry regulation.

But “offsetting” ***emissions*** by using the carbon sink is contested by scientists who argue it is difficult to accurately measure carbon ***removals*** and that the size of the EU’s sink is inherently unstable.

**Load-Date:** July 16, 2021

**End of Document**



[***Off-farm activities are a growing share of food-system greenhouse gas emissions***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:62WG-YCT1-JDG9-Y23P-00000-00&context=1516831)

Impact News Service

June 8, 2021 Tuesday

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**Length:** 1152 words

**Body**

Rome, Italy: Food and ***Agriculture*** Organization has issued the following press release:

Greenhouse gas (GHG) ***emissions*** due to ***land*** use changes such as converting ***forests*** to ***agricultural*** ***land*** have been decreasing over the past 20 years, a decline that has been counterbalanced by increased ***emissions*** - notably high in industrialized countries - from off-farm activities before and after food production according to a new study led by the Food and ***Agriculture*** Organization of the United Nations (FAO) and published today in Environmental Resource Letters.

The report, 'Greenhouse Gas ***Emissions*** from the Food System: Building the Evidence Base', estimates that food-system ***emissions*** amounted to 16 billion tonnes of carbon dioxide or equivalents (CO2eq) in 2018, an 8 percent increase since 1990. They now represent 33 percent of all human-caused GHG ***emissions***.

That, lead author Francesco Tubiello, a senior statistician and climate change specialist at FAO, highlights how the global food system represents a 'larger GHG mitigation opportunity than previously estimated and one that cannot be ignored in efforts to achieve the Paris Agreement goals'.

Governments around the world are pledging to reduce their GHG ***emissions*** and pursue carbon neutrality, and many have included mitigation ***targets*** for their ***agriculture*** sectors in their national plans. However, action in food and ***agriculture*** goes well beyond impacts on farms and ecosystems. Analyzing ***emissions*** trends through the broader lens of food systems offers additional insights and opens a range of possible solutions across the entire food production and consumption chain.

The new study provides rich data sets that are being refined ahead of the UN's Food Systems Summit 2021, with important components already available for consultation here . It considers GHG ***emissions*** linked to farm gate production, ***land*** use change at the boundary between farms and natural ecosystems, and supply chains including consumption and waste disposal, to offer a crisper and more granular assessment of trends at the global, regional and country levels.

Over recent decades food systems ***emissions***, both in absolute and per-capita levels, are increasingly dominated by farm gate and supply chains processes, with the impacts from ***land*** use change decreasing as economies develop. Furthermore, the study highlights important differences among countries, with developed economies per capita food systems ***emissions*** nearly twice those in developing countries.

Finally, the study offers an operational map to better identify food-relevant components in the national ***emissions*** plans communicated to the United Nations Framework Convention on Climate Change using Intergovernmental Panel on Climate Change (IPCC) categories. Currently, countries report data in their Nationally Determined Contributions but lack a proper quantification of food systems ***emissions*** within National Greenhouse Gas Inventories (NGHGIs).

The research team that compiled the study also consists of experts from Columbia University and NASA, several UN agencies and numerous policy-focused research centers.The open-access report, which builds on another recent data-rich FAO study, offers the full spectrum of technical findings, and represents an important step for building a full database within FAOSTAT.

One emergent theme is that optimal GHG mitigation strategies require a focus on activities before and after farm production, ranging from the industrial production of fertilizers to refrigeration at the retail level, as this is the area where ***emissions*** are growing fastest - due in part to a slowdown in deforestation.

Key findings

In 2018, GHG ***emissions*** from food systems were more than 16 billion tonnes CO2eq, largely emitted in developing countries in terms of absolute amounts.

Global per capita ***emissions***, which decreased from 1990 to 2010 from 2.9 to 2.2 tonnes CO2eq, were characterized by important differences between developed and developing economies. Per capita ***emissions*** in developed countries, at 3.6 tonnes CO2eq in 2018, were nearly twice those in developing countries.

Farm-gate and pre and post production ***emissions*** (those largely along supply chains, consumption and waste) represented two-thirds of the food systems total in 2018, with the role of ***emissions*** from ***land*** use change having decreased over time.

On ***agricultural*** ***land*** - crop and livestock processes within the farm gate but also including relevant ***land***-use changes - amounted to 10.4 Gt of CO2eq, 80 percent of which occurred in developing countries. That represents a 3 percent decline from 1990, as increased on-farm ***emissions*** of nitrous oxide and methane were more than offset by a decrease in ***emissions*** from ***land***-use change such as deforestation or peatland degradation.

Net ***forest*** conversion - from natural ecosystems to ***agricultural*** croplands or pastures, a proxy for deforestation- remained the largest GHG ***emission*** source over this period, at nearly 3 billion tonnes CO2 per year, but declined significantly over time, by over 30 percent from 1990 to 2018.

The new analysis adds detailed country data estimates on domestic food transportation, which emitted globally a mere 0.5 Gt CO2eq in 2018, but have increased by nearly 80 percent since 1990, and nearly tripled in developing countries.

GHGs generated by energy use - largely carbon dioxide from fossil fuels - along the supply chain amounted to over 4 Gt CO2eq in 2018, an increase of 50 percent since 1990.

The FAO-led study also characterizes country-level ***emissions*** from food waste disposal, half of which consist of methane, reaching globally nearly 1 Gt CO2eq in 2018.

What to do?

The declining trend of GHGs linked to ***land***-use change is welcome, but points to the importance of maintaining and even accelerating the good progress achieved in recent years, while focusing on designing climate-friendly practices along the whole food supply chain including - the authors note - the critical role that dietary choices and consumption patterns can play by impacting supply-side production activities.

Assessing the data and trends from a food-systems perspective points to some immediately actionable pathways - such as improving nitrogen use efficiencies in crop and livestock production, mitigating solid food waste disposal and optimizing on-farm energy use - as well as accelerated efforts to improve management of ***agricultural*** ***land*** while protecting natural ecosystems They also underscore that energy use beyond the farm gate will become an increasingly prominent component of total food-system GHG ***emissions*** in the coming decades, so that food-related mitigation can benefit from a whole-system view and broader planning at national level.

'The goal is to complement current ***emissions*** on ***agricultural*** ***land*** with significant carbon ***removals***, based on improved landscape management and more efficient production, thus advancing a carbon-neutral food system,' says Tubiello.

**Load-Date:** June 10, 2021

**End of Document**



[***Amazon rainforest now emitting more CO2 than it absorbs***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:634R-CSH1-DY4H-K1C4-00000-00&context=1516831)

The Guardian (London)

July 14, 2021 Wednesday 4:00 PM GMT

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**Section:** ENVIRONMENT; Version:3

**Length:** 877 words

**Byline:** Damian Carrington Environment editor

**Highlight:** Cutting ***emissions*** more urgent than ever, say scientists, with ***forest*** producing more than a billion tonnes of carbon dioxide a year

**Body**

The Amazon rainforest is now emitting more carbon dioxide than it is able to absorb, scientists have confirmed for the first time.

The ***emissions*** amount to a billion tonnes of carbon dioxide a year, according to a study. The giant ***forest*** had previously been a carbon sink, absorbing the ***emissions*** driving the climate crisis, but is now causing its acceleration, researchers said.

Most of the ***emissions*** are caused by fires, many deliberately set to clear ***land*** for [*beef*](https://www.theguardian.com/environment/2019/jul/02/revealed-amazon-deforestation-driven-global-greed-meat-brazil) and [*soy production*](https://www.theguardian.com/environment/2020/jul/16/a-fifth-of-brazilian-soy-in-europe-is-result-of-deforestation-amazon-jair-bolsonaro). But even without fires, hotter temperatures and droughts mean the south-eastern Amazon has become a source of CO2, rather than a sink.

Growing trees and plants have taken up about a quarter of all fossil fuel ***emissions*** since 1960, with the Amazon playing a major role as the largest tropical ***forest***. Losing the Amazon's power to capture CO2 is a stark warning that slashing ***emissions*** from fossil fuels is more urgent than ever, scientists said.

The research used small planes to measure CO2 levels up to 4,500m above the ***forest*** over the last decade, showing how the whole Amazon is changing. Previous studies indicating the Amazon was becoming a source of CO2 were based on satellite data, which can be hampered by cloud cover, or ground measurements of trees, which can cover only a tiny part of the vast region.

The scientists said the discovery that part of the Amazon was emitting carbon even without fires was particularly worrying. They said it was most likely the result of each year's deforestation and fires making adjacent ***forests*** more susceptible the next year. The trees produce much of the region's rain, so fewer trees means more severe droughts and heatwaves and more tree deaths and fires.

The government of Brazil's president, Jair Bolsonaro, has been harshly criticised for [*encouraging more deforestation*](https://www.theguardian.com/world/2019/jul/19/jair-bolsonaro-brazil-amazon-rainforest-deforestation) , which has [*surged to a 12-year high*](https://www.theguardian.com/environment/2020/dec/01/amazon-deforestation-surges-to-12-year-high-under-bolsonaro) , while [*fires hit their highest level in June since 2007*](https://www.reuters.com/business/environment/brazil-sees-most-june-fires-amazon-rainforest-since-2007-2021-07-01/).

Luciana Gatti, at the National Institute for Space Research in Brazil and who led the research, said: "The first very bad news is that ***forest*** burning produces around three times more CO2 than the ***forest*** absorbs. The second bad news is that the places where deforestation is 30% or more show carbon ***emissions*** 10 times higher than where deforestation is lower than 20%."

Fewer trees meant less rain and higher temperatures, making the dry season even worse for the remaining ***forest***, she said: "We have a very negative loop that makes the ***forest*** more susceptible to uncontrolled fires."

Much of the timber, beef and soy from the Amazon is exported from Brazil. "We need a global agreement to save the Amazon," Gatti said. Some European nations have said they will [*block an EU trade deal with Brazil*](https://www.theguardian.com/world/2020/oct/20/eu-seeks-amazon-rainforest-protections-pledge-from-bolsonaro-in-push-to-ratify-trade-deal) and other countries unless Bolsonaro agrees to do more to tackle Amazonian destruction.

The research, [*published in the journal Nature*](https://www.nature.com/articles/s41586-021-03629-6) , involved taking 600 vertical profiles of CO2 and carbon monoxide, which is produced by the fires, at four sites in the Brazilian Amazon from 2010 to 2018. It found fires produced about 1.5bn tonnes of CO2 a year, with ***forest*** growth ***removing*** 0.5bn tonnes. The 1bn tonnes left in the atmosphere is equivalent to the annual ***emissions*** of Japan, the world's fifth-biggest polluter.

"This is a truly impressive study," said Prof Simon Lewis, from University College London. "Flying every two weeks and keeping consistent laboratory measurements for nine years is an amazing feat."

"The positive feedback, where deforestation and climate change drive a release of carbon from the remaining ***forest*** that reinforces additional warming and more carbon loss is what scientists have feared would happen," he said. "Now we have good evidence this is happening. The south-east Amazon sink-to-source story is yet another stark warning that climate impacts are accelerating."

Prof Scott Denning, at Colorado State University, said the aerial research campaign was heroic. "In the south-east, the ***forest*** is no longer growing faster than it's dying. This is bad - having the most productive carbon absorber on the planet switch from a sink to a source means we have to eliminate fossil fuels faster than we thought."

A satellite study published in April found the Brazilian [*Amazon released nearly 20% more carbon dioxide*](https://www.theguardian.com/environment/2021/apr/30/brazilian-amazon-released-more-carbon-than-it-absorbed-over-past-10-years) into the atmosphere over the past decade than it absorbed. Research that tracked 300,000 trees over 30 years, published in 2020, showed [*tropical* ***forests*** *were taking up less CO2*](https://www.theguardian.com/environment/2020/mar/04/tropical-forests-losing-their-ability-to-absorb-carbon-study-finds) than before. Denning said: "They're complementary studies with radically different methods that come to very similar conclusions."

"Imagine if we could prohibit fires in the Amazon - it could be a carbon sink," said Gatti. "But we are doing the opposite - we are accelerating climate change."

"The worst part is we don't use science to make decisions," she said. "People think that converting more ***land*** to ***agriculture*** will mean more productivity, but in fact we lose productivity because of the negative impact on rain."

Research published on Friday estimated that [*Brazil's soy industry loses $3.5bn a year*](https://www.sciencedirect.com/science/article/pii/S0305750X21001972) due to the immediate spike in extreme heat that follows ***forest*** destruction.

This article was amended on 14 July 2021. The reference to ***forests*** switching "from a sink to a source" of carbon had been expressed the other way around in an early version.

**Load-Date:** July 14, 2021

**End of Document**



[***What would happen to the climate if we reforested the entire tropics?***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:62VM-J6K1-F0YC-N22Y-00000-00&context=1516831)

Impact News Service

June 5, 2021 Saturday

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**Length:** 1066 words

**Body**

Cologny: World Economic Forum has issued the following press release:

A study has looked at the effects of reforesting the entire tropics on the global climate. This simulation was created using the UK Met Office's climate change model. If the tropics were reforested, the model predicts that the oceans, soil and vegetation would absorb less carbon dioxide.

What would happen if every single patch of farmland in the tropics, from Brazil through Congo, India and Indonesia, was abandoned overnight and left to turn back into ***forests***? That’s the question we investigated in our new research. Trees and ***forests*** have become increasingly important in plans to tackle the climate emergency, yet our work shows that once you factor in how the soil, oceans and other parts of the Earth system would respond, tree planting is not as potent a solution as it may first seem.

Of course, abandoning ***agriculture*** in the tropics cannot be a solution to climate change. This was a hypothetical and idealised experiment, but one that helps us to explore how the global carbon cycle might respond to ***forest*** restoration and tree planting on a vast scale. And ***targeting*** the tropics shows maximum impact as trees grow fast there.

To investigate the question, we used the UK Met Office’s climate change model – a computer simulation of the Earth as a system in which the oceans, ***land*** and climate interact and affect each other. We simulated two futures. First, a scenario where the world takes serious action to limit warming to less than 2℃. The second scenario was identical, except all farming across the tropics was stopped and the original vegetation, mostly ***forests***, would recover.Have you read?

The oceans are absorbing more carbon than previously thought How to save the world's ***forests*** with carbon credits Climate change: Are ***forests*** carbon sinks or carbon sources?

The difference between the two scenarios shows that the new tropical trees would store an extra 124 billion tonnes of carbon by the year 2100, or around 13 years’ worth of today’s rate of fossil fuel ***emissions***. All this extra carbon would have been taken from the atmosphere through photosynthesis. However, carbon in the atmosphere – which matters for climate change – would drop by only 18 billion tonnes, just two years’ worth of ***emissions***. What explains the huge difference?

The reason is that other parts of the Earth system counteract the effect of the new tree growth. If the tropics were reforested, our model predicts that the oceans, soil and vegetation would absorb less carbon dioxide. By the end of the century, tropical trees would take up an extra 124 billion tonnes of carbon (or 124 gigatonnes, Gt), but tropical soils would take up 83 Gt less carbon, as the turnover of dead plants is much slower in ***forests*** compared with grasses and crops that die annually, meaning lower carbon inputs in ***forest*** soils and lower carbon storage.

Lower carbon dioxide levels in the atmosphere would also affect vegetation and soils elsewhere in the world. Less carbon dioxide in the atmosphere would mean plant growth slows. And just as in the tropics, less carbon would be taken up by soils.

There would be one other major change to the Earth system. The oceans slow climate change by ***removing*** carbon dioxide from the atmosphere: as CO₂ levels increase some of the extra carbon dioxide dissolves into the seawater. And in our model, the oceans would take up less carbon since the new tropical trees would lower atmospheric CO₂.

To recap: we started with new trees in the tropics taking 124 Gt of carbon out of the atmosphere. Avoiding deforestation adds a further 10 Gt. But once you subtract the carbon no longer stored in tropical ***forest*** soils (83 Gt), in soils and vegetation elsewhere (18 Gt), and in the oceans (15 Gt), you aren’t left with much.How the full tropical reforestation scenario adds up.How the full tropical reforestation scenario adds up.Image: Simon Lewis, Alexander Koch, Chris Brierley

Remarkably, reforesting the tropics – after accounting for soil, vegetation, and ocean responses – results in only 18 Gt of carbon taken from the atmosphere. This is an 86% reduction from our initial extra carbon in tropical trees. This 18 Gt equates to just ten parts per million reduction in atmospheric carbon dioxide.

The Earth system works against us

What we found in our hypothetical scenario is the reverse of what is happening today. When carbon dioxide is released from burning fossil fuels, a little less than half of those ***emissions*** remain in the atmosphere and contribute to climate change. The rest are absorbed by the oceans, soil and vegetation. This has been a great free subsidy from nature.Cities, net zero carbon, environment, energyWhat is the Forum doing to help cities to reach a net-zero carbon future?

In a major step, nine cities and more than 70 organizations in 10 different sectors have come together to build further momentum for a new multi-year initiative: Net Zero Carbon Cities.

Together with the Forum, they have created a vision for the future and launched a new framework to help cities rethink urban ecosystems, ensuring that they are greener, efficient, resilient, circular and more equitable.Image: Integrated energy systems in cities (Source: Net Zero Carbon Cities: An Integrated Approach, 2021, World Economic Forum)

From policy-makers to businesses, city administrators, civil society and the financial sector, the World Economic Forum is convening a range of stakeholders with a role to play if global cities have a chance of reaching the net-zero carbon goal by 2030.

Companies can join the integrated approach to help shape city ecosystems to become net zero carbon by joining a Forum platform. Find out more in our impact story.

But here is the catch: just as the amount of carbon absorbed in the ***land*** and ocean increases as we pump more carbon dioxide into the atmosphere, the reverse happens when we take it out of the atmosphere. The Earth system starts to work against us when we plant trees or use other methods of ***removing*** atmospheric CO₂.

These results are sobering. Even something as radical as reforesting the entire tropics – far beyond any plausible real-world policy outcome – would have less influence on the climate than you might think. But these results also highlight that the best way to avoid dangerous global heating is by not releasing fossil carbon into the atmosphere in the first place.

**Load-Date:** June 6, 2021

**End of Document**



[***We can't burn our way out of the climate crisis***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:62S7-NS51-JCF9-42YB-00000-00&context=1516831)

EurActiv.com

May 26, 2021 Wednesday

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**Length:** 1148 words

**Byline:** Peg Putt

**Highlight:** In its new Net Zero scenario, the International Energy Agency (IEA) maps a 60% increase in bioenergy by 2050. But Swapping burning wood for burning coal won't save the climate, warns Peg Putt.

**Body**

*Peg Putt is coordinator of the EPN working group on* ***forests****, climate and biomass, and former Australia Greens Party MP (1993-2008) and leader.*

After years of pressure, the International Energy Agency (IEA) has finally released a roadmap modelling how the world can achieve carbon neutrality by 2050 and limit global warming to 1.5ºC.

It rightly flags no new investment in fossil fuel supply, but wrongly builds in a 60% expansion in bioenergy: from around 60 exajoule (EJ) in 2020 to around 100 EJ in 2050.

Swapping burning wood for burning coal won't save the climate, but the IEA buys into the false assumption that energy from ***forest*** biomass is carbon neutral when it is actually a major ***emissions*** source.

As the European Academy of Sciences Advisory Council (EASAC) said in an [*open letter*](https://easac.eu/media-room/press-releases/details/european-national-academies-of-science-easacs-message-to-iea-bioenergy-lets-debate-the-real-issues/), "*when a power station switches from coal to wood pellets, a significant amount of extra CO2 is released, so there follows a period (carbon payback period) during which switching from coal to* ***forest*** *biomass increases atmospheric levels of CO2. This is often a long period - much beyond the time we have available to meet Paris Agreement* ***targets*** *of limiting warming to 1.5-2°C.*"

Interestingly that letter was responding to IEA Bioenergy, an associated body to the IEA that has for some time been acting as an advocate for bioenergy and aggressively challenging expert science that disagrees with their claims.

The IEA roadmap puts natural ***forests*** under massively increased threat whilst plantations also expand dramatically, fuelling ***land*** grabs and driving people from their homes at the expense of their rights to food and livelihoods.

There is a huge increase in burning "***forest*** wood and residues" for energy, between four and five times current quantities. This heralds expanded and accelerated plunder of natural ***forests*** with serious impacts on biodiversity whilst also degrading and destroying the valuable carbon stocks these ***forests*** keep out of the atmosphere.

Not only that, the important alternative of deploying ***forests*** to draw down carbon goes unrecognised and is actively undermined by a failure to emphasise the importance of protection and restoration of natural ***forests*** to reducing ***emissions*** and ***removing*** atmospheric carbon dioxide while supporting biodiversity, resilience and well-being.

Altogether a total area of 410 million hectares of ***land***, an area the size of India and Pakistan combined is slated for biomass production by 2050. Around 270 million hectares is ***forests***, representing a quarter of the global area of managed ***forests***.

In an Alice in Wonderland moment, the IEA thinks all this can be done "sustainably", without the inevitable impacts on ***agriculture*** and our ability to feed the world, on structurally oppressed people, and on natural ecosystems in a time of biodiversity crisis.

We have often explained that sustainability is not a measure of greenhouse gas reductions, and represents a diversionary tactic.

In most parts of the world "sustainability" is not an ecological concept as applied to forestry - instead being conceived as the ability to keep on taking wood in a series of logging rotations over time. In the EU, where "sustainability" window dressing is more developed, a new report from [*FERN*](https://www.fern.org/) exposes that the sustainability criteria of the Renewable Energy Directive (RED) are ineffective at halting ***forest*** destruction.

The IEA seems to also have conjured up a fantasy that there's enough marginal ***land*** going begging that can be utilised for biomass production. There is no magic marginal ***land*** solution.

M*arginal* ***land*** *is where people have been driven to as* ***agricultural*** *expansion has dispossessed them, and where such* ***land*** *is empty it is vital to use for* ***forest*** *restoration to draw down and store carbon and tackle the biodiversity crisis. The last thing we should be doing is clearing and burning it to establish masses of monoculture plantations for even more large scale burning for energy.*

Unpicking the detail further, "modern bioenergy" meets almost 20% of global energy needs by 2050, of which the vast majority is solid biomass. Rapid replacement of "traditional" biomass with "modern" biomass by 2030 means a transition to a commodified supply, with big implications for the poorest and most marginalised people in the world.

There are serious doubts that this is feasible, so remaining traditional biomass use should be added to the vast amounts envisaged in the IEA scenario, since its use will not disappear rapidly at all.

There's a large amount of Carbon Capture and Storage (CCS) in the roadmap, including Bioenergy with Carbon Capture and Storage (BECCS). BECCS is unproven at scale, and assumptions of negative ***emissions*** rely on that wrong assumption that bioenergy is carbon neutral.

In the IPCC Special Report on Climate Change and ***Land*** of August 2019 is a strong warning that large scale bioenergy and BECCS is not a 'get out of jail free' card.

A stark picture is painted of enormously damaging impacts on food security, ecosystem and ***land*** degradation and desertification, and adaptation - a tidal wave of impacts on people and nature that effectively rule out the mass tree plantings required by controversial mitigation schemes that could cover huge expanses of current cropland.

The IEA seems to have failed to do their homework on bioenergy and BECCS.

**The new roadmap didn't have to be this way.**

The world has to move beyond burning both fossil fuels and ***forests*** for energy - to genuine low ***emissions*** renewables.

The use of bioenergy in the IEA roadmap is contrary to findings in the IPCC Special Report on Global Warming of 1.5°C. Therein the IPCC depicts one pathway that avoids temperature overshoot and doesn't rely on bioenergy with carbon capture and storage (BECCS).

This scenario envisions a decrease in bioenergy relevant to 2010. The crucial difference is that the IPCC prioritises maximising carbon storage by ***forests***, not burning them for energy.

It is possible to limit global warming to 1.5 and vital to do so to avoid irreversible impacts on ***land*** and ***forest*** systems that would then exacerbate the climate crisis. Limiting global warming to 1.5°C requires fast and spirited climate action and deep ***emissions*** cuts that can be only be achieved tough actions in all sectors.

***Forests*** can play a role but they, and all dependent on them, are also at risk. Action here is imperative but no substitute for strong action on fossil fuel use and the comprehensive upscaling of low ***emissions*** renewable energy.

Changes in production and consumption patterns are vital as well as the protection and wide-ranging careful restoration of our natural ***forests*** and other vital ecosystems.

[***IEA criticised over growing share of bioenergy in net-zero scenario***](https://www.euractiv.com/section/climate-environment/news/iea-criticised-over-growing-share-of-bioenergy-in-net-zero-scenario/)

The International Energy Agency (IEA) published a new energy scenario on Tuesday (18 May), modelling for the first time how the world can achieve carbon neutrality by 2050 and limit global warming to 1.5ºC.

**Load-Date:** May 26, 2021

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[***First carbon-negative power plant***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:62TY-DRT1-JBPJ-72JH-00000-00&context=1516831)

New Scientist

June 2, 2021

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**Section:** NEWS; News & Technology; Pg. 13; Vol. 250; No. 3337; ISSN: 0262 4079

**Length:** 543 words

**Byline:** Adam Vaughan

**Highlight:** Plans for the world's first carbon-negative power station have been criticised

**Body**

UK ENERGY firm Drax's plan to turn a biomass power plant in the north of England into the world's first carbon-negative power station is receiving strong pushback.

By 2027, Drax hopes to retrofit a plant near Selby for bioenergy with carbon capture and storage (BECCS). The aim is for trees to suck millions of tonnes of carbon dioxide from the air as they grow, before being burned for power and the CO2 captured and piped below the North Sea.

In climate models from the UN's Intergovernmental Panel on Climate Change (IPCC), BECCS is seen as the main way to balance CO2 ***emissions***.

"The key issue is we are running out of time to hit the 1.5°C ***target***," says Will Gardiner at Drax, referring to the Paris Agreement's toughest goal. "Increasingly, you have people realising negative ***emissions*** have to be part of the solution. The case for BECCS is it's available today."

New models suggest the IPCC's estimates may be overly optimistic, but BECCS has had its critics for years due to concerns over the ***land*** needed to grow the plants to be burned, and the knock-on effect on food prices, biodiversity and water.

A recent report by UK non-profit organisation Ember estimates that subsidies for the Drax project would cost UK consumers £31.7 billion over 25 years. But it assumes that Drax eventually converts all four of its power station's generating units, rather than the two it has publicly committed to converting. It is clear, however, that the two units, which Drax estimates will cost £1 billion each, won't happen without public financial support.

A Drax spokesperson noted that the report assumes there will be a new-build BECCS facility, rather than a retrofit, and a 25-year subsidy contract rather than the 15 years the UK government is considering.

Other arguments against the plans are based on environmental concerns. A principal issue is the time it takes for a newly planted tree to absorb carbon released by a mature one burned at a BECCS facility.

Michael Norton at the European Academies' Science Advisory Council says: "You can absolutely rule out ***forest*** biomass as a source [for BECCS] because the payback period is too long."

Drax intends to use wood pellets from North American trees for its BECCS scheme, with some biomass coming from sunflower husks and other ***agricultural*** waste.

Another recent report, by a team at University College London, notes the potential environmental risks, but concludes that BECCS has a "significant" role to play in the UK meeting its goal of reaching net-zero ***emissions*** by 2050. The report finds that BECCS ***removes*** slightly less CO2 than earlier estimates from the UK government's climate advisers.

Jim Watson, one of the UCL report's authors, says: "We're not saying the Drax model of BECCS should be ruled out because it's fundamentally unsustainable, it's more to say: what are the conditions that could make such a model sustainable?" He says we may need more regulation along the biomass supply chain, even if it is overseas, and to run a smaller trial.

Drax could perhaps ***remove*** hundreds of thousands of tonnes of CO2 annually, rather than the 4 million tonnes a year it hopes each generating unit will ***remove***, he says.

Ultimately, Watson thinks we should learn by doing BECCS, rather than writing it off too early.

**Load-Date:** June 3, 2021

**End of Document**



[***No pollinators mean no agriculture, Commission Vice-President warns***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:6111-KYT1-JCF9-40GF-00000-00&context=1516831)

EurActiv.com

October 7, 2020 Wednesday

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**Length:** 527 words

**Byline:** Gerardo Fortuna

**Highlight:** Speaking before the European Parliament's plenary, the Dutch Commissioner Frans Timmermans cautioned farmers about the need to change tack on European ***agricultural*** policy.

**Body**

On Tuesday (6 October), the Commission's executive vice-president for the Green Deal pointed out the alarming situation of biodiversity in Europe and its effect on ***agriculture***.

"If we continue like this, there will be no pollinators anymore," he told MEPs ahead of the vote on the EU Climate Law.

This new piece of legislation is a core element of the Commission's pivotal Green Deal. It aims at scaling up the EU's ambition for reaching the climate neutrality by 2050 by proposing an increase in the 2030 ***target*** for ***emission*** reduction from 40% to 55%.

"How are you going to explain [the loss of pollinators] to farmers, when they say 'let's keep the present ***agricultural*** policy'?" he added, criticising the persistent reticence in embracing the new green elements due to be implemented in the EU's Common ***Agricultural*** Policy (CAP).

He was responding, in particular, to the Polish lawmaker Anna Zalewska from the European conservatives group (ECR), who suggested he go back to farmers and talk to them before taking any decision on the EU budget that may affect farmers.

"We have to remember that we are all responsible for biodiversity. Now farmers are not only responsible for our food, but we are going to make them responsible for our climate," she said.

"That's too much," the right-wing MEP concluded.

But Timmermans responded by saying that there will be no ***agriculture*** if there are no pollinators.

According to Timmermans, Europe needs to look after its ***forests***, grasslands and peatlands.

"In that context, I believe it is wise to include carbon sink in our ***targets*** to make sure we increase the health of our natural environment," he said.

[***EU mulls over plan to boost carbon-storage on farmlands***](https://www.euractiv.com/section/agriculture-food/news/eu-mulls-over-plan-to-boost-carbon-storage-on-farmlands/)

Farmers and foresters need to be "directly incentivised" to put in practice carbon-capture crops and other measures intended to reduce net greenhouse gases (GHG), according to an update of the European Commission's Climate Law.

The Climate Strategy seeks to store more carbon on European farmlands and ***forests*** through a robust carbon ***removal*** certification scheme.

To do so, the EU executive plans to overhaul several pieces of legislation in 2021, such as the on ***Land*** Use, ***Land*** Use Change and Forestry regulation (LULUCF) and the Effort Sharing Regulation.

Liberal MEP Asger Christensen presented an amendment on behalf of the Parliament's ***agriculture*** committee (COMAGRI) advocating for a soil carbon sequestration scheme supported by establishing a separate trading scheme for negative ***emissions*** in its opinion on the Climate Law.

"If we're going to have a separate quota system, there should be possibilities for financing the green transition," he explained during the debate.

According to Christensen, the EU should support farmers in sequestering carbon dioxide and the ***agricultural*** sector wants to make a considerable contribution to the green transformation, but this should not detriment food safety or production.

[***Europe revives carbon farming but without access to carbon markets***](https://www.euractiv.com/section/agriculture-food/news/europe-revives-carbon-farming-but-without-access-to-carbon-markets/)

The concept of soil carbon sequestration, a cornerstone of regenerative farming, is regaining strength as a key measure in both climate mitigation and adaptation.

*[Edited by Natasha Foote]*

**Load-Date:** October 7, 2020

**End of Document**



[***Walmart Raises Targets To Zero Emissions By 2040***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:60WN-03T1-J9XT-N190-00000-00&context=1516831)

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**Length:** 340 words

**Body**

BENTONVILLE (dpa-AFX) - Amid the growing climate crisis, Walmart said it is raising its ambition to zero ***emissions*** by 2040, without the use of carbon offsets, across its global operations. The retail giant, along with the Walmart Foundation, also committed to help protect, manage or restore at least 50 million acres of ***land*** and one million square miles of ocean by 2030. With the move, the company said it aims to become regenerative, and want to take an important role in transforming the world's supply chains to be regenerative. Under its plan, Walmart would harvest enough wind, solar and other renewable energy sources to power its facilities with 100% renewable energy by 2035. Further, it will electrify and zero out ***emissions*** from all of its vehicles, including long-haul trucks, by 2040. In addition, Walmart plans to transition to low-impact refrigerants for cooling and electrified equipment for heating in its stores, clubs, and data and distribution centers by 2040. The company and its Foundation would continue to support efforts to preserve at least one acre of natural habitat for every acre of ***land*** developed by the company in the U.S. Further, regenerative ***agriculture*** practices, sustainable fisheries management and ***forest*** protection and restoration will be adopted. As of now, the company powers around 29 percent of its operations with renewable energy and diverts around 80 percent of its waste from landfills and incineration globally. Walmart is also working with suppliers through its Project Gigaton initiative to avoid a gigaton of greenhouse gas ***emissions*** by 2030. Last week, tech major Microsoft teamed with energy giant bp plc to form strategic partnership to drive digital innovation in energy systems and advance net zero goals. In January 2020, Microsoft announced its goal to be carbon negative by 2030 and ***remove*** more carbon from the environment than it has emitted since its founding by 2050. Telecom giant AT&T also recently announced its commitment to be carbon neutral by 2035.

**Load-Date:** September 21, 2020

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[***Upward expansion and acceleration of forest clearance in the mountains of Southeast Asia***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:671W-P2M1-JCWX-C2GK-00000-00&context=1516831)

Nature Sustainability

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**Section:** Pg. 892-899; Vol. 4; No. 10; ISSN: 2398-9629

**Length:** 5290 words

**Byline:** [*zengzz@sustech.edu.cn*](mailto:zengzz@sustech.edu.cn)

**Body**

Main

Tropical ***forests*** are the largest terrestrial component of the global carbon cycle, storing 247 Pg C in above- and belowground biomass. However, recent anthropogenic-influenced ***forest*** loss has reshaped tropical ***forests*** profoundly, weakening their ability to store carbon and regulate climate. Currently, across the tropics, the amount of carbon sequestered by intact ***forests*** and ***forest*** regrowth is approximately similar to that released from ***forest*** loss, suggesting that tropical ***forests*** probably act as a neutral contributor to the global carbon cycle. ***Forest*** loss in the tropics, which dominates the total loss worldwide in the twenty-first century–, has been driven largely by ***agricultural*** intensification and/or extensification to support demands for human/animal food trade, profit-driven (illegal) logging and other activities that are inherently linked to population growth–. Of concern is that acceleration of ***forest*** clearance in the future will intensify carbon stock loss, potentially transforming tropical ***forests*** into important net carbon sources,,, as well as disrupting biodiversity patterns, human livelihoods, hydro-geomorphological processes and ecosystem functions.

The general notion is that tropical deforestation worldwide occurs primarily in lowland areas. This sentiment aligns with previous work showing substantial ***forest*** losses at low elevations but only negligible losses, and even some ***forest*** gains, in the mountains,,. However, in Southeast Asia (SEA), where approximately half of the world’s tropical mountain ***forests*** are located, and extensive ***forest*** losses in the lowlands of Indonesia have occurred,, recent studies have reported new croplands and plantations replacing mountain ***forests*** in Laos and Thailand of montane mainland SEA,. Yet the applicability of these results, as an indicator of a regional trend is debatable, as some global analyses, indicate an increase in ***forest*** cover in this region. New spatiotemporal analyses conducted at high resolution and with common vegetation definitions are needed to address these inconsistencies related to topography of ***forest*** loss in the mountains and lowlands of SEA.

In this article, we analyse multiple high-resolution satellite datasets to provide a comprehensive assessment of changes in topographical patterns of ***forest*** clearance and related carbon loss across SEA during the first two decades of the twenty-first century. The analyses incorporate the global mountain-extent map with two 30-m-resolution products reporting the global ***forest***-cover change and aboveground live woody biomass (AGB) density (). Owing to limitations of distinguishing tree types in the satellite products used, unless specifically stated, ‘***forest*** losses’ incorporate those from primary ***forest***, secondary ***forest*** disturbance and tree-dominated plantations, including oil palm and rubber. As the mountains of SEA hold more ***forest*** biomass carbon than lowlands (Supplementary Fig. ), a better understanding of ***forest*** and related biomass carbon dynamics is crucial for reducing uncertainties in the global carbon cycle, as well as guiding ***land*** management in the region.

Results

This section presents our findings of ***forest*** loss in SEA, including the patterns of ***forest*** loss and related topography and carbon loss.

Accelerating ***forest*** loss and related topography

We find a total ***forest*** loss of 61 Mha in SEA during the period 2001–2019, which is equivalent to a rate of 3.22 Mha yr−1 (Table , Fig. and Supplementary Fig. ). Annual ***forest*** loss of the 2010s (4.02 Mha yr−1) was nearly twice that of the 2000s (2.33 Mha yr−1), with the greatest loss occurring in 2016 (5.79 Mha yr−1). Approximately 31% of the loss during the 19-year period (19 Mha; 1.00 Mha yr−1) occurred within the 61 mountains that occupy 1.7 million km2 of the region (38% of SEA’s ***land*** surface; Supplementary Fig. ). We also find a significant increase in annual ***forest***-loss area across SEA since 2001, with an acceleration rate of 0.17 ± 0.03 Mha yr−2 (P < 0.01). The annual rate of mountain ***forest*** loss increased 2.4-fold from 0.58 Mha yr−1 in the first decade to 1.38 Mha yr−1 in the second decade (Fig. ).

***Forest*** and related carbon loss in the mountains and lowlands of SEA

| **Variables** | **Year range** | **All *forests*** | | | **Primary *forests*** | | | **Secondary *forests*** | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **SEA** | **Mountains** | **Lowlands** | **SEA** | **Mountains** | **Lowlands** | **SEA** | **Mountains** | **Lowlands** |
| Gross ***forest*** loss (Mha yr?1) | 2001?2019 | 3.22 | 1.00 | 2.22 | 0.93 | 0.26 | 0.67 | 2.29 | 0.74 | 1.55 |
| 2001?2009 | 2.33 | 0.58 | 1.76 | 0.72 | 0.18 | 0.54 | 1.61 | 0.40 | 1.21 |  |
| 2010?2019 | 4.02 | 1.38 | 2.64 | 1.11 | 0.33 | 0.78 | 2.91 | 1.05 | 1.86 |  |
| Gross ***forest*** gain (Mha yr?1) | 2001?2019 | 1.32 | 0.34 | 0.98 | N.A. | N.A. | N.A. | 1.32 | 0.34 | 0.98 |
| Gross ***forest*** carbon loss (Tg C yr?1) | 2001?2019 | 424 | 136 | 288 | 167 | 48 | 119 | 257 | 88 | 169 |
| 2001?2009 | 330 | 88 | 242 | 128 | 33 | 95 | 202 | 55 | 147 |  |
| 2010?2019 | 508 | 179 | 329 | 202 | 62 | 140 | 306 | 117 | 189 |  |
| ***Forest***-loss acceleration (10?2 Mha yr?2) | 2001?2019 | 17 ± 3\* | 8 ± 1\* | 9 ± 2\* | 4 ± 1\* | 2 ± 0\* | 2 ± 1 | 14 ± 2\* | 7 ± 1\* | 7 ± 1\* |
| 2001?2009 | 26 ± 5\* | 6 ± 1\* | 20 ± 4\* | 11 ± 2\* | 2 ± 0\* | 9 ± 1\* | 15 ± 4\* | 3 ± 1\* | 12 ± 3\* |  |
| 2010?2019 | 10 ± 9 | 11 ± 3\* | ?1 ± 7 | ?5 ± 3 | 1 ± 1 | ?5 ± 2 | 15 ± 6\* | 10 ± 2\* | 5 ± 4 |  |
| ***Forest*** carbon loss acceleration (Tg C yr?2) | 2001?2019 | 18 ± 4\* | 10 ± 1\* | 8 ± 3\* | 7 ± 2\* | 3 ± 0\* | 4 ± 2 | 11 ± 2\* | 7 ± 1\* | 5 ± 2\* |
| 2001?2009 | 35 ± 7\* | 8 ± 2\* | 27 ± 5\* | 19 ± 3\* | 4 ± 1\* | 15 ± 2\* | 16 ± 5\* | 4 ± 1\* | 12 ± 4\* |  |
| 2010?2019 | 1 ± 12 | 10 ± 4\* | ?9 ± 8 | ?7 ± 6 | 1 ± 2 | ?9 ± 4 | 8 ± 6 | 9 ± 2\* | 0 ± 4 |  |
| Trend in mean elevation (10?1 m yr?1) | 2001?2019 | 64 ± 13\* | 46 ± 15\* | 16 ± 3\* | 50 ± 17\* | 16 ± 16 | 27 ± 7\* | 52 ± 11\* | 38 ± 11\* | 7 ± 2\* |
| 2001?2011 | 1 ± 19 | 11 ± 28 | 0 ± 5 | ?56 ± 15\* | ?66 ± 23\* | ?16 ± 9 | 8 ± 18 | 20 ± 23 | ?3 ± 4 |  |
| 2011?2019 | 151 ± 38\* | 95 ± 57\* | 37 ± 10\* | 195 ± 30\* | 127 ± 46\* | 85 ± 16\* | 113 ± 37\* | 62 ± 46\* | 21 ± 7\* |  |
| Trend in mean slope (10?2 deg yr?1) | 2001?2019 | 11 ± 2\* | 12 ± 2\* | 3 ± 1\* | 11 ± 3\* | 6 ± 3\* | 8 ± 2\* | 9 ± 2\* | 11 ± 2\* | 0 ± 0 |
| 2001?2009 | ?4 ± 3 | 1 ± 5 | ?2 ± 0 | ?17 ± 0\* | ?14 ± 0\* | ?9 ± 0\* | ?4 ± 0 | 2 ± 4 | ?4 ± 1\* |  |
| 2009?2019 | 22 ± 5\* | 20 ± 8\* | 7 ± 2 | 31 ± 7\* | 21 ± 8\* | 19 ± 6\* | 19 ± 5\* | 17 ± 7\* | 4 ± 2\* |  |

\*Statistically significant trend at the level of P < 0.05. N.A., not applicable.

Time series of ***forest***-loss area and associated topography across SEA during the period 2001–2019.

a, Annual ***forest***-loss area in the lowlands (pink bars) and mountains (blue bars) and the ratio of mountain ***forest***-loss area to total ***forest***-loss area (orange line). Inset bars show trends in lowland and mountain ***forest***-loss area in the 2000s and 2010s. Different letters above the bars indicate statistically significant differences (P < 0.05) between trends for lowlands and mountains during the 2000s (black letters) and 2010s (red letters). b, Mean elevation (solid black lines) and slope (solid red lines) of ***lands*** incurring ***forest*** loss. Dotted lines are trend lines for mean elevation (black) and slope (red) before and after IPs, which were estimated by piecewise regression. Inset bars show trends in mean elevation (black) and slope (red) before and after IPs. Error bars indicate the standard error of linear trends. \*Statistically significant trend at the level of P < 0.05; \*\*statistically significant trend at the level of P < 0.01.

***Forest*** loss occurring in the lowlands of SEA significantly accelerated only during the 2000s (0.20 ± 0.04 Mha yr−2, P < 0.01), with a non-significantly decreasing trend in the following decade (−0.01 ± 0.07 Mha yr−2, P = 0.92). This pattern mirrors the fact that there were limited lowland ***forests*** that could be converted to croplands in some regions over SEA during the 2010s, as lowland ***forests*** had continued to be cleared since the 1980s. Regarding mountain ***forest*** loss, the near doubling of acceleration rates from the first (0.06 ± 0.01 Mha yr−2, P < 0.01) to the second (0.11 ± 0.03 Mha yr−2, P < 0.01) decade resulted from accelerated conversion of ***forests*** for crop plantation in the mountains. Further, the trend in lowland ***forest*** loss was significantly different from that in the mountains during the 2000s (P < 0.05), but this difference was no longer statistically significant during the 2010s (Fig. ). Taken together, these patterns reveal that ***forest*** loss in the mountains increasingly made up a substantial portion of total ***forest*** loss in SEA from 2001 (24%) to 2019 (42%), which is a new finding,,.

Incorporating data on primary ***forest*** extent in 2001, we further estimate that annual loss of primary ***forest*** from 2001 to 2019 was 0.93 Mha yr−1 (Table and Supplementary Fig. ), with 0.26 Mha yr−1 (28%) occurring in the mountains and 0.67 Mha yr−1 (72%) in the lowlands. These equate to 2.9% and 7.3% losses of the primary ***forest*** extent in 2001. Throughout the 19-year period, secondary ***forest*** loss always exceeded primary ***forest*** loss in both the lowlands and the mountains. Whereas secondary ***forest*** loss accelerated significantly throughout the whole period (0.14 ± 0.02 Mha yr−2, P < 0.01), the significant acceleration in primary ***forest*** loss in the first decade (0.11 ± 0.02 Mha yr−2, P < 0.01) gave way to a non-significant decline in primary ***forest*** loss in the second decade (−0.05 ± 0.03 Mha yr−2, P = 0.19). Two trends emerged during the 2010s: (1) secondary ***forest*** loss in the mountains greatly increased (0.10 ± 0.02 Mha yr−2, P < 0.05) and (2) primary ***forest*** loss in the lowlands non-significantly decreased (−0.05 ± 0.02 Mha yr−2, P = 0.06). As the trend in secondary ***forest*** loss is much larger than that of primary ***forest*** loss over the 19-year period, the ratio of primary-to-total ***forest*** loss decreased from >30% to 20%. Collectively, the increase in mountain ***forest*** loss in the 2010s originated primarily from secondary ***forest*** loss, while the overall reduction in primary ***forest*** loss resulted from reductions in the lowlands.

An elevational shift in the frontier of ***forest*** loss in the region is further supported by changes in the elevation and slope of mean ***forest*** loss midway through the 19-year study period (Fig. ). Piecewise regression reveals an inflection point (IP) for mean elevation of ***forest*** loss that occurred in 2011 and an IP for mean slope of ***forest*** loss that occurred in 2009 (Fig. ). Within the period after the IPs, the mean elevation and slope increased significantly at rates of 15.1 ± 3.8 m yr−1 (P < 0.01) and 0.22 ± 0.05° yr−1 (P < 0.01), respectively. Importantly, ***forest*** loss in the mountains accounted for most of the observed increases in both mean elevation (64%; 9.6 ± 2.7 m yr−1, P < 0.01) and slope (64%; 0.14 ± 0.04° yr−1, P < 0.01) after the IPs (Fig. ).

Trends in mean elevation and slope of ***lands*** incurring ***forest*** loss following the IPs.

a,b, Trend in mean elevation (a) and slope (b) following the IPs in the eight countries of SEA (green bars), all of SEA (orange bars), lowlands (pink bars) and mountains (blue bars). Three countries in SEA (Brunei, East Timor and Singapore) are not presented here because their combined ***forest*** loss is only 0.2% of the SEA total. The error bars indicate the standard error of the linear trend. \*\*Statistically significant trend at the level of P < 0.01. c,d, Spatial patterns of trends in mean elevation (c) and slope (d) of ***lands*** incurring ***forest*** loss in 0.25° cells across SEA. Black dots indicate mountain regions. The IPs for mean elevation and slope are around 2011 and 2009, respectively (Fig. ). Trends in mean elevation and slope of ***lands*** incurring ***forest*** loss in each 0.25° cell or each country (or in the lowlands and mountains) were calculated considering the weight of ***forest*** loss using equations () and (), respectively ().

Regional patterns of trends in the mean elevation and slope where ***forest*** loss occurred (***forest***-loss topography) show that east Sumatra and Kalimantan (Indonesia), north Laos, and northeast Myanmar contribute to most of the increases in ***forest***-loss topography after IPs (Fig. ). In some regions, a decreasing trend in ***forest***-loss topography occurred, such as on the Malay Peninsula (including southern Thailand and Malaysia) and in Vietnam (Supplementary Fig. ). In Indonesia, which experienced the largest magnitude of ***forest*** loss (Supplementary Fig. ), a sharp increase in ***forest***-loss topography occurred during the second decade (Supplementary Fig. ). These losses in Indonesia contribute to most of the increase in mean elevation (44% or 6.6 ± 1.6 m yr−1, P < 0.01) and slope (41% or 0.09 ± 0.03° yr−1, P < 0.01) in SEA after the IPs (Fig. ). Also of regional importance were the increases in ***forest***-loss topography in Laos (28% for SEA’s elevation and 23% for SEA’s slope) and Myanmar (26% for SEA’s elevation and 23% for SEA’s slope). In other countries, such as Thailand and the Philippines, trends in ***forest***-loss topography were comparatively small (Supplementary Fig. ).

Carbon loss resulting from ***forest*** clearance

The observed shift in ***forest*** loss to higher elevations and steeper slopes is of concern because mountain ***forests*** in the region tend to have higher carbon stocks than lowland ***forests***: 141 ± 49 Mg C ha−1 in the mountains versus 101 ± 69 Mg C ha−1 in the lowlands (Supplementary Fig. ). By incorporating the ***forest*** change calculations in the previous section with the ***forest*** carbon stock map (), we estimate the total ***forest*** carbon loss in SEA during 2001–2019 was 8,050 Tg, equivalent to a rate of 424 Tg C yr−1 (Fig. and Table ). As with annual ***forest*** loss, ***forest*** carbon stock loss increased continuously throughout the entire period, accelerating significantly at a rate of 18 ± 4 Tg C yr−2 (P < 0.01; Fig. and Table ). Nearly a third of the loss in ***forest*** carbon stocks (2,584 Tg C; 136 Tg C yr−1) occurred in the mountains; lowland ***forest*** carbon stock losses totalled 5,466 Tg (68%; 288 Tg C yr−1). Mountain ***forest*** carbon loss accelerated significantly in both the first (8 ± 2 Tg C yr−2, P < 0.01) and second (10 ± 4 Tg C yr−2, P < 0.05) decades, whereas the significant acceleration of lowland ***forest*** carbon stock loss in the first decade (27 ± 5 Tg C yr−2, P < 0.01) was followed by a non-significant decrease in the 2010s (−9 ± 8 Tg C yr−2, P = 0.30). These trends result in the increasing contribution of mountain ***forest*** carbon loss to total ***forest*** carbon loss in the second decade of the twenty-first century. Moreover, increasing clearance of mountain ***forests*** with dense carbon stocks results in a disproportionate loss of carbon stocks relative to past times when ***forest*** loss was more prevalent at lower elevations. For example, in 2019, the last year of the analysis, mountain ***forest*** carbon loss was 119 Mg C ha−1 yr−1, which was 7% higher than that of the lowlands. If these carbon-loss rate trajectories continue, annual ***forest*** carbon loss in the mountains will exceed that of lowlands by 2022.

Time series of ***forest*** carbon loss and associated topography across SEA during the period 2001–2019.

a, Annual ***forest*** carbon loss in the lowlands (pink bars) and mountains (blue bars) and the ratio of mountain ***forest*** carbon loss to total ***forest*** carbon loss (orange line). Inset bars show the trends in lowland and mountain ***forest*** carbon loss in the 2000s and 2010s. Error bars show the standard error of the linear trends. \*Statistically significant trend at the level of P < 0.05; \*\*statistically significant trend at the level of P < 0.01. Different letters above the bars indicate statistically significant differences (P < 0.05) between trends for lowlands and mountains during the 2000s (black letters) and 2010s (red letters). b, Carbon loss in elevation–year space.

In agreement with the ***forest***-loss trends, the frontier of ***forest*** carbon loss also climbed to higher elevations and steeper slopes during 2001–2019 (Fig. ). However, there are stark regional differences in ***forest*** carbon-loss patterns with respect to topography (Fig. ). In maritime SEA during the 2000s, most ***forest*** carbon losses took place in the lowlands (Fig. ), particularly on some Indonesian islands (for example, Sumatra, Kalimantan) and the Malay Peninsula (Fig. ). ***Forest*** carbon loss in the lowlands of maritime SEA accounted for 65% of SEA’s total carbon loss in the 2000s. In the 2010s, lowland ***forest*** carbon loss decreased, particularly in Sumatra and Kalimantan (Fig. ). However, positive trends in annual ***forest*** carbon loss occurred throughout many mountainous areas of mainland SEA, pushing upwards and accelerating in the mountains of Laos and Myanmar. Although ***forest*** and related carbon loss in Vietnam and the Malay Peninsula increased (Fig. and Supplementary Fig. ), the topography of ***forest*** loss in those regions decreased (Fig. and Supplementary Fig. ), indicating that ***forest*** (carbon) loss accelerated in regions with lower elevations, a pattern that is opposite to those observed in Myanmar and Laos. Overall, we conclude that the hotspots of ***forest*** carbon loss, while mirroring those of ***forest*** loss in general, were found predominantly in lowland maritime SEA in the 2000s. They were then located disproportionately in the mountains of mainland SEA in the 2010s, particularly in northern Laos and northeast Myanmar, locations strongly associated with increased ***forest*** loss at higher elevations and on steeper slopes (Fig. ).

Spatial patterns of ***forest*** carbon loss across SEA during the period 2001–2019.

a, Mean annual ***forest*** carbon loss in the 2000s. b, Change in mean annual ***forest*** carbon loss in the 2010s relative to the 2000s. c,d, Trend in mean annual ***forest*** carbon loss in the 2000s (c) and 2010s (d). Grey dashed lines show mainland SEA (inside the box) and maritime SEA (outside the box). Black dots indicate mountain regions.

Discussion

In this section, we discuss the net changes in ***forest*** loss, implications and potential limitations that need to be further addressed in future studies. Finally, we summarize our findings.

Net changes

In the dynamic environments of SEA, ***forest*** losses were also counteracted to some degree by ***forest*** gains during the study in both lowland and mountain areas. Using the data developed by Hansen et al., we determine that ***forest*** gains during the period of 2001–2012 were 10.3 Mha (0.86 Mha yr−1) in the lowlands and 2.7 Mha (0.23 Mha yr−1) in the mountains (Supplementary Fig. ). These gains result in the net-to-gross loss proportion of 56% and 66% in the lowlands and mountains, respectively, during this abbreviated period. The lower net-to-gross loss rate in the lowlands may be related to extensive oil palm and timber plantation establishment following the ***removal*** of ***forest*** or older plantations, as maturing plantations would be counted as ***forest*** gain once plants exceed the threshold 5 m tree height definition of Hansen et al.,. By assuming that the net-to-gross loss ratios during 2013–2019 are the same as those in the earlier period, we estimate a 23.6 Mha (1.24 Mha yr−1) net ***forest*** loss in the lowlands and a 12.5 Mha (0.66 Mha yr−1) net ***forest*** loss in the highlands during 2001–2019 (Supplementary Fig. ). These estimates of net loss are probably conservative, given that ***forest*** loss accelerated at a rate of 0.17 ± 0.03 Mha yr−2 (P < 0.01) throughout the entire period (Table ).

Overall, our net estimates also reveal a clear fingerprint of mountain ***forest*** loss that is accelerating in some countries of SEA (for example, Indonesia, Myanmar, and Laos) during the early twenty-first century, due primarily to expansion of ***agriculture*** for crop plantation,. The accelerating mountain ***forest*** loss in the 2010s, originated from secondary ***forest*** loss, mirrors the replacement of swidden fields with other ***agriculture*** systems. For example, a notable shift from swidden fields, where secondary ***forests*** regenerate during fallow period, to permanent ***agriculture*** systems is reported in the mountains of Laos, indicating that these ***forest*** losses in the mountains of SEA are partly a result of ***agriculture*** intensification. This pattern, however, is different from ***agricultural*** expansion in the Midwestern United States, which made the farms in the northeastern United States not profitable and hence resulted in ***forest*** regeneration in that region.

Implications

Our results demonstrate not only a continuation of ***forest*** loss in SEA as reported in sub-regions during previous periods,, but also an acceleration in loss that includes encroachment into ***forests*** at higher elevations with higher carbon density. These trends influence the roles tropical ***forests*** play in the context of global climate mitigation, biodiversity conservation and global carbon cycling. For example, the observed acceleration in ***forest*** carbon loss counters efforts to limit global warming to below 2 °C by the end of this century. The climb in the ***forest***-loss frontier also represents a challenge for climate change assessments as current Earth system models do not differentiate mountain from lowland ***forest*** loss because of their coarse spatial resolutions, potentially resulting in the misrepresentation of climate feedbacks. In addition to the warming triggered by ***forest*** carbon loss to the atmosphere through biochemical feedbacks, tree replacement increases surface temperature at a variety of scales through biophysical feedbacks,. In the mountains of SEA, where most deforested ***lands*** are converted to croplands, warming effects related to ***forest*** loss tend to be amplified due to suppressed evapotranspiration, raising local temperatures by up to 2 °C–. The acceleration of mountain ***forest*** loss in the region has probably already enhanced these warming effects and influenced the carbon budget.

The acceleration in ***forest*** loss also affects biodiversity conservation in the region because a great number of endemic species are found in the mountains of SEA. While widespread conversion of ***forests*** to croplands substantially reduces species richness and alters community composition in general, loss of mountain ***forest*** habitat is particularly detrimental,. Tropical montane species typically live within specific hydro-thermal environments, which are dramatically altered during ***forest*** conversion, increasing extinction risk,. Deforestation also interacts with climate changes, forcing species to redistribute, often to higher and cooler locations. Mountain ***forest*** loss threatens to reduce the area of suitable habitat to accommodate these types of relocations.

Beyond the direct loss of carbon associated with vegetation biomass ***removal*** and habitat loss, ***forest*** loss also affects the carbon cycle through diminishing photosynthesis and altering soil carbon stocks. For example, ***forest*** loss directly lowers landscape-wide photosynthesis due to decreases in leaf area and alteration of vegetation functioning. ***Forest*** conversion also alters basic water-balance processes, including evapotranspiration, infiltration and water storage–, thereby modulating vegetation growth and associated carbon assimilation. Soil erosion accelerated by ***forest*** conversion, particularly on sloping ***lands***, exhumes soil carbon that may be quickly released to the atmosphere or transported into downslope flood-plain locations, water bodies or the ocean, where it is stored/lost at variable timescales,. Unfortunately, because of the absence of regional data on soil carbon stocks, we were not able to account for losses of this component, which for some ***forest*** conversion outcomes are substantial,.

Uncertainties and caveats

With regard to uncertainties in our analysis, fragmentation and edge effects of ***forest*** losses can alter microclimates and thus regulate the growth and structure of nearby trees, causing additional long-term carbon losses on the landscape that we could not quantify. Additional uncertainty relates to our inability to detect ***forest*** conversions at scales smaller than a Landsat pixel, for example, those related to small-scale, fallow-based swidden ***agriculture***, which is still practiced in some areas of SEA,. Again, our estimates also represent absolute ***forest*** carbon losses, not net losses that incorporate biomass carbon gains that could not be calculated from available data with confidence. Even with these uncertainties in mind, the acceleration of loss in mountain ***forests*** with high carbon density that we find on the basis of immediate vegetative biomass changes alone portends additional redistributions and losses of carbon in the near future, potentially nudging SEA’s ***forests*** to be a net carbon source in the global carbon budget, rather than a neutral actor. To reduce these uncertainties, future studies could integrate higher-resolution satellite and lidar datasets to map primary and secondary ***forests*** and related biomass carbon loss more accurately. More studies on above- and belowground carbon recovery associated with ***forest*** regrowth are also needed.

In summary, our results reveal changing topographical patterns associated with ***forest*** loss in SEA during the first two decades of the twenty-first century. The shift is characterized by an upward expansion in the frontier of ***forest*** exploitation, from occurring predominantly in the lowlands to increasingly encroaching ***forests*** at higher elevations with comparatively higher carbon stocks and more-sensitive species. The acceleration of this trend throughout the two decades provides new insight regarding ***forest*** and carbon dynamics in the region that has not been recognized in previous climate change assessments or parameterized in current model configurations simulating impacts. Such exclusion misrepresents regional biophysical and biochemical feedbacks of deforestation. Collectively, knowledge of the ascent of the frontier of ***forest*** loss across SEA is needed to develop effective policies to manage concomitant negative impacts on biodiversity, water resources, ***land*** degradation and the carbon cycle. This knowledge is valuable for developing strategies to reduce future losses of remaining ***forests*** that still have great ability to preserve valuable ecosystem services, including atmospheric carbon dioxide capture and biodiversity conservation.

Methods

This section provides details on the datasets and methods used for quantifying changes in topographical patterns of ***forest*** clearance and related carbon loss across SEA.

High-resolution ***forest***-cover change and primary ***forest*** extent products

To quantify ***forest***-cover change over SEA from 2001 to 2019, we used a high-resolution remote sensing product that maps tree-cover change at a spatial resolution of 30 m (version 1.7; ref. ). The dataset has user’s and producer’s accuracies of >83% over the tropics. A previous independent assessment indicated that, in SEA, the data have user’s and producer’s accuracies of 93.2% and 81.2%, respectively. This dataset defines trees as “all vegetation taller than 5 m in height”, and ***forest*** loss (including via deforestation and ***forest*** degradation) as “the mortality or ***removal*** of all tree cover within a 30 m pixel”,. This operational definition results in the case that planted vegetation, such as rubber and oil palm plantations, is mapped as trees when taller than 5 m. ***Removal*** of such vegetation is counted as tree-cover loss. Following these definitions, the data provide maps of ***forest***-cover loss and the year of loss during 2001–2019 and ***forest***-cover gain during 2001–2012. ***Forest*** loss across SEA exhibits a continuous increase trend from 2001 to 2019, confirming that changes in the loss-detection method do not dominate the long-term trend. To separate ***forest***-loss type, we further used a dataset on the extent of primary ***forests*** at 30 m spatial resolution for the year 2001 in SEA.

Topography data

We used both mountain-extent maps and a digital elevation model to quantify the topographic pattern of ***forest*** loss. Mountain extent in SEA was mapped by a series of mountain polygons developed by the Global Mountain Biodiversity Assessment (GMBA) inventory (version 1.2; ref. ). The GMBA inventory defines a 2.5-arcmin pixel as mountainous if the geometrical amplitude between the highest and lowest elevation exceeds 200 m. Following this definition, there are 61 mountain regions in SEA (Supplementary Fig. ), occupying 1.7 million km2 (38%) of SEA’s ***land*** surface. The remaining 62% of SEA’s ***land*** surface is treated as lowland. The associated elevation information in the lowlands and mountains, at a spatial resolution of 30 m, is collected from the Advanced Spaceborne Thermal ***Emission*** and Reflection Radiometer Global Digital Elevation Model (version 3; ref. ). Slope information is estimated from elevation data using the average maximum method.

***Forest*** carbon stocks

We calculated ***forest*** carbon losses by incorporating the high-resolution AGB density map of Zarin et al. into our analyses of ***forest*** loss. The map represents AGB density (in a unit of Mg per hectare of biomass) at a spatial resolution of 30 m circa 2000. The AGB map was generated using a random ***forest*** model and a statistical model from measured ***forest*** biomass, the Geoscience Laser Altimeter System lidar data and gridded variables such as Landsat 7 Enhanced Thematic Mapper Plus reflectance and biophysical variables, such as precipitation. Due to lack of data, we estimate belowground biomass (BGB) at the pixel level with the empirical allometric model of Mokany et al. that has been widely used for BGB estimations,: BGB = 0.489 × AGB0.89. Total ***forest*** vegetation biomass, calculated as the sum of AGB and BGB, was converted to total ***forest*** biomass carbon stocks using a conversion factor of 0.5 (refs. ,).

***Forest***- and carbon-loss calculations and analysis

We estimated ***forest***-loss area by summing the areas of ***forest***-loss pixels that are dependent on their geographical location. The area of ***forest*** carbon loss was calculated by overlapping the ***forest***-loss data with the ***forest*** carbon stock density map (including aboveground and belowground). We used committed ***emissions*** of carbon from ***forests*** to the atmosphere on ***forest*** loss, even though some of the carbon associated with tree ***removal*** degrades on site or over time or is embedded within wood products.

As both ***forest***-loss area and ***forest*** carbon loss showed near-uniform increases over time, we applied a simple least-squares linear regression model to quantify the rate of change (Figs. and and Supplementary Figs. and ). By contrast, because trends in mean elevation and slope of ***lands*** incurring ***forest*** loss in the 2000s and 2010s were nonlinear (Fig. ), we used a piecewise linear regression model– to (1) determine where the trends in the time series of mean elevation and slope change (IPs) and (2) quantify the trends before and after the IPs. We also used a statistical model in Real Statistics Resource Pack to test whether the differences in trends between mountain ***forest*** (carbon) loss and lowland ***forest*** (carbon) loss was statistically significant.

To demonstrate the spatial pattern of increases following IPs, we separated them into each 0.25° cell and used the equations:where Ht,k and It,k are the mean elevation and slope in year t for the kth 0.25° cell; (245.5 m) and (9.3°) are the mean elevation and slope of ***forest*** loss across SEA after IPs, respectively; st,k and st are ***forest***-loss area in year t for the kth 0.25° cell and other cells, respectively. While the elevation and slope data for other cells are assumed to be the means of SEA ( and ), the elevation and slope data for the kth 0.25° cell are realistic. Thus, trends in the time series after IPs are caused by the changes only in the kth 0.25° cell. We then used a piecewise linear regression model to calculate trends in mean elevation and slope before and after identified IPs. Following this method, we calculated the trends caused by each cell for countries (by summing all cells in each country), mountains (by summing all cells in the mountains) and lowlands (by summing all cells in the lowlands).

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**Notes**

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[***How trees and forests reduce risks from climate change***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:671W-P2B1-JCWX-C2RR-00000-00&context=1516831)

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**Body**

Trees are one of the world’s most cost-effective carbon sinks, according to economists. Business and political leaders consider planting trees a unifying solution for carbon ***emissions***. For scientists who study trees, reforestation, the carbon cycle and biodiversity in ***forests***, the focus on replenishing tree cover as a nature-based climate solution drives concern because reducing risks from climate change will require vastly more than tree cover, ***forest*** protection and planting trees, underpinning the risks and challenges of focusing solely on trees for their carbon benefits.

In 2020, planting trees and ***forests*** gained widespread prominence when world leaders coalesced around the Trillion Trees Campaign, the launch of 1t.org at the World Economic Forum, the new United States One Trillion Trees Interagency Council and other existing international initiatives such as the Bonn Challenge, managed by the International Union for the Conservation of Nature (IUCN), which seeks to restore up to 350 million hectares of degraded and deforested ***lands*** around the world by 2030, an ambitious socio-environmental goal that also includes mitigating climate change. Nature-based solutions, which include trees, have the potential to draw down up to 30% of excess carbon. However, the focus on planting trees as a prominent mitigating strategy for climate change may be disproportionately too high, scientists say, because large-scale tree planting schemes are not as simple as they sound.

The role trees can play in tackling climate change is changing against a backdrop of increased ***forest*** loss from deforestation through a combination of fires, logging, roads and ***forest*** fragmentation driven by social needs, scientists say. Global climate disruption, too, adds both risks and challenges. Areas that were once ***forests*** are being lost to fires, pests and drought, and some are so severely damaged from fire that they will not regrow. Particularly in light of uncertainties regarding future climate change impacts on ***forests***, the lack of coordination between decision-makers, ***forest*** management and scientists who study the carbon cycle, ecology and ***forests*** at the local and regional levels is concerning.

In 2019, Thomas Crowther and colleagues published a paper on global ***forest*** restoration potential that caught international attention. News headlines and large corporations latched onto the idea that planting trees could save the world. “I was watching this and it was just devastating for me”, said Crowther, a professor of ecology at ETH Zurich who researches global ecosystem ecology. “There was chaos after that paper. What I learned from that process is that incredible nuances are necessary in communicating about this topic. Of course, the idea that you can plant a trillion trees is not only physically impossible, it’s also really potentially dangerous because it’s so hard to replicate the perfection of nature”.

Crowther makes clear that he and those involved in studying global ***forest*** restoration potential do not mean it all comes down to tree planting. While trees are an important part of the mix, a tiny fraction is likely to be tree planting, he says, and probably within agroforestry settings, where finding the right species or the right diversity of species can increase food production or economic benefits (Fig. ). “It’s only in that social context that tree planting is valuable”, he said. Since the 2019 paper, Crowther has turned his focus to understanding the potential amount of ***land*** available for natural ***forest*** regeneration, and what proportion of ***land*** needs assistance, where it’s been degraded. “There’s too much focus on the carbon and climate angle, which is part of it, but it’s only the part that comes after the biodiversity and human benefits”, he said.

Agroforestry on a coffee plantation in Ecuador.

Morley Read / Alamy Stock Photo

There are many ways to increase ***forest*** cover — let trees grow back on their own, plant trees (and a combination of these two approaches), set up an agroforestry system or plantation if livelihoods are a predominant motivation, or simply avoid cutting down a ***forest*** in the first place. ***Forest*** restoration scientist Susan Cook-Patton of The Nature Conservancy researches how to increase ***forest*** cover and the carbon biodiversity costs of those different choices. “The enthusiasm about reforestation is merited because it’s a tried-and-true, working-for-millennium tool”, said Cook-Patton. ***Forests*** today are just one of many ways to reverse the damage of climate change if we can increase ***forest*** cover, keep the old ***forests*** standing and value ***forests*** socially when weighed against other ***land*** uses. “We’ve got a decade to get this right”, she said.

“We’ve got a decade to get this right”

New ***forests*** capture a substantial amount of carbon, especially after their first ten years. “It’s what they do best. They suck carbon out of the atmosphere and store it in the wood”, said Cook-Patton. When presented with the chore of how to reforest ***land*** to capture carbon, she interrogates each project approach using practice-based accounting. “There’s no such thing as ‘I’m going to do reforestation and get x amount of carbon’”, she says. “I have to ask, where are you doing it, what are you doing, and what’s the site like? And then I can figure how much carbon you are going to get”. Even then, calculations are based on models that include data in the biomes and not necessarily fine-tuned, place-based measurements.

Broad initiatives to paint the globe with a trillion trees are seen as overly ambitious by many scientists. On one side of the equation, trees improve the air and water quality, and benefit biodiversity, society, health and climate. On the other side, reforestation can be harmful depending on type of tree species used, the location selected, impacts on local communities and whether the trees can be actively managed to sustain their growth — and protect investment — to avoid harvest while they work to soak up carbon. Plus, the world doesn’t have enough tree stock and infrastructure to plant that many trees.

Ecologist Robin Chazdon, professor emerita at the University of Connecticut and research professor at the University of the Sunshine Coast, has spent much of her career studying restoration of ***forests*** that have regrown after being cleared, including the Atlantic ***Forest*** in Brazil (Fig. ). In 2016, while conducting analyses on the regrowth of these secondary ***forests***, she and colleagues found that one of the most effective methods of capturing carbon in the tropics is just protecting ***forest*** regrowth on a very large scale. The natural regrowth provides a substantial role in ***removing*** carbon from the air even without costly tree plantings, she said.

A 31-year-old rainforest that regenerated naturally on cleared ***land*** used briefly for pasture in the Peje Annex at La Selva Research Station in northeastern Costa Rica.

At this stage of succession, the understory is colonized by shade-tolerant tree and shrub species and the ***forest*** canopy is dominated by fast-growing early successional tree species. The stilt palm lriartea deltoidea is a common species regeneration in this ***forest***.

Robin Chazdon

Regrowing secondary ***forests*** is low cost and provides a substantial uptake of carbon. While landowners can put up a fence, stop mowing, ***remove*** cattle, protect ***land*** from fire, plant trees in a few ***targeted*** areas or take any number of steps to protect the ***land*** from disturbance, not much else is needed. In their study, Chazdon and colleagues found that, if left alone for 40 years, secondary ***forests*** that existed in 2008 would capture the equivalent amount of carbon ***emissions*** generated in all of Latin America and the Caribbean between 1993 and 2014 (ref. ).

Chazdon said she advocated for an increased scientific role as part of a policy package toward natural climate solutions, and says her ideas can fall flat with policy-makers and global organizations who focus on reducing climate change. They overlook the practice of protecting regrowing ***forests***, she says. Among other things, letting the ***forest*** regrow is a do-nothing approach that doesn’t support budgets. “In the few venues where I could get feedback from people running a forestry agency or within government bureaucracies, there’s competition within the government or within sectors for more money, and the last thing they want to do is do more with less money. They want to elevate their budget as much as possible. The more you can advocate for all this money to plant all these trees, the stronger is your claim on those resources”, she said. “They’re really not focused on cost effective activities. It’s a perversity of the way funds are allocated and the way power is linked to money”.

Carbon cycle scientist Grant Domke, of the US ***Forest*** Service, recently examined how much additional carbon the US could absorb by adding more trees to the productive ***forests*** that are currently understocked. Rather than looking at averages for his analysis, he and his co-authors relied on actual measurements of trees on federally managed ***land***. Of the estimated 130,000 plots, 80,000 plots had measurements for the trees that are 2.54 cm in diameter and larger in the US, as well as seedlings. The analysis found that by fully stocking US ***forests*** — that is, planting 1.2 billion trees each year — carbon sequestration capacity would be increased by approximately 20% (ref. ). For comparison, US ***forests*** and harvested wood products currently offset the equivalent of 14% of economy-wide carbon ***emissions*** annually. The additional trees would increase this to 16.8%.

The potential to stock ***forests*** to capacity is unclear. Domke’s latest analysis includes identifying the ***forests*** that have a reduced carbon sequestration capacity due to disturbances in growth such as pests and disease, as well as from drought and fires that limit the recovery of those ***forests*** to their previous capacity. If ***forest*** ***land*** is currently understocked, it doesn’t necessarily mean it makes sense to fully stock some areas, Domke explained. Planting trees on ***forest*** ***land*** is not a silver bullet. The trees might not grow. He said, “if we plant these seedlings and saplings, really what we are doing is investing in future sequestration. It takes time, and if we want to ensure survival, then the dividends are large, but there is some risk, particularly given changes in disturbance dynamics”. In New Mexico, for instance, some ***forest*** regeneration projects have just a 17% success rate, according to Domke.

Domke’s future research aims to understand the changes in the carbon sequestration rate of ***forests***. “Every year in the US we lose on the order of 1.2 million hectares of ***forest***, so the fact is we can’t even maintain existing ***forest*** due to pressures from other ***land*** uses and human activities, and we are proposing to enhance that?” Domke said. The US has a growing backlog of areas on the federal ***land*** base that it is mandated to maintain as ***forest*** cover. Domke says that increases in the frequency and severity of disturbances, combined with prolonged drought in some areas, have made it challenging, given current infrastructure, to recover the ***forests*** or to stay in front of those disturbances and make sure that those ***lands*** are reforested post disturbance. Fires usually open up serotinous cones and prime them to grow in the organic layer following a burn. “Now, some sites cannot realize their full potential because the fires burn the organic material to the substrate, and there’s nothing to establish on”, said Domke. “Maintaining ***forests*** as ***forests*** is huge, but we need to temper expectations so that we can avoid risk and ***emissions***”.

The supply chain to reforest in the US is far from adequate. A recent study found that nurseries need to increase their production of seedlings by an additional 1.7 billion each year, a 2.3-fold increase over current production. To reforest 26 million hectares by 2040 with 30 billion trees would cost US$33 billion. Investments are needed to build a fundamental route to reforestation that includes collecting and storing tree seeds, expanding nurseries, developing a workforce and improving planting practices and vegetation treatments.

The rise in international policies to support quickly planting trees to sequester carbon has increased scientific interest, and increasingly researchers have found that planting trees is not the easiest and most effective way to gain immediate carbon sinks from trees. Yiwen Zeng, a senior research fellow at the Center for Nature Based Solutions at the National University of Singapore, sees constraints playing out through social and environmental dynamics in Southeast Asia.

“The area has high potential for sequestering carbon, but at the same time, you have this growing population and competing need to produce food to not just feed Southeast Asia, but the rest of the world as well”, Zeng said. “We need to try to figure out whether or not this reforestation potential can actually be realized, and how much can be realized if we consider all the different stakeholders involved”. While many areas in Southeast Asia are classified by policy-makers and scientists as degraded ***lands*** that have lost ***forest*** biomass or have depleted levels of soil nutrients but can be reforested, a great deal of subsistence farming takes place on those ***lands***. Thus, for a tree project to work, it needs to take into account the social and economic needs of those local people, or the reforestation won’t be successful.

It’s this social context and lack of coordination with local people that limits reforestation as a climate solution in Southeast Asia and around the world. A lot of resources, coordination and involvement of local stakeholders need to occur for reforestation to combat climate change, Zeng urges.

The adage that planting trees is always good is receiving more nuance as nature-based solutions become more prominent in the attempt to mitigate climate change. “As we look at climate mitigation through ***forest*** restoration as a critical strategy for ***removing*** carbon from the atmosphere, we have to understand: to what extent does tree planting and ***forest*** restoration contribute to livelihoods and well-being, and what are the opportunity costs?” said environmental social scientist James (J.T.) Erbaugh, who studies institutional change, international development and environmental conservation at Dartmouth College. “Success really depends on empowering local communities”.

“Success really depends on empowering local communities”

Erbaugh’s work has focused on Indonesia and with Indigenous people and local communities to ensure the success of ***forest*** restoration for sequestering carbon, conserving biodiversity and contributing to local livelihoods. Previous studies have often sought to quantify where ***forest*** restoration might occur without considering who lives there and what their lives might be like. “The need to plan for long-term restoration really rests on strong institutions in collaboration with each other”, he said.

Actors within government, and at the local level, were disappointed with the outcomes of ***forest*** conservation because it took a long time, Erbaugh explained, adding that it’s difficult to prove that you have actually reduced deforestation and degradation. Ultimately, it comes down to understanding how well-intentioned conservation projects have excluded and disenfranchised Indigenous people and their local communities. “Employing an inclusive approach to ***forest*** restoration is a just and sustainable way to address climate change, which can also help ensure the long-term viability of such initiatives”, he added.

Erbaugh has studied protected areas around the world and found a significant amount of human development in the protected areas. He says that isn’t a reason to increase regulation and monitoring and sanctioning of protected areas. Rather, rules need to align with the people who depend on the ***forests*** and live there, including the ethics of balancing livelihoods while also conserving and restoring ***forests***, if possible.

Along these lines, Chazdon and others are now advocating for a much stronger approach that links the social and environmental benefits with the governance and policy decisions through a synthesis approach that includes a family of models that manages the trade-offs of multiple ecological insights. “It is a map for initial conversation that you can fine-tune at the local scale”, she said. From 2016 to 2018, Chazdon co-led collaborative research meetings on tropical reforestation at the US National Socio-Environmental Synthesis Center between international ***forest*** research networks and institutions that brought together 30 researchers, policy specialists and practitioners to understand the ecological and social drivers and impacts of reforestation, and the feedbacks between ***forest*** recovery and human society at local, municipal and regional levels. She said, “you can start with a lot of guidance on where tree planting is most effective, where natural regeneration has the highest capacity to store carbon, where ***agriculturally*** focused activities could be most effective, such as near roads and closer to villages… taking all those spatial issues into account. What we have so far does not include the economic part of that”.

Bringing together open data from Chazdon and thousands of others to support this multifactorial approach is Crowther’s latest project. Restor ([*https://restor.eco*](https://restor.eco)) is a non-profit data platform that will launch in late spring 2021 and bring local transparency and connectivity to 50,000 of the world’s restoration projects. Trees have taken on a high visibility role in the global effort to mitigate climate change, and ambitious tree planting programmes have attracted prominence to replace ***forests*** being lost, creating both challenges and opportunities for researchers. Yet, despite global numbers, government and governance of these plans will take place at the local level.

“Restoration isn’t a global thing. It’s a local challenge for local communities”, Crowther said, adding that when local communities are empowered by restoration, it becomes sustainable. “If the local biodiversity is good and if the local people are good, then we are all good”.

The world’s ***forests*** absorb a substantial amount of the carbon dioxide ***emissions*** that humans produce, and this has a tremendous social and economic value. ***Forests*** will continue to be valued for what they can do to alleviate climate change and support biodiversity. However, to comprehend the scale of how trees can capture the world’s excess carbon and increase tree cover, research indicates we must focus on local and municipal solutions that are sustainable and benefit local people, natural systems and economies.

**Load-Date:** May 3, 2023

**End of Document**



[***CSF and Fellow Conservation Organizations Support Amendments to Regional Conservation Partnership Program (RCPP) Eligibility Criteria***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:613Y-RXP1-JDG9-Y2BP-00000-00&context=1516831)

Impact News Service

October 20, 2020 Tuesday

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**Length:** 380 words

**Body**

Washington DC: Congressional Sportsmen's Foundation has issued the following press release:

On October 15, the Congressional Sportsmen’s Foundation (CSF) and several conservation partners submitted a letter to Acting Chief Kevin Norton of the U.S Department of ***Agriculture***’s (USDA) Natural Resources Conservation Service (NRCS) regarding recent amendments to the Regional Conservation Partnership Program’s (RCPP) current Application for Public Funding (APF). A conservation program authorized and funded through the Farm Bill, RCPP leverages partner funding from diverse matching sources with dollars received through RCPP grants to implement critical conservation practices on ***agricultural*** or ***forest*** ***lands***. The letter, signed by 10 organizations, thanked Chief Norton for the NRCS’s actions to address concerns about program eligibility for nonindustrial private ***forest*** landowners.

Originally released on August 6 with an application deadline of November 4, the current APF included eligibility criteria that created confusion among nonindustrial private landowners who utilize their ***forest*** ***lands*** for commercial purposes, like selling timber to processors. These criteria were meant to further distinguish ineligible industrial ***forest*** ***lands*** (i.e , those owned by entities that also process timber) from nonindustrial private ***forests*** that are a primary ***target*** for RCPP ***forest*** conservation efforts. In response, several organizations representing ***forest*** landowners, conservationists, and sportsmen shared their concerns with NRCS and USDA officials. Fortunately, during a hearing with members of the U.S House of Representative’s ***Agriculture*** Committee on October 1, Chief Norton announced plans to ***remove*** the eligibility language that was creating the confusion and extend the application deadline through the end of November. The amended APF was published on October 14.

CSF and our partners appreciate Chief Norton and the NRCS’s willingness to ensure that all interested and eligible landowners can apply for RCPP funding to address ***forest*** conservation needs. With a total of $360 million available during this application period, there exists a great opportunity to implement conservation efforts throughout our nation’s ***forests*** for the benefit of landowners, wildlife, and sportsmen.

**Load-Date:** October 21, 2020

**End of Document**



[***Drax boss: We need to go further on carbon storage to hit net-zero commitments***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:61X6-T6B1-JDG9-Y51J-00000-00&context=1516831)

Impact News Service

February 2, 2021 Tuesday

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**Length:** 1033 words

**Body**

London: IEA Clean Coal Centre has issued the following press release:

Tackling climate change requires global collaboration. As a UK-US sustainable energy company, with communities on both sides of the Atlantic, we at Drax are keenly aware of the need for thinking that transcends countries and borders. Joe Biden becomes the 46th President of my native country at a crucial time, ensuring there is global leadership and collaboration on climate change. Starting with re-joining the Paris Agreement, I am confident that the new administration can make a significant difference to this once-in-a-lifetime challenge. This is why Drax and our partners are mobilising a transatlantic coalition of negative ***emissions*** producers. This can foster collaboration and shared learning between the different technologies and techniques for carbon ***removal*** that are essential to decarbonise the global economy.

Whilst political and technical challenges lie ahead, clear long-term policies that spur collaboration, drive innovation and enable technologies at scale are essential in achieving the UK and US’ aligned ***targets*** of reaching net zero carbon ***emissions*** by 2050.

Collaboration between countries and industriesWhat makes climate change so difficult to tackle is that it requires collaboration from many different parties on a scale like few other projects. This is why the Paris Agreement and this year’s COP26 conference in Glasgow are so vital. Our effort towards delivering negative ***emissions*** using bioenergy with carbon capture and storage (BECCS) is another example of ambitious decarbonisation that is most impactful as part of an integrated, collaborative energy system. The technology depends upon sustainable ***forest*** management in regions, such as the US South where our American communities operate. Carbon capture using sustainable bioenergy will help Drax to be carbon negative by 2030 – an ambition I announced at COP25, just over a year ago in Madrid.

Experts on both sides of the Atlantic consider BECCS essential for net zero. The UK’s Climate Change Committee says it will play a major role in tackling carbon dioxide (CO2) ***emissions*** that will remain in the UK economy after 2050, from industries such as aviation and ***agriculture*** that will be difficult to fully decarbonise.

Meanwhile, a report published last year by New York’s Columbia University revealed that rapid development of BECCS is needed within the next 10 years in order to curb climate change.

A variety of negative ***emissions*** technologies are required to capture between 10 per cent and 20 per cent of the 35 billion metric tonnes of carbon produced annually that the International Energy Agency says is needed to prevent the worst effects of climate change. We believe that sharing our experience and expertise in areas such as forestry, bioenergy, and carbon capture will be crucial in helping more countries, industries and businesses deploy a range of technologies.

A formal coalition of negative ***emissions*** producers that brings together approaches including ***land*** management, afforestation and reforestation, as well as technical solutions like direct air capture (DAC), as well as BECCS, would offer an avenue to ensure knowledge is shared globally. It would also offer flexibility in countries’ paths to net zero ***emissions***. If one approach under-delivers, other technologies can work together to compensate and meet CO2 ***removal*** ***targets***. As with renewable energy, working in partnership with governments is essential to develop these innovations into the cost-effective, large scale solutions needed to meet climate ***targets*** in the mid-century.

A shared economic opportunityI agree whole heartedly that a nation’s economy and environment are intrinsically linked – something many leaders are now saying, including President Biden. The recently approved US economic stimulus bill, supported by both Republicans and Democrats in Congress and which allocates $35 billion for new clean energy initiatives, is a positive step for climate technology and job creation.

Globally as many as 65 million well-paid jobs could be created through investment in clean energy systems. In the UK, BECCS and negative ***emissions*** are not just essential in preventing the impact of climate change, but are also a vital economic force as the world begins to recover from the effects of COVID-19. Government and private investments in clean energy technologies can create thousands of well-paid jobs, new careers, education opportunities and upskill workforces. Developing BECCS at Drax Power Station, for example, would support around 17,000 jobs during the peak of construction in 2028, including roles in construction, local supply chains and the wider economy. Additional jobs would be supported and created throughout our international supply chain. This includes the rail, shipping and forestry industries that are integral to rural communities in the US South.

We are also partnered with 11 other organisations in the UK’s Humber region to develop a carbon capture, usage and storage (CCUS) and hydrogen industrial cluster with the potential to spearhead creating and supporting more than 200,000 jobs around the UK in 2039. The expertise and equipment needed for such a project can be shared, traded and exported to other industrial clusters around the world, allowing us to help reach global climate goals and drive global standards for CCUS and biomass sustainability. Clear, long-term policies are essential here, not just to help develop technology but to mitigate risk and encourage investment. These are the next crucial steps needed to deploy negative ***emissions*** at the scale required to impact CO2 ***emissions*** and lives of people.At Drax we directly employ almost 3,000 people in the US and UK, and indirectly support thousands of families through our supply chains on both sides of the Atlantic. Drax Power Station is the most advanced BECCS project in the world and we stand ready to invest in this cutting-edge carbon capture and ***removal*** technology. We can then share our expertise with the United States and the rest of the world – a world where major economies are committing to a net zero future and benefiting from a green economic recovery.

**Load-Date:** February 2, 2021

**End of Document**



[***UN: Indigenous peoples are best guardians of Latin America's forests; LATIN AMERICA FORESTS***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:6296-4G71-DYB6-53KD-00000-00&context=1516831)

EFE - English Newswire

March 25, 2021 Thursday 9:26 PM GMT

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**Section:** NEWS

**Length:** 665 words

**Byline:** pnm/mc

**Body**

**ABSTRACT**

Santiago, Mar 25 (EFE).- The indigenous peoples of Latin America and the Caribbean are the best guardians and managers of the region's ***forests***, seen in the significantly lower deforestation rates in their territories, the United Nations said in a report published Thursday.,Based on a review of around 300 studies and two decades of scientific evidence, it reveals for the first time that indigenous and tribal communities play a "fundamental" role in combating deforestation, conserving ***forests*** and

**FULL TEXT**

Santiago, Mar 25 (EFE).- The indigenous peoples of Latin America and the Caribbean are the best guardians and managers of the region's ***forests***, seen in the significantly lower deforestation rates in their territories, the United Nations said in a report published Thursday.

Based on a review of around 300 studies and two decades of scientific evidence, it reveals for the first time that indigenous and tribal communities play a "fundamental" role in combating deforestation, conserving ***forests*** and biodiversity and reducing greenhouse gas ***emissions***.

"We should thank the indigenous communities for their much better ***forest*** conservation (relative to) other territories," said Julio Berdegue, assistant director general and regional representative for Latin America and the Caribbean of the UN's Food and ***Agriculture*** Organization (FAO).

He said in that regard that an important element has been the recognition of the territorial rights of these peoples, who have been able to prohibit the pursuit of ecosystem-destroying economic activities.

Between 2000 and 2012, "the rate of deforestation inside tenured indigenous forestlands (across the Amazon) was 2.8 times lower than outside these areas in Bolivia, 2.5 times lower in Brazil and 2 times lower in Colombia," the report said.

Forty-five percent of the intact ***forest*** in the Amazon basin is found in territories managed by indigenous communities, who have avoided "between 42.8 and 59.7 million metric tons of CO2 ***emissions***" annually, equivalent to ***removing*** between 9 million and 12.6 million vehicles from the roads per year.

The area of intact ***forest*** decreased by only 4.9 percent between 2000 and 2016 in indigenous areas of the region, compared to a 11.2 percent reduction in non-indigenous areas, according to the UN.

"This shows that their voice must be taken into account in all initiatives related to climate change, biodiversity and forestry," said the president of the Fund for the Development of Indigenous Peoples of Latin America and the Caribbean (FILAC), Myrna Cunningham.

Indigenous and tribal peoples number more than 60 million in the region and participate in the communal governance of between 320 million and 380 million hectares of ***forests***, which store around 34 billion metric tons of carbon, more than all of Indonesia's ***forested*** areas, according to the report.

A relevant factor in perpetuating native communities' conservation capacity, according to the study, is "the revitalization of traditional cultures and knowledge and (the provision of) support to their organizations."

"Indigenous culture and spirituality itself is nurtured by the protection of ***forests*** and nature," Cunningham, who also is a Nicaraguan indigenous activist, said. "We play a key role at this moment when nature is so much under threat."

The ability to avoid deforestation is being "eroded by many activities such as illegal mining, criminal groups linked to drug trafficking and the overexploitation of ***agricultural*** (resources) with the cultivation and transportation of illicit crops," Berdegue said.

The report produced by the FAO and FILAC said deforestation also is triggered by global demand for minerals, fuels, ***forest*** products and tourism and the continuous expansion of roads and transport infrastructure.

Those institutions therefore called on the region's governments to "invest in projects that strengthen the role played by indigenous and tribal peoples in ***forest*** governance" and to "strengthen communal ***land*** rights." EFE

**Load-Date:** March 25, 2021

**End of Document**



[***IOC reveals details of its “Olympic Forest” project***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:62XY-R6T1-JDG9-Y1DH-00000-00&context=1516831)

Impact News Service

June 17, 2021 Thursday

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**Length:** 979 words

**Body**

Lausanne, Switzerland: International Olympic Committee has issued the following press release:

The International Olympic Committee (IOC) announced today the details of its project to plant the “Olympic ***Forest***” in Mali and Senegal, an element of the IOC’s climate-positive strategy.

The project is a contribution to the Great Green Wall initiative, which restores degraded landscapes across Africa’s Sahel region. It will involve planting around 355,000 native trees across approximately 90 villages in Mali and Senegal – host of the Youth Olympic Games Dakar 2026 – and will cover a combined area of around 2,120 hectares.

More than planting trees, the Olympic ***Forest*** will contribute to increasing the local communities’ food and economic security. The IOC will work hand in hand with local communities to ensure the Olympic ***Forest*** creates diverse social, economic and environmental benefits in an area which has experienced increased droughts and floods, leading to a steady degradation of ***land*** and sources of food.

The IOC has committed to reducing its carbon ***emissions*** by 30 per cent by 2024, and by 45 per cent by 2030, in line with the Paris Agreement. By compensating for more than 100 per cent of the IOC’s residual ***emissions***, the Olympic ***Forest*** will help the organisation become “climate positive” by 2024. The Olympic ***Forest*** is expected to sequester 200,000 tonnes of CO2 equivalent (t CO2e), which is more than the IOC’s estimated ***emissions*** for the 2021-2024 period and can be compared to the ***emissions*** of approximately 32,000 return flights from Geneva to Tokyo.

“Addressing climate change is one of the IOC’s top priorities, and we are fully committed to reducing our ***emissions*** in line with the Paris Agreement,” said IOC President Thomas Bach. “The Olympic ***Forest*** will support communities in Mali and Senegal by increasing their climate resilience, food security and income opportunities, and will help the IOC become climate positive already by 2024. The Olympic Movement is about building a better world through sport, and the Olympic ***Forest*** is an example of that. ”

“With Dakar 2026, our goal is to go beyond sport and use the Games as an opportunity to raise young people's awareness, and beyond them that of the various stakeholders, about today's sustainability challenges and ways in which we can help address them,” said IOC Member Mamadou Diagna Ndiaye, President of the Dakar 2026 Youth Olympic Games Organising Committee. “This approach is in line with the country's priorities and reflected in the Dakar 2026 Edition Plan. The Olympic ***Forest*** paves the way in this direction.'“Olympic ***Forest***” projectGetty Images

By helping to restore degraded soils, the Olympic ***Forest*** will increase the food and economic security of local communities and will help them adapt to the consequences of climate change. It will increase local biodiversity and enable sustainable ***agricultural*** practices, such as agroforestry, and the commercial use of non-timber products, such as nuts, fruits and fibres.

To create the Olympic ***Forest***, the IOC will work with Tree Aid, a non-profit organisation with over 30 years’ experience working with people in the drylands of Africa to tackle poverty and the effects of the climate crisis by growing trees and restoring and protecting ***land***.

In its initial phase, the project will involve engaging with local communities to analyse their needs, identifying project areas, establishing a monitoring and evaluation plan and setting up plant nurseries. Planting, which will involve a diverse range of native tree species, is scheduled for the second and third quarters of 2022.“Olympic ***Forest***” projectTree Aid

17 June, the project’s launch date, is the World Day to Combat Desertification and Drought. It follows the recent launch of the UN Decade on Ecosystem Restoration, of which the Great Green Wall is a flagship project.

The UN Environment Programme (UNEP) and the UN Convention to Combat Desertification (UNCCD) both provide advice to the project.

“The Olympic ***Forest*** will be an inspirational contribution to Africa’s Great Green Wall and shows how conserving and restoring nature can address climate change while generating sustainable livelihoods,” said Inger Andersen, Executive Director of UNEP. “Through this initiative, the IOC is showing climate leadership within the sports world and beyond, and highlighting that we all have a role to play in preserving a healthy planet for future generations. ”

The carbon savings generated by the Olympic ***Forest*** will be independently certified according to Plan Vivo, a standard that supports communities and smallholders at the forefront of the climate crisis and also guarantees the creation of socio-economic benefits for local communities and additional environmental benefits such as the restoration of damaged ecosystems.

While the initial project will last four years, the IOC plans to open it up in the future to other organisations in the Olympic Movement so that they can contribute and grow the Olympic ***Forest*** further.“Olympic ***Forest***” projectTree Aid

“Tree Aid is honoured to be working with the IOC to deliver this ambitious and exciting new initiative,” said Tree Aid CEO Tom Skirrow. “As we enter the UN Decade of Ecosystem Restoration, making the Great Green Wall a success is more important than ever to secure the future of the region and the people who live there. The Olympic ***Forest*** shows what is possible when we all work together. ”

In addition to its own efforts to become climate positive, the IOC announced in March 2020 that all Olympic Games will be required to be climate positive from 2030 onwards – ***removing*** more carbon from the atmosphere than they emit. Until then, Organising Committees, including Tokyo 2020 and Beijing 2022, have committed to holding carbon-neutral Games, while Paris 2024 has recently announced its ambition to stage the first climate-positive Games.

**Load-Date:** June 17, 2021

**End of Document**



[***Food–energy–water implications of negative emissions technologies in a +1.5 °C future***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:671W-P2B1-JCWX-C2JB-00000-00&context=1516831)

Nature Climate Change

August 2020

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**Section:** Pg. 920-927; Vol. 10; No. 10; ISSN: 1758-678X,1758-6798

**Length:** 5282 words

**Byline:** [*andres@virginia.edu*](mailto:andres@virginia.edu)

**Body**

Main

During the 2015 UNFCCC Conference of the Parties in Paris, world leaders agreed to limit global temperature increase relative to pre-industrial levels to well below 2 °C and pursue efforts to meet a 1.5 °C ***target*** by 2100 (refs. ,). These ***targets*** require rapid declines in greenhouse gas ***emissions***, reaching net zero by mid-century,. Recent progress on mitigation has been highly inconsistent with this goal,. With ***emissions*** still rising, integrated assessment modelling (IAM) scenarios of the global economy and climate system have increasingly relied on the presumed ability to deploy net-negative ***emissions*** activities to meet these ambitious climate ***targets***,. There are a number of ways by which to ***remove*** already emitted CO2 from the atmosphere–. Yet the vast majority of IAM scenarios include just two ***land***-based negative ***emissions*** technologies (NETs): bioenergy with carbon capture and storage (BECCS) and afforestation (Extended Data Fig. ),. The degree to which these NETs would compete for productive ***agricultural*** and natural ***land***, as well as their impact on water resources if deployed at climatically relevant (that is, GtCO2 yr−1) scales has raised concerns about the viability of these approaches–.

In light of the foreseeable tradeoffs inherent to ***land***-based negative ***emissions*** approaches, recent work has focused on developing direct air capture (DAC) technology. DAC is an engineered separation process that uses aqueous or amine sorbents to ***remove*** CO2 from ambient air, compress it and inject it into geologic reservoirs. The physical footprint of these units would be much smaller than BECCS or afforestation, and it would not require any particular ***land*** type, only proximity to a geologic reservoir for storage,,. However, CO2 exists in low concentrations in ambient air, so DAC is likely to be energy intensive to deploy. This is intuitively the case for DAC processes that require combustion heat, for which fossil fuels are currently the most economical source. However, processes that are capable of using renewable energy or waste heat would still entail large-scale construction of infrastructure (for example, solar photovoltaic) for the purpose of disposing of CO2 emitted previously. Due to these very high assumed costs, DAC has not been included in many integrated modelling scenarios to date,. However, multiple companies now have commercial-scale prototypes, claiming much lower costs than previously estimated–, and several recent IAM studies have incorporated DAC into their mitigation and negative ***emissions*** portfolios,–. In these deep decarbonization scenarios, the availability of DAC can reduce mitigation costs, avoid immediate stranding of fossil fuel assets and benefit energy-exporting countries by preserving the value of their fossil fuel reserves under stringent climate policies. Meeting a 1.5 °C temperature ***target*** may now only be possible if large-scale DAC is available. Relying on the future availability of DAC and then failing to achieve the rapid scale-ups to global-scale deployment could risk overshooting this ***target*** by up to 0.8 °C (ref. ).

Increased near-term mitigation effort is required to avoid the steepest tradeoffs associated with future rapid decarbonization, and to avoid ‘lock-in’ to large-scale deployment of NETs to meet the Paris ***targets***,. But the emergence of DAC as a possible climate mitigation strategy makes it important to gain understanding of its side effects if deployed at GtCO2 yr−1 scales, weighed against its potential to reduce some of the undesirable impacts of BECCS and afforestation (for example, ***land*** and water demand) and to offset ***emissions*** from expensive-to-mitigate sectors (for example, liquid fuels for transportation). The unprecedented financial transfers, (for example, ***emissions*** offsets and direct public subsidies) that would be required to reach net-negative ***emissions*** globally make it even more critical to understand these potential side effects in advance, and minimize the extent to which the deployment of any NET generates unintended consequences of its own. Previous work on the potential benefits and side effects of DAC has emphasized its ability to reduce energy system transition burdens (for example, CO2 prices), while itself requiring large amounts of energy,,. It has been shown that DAC would substantially reduce water use for negative ***emissions*** compared with total evapotranspiration from bioenergy crop and ***forest*** cultivation, plus additional water demand for bioelectricity generation,. However, it is also important to understand how different NETs could affect water quality (for example, through thermal and chemical pollution) associated with withdrawals from surface and groundwater, as well as consumption (that is, evaporative losses) that contribute to water scarcity,. Proper contextualization of each of these relative to other current and projected anthropogenic perturbations to water resources is also imperative to best inform policymakers and other stakeholders considering multiple environmental objectives (for example, water conservation and climate mitigation). The ***land***-use impacts of DAC are considered negligible compared with BECCS and afforestation, but detailed quantitative assessment of the implications for global ***agriculture*** systems (for example, food prices) is largely missing from the IAM literature on DAC and other NETs. In particular, spatially disaggregated results for where different NETs might be deployed under different policies and assessments of the associated impacts on food, water and energy systems are needed to better inform equity considerations of international policymaking.

Here we use the Global Change Assessment Model (GCAM), a technology-rich IAM with detailed treatment of the energy, water and ***land*** sectors, to evaluate the impacts and tradeoffs of a portfolio of three distinct types of NET (afforestation, BECCS and DAC) in meeting two representative ***emissions*** pathways from the IPCC Special Report on Global Warming of 1.5 °C (ref. ). We investigated whether DAC could help ameliorate costly food–water–energy tradeoffs when deployed alongside BECCS, afforestation and other technology options for avoiding CO2 ***emissions*** altogether (for example, renewables and point-source CCS). In light of recent, more optimistic estimates for the cost of DAC technology, we investigate when this technology could begin to play a role in the mitigation portfolio under aggressive near-term decarbonization policy that seeks to limit the overdraft of a small and rapidly dwindling 1.5 °C global ***emissions*** budget. Additionally, the side effects associated with increased negative ***emissions*** requirements resulting from delayed mitigation ambition for meeting the same end-of-century temperature goal are quantified. Finally, we provide greater resolution as to where DAC and other negative ***emissions*** activities and associated side effects could take place spatially, at the scale of geopolitical regions. Throughout our analysis, we compare ***land***, water and energy use for each of these NETs with other current-day and projected anthropogenic perturbations to these resources.

Effects of BECCS and afforestation

DAC deployment may never reach GtCO2 yr−1 scales because it is too expensive or otherwise infeasible. The implications for energy, water and food systems associated with meeting the low-overshoot ***emissions*** trajectory without the use of DAC are shown in Fig. . The higher overshoot trajectory was infeasible without the availability of DAC due to constraints on ***agricultural*** and ***forested*** ***land*** expansion for ***agricultural*** production and climate mitigation. In the low-overshoot trajectory, BECCS is used to produce 226 EJ yr−1 in 2100, over 38% of current-day primary energy demand. The use of modern biomass without CCS for heat, electricity generation and liquid fuels production, as well as ‘traditional biomass’ for fuel, is projected to decline from a combined 83 EJ yr−1 at initiation of our imposed climate policy in 2025 to 16 EJ yr−1 in 2100. The role of fossil fuels is substantially reduced, and the use of unabated coal rapidly declines to near zero following initiation of the climate policy. ***Land*** for dedicated bioenergy crop production expands rapidly to over 5 Mkm2, a ***land*** area equivalent to over 50% of the ***land*** area of the United States and over 25% of present-day global cropland area. Net deforestation is halted by 2025, but the largest increases in ***forested*** ***land*** area occur later in the century as institutions for pricing and enforcing pricing of ***land***-use change carbon are assumed to be phased in. The increase in ***land*** devoted to bioenergy crops and afforestation comes at the expense of grasslands, pasture and production of other crops. These results are broadly consistent with previous IAM studies incorporating BECCS and afforestation to meet aggressive climate ***targets***. Evaporative losses from biomass irrigation and thermal bioelectricity generation are large, reaching a peak of 187 km3 yr−1 in 2050. This is equivalent to nearly 15% of irrigation water consumption in 2010 (refs. ,). Fertilizer use for bioenergy crop cultivation peaks in 2045 at nearly 30% of current-day fertilizer demand. Such drastic increases in fertilizer demand for the purposes of climate change mitigation would have large environmental side effects, such as water quality degradation,, and also climate effects that run counter to CO2 ***removal*** as excess soil nitrogen is converted to N2O (ref. ).

Side effects of limiting warming to below 1.5 °C without DAC available.

a–d, Projected global energy (a), water (b), ***land*** (c) and fertilizer (d) demands for meeting a 1.5 °C end-of-century temperature ***target*** with low overshoot, assuming only BECCS and afforestation/reforestation will be available for negative ***emissions***. The high-overshoot case could not be solved without the availability of DAC.

We report results for the lower (that is, more optimistic) estimates of energy and cost inputs for DAC technology to best illustrate the potential impacts of this technology if deployed at large scale (Fig. ). Because DAC acts as a backstop to the exponential increase in CO2 price, the mere availability of DAC in the mitigation portfolio has a much stronger effect on the results than variation within the range of cost and energy inputs assessed here. In the low-overshoot case, DAC is deployed at gigaton scales as early as 2035, in contrast to other IAM results, which typically delay such large DAC deployments past mid-century. This primarily follows the imposition of the ***emissions*** constraint, wherein we sought to model a scenario in which aggressive mitigation action is taken to limit peak temperature rise, rather than allowing the largest negative ***emissions*** requirements to be pushed far into the future to meet an end-of-century ***target*** by allowing a large overshoot. Spatially, DAC is projected to be deployed primarily in regions such as the United States, South America, China and Australia, which have abundant geologic storage capacity, large natural gas reserves and the potential for inexpensive, relatively low-carbon electricity.

Positive and negative CO2 ***emissions*** by sector and region.

a–c, Positive and negative CO2 ***emissions*** by sector in the scenario of low overshoot with no DAC (a), low overshoot with DAC available (b) and high overshoot with DAC available (c). d, Spatial distribution of DAC deployment in the low-overshoot scenario. Negative ***land***-use-change ***emissions*** indicate afforestation (dark green), while BECCS includes the use of biomass to produce carbon-negative electricity, liquid fuels and industrial products (light green). Results from less optimistic parametrizations of DAC can be found in the .

In all cases, much of the negative ***emissions*** requirement is driven by sectors that are recalcitrant to decarbonization (for example, transportation). DAC displaces the use of BECCS and afforestation for negative ***emissions***, but it also reduces the need for ***emissions*** abatement in the model. Namely, gross-positive ***emissions*** are higher in scenarios in which DAC is available, because those ***emissions*** can be offset using DAC while still meeting constraints on net ***emissions***. The negative ***emissions*** pathway of using bioliquids to manufacture durable products and thereby storing carbon (that is, bioindustrial feedstocks) is not actively utilized when low-cost DAC is available, as the biomass and ***land*** area devoted to its growth can be more profitably used for other purposes such as transportation fuels or food crops. In the high-overshoot case, even relatively modest delays in near-term mitigation greatly increase the reliance on future negative ***emissions***, which must be met by DAC due to constraints on ***land*** available for BECCS and afforestation. This highlights the importance of aggressive mitigation in the near term, as DAC, and indeed all NETs, have yet to be deployed at scale, and high overshoot may be irreversible if these technologies prove infeasible or incapable of keeping up with runaway climate change.

Crop pricing under NET deployment

We consider three major grain staple crops: corn (maize), wheat and rice, and quantity-weight the results by mass to better reflect regional differences in food supply. Food prices peak at 15% above 2010 levels in the no climate policy case due to population growth and a growing global middle class. This is likely an underestimate of food price increases that would occur in the absence of climate mitigation action, because GCAM does not currently consider climate damage such as reduced yields or crop failures due to extreme drought or flooding that are expected in a warmer world–. Incorporating such bidirectional feedbacks between the Earth and human socioeconomic systems into GCAM is an area of cutting-edge, ongoing research. To meet a low-overshoot trajectory without the large-scale availability of DAC, end-of-century food prices are projected to increase by sevenfold relative to 2010 levels. Food price impacts are regionally heterogeneous and are projected to be most heavily concentrated in sub-Saharan Africa. The availability of low-cost DAC attenuates the most severe effects of ***land***-intensive negative ***emissions*** on food markets, but food prices still increase by approximately threefold globally relative to 2010 levels and regional disparities remain, owing to still-large ***land*** use for BECCS and afforestation. These severe food price increases are largely attributable to the imposed constraint on the ability of ‘commercial ***land***’ (for example, ***agricultural*** and forestry activities for food, fibre and bioenergy production) to expand into otherwise ‘natural’ uses of ***land*** (Fig. ). If this ***land*** protection constraint is relaxed, food price impacts would be less severe in both the DAC and no-DAC scenarios, but at the expense of even larger-scale conversion of natural ***lands*** to ***agricultural*** production and managed ***forest***.

Food crop price and global ***land***-use impacts of NET deployment.

a, Regionalized food crop prices relative to 2010 levels for the low-overshoot trajectory. b, Differential ***land*** use between DAC available and no-DAC scenarios. Combined ***land*** use devoted to BECCS and afforestation in the no-DAC scenario is over 5 Mkm2 (see Fig. ). The availability of low-cost DAC can reduce this requirement by approximately 1 Mkm2 in 2050, freeing up more ***land*** for food production and ameliorating the most severe food price impacts.

Water and energy use of NETs

Water consumption for DAC is comparable to that of bioenergy crop irrigation (Fig. ). This result is in contrast to a previous report where BECCS and afforestation sequestration was scaled by a water use factor that included the total evapotranspiration of unirrigated bioenergy crop cultivation, without subtracting the evapotranspiration of the food crops as well as native vegetation that the bioenergy crops would be replacing. GCAM calculates water consumption, water withdrawals and crop evapotranspiration for ***agricultural*** and industrial sectors endogenously. This treatment of water use produces a different result than would be obtained by linearly scaling the water intensity of each NET. DAC reduces the demand for negative ***emissions*** from BECCS, but also allows for increased positive ***emissions*** to the atmosphere, which are then offset by DAC. Therefore, even though DAC is still less water intensive than bioenergy crop irrigation, large DAC deployments result in increased total water use for negative ***emissions***—a phenomenon analogous to a rebound effect. Further, irrigated cropland that would be used for BECCS if DAC were not available is then freed up for other ***agricultural*** production, further increasing water demand. To meet the same low-overshoot ***emissions*** constraint, the availability of DAC results in a net increase in total water consumption of nearly 35 km3 yr−1 in 2050, approximately 35% of current-day evaporative losses for electricity production globally. The increased late-century negative ***emissions*** requirement in the high-overshoot scenario, which is met by DAC, increases water consumption even further. Input assumptions and calculated intensity factors (tH2O/tCO2 sequestered) are reported in the .

Water use and displacement of ***emissions*** abatement of large-scale DAC.

a,b, Global consumptive water use for BECCS and DAC under low (a) and high (b) overshoot of the 1.5 °C temperature ***target***. c, Differences in the year 2050 for biophysical water demand, withdrawals and consumption by sector for low-overshoot scenarios in which DAC is and is not available. The availability of DAC decreases evapotranspiration related to human activities but increases overall withdrawals and consumption. d, Effect of DAC on NET deployments and abatement effort. Decreased abatement effort indicates increased gross positive CO2 ***emissions***.

Results for primary energy consumption by source for low and high overshoot of the 1.5 °C temperature ***target*** are reported in Fig. . As in the no-DAC scenario, fossil fuels continue to play a large role in the global energy system, but their ***emissions*** are mostly abated using CCS technology (that is, CO2 ***emissions*** are captured at point sources). Even with DAC, unabated coal shows precipitous drop-offs at the initiation of the climate policy, while unmitigated oil and gas continue to be used for transportation and industrial processes that are recalcitrant to decarbonization. In the low-overshoot case, process heat and electricity requirements for DAC together account for 100 EJ yr−1 of energy demand by 2100, with process heat requirements accounting for 85 EJ yr−1 of this. For context, global natural gas demand in 2018 was approximately 130 EJ. Even relatively modest delays in aggressive mitigation in the high-overshoot scenario result in increased energy demand from DAC to ***remove*** previously emitted CO2. Differences between low-overshoot scenarios in which DAC is and is not available are shown in Fig. c. Increases in demand for other fuels (for example, conventional natural gas and oil) occur because the availability of DAC allows other industries to abate their ***emissions*** less aggressively and be offset by DAC. Additional demand for natural gas CCS is due to DAC process-heat requirements.

Effects of DAC on primary energy consumption.

a,b, Primary energy consumption by source for low-overshoot (a) and high-overshoot (b) scenarios with DAC available. Natural gas with CCS for DAC process heat is subtracted to avoid double counting and shown separately in purple. c, Differences between two low-overshoot scenarios in which DAC is and is not available, where virtually all of the increase in natural gas CCS is driven by DAC. Increases in energy demand from other sources occur because low-cost DAC enables less aggressive ***emissions*** abatement. Electricity consumption for DAC is a secondary energy demand and is not shown separately. The dashed vertical line in each subfigure indicates the start of the climate policy.

Conclusions

Modelling results obtained using GCAM suggest that DAC technology can make substantial contributions before mid-century to the deep ***emissions*** reductions necessary to meet a 1.5 °C end-of-century temperature increase goal. Given the global ambition to aggressively mitigate climate change in the near term, DAC could begin ***removing*** multiple GtCO2 yr−1 from the atmosphere as early as 2035, even assuming present-day financial and energy inputs. The availability of DAC can reduce the steepest tradeoffs associated with ***land*** and fertilizer use for BECCS and afforestation. However, even with large-scale DAC availability, BECCS and afforestation deployment will still have large effects on other commodity markets, food in particular, with expected impacts concentrated heavily in the Global South. We also find that reductions in bioenergy crop irrigation withdrawals and consumption are largely offset by increased water use for DAC. In the case of water consumption, evaporative losses from DAC are over 100% of the reduction in BECCS-related consumptive water use that DAC technology enables. This is due to a ‘water rebound effect’ where the less water-intensive technology (DAC) is used at higher rates because it displaces ***emissions*** abatement, increasing overall water use. Indeed, much of the negative ***emissions*** requirement in all scenarios is driven by offsets for recalcitrant sectors (for example, liquid fuels for transportation). Thus, research and policies aimed at avoiding ***emissions*** from these distributed sources in the first place could substantially reduce the projected tradeoffs associated with all NETs. This highlights the importance of detailed consideration of interaction effects between NETs and ***emissions*** abatement by policymakers and the models informing them, as well as environmental impacts (for example, water use) not directly related to climate. IAM research into NETs with potential co-benefits (for example, ***agricultural*** soil carbon and coastal wetlands protection and restoration) could further highlight ways to alleviate negative side effects associated with planting trees, growing bioenergy crops or building industrial facilities solely for the purpose of large-scale carbon ***removal***. It is crucial, however, that modelling results projecting large-scale future deployments of ‘more sustainable’ negative ***emissions*** are communicated so as to not justify further delays in implementing ambitious mitigation policy in the near term.

Consistent with other IAM studies of DAC, we find that this technology will require large energy input, up to 115% of current-day natural gas consumption for process heat alone. Any robust climate policy including DAC in the mitigation portfolio should therefore consider natural gas life cycle ***emissions*** (for example, leakage during extraction and transport) to avoid offsetting the climate benefit of the CO2 ***removal***. The fundamental issue of increasing future energy requirements for CO2 ***removal*** to compensate for failure to decarbonize in the near term exists even with DAC processes that can use renewable energy for process heat and electricity. The magnitude and distribution of food price increases projected to result from ***land***-based carbon ***removal***, even with large-scale deployments of DAC, raise profound intra- and inter-generational equity concerns. While these concerns have been well covered in the literature with respect to the risks and burdens of climate change itself (for example, refs. ,), additional attention is needed to address the distribution of burdens of negative ***emissions*** intended to mitigate it. Most critically, we emphasize the need for urgent action on decarbonization policy that is the precondition for any kind of large-scale mitigation activity, let alone global-scale net-negative ***emissions***. Just as climate impacts (for example, sea-level rise and extreme weather events) will continue to become more severe with delayed action, the food, energy and water tradeoffs of DAC and other negative ***emissions*** technologies will only increase in magnitude the longer mitigation is delayed and the need for their deployment increases.

Methods

We used GCAM version 5.2, accessed on 8 November 2019, and ran scenario permutations on the University of Virginia high-performance computing cluster, Rivanna. We imposed two constraints on global CO2 ***emissions*** pathways, which represent high- and low-overshoot trajectories of the 1.5 °C end-of-century temperature ***target*** from the IPCC Special Report on Global Warming of 1.5 °C. Both ***emissions*** constraints are assumed to begin in 2025. The first ***emissions*** pathway seeks to limit overshoot of the 1.5 °C temperature ***target***, which is broadly consistent with the scenario design logic suggested by Rogelj et al.. The peak mean global temperature reached in this scenario is 1.56 °C above pre-industrial levels in year 2045, before subsequently declining to 1.32 °C by 2100. The second pathway allows near-term mitigation to proceed more slowly, with associated higher intermediary overshoot of the 1.5 °C temperature ***target***, peaking at 1.78 °C in 2055, before returning to approximately the same temperature as the low-overshoot scenario by 2100. This allows direct assessment of the impact of delays in near-term ambition on longer-term tradeoffs associated with negative ***emissions***. We emphasize that an explicit consideration in our scenario design was to reduce end-of-century warming as well as reliance on future net-negative ***emissions***, and that both ***emissions*** trajectories are at odds with current and intended future climate action. Additional delays in mitigation will increase the requirement for negative ***emissions*** in the future,. The ***emissions*** constraints imposed, as well as the resulting CO2 concentrations and global average temperature anomaly trajectories, are reported along with historical data for each of these in Extended Data Fig. (refs. ,,). GCAM endogenously calculates the CO2 prices required to meet the ***emissions*** constraint imposed in each model period. ***Land***-use change ***emissions*** are included under the constraint, and their price is determined as an exogenously specified proportion of the fossil ***emissions*** price. This is done because, whereas fossil fuels are largely a market commodity, much of the ***land*** use and ***agriculture*** occurs outside of regulatory frameworks in many countries. Pricing ***land***-use change ***emissions*** immediately at 100% of the fossil carbon price therefore ignores existing institutional barriers to implementing ***land***-use ***emissions*** policy, including uncertainties in quantifying fluxes and reversal risks of biospheric carbon storage–. To represent long-term improvements in institutions for implementing ***land***-use policy, ***land***-use change ***emissions*** are priced here as a linearly increasing proportion of fossil and industrial ***emissions*** price, from 0% in 2025 to 100% by 2100.

DAC requires energy input in the form of process heat and electricity and financial inputs for capital expenditure and non-energy operations and maintenance. While some DAC processes require negligible water use and may actually produce water from humid air, the process modelled here relies on aqueous reactions between atmospheric CO2 and a hydroxide solution and has evaporative water losses at the air contactor,–. There is large parametric uncertainty with regard to the energy intensity and total cost of DAC, the latter of which depends heavily upon the assumed capital recovery factor, as well as the energy source. We focus on DAC processes requiring high-temperature heat from natural gas combustion, rather than those using lower-quality waste heat or 100% renewable electricity, because detailed and harmonized specifications for these latter processes are not available in the literature due to commercial confidentiality. Energy and financial input parametrizations for high- and low-cost DAC follow those used by Realmonte et al., representing upper and lower estimates for hydroxide-based DAC processes from recent literature,,. Per tCO2 sequestered from the atmosphere, for low-cost DAC we assume process heat input of 5.3 GJ, electricity input of 1.3 GJ and non-energy financial input of US$180. Parametrization and results for high-cost DAC, for which we used less optimistic parametrizations for energy and financial inputs, are provided in the . Electricity input for DAC is assumed to come from each region’s grid; generation fuel mix and therefore cost and carbon intensity is calculated endogenously. Financial inputs are assumed to remain constant in real terms over time. For water, we assume 4.7 tH2O/tCO2 following the detailed material balances provided by Keith et al., with withdrawals and consumption assumed equal. Process heat for DAC is assumed to come from natural gas with a 95% capture rate for combustion CO2 ***emissions***, consistent with oxyfuel CCS processes. For other CCS processes, the standard GCAM assumptions for CO2 capture rates are used (85–95%). The storage cost for carbon captured from DAC and other sources is calculated separately and endogenously by GCAM.

In equilibrium, DAC indirectly competes with other NETs for its share of contribution to the ***emissions*** reduction. For instance, given a constraint on ***emissions***, GCAM will endogenously calculate the lowest cost option to achieve the goal by comparing the cost-effectiveness of BECCS (in both bioliquids and bioelectricity) and afforestation. Bioenergy crops can be used to achieve net-negative ***emissions*** by displacing the use of fossil fuels with CCS in electricity generation (bioelectricity), converted to liquid transportation fuels and sequestering the resulting high-purity CO2 streams (biofuels), or used as feedstocks in durable products manufacture such as plastics (bioindustrial feedstocks). BECCS therefore largely competes on the energy supply side, but also competes for carbon-negative subsidies. Afforestation largely competes with other ***land***-use demands, such as food crops and pasture, but also competes for carbon-negative subsidies. We placed no external constraints on the use of DAC and removed the default constraint on the amount of bioenergy used for negative ***emissions***. BECCS was instead allowed to freely compete with other uses of ***land*** based on their costs, yield and water demand. However, we kept in place the standard GCAM assumption that 90% of natural ***lands*** (non-commercial) are removed from economic competition (that is, not available for expansion for bioenergy, food and fibre production, or afforestation). This is done to place reasonable biophysical constraints on the deployment of ***land***-based mitigation and negative ***emissions***, and to preserve much of the remaining natural ***land*** for biodiversity, species, watershed protection, recreation and cultural value as reflected in the UN Sustainable Development Goals and many national-level policies. Descriptions of other GCAM model specifications can be found in the GCAM documentation.

Online content

Any methods, additional references, Nature Research reporting summaries, source data, extended data, supplementary information, acknowledgements, peer review information; details of author contributions and competing interests; and statements of data and code availability are available at [*https://doi.org/10.1038/s41558-020-0876-z*](https://doi.org/10.1038/s41558-020-0876-z).

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**Notes**

Supplementary informationSupplementary information is available for this paper at [*https://doi.org/10.1038/s41558-020-0876-z.Publisher’s*](https://doi.org/10.1038/s41558-020-0876-z.Publisher’s) note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

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[***New research finds sage grouse populations grow faster in areas with juniper tree removal***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:62XG-WD41-JDG9-Y4WR-00000-00&context=1516831)

Impact News Service

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**Body**

Washington: US Department of ***Agriculture*** has issued the following news release:

Recently published research found sage grouse populations grow faster in areas restored by ***removing*** juniper trees, highlighting a key to sage grouse conservation efforts in the West.

The research, culminating findings of an eight-year study in the Warner Mountains conducted by University of Idaho and Oregon State University students and advisors, found that strategically ***removing*** encroaching trees spells good news for sage grouse, a declining upland bird that serves as a key indicator for the overall health of the sagebrush biome.

This study adds to a growing body of research -- much of it based on the long-term study in the Warner Mountains -- that documents the numerous benefits of conifer ***removal*** for wildlife and grazing ***lands***.

The Warner Mountains run north to south from southern Oregon into northern California. In Oregon’s Warner Mountains, sagebrush rolls across hillsides and valley bottoms, providing productive ***land*** for livestock and wildlife.

Like many places in the West, these valuable rangelands are at risk from encroaching trees that displace wildlife, reduce livestock forage, and decrease available water. More than one million acres of sagebrush grazing ***lands*** in the Great Basin have turned into pinyon-juniper ***forests*** in the past two decades alone.

Sage grouse, a bird who evolved in a large and treeless landscape, suffer when trees take over. Birds avoid mating or nesting if there are more than a couple trees on the landscape, likely because conifer woodlands are riskier habitats for grouse with more predators. Other sagebrush-reliant wildlife like mule deer and songbirds are also negatively impacted when conifers crowd out the perennial plants they need for food and cover.

“In places where junipers were removed, the sage grouse population grew at a rate that was 12 percent greater than in an area where no trees were cut,” explained Andrew Olsen, who led the research for Oregon State University. “By ***targeting*** ***removal*** where sagebrush plants were still intact, we bought instant habitat for a declining bird species. ”

Unfortunately, trees are taking over America’s grazing ***lands*** at an alarming rate. Conifers like Western Juniper have expanded by as much as 600% over the last 150 years — and 90 percent of that expansion has occurred in sagebrush country.

Olsen’s research demonstrates how ***removing*** expanding conifers before they get too dense can bring back the birds. A previous study from the Warner Mountains found that 29% of marked hens moved back to nest in restored habitat just three years after conifers were cut. Additional research in the Warners also revealed the abundance of sagebrush-loving songbirds, also species adapted to large treeless expansions, doubled following restoration through juniper ***removal***.

“While conifer ***removal*** in the Warners has been shown to help sage grouse, many different wildlife and plant species are also benefiting from the restoration of these open sagebrush habitats,” said Todd Forbes, district manager of the Bureau of ***Land*** Management’s Lakeview District in Oregon.

Other key project partners include the Bureau of ***Land*** Management, USDA Natural Resources Conservation Service, private landowners, Oregon Department of Fish and Wildlife, and NRCS Conservation Effects Assessment Project.

NRCS Working ***Lands*** for Wildlife

Through the USDA’s Natural Resources Conservation Service’sWorking ***Lands*** for Wildlifeprogram, landowners in sagebrush rangelands receive incentives to ***remove*** junipers on their properties, helping sage grouse populations thrive.

Beginning in 2010, the USDA’s Natural Resources Conservation Service teamed up with private landowners through the Working ***Lands*** for WildlifeSage Grouse Initiative, public ***land*** managers with the Bureau of ***Land*** Management, and other local partners on a collaborative, large-scale conifer ***removal*** effort in the Warner Mountains. The groups also enlisted the help of university scientists to monitor the outcomes of their work over time.

'The big value is that ***removing*** conifers gives you a reset,' said John O’Keeffe, who ranches near Adel, Oregon, and partnered with NRCS Oregon to ***remove*** junipers on his property. “As the trees get thicker and thicker, you lose your understory vegetation and that puts your topsoil at risk. Conifer ***removal*** keeps the ***land*** in a state where we have native bunchgrass that allow for cattle, grouse, deer, and antelope. Once the conifers get too dense, you lose all of that. ”

Using hand-held chainsaws to minimize ecological disturbance, private landowners like O’Keeffe worked alongside public ***land*** managers at BLM to strategically ***remove*** trees from 34,000 acres (53 square miles) to restore and expand sagebrush habitat. The project partners ***targeted*** tree ***removal*** places where there was still a healthy understory of native shrubs and plants so birds could move into the habitat right away.

While conifer ***removal*** was underway, researchers monitored the outcomes by tracking 417 sage grouse hens with transmitters. The latest Oregon State University study quantified how the bird’s population growth rate has changed over time. Olsen and other researchers marked hens in a 109,000-acre treatment site where trees were removed, as well as in a nearby control site, an 82,000-acre landscape where no conifer ***removal*** occurred. They compiled different vital rates of these hens with lek count data from the region.

Five years after conifer ***removal***, the growth rate of the sage grouse population was about12% higherthe treatment site than at the control site. Plus, the survival rates increased for most stages of the bird’s life cycle where junipers were cut. This is encouraging news for conservationists who have been collaborating on similar conifer ***removal*** projects across the West to restore open sagebrush habitat.

“We couldn’t be more excited about this new science,” said Ron Alvarado, state conservationist for NRCS Oregon. “Our strategic conservation efforts to help ranchers restore sagebrush rangelands are working. These findings highlight that conservation success. ”

Over the next five years, NRCS will continue to help ranchers across the West ***remove*** conifers to boost ***agricultural*** productivity and benefit wildlife. NRCS’ Working ***Lands*** for Wildlife recently released aFramework for Conservation Action in the Sagebrush Biome, which details how local, state, and federal partners plan to work together on voluntary, incentive-based strategies to address the main threats facing sagebrush rangelands. In addition, the BLM and NRCS developed theRangeland Analysis Platform, a free online mapping tool that helps landowners plan conifer ***removal*** projects by showing how and where tree cover has changed over time.

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[***Deforestation and reforestation impacts on soils in the tropics***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:693W-H851-F129-P0H0-00000-00&context=1516831)

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**Body**

Introduction

Soils in the tropics provide essential functions, (such as nutrient storage and recycling–, carbon (C) storage and greenhouse gas (GHG) ***emissions***,, erosion resistance and water storage, drainage and filtration–), and soil variability within and amongst landscapes promotes biodiversity of tropical ***forests***–. The properties of soils under natural tropical ***forests*** reflect long-term soil-vegetation feedbacks, influenced by the high productivity, regular litter input and permanent deep root systems that are characteristic of these ***forests***, all of which stimulate activity of soil organisms,. Compared with ***agricultural*** ***land*** uses, tropical ***forests*** promote efficient soil-nutrient recycling, and modulate soil temperature and moisture.

Humans have shaped tropical ***forests*** and their soils for millennia, especially since the onset of ***agriculture***,. For centuries, during was a main cause of ***forest*** clearing, but was offset by natural regrowth during , thus, preventing significant net . Tropical deforestation as a global process started during colonial times and intensified in the second half of the twentieth century as a result of the demand-driven expansion of logging and ***agricultural*** ***land***, typically supported by government policies. At 5.5 million hectares (ha) per year (based on the 2010–2015 period), tropical deforestation continues to be the largest contributor of global natural ***forest*** losses (Fig. ). Substantial area that was formerly cleared for ***agriculture*** has also been abandoned, commonly because of soil degradation, and now provides areas for by or replanting. Indeed, replanted ***forest*** area has increased rapidly, at approximately 1 million ha per year between 1990 and 2015, a trend that is projected to continue. Currently, the total area of in tropical countries (541 million ha) is only approximately half of regenerating ***forests*** (1,172 million ha), illustrating their global significance,.

Tropical tree cover change and soils based on dominant clay mineralogy.

a | Tropical tree cover changes between 2000 and 2018 in areas that had greater than 60% tree cover in 2000 (ref.). b | Tropical soils with high-activity and low-activity clays, based on the SoilGrids250m dataset and categorized using the FAO World Reference Base for soil resources. Pixels classified as Ferralsols, Acrisols, Lixisols, Nitisols and Sesquisols were categorized as soils with low-activity clays, while Cambisols, Luvisols, Vertisols, Planosols and Alisols (and others) were categorized as soils with high-activity clays. For panel b, ***forest*** areas were delineated based on FAO Global ***Forest*** Resources Assessment as tropical rainforests, tropical moist deciduous ***forests***, tropical dry ***forests*** and tropical mountain ***forests***. Tree cover data from: [*http://earthenginepartners.appspot.com/science-2013-global-****forest***](http://earthenginepartners.appspot.com/science-2013-global-forest).

Deforestation and reforestation can lead to profound changes in that directly and indirectly affect many soil functional processes,. For example, deforestation generally leads to lower soil organic carbon (SOC) stocks,,–, higher soil bulk density and changes in soil pH (ref.). Changes in dynamic soil properties occur most rapidly in the organic-matter-rich with the highest biological activity,. Deeper soil horizons (>50 cm) are also affected by deforestation and reforestation, although changes there occur more slowly and often become substantial only after several decades. However, most studies do not report long-term changes in dynamic soil properties — of those reviewed here, only 48% included ***land*** uses ≥25 years old. Nevertheless, most studies assumed that a steady state was reached within the period studied or that further changes were insignificant,. In combination with the undersampling of deeper soil horizons, this assumption has led to the relatively widespread view that only topsoils are affected by deforestation and reforestation, and that within approximately one or two decades following deforestation, most dynamic soil properties have reached steady-state or equilibrium values,.

In this Review, we examine the impacts of deforestation and reforestation on soils in the tropics. We compile changes in dynamic soil properties following ***forest*** clearing and during ***forest*** regeneration, explicitly including results from studies that covered several decades and/or measurements from deeper . These quantitative results are framed in a broader context by reviewing evidence of how changes in dynamic soil properties affect important soil functions. Finally, we discuss how soil-management practices in ***land***-use transitions affect soil functionality and identify important knowledge gaps.

Impacts on dynamic soil properties

Dynamic soil properties, which we use here to describe characteristics that change over years to decades owing to ***land***-use change and management, include soil pH, (ECEC), base saturation, bulk density (BD), SOC and soil C:N ratio. Anthropogenic activities during and following deforestation or reforestation, such as slash-and-burn management or the replanting of trees, alter these properties both directly and indirectly (Fig. ). In the following sections, we present changes in dynamic soil properties from a compilation of 120 studies of ***forest***-related ***land***-use change in 35 tropical countries ().

Linkages between ***land***-use changes, soil properties and soil functions.

a | Hypothesized linkages during and following deforestation between human activities (grey boxes with short-dashed outlines), vegetation response variables (red and blue boxes with long-dashed outlines) and dynamic soil properties (red and blue boxes with solid outlines). Red boxes indicate a decrease in the property or function, blue indicates an increase, and red and blue together represent various or diverging responses. Deforestation often involves the use of heavy machines, which can increase soil bulk density (BD) (arrow 1). ***Removal*** of trees strongly reduces deep, permanent tree roots and litter input, which, in turn, lead to a reduction in the soil organic matter (SOM) content (arrow 2). Tree ***removal*** can also induce soil compaction, as litterfall is reduced and macropores collapse after remaining tree roots decompose. Slash-and-burn decreases macrofaunal activity, which, together with tree ***removal***, increases BD, (arrow 3). As decomposed SOM has a lower C:N ratio than fresh litter, there is a reduction in the C:N ratio of the remaining SOM in the years following deforestation (arrow 4). A reduction in SOM further contributes to an increase in BD because the SOM has a lower density than the mineral soil fraction (arrow 5). Burning of the remaining slash leads to direct nutrient losses by volatilization and an input of nutrients through ashes on the topsoil, increasing the pH (arrow 6) and base saturation, (arrow 7). Owing to the presence of low-activity clays and SOM, the effective cation-exchange capacity (ECEC) of many soils in the tropics depends on pH. An increase in pH raises the ECEC (arrow 8), whereas a decrease in SOM content has the opposite effect (arrow 9). b | Reforestation (secondary succession or replanted ***forest***) often leads to opposite changes in dynamic soil properties because of the establishment of a permanent deep root system and increasing litter input. Deep and permanent roots will also lead to the uptake of nutrients, including base cations with congruent release of H+ by roots, which can decrease soil pH. c | Linkages of dynamic soil properties to selected soil functions.

Soil pH, ECEC and base saturation

Although tropical ***forests*** are located on diverse soil types, most remaining natural ***forests*** are located on heavily weathered soils with low-activity clays (LAC soils, Fig. , Box ), which have inherently low pH (from our dataset: 4.82 ± 0.02), acid-buffering capacity and fertility. Compared with LAC soils, the inherent soil pH of high-activity clay (HAC) soils under natural ***forests*** is typically higher (5.83 ± 0.07 in the reviewed studies), as they are buffered by the release of base cations (Ca2+, Mg2+, K+, Na+) during silicate weathering of primary or clay minerals. In general, soil pH increases following slash-and-burn management (Figs ,), as seen in all soil depths of <10-year-old croplands (Fig. , Supplementary Fig. ), owing to the input of carbonate-containing ashes that buffer soil pH to values between 6.5 and 7.5 (ref.). In the absence of during ***land*** management, the net nutrient export by harvested products and leaching losses cause a net release of H+ that can eventually lead to a drop in soil pH over time. Indeed, in >25-year-old croplands, soil pH decreases to values below those of the original ***forest*** soils in the top 10 cm (Fig. ). Changes in pH following slash-and-burn management are less pronounced in HAC soils compared with LAC soils (Supplementary Fig. ).

Changes in soil properties during ***land***-use change for croplands and pastures.

Relative change ([converted − reference]/reference); bars are bootstrapped 95% confidence intervals from 10,000 randomizations) in dynamic soil properties following deforestation for cropland (panel a), reforestation of cropland (panel b), deforestation for pastures (panel c) and reforestation of pastures (panel d). Old-growth ***forest*** is the reference ***land*** use for deforestation (panels a and c), whereas cropland (panel b) or pasture (panel d) is the reference ***land*** use for secondary ***forest***. Results are presented as aggregated years for young (<10 years), intermediate (10–25 years) and old (>25 years) croplands, pastures and secondary ***forests***. The number of observations are reported in Supplemental Table . Changes in soil properties progress to deeper depths decades after deforestation; reforestation restores some soil properties, mainly in the topsoil, but their values do not reach those of the original ***forests***. Symbols adapted courtesy of the Integration and Application Network, University of Maryland Center for Environmental Science ([*http://ian.umces.edu/symbols/*](http://ian.umces.edu/symbols/)).

Changes in soil properties during ***land***-use change for tree cash crop plantations and agroforestry.

Relative change ([converted − reference]/reference); bars are bootstrapped 95% confidence intervals from 10,000 randomizations) in dynamic soil properties following deforestation for tree cash crop plantations (panel a) and agroforestry (panel b). Old-growth ***forest*** is the reference ***land*** use. Results are presented as aggregated years for young (<10 years), intermediate (10–25 years) and old (>25 years) ***land*** uses. The number of observations are reported in Supplemental Table . Diverse agroforestry systems appear to be more successful than tree cash crop plantations in maintaining soil organic matter and effective cation-exchange capacity. Symbols adapted courtesy of the Integration and Application Network, University of Maryland Center for Environmental Science ([*http://ian.umces.edu/symbols/*](http://ian.umces.edu/symbols/)).

Conversion of ***forests*** to pastureland also rapidly increases soil pH owing to ash input (24% increase in the top 10 cm and 9% increase in 10–50 cm, Fig. ), followed by a slow decrease in pH in subsequent years (Fig. ). In contrast to croplands, >25-year-old pastures maintain soil pH values above those of the original ***forests*** (3–9% increase, Fig. ), likely because only small amounts of base cations are exported through harvest and leaching. As with crop and pastureland, tree cash crop plantations (such as for rubber and oil palm) are often established using slash-and-burn management,; soil pH increases with age in these plantations, likely because of regular liming (Fig. ).

Most soils are negatively charged and retain positively charged nutrients (including K+, Ca2+, Mg2+ and NH4+) in exchangeable form in the soil, referred to as ECEC when measured at field pH (ref.) (Box ). LAC soils have low, pH-dependent ECEC, with a value of 3.20 ± 0.15 cmolc kg−1 in the natural ***forest*** soils included here. The ECEC is higher in HAC soils under natural ***forests***, with a value of 9.95 ± 1.05 cmolc kg−1 in the reviewed studies. Following slash-and-burn management, the inherently low ECEC of LAC soils quickly increases in both croplands (up to 35% increase compared with ***forests***, Supplementary Fig. ) and pastures (25–31% increase, Supplementary Fig. ). In contrast, the inherently high ECEC of HAC soils decreases with ***forest*** conversion to croplands (Supplementary Fig. ). Eventually (after >25 years), ECEC values of both LAC and HAC soils fall below those of the original ***forested*** soils, related to long-term SOC decreases following deforestation.

Base saturation (the percentage of ECEC occupied by exchangeable bases) increases with increase in soil pH, and a base saturation above 50% is considered favourable because of the availability of bases as nutrients and the low amount of exchangeable Al, which can be toxic. Under natural ***forests***, the base saturation of LAC soils is typically low (15.5% ± 0.8 in the reviewed studies), owing to the low soil pH, whereas the base saturation of HAC soils is higher (66.6% ± 2.4 in the studies included here). Following slash-and-burn management, base saturation rapidly increases in LAC soils due to the base-containing ashes (Fig. ,, Supplementary Fig. ). In contrast, such change is less pronounced in HAC soils, probably resulting from the higher initial base saturation and the presence of weatherable minerals (Supplementary Fig. ). After 25 years or more, the base saturation of pasture soils remains slightly elevated relative to the original ***forested*** values (Fig. , Supplementary Fig. ), but is relatively lower in cropland soils (Fig. , Supplementary Fig. ), likely owing to long-term base-cation export. In tree cash crop plantations on LAC soils, liming (a common practice in these systems) might have contributed to the higher base saturation of the top 50 cm of soil in >25-year-old plantations relative to the original ***forests*** (Fig. ).

Reforestation of croplands or pastures often does not result in clearly reversed trends for soil pH, ECEC and base saturation (Fig. ,). For instance, the net transfer of base cations from the soil to trees in can lead to a decrease in pH (Fig. ), but nutrients are also returned to the soil through litterfall, which could compensate for this effect, by replenishing the base cations. The increased ECEC in the reforested cropland topsoil within 10 years is likely related to the increase in SOC (Fig. ), as organic-acid groups and phenolic groups impact the pH-dependent ECEC of LAC soils (Box ). Generally, changes in pH and ECEC following reforestation take decades before possibly reaching values similar to those of original ***forest*** soils, a notable contrast to the rapid changes in these properties following deforestation. Importantly, the data compiled here highlight that there are fewer published studies on reforestation compared with deforestation (Supplemental Table ), which contributes to unclear trends in pH, ECEC and base saturation under secondary ***forests***.

Box 1 Diversity of soils in the tropics

Soils in tropical areas have diverse properties, varying fertility and different reactions to ***land***-use changes,. Several FAO soil groups (such as Ferralsols, Acrisols, Lixisols, Nitisols and Sesquisols) or USDA soil orders (such as Oxisols and Ultisols) largely occur in tropical regions, and are old, highly weathered, deep (up to 20 m), acidic and generally low-fertility soils with little primary mineral reserves for replenishment of nutrients via weathering. These low-activity clay (LAC) soils cover about 44% of the tropics (left image in the figure, scale shown in centimetres), mainly under tropical rainforest or savannah,, and are dominated by a kaolinitic-clay mineralogy. LAC soils have pH-dependent charge, mostly from hydroxide groups (-OH) at the edges of clay minerals, as well as phenolic (-OH) and organic-acid groups (-COOH) of soil organic matter. Depending on the pH of the soil, H+ ions are dissociated from these groups, resulting in negative charges, or dissolved H+ ions are adsorbed, leading to positive charges, especially in the subsoil with low soil organic matter content. In practice, these properties mean that the negative charge of LAC soils is low and, if the pH increases, more H+ will be dissociated and negative charge and effective cation-exchange capacity (ECEC) increase. The anion exchange capacity of LAC soils increases with decreasing pH. The ECEC of LAC soils, thus, depends on the pH and organic matter content of the soil.

Other FAO soil groups (such as Luvisols, Cambisols, Vertisols and Alisols) or USDA soil orders (Alfisols, Inceptisols and Vertisols) are younger, less weathered, often not deeper than 1–2 m and generally fertile, covering approximately 32% of the tropics (right image in the box figure). The clay mineralogy of these high-activity clay soils is often dominated by smectite, illite or vermiculite, and the soils have large, permanent negative charge, which mainly originates from substitutions of ions in silicate-clay minerals. As this charge originates from inside the clay lattice, it cannot be neutralized by covalent bonding of dissolved cations and the ECEC, thus, does not change with soil pH. Images courtesy of N. A. Jelinski, University of Minnesota.

Bulk density, SOC and C:N ratios

***Land***-use change in tropical regions impacts soil BD, an indicator of compaction or porosity that is influenced by root biomass, biological activity, SOC content and ,. Changes in BD following deforestation can be caused by the use of heavy machines,, modifications in macrofaunal activities, foot traffic by grazing animals and decreases in root biomass and SOC content (Fig. ). The mean BD of LAC soils under natural ***forests*** with a clay content ≥60% (top 10 cm) is 0.84 ± 0.03 g cm−3 and 1.22 ± 0.03 g cm−3 for soils with ≥60% sand, according to the data compiled here. Following deforestation, BD rapidly increases, in the top 50 cm in both LAC and HAC soils (4–13% increase for croplands and 4–15% increase for pastures, Fig. ,, Supplementary Fig. ). There is a progressive increase in BD at deeper depths as croplands age, probably related to the concurrent decrease in SOC (Fig. , Supplementary Fig. ). Compared with the BD increases of soils in croplands and pastures that have been converted for at least 25 years (15% and 22% increases, respectively, in the top 10 cm), the increases in tree cash crop plantations (9%) and systems (12%) are lower (Fig. ). These differences are likely related to the permanent root systems of tree-based ***land*** uses in combination with high biological activity (stimulated by litter input) and absence of grazing animals, promoting lower BD in the tree-covered systems.

Deforestation and reforestation lead to drastic changes in inputs of litter or organic residues, which, together with changes in microclimate (such as soil temperature and moisture), affect soil biological activity and decomposition rate. These changes, in turn, lead to the alteration of SOC, as it reflects a dynamic equilibrium between input (litter or organic residues) and loss rates (decomposition), and depends on stabilization by clay content, clay mineralogy, soil-aggregate formation and soil biological activity. SOC also interacts with many other soil properties, including BD, ECEC, biological activity and soil-aggregate stability (Fig. ,). In tropical ***forests***, clay and base-cation contents, rainfall and root biomass appear to be better predictors of SOC than ,.

SOC is a mixture of fractions that have a wide range of residence times (from less than a year to centuries or millennia) and respond differently to ***land***-use change. Changes in SOC stocks following deforestation and reforestation have been studied extensively because of the prominent role that ***land***-use trajectories play in the contemporary global C budget,,,. Earlier reviews have shown decreases between 18% and 25% in SOC stocks of the top 0.3 m depth following deforestation for annual crops,. Our Review similarly finds that, in both LAC and HAC soils, the top 10 cm of cropland soil loses, on average, 17% of the original ***forests***’ SOC contents during the first 10 years following deforestation (Fig. ). However, topsoils of croplands continue to lose SOC: 29% on average after 10–25 years and 58% for croplands >25 years (but <100 years) old (Fig. , Supplementary Fig. ). Several studies have reported substantial labile SOC stocks and microbial activity below 50-cm depth in deeply weathered tropical ***forest*** soils,,,. Although the SOC contents in depths ≥50 cm of croplands ≤25 years old did not differ from the original ***forests*** (Fig. ), soils at ≥50-cm depth and >25 years old contain 35% less SOC content compared with the original ***forests*** (Fig. , Supplementary Fig. ). Thus, we did not find evidence of a new equilibrium in SOC contents within two decades of ***land***-use change, neither in LAC nor in HAC soils, as was postulated previously,. How long SOC losses will effectively continue following deforestation is unclear — a 2018 study suggests that the present-day SOC pool turnover times in the Yucatán Peninsula continue to be reduced as a result of Mayan deforestation 1,000 years earlier. Thus, soils in large areas of the tropics likely continue to be a CO2 source even decades after clearing the original ***forests***, which might be underestimated by current C accounting methods. For example, the Tier 1 approach in the IPCC Guidelines for National Greenhouse Gas Inventories only considers a default soil depth of 30 cm and that changes in SOC stocks occur over a period of 20 years.

For pastures, the direction and magnitude of changes in SOC stocks following deforestation have been linked to clay mineralogy and precipitation, and the SOC stocks in some LAC soils even increase following deforestation. The dynamic nature of these changes becomes apparent in our dataset: in LAC soils, SOC contents in <10-year-old pastures increase in the top 10 cm (16%, Supplementary Fig. ) compared with the original ***forests***, likely as a result of the temporary increase in nutrient availability from ashes,, the mineralization of organic N (refs,) and the fine-root growth of grasses in the topsoil. However, such increase is transitory, as the topsoils of >25-year-old pastures lose 19% of SOC compared with the original ***forests*** (Fig. ). In HAC soils, topsoil SOC contents rapidly decrease and continue in >25-year-old pastures (Supplementary Fig. ), indicating that SOC contents decrease on a longer timescale. Reports of >25-year-old pastures with higher SOC stocks than the original ***forests*** are mostly related to improved management: the pastures were either fertilized,, had significant C and N input from legumes or had low grazing intensities.

Deforestation for tree cash crop plantations reduces SOC contents by 20–22% (Fig. ), which is detectable down to 50-cm depth in >25-year-old plantations. SOC stock losses from tree cash crop plantations may be as high as 50% (refs,) and can be predicted by the magnitude of SOC stocks in the original ***forests***,. Diverse agroforestry systems often maintain SOC stocks in comparison with the original ***forests***, especially in humid climates,,, potentially owing to higher nutrient and organic inputs in home gardens, N inputs from legume shade trees, and a high ecosystem . In drier regions, agroforestry systems have the tendency to lose SOC. From our dataset, agroforestry systems indeed show an average decrease of 24% in SOC contents after >25 years, which is only detectable in the top 10 cm (Fig. ).

The C:N ratio of soil organic matter (SOM) typically decreases with increasing turnover time. The data here show that soil C:N ratios in ≤25-year-old croplands were similar to those of the original ***forests***, but decrease after >25 years (Fig. ), suggesting that the lower SOC contents of older croplands might have slow turnover times. In contrast, an increase in soil C:N ratio with pasture age is often observed in unfertilized pastures (for example, the >10-cm depth in >25-year-old pastures, Fig. ), which is interpreted as a progressive decline in N availability with pasture age, potentially in combination with the invasion of woody shrubs with a high litter C:N ratio in old, degraded pastures.

Reforestation of cropland and pastures through secondary succession or tree plantations reverses the decreasing trend in SOC contents, leading to a 14% increase of SOC in the topsoils within 10–25 years for secondary ***forests*** converted from former croplands (Fig. ) and an 18% increase of SOC from former pastures (Fig. ). Reforestation of former croplands also increases the C:N ratios of SOM in the topsoil (Fig. ). Although secondary ***forests*** restore some of the SOC contents lost following deforestation and generally reverse trends in BD and C:N ratios, these appear to be mainly limited to the topsoil (Fig. ,). A pattern starts to emerge showing that the SOC, BD and C:N ratios in subsoils are restored much more slowly than in topsoils, and do not reach values comparable to the original ***forest*** within a few decades. Obviously, the low number of observations for secondary ***forests*** >25 years old in which subsoils were sampled (Supplemental Table ) contribute to the uncertainty of this statement.

Soil biology

The changes in dynamic soil properties with ***land***-use change are mediated by soil biological communities that, in turn, can alter soil functions, including decomposition and/or nutrient cycling,, greenhouse gas ***emissions***, and water storage, (Fig. ), and biocontrol through predation,. For example, conversion of tropical ***forests*** to tree cash crop plantations decreases macro-invertebrate and biomass, driven by decreases in litterfall and overall energy fluxes, and shifts from predator to omnivore dominance. Such ***land***-use conversion directly causes the species richness of and omnivores to decrease, and reduces the biomass of omnivores and reliant predators. However, the same ***land***-use conversion can indirectly increase biomass and species richness through the bottom-up cascading effects of microclimate, SOM and soil nutrients, which then enhances omnivore biomass and the species richness of detritivores and their predators. The net impacts of ***land***-use change for tree cash crop plantations are decreases in functional diversity of the decomposer community, decomposition and soil-N-cycling rates; the latter is associated with reductions in microbial biomass and SOM. The differences between direct and indirect changes highlight that overall changes in ecosystem functions cannot be linked to a single soil function.

Within the microbial community, conversion of ***forests*** to tree cash crop plantations can cause decreases in fungi (ectomycorrhizae, arbuscular and ericoid , which are important for P and organic N acquisition) and increases in and fungi, as seen in Indonesian plantations; this restructuring of the fungal community suggests enhanced pathogens in plantations. The bacterial community also differs between plantation soils and ***forest*** soils in Indonesia, with the relative abundance of Alphaproteobacteria decreasing and Acidobacteria increasing with increased ***land***-use intensity, and the diversities of the bacterial and archaeal communities increasing in plantations relative to ***forest***. These changes were related to increases in soil pH, base saturation, C:N ratio and extractable P due to liming and chemical fertilizations in tree cash crop plantations on LAC soils,.

Understanding the changes in populations and communities of soil-dwelling invertebrates during secondary succession and determining the role of microbial symbionts (like mycorrhizal fungi, and N-fixing bacteria) in facilitating successional dynamics of trees are two major themes addressed by soil-biology research. The regeneration of secondary ***forest*** often leads to rapid increases in litterfall production and decomposition, with fluxes approaching those in older ***forests*** within several decades,. However, populations and communities of litter and soil invertebrates do not necessarily change in concert with litterfall quantities during succession, and, instead, can be more responsive to changes in litter chemistry. The abundances of many macro-invertebrate groups increase with ***forest*** regeneration,, although some groups of organisms do not — Earthworms, for example, decrease in successional ***forests*** compared with pastures. Similarly, the diversity and species composition of invertebrates in secondary ***forests*** relative to older ***forests*** show varying patterns, with communities becoming increasingly similar to old ***forests*** in some studies but not in others. Inconsistent methodology hampers the determination of what drives the divergent responses of soil biological communities to ***forest*** regeneration, which, ultimately, might depend on a number of factors beyond dynamic soil properties, such as proximity to sources of colonizers and plant-species composition.

Deforestation and soil function

Soil functions emerge from a combination of inherent soil properties (soil texture, soil mineralogy) and dynamic soil properties and processes (Fig. ), and are critical to ecosystem function. Here, we review how the drastic changes in dynamic soil properties following deforestation affect nutrient storage and recycling, C storage and GHG ***emissions***, water storage, drainage and filtration, and erosion resistance (Fig. ).

Deforestation and reforestation impacts on soil functions.

a | ***Land***-use-change trajectory on high-activity clay (HAC) soils. Stage 1: tropical natural ***forests*** are relatively rich in nitrogen (N) and rock-derived nutrients, and nutrient leaching is substantial. Nutrients and water are efficiently cycled with large carbon (C) and nutrient stocks in vegetation and soil. Soils are a net nitrous-oxide source and methane sink. Stage 2: slash-and-burn management leads to a net transfer of nutrients from vegetation to the soil surface. N leaching is large and base-cation leaching is moderated by the large effective cation-exchange capacity in HAC soils. Net soil C and greenhouse gas (GHG) ***emissions*** are high. Stage 3: the relatively long cropping phase with high initial productivity declines with time. Nutrient-leaching losses, net soil C and GHG ***emissions*** decrease with years of unfertilized cropping, owing to nutrient uptake and harvest export by crops and slowly declining soil nutrient stocks. Stage 4: secondary succession occurs quickly and experiences N limitation during the early years, later mitigated by increased N fixation. Nutrient and water cycling between vegetation and soil increase with time; consequently, leaching losses mirror nutrient cycling and soils increasingly become a net C and GHG sink. b | ***Land***-use-change trajectory on low-activity clay (LAC) soils. Stage 1: tropical natural ***forests*** on LAC soils are relatively rich in N but low in rock-derived nutrients, with substantial N leaching and low base-cation leaching. Water and rock-derived nutrients are efficiently cycled, and C and nutrient stocks are largely stored in vegetation. Soils are a net nitrous-oxide source and a methane sink. Stage 2: after slash-and-burn management, N leaching is relatively small because of substantial anion-exchange capacity in the subsoil, whereas base-cation leaching is relatively large because of small effective cation-exchange capacity in LAC soils. Stage 3: relatively short cropping phases as compared with HAC soils have high initial productivity, followed by rapid decline with time (unless fertilized). Nutrient-leaching losses, net soil C and GHG ***emissions*** quickly decrease. Stage 4: secondary succession occurs slowly, with N limitation during the early decades. Nutrient and water cycling between vegetation and soil, net C and GHG sinks in soils increase over a longer timescale than in HAC soils. Arrow width represents relative flux size.

Nutrient storage and recycling

Nutrient storage and recycling are arguably the dominant soil functions influencing primary production in the humid tropics, and are strongly linked to multiple dynamic soil properties that drastically change with deforestation (Fig. ,). In natural, tropical ***forests***–, N enters the system mainly through N fixation, N cycling and accumulation rates are large, and the systems are often not N-limited, (Fig. ). Rock-derived nutrients, such as P and base cations, are derived from weathering (mainly in HAC soils) or dust (mainly in primary-mineral-depleted LAC soils), (Fig. ). Whereas HAC soils typically have higher soil P availability and less efficient P recycling, the majority of LAC soils have a high capacity for P sorption (Fig. ), explaining the low availability and efficient recycling of P in many natural, tropical ***forests*** (Fig. ).

During slash-and-burn management, as much as 95–98% of N in the is volatilized, whereas 27–47% of P and 10–48% of base cations can be exported as ash particles,. However, there is also a significant increase of mineral N, P and base cations in the soil afterwards, owing to the input from ashes, oxidation of organic material to mineral nutrients from high temperatures during burning and high mineralization rates following clearing,, (Fig. ). The pH-related, transitory increase in ECEC following deforestation improves the LAC soils’ capacity to retain base cations, although this increase is not enough to prevent substantial leaching losses following pulse release of nutrients from the burning of slash. In unfertilized systems, SOM continues to decrease following deforestation, leading to decreasing N and P availability (Fig. ) and corresponding crop yields,. In these systems, harvest exports of N and P typically surpass their inputs, unless there is significant nutrient redistribution within a farm caused by management, erosion and water movement or unless N is added by leguminous shade trees, crops or plants mixed in pastures. The gradual decline of ECEC in LAC soils following deforestation (Fig. ,, Supplementary Fig. ) may limit the efficient retention of nutrients. In contrast, the base-cation stocks of HAC soils are normally sufficient for decades following deforestation, and weathering of primary minerals can replenish lost base cations (Supplementary Fig. ). Diverse agroforestry systems are more successful than other ***land*** uses in retaining soil N, P and other nutrients, although reports vary from no difference in soil-nutrient levels compared with the original ***forests***, (observed mainly in humid climates) to substantial decreases, (observed mainly in drier climates).

Carbon storage and GHG ***emissions***

An estimated 1,037 Pg C is stored as SOC in the top 3 m of soil in tropical biomes (tropical evergreen ***forests***, tropical deciduous ***forests*** and tropical savannahs), which is 44% of the global estimate. These substantial SOC stocks are vulnerable to losses with ***land***-use conversion. Historically, 50 Pg C of SOC losses can be related to deforestation in the tropics, which is 37% of the global estimate of 133 Pg C of the net SOC losses since the onset of ***agriculture***. This C is released largely as CO2 during decomposition of labile SOM and combustion during slash-and-burn; thus, CO2 ***emissions*** are a major side effect of deforestation.

Other potent GHGs, methane (CH4) and nitrous oxide (N2O), are both produced and consumed in tropical ***forests*** by soil microbial processes,. Well-drained tropical-***forest*** soils contribute about 25% (6.4 Tg per year) to the global CH4 sink. Annual CH4 uptake is lower in soils with high clay contents and during the wet season,, due to diffusion limitation of atmospheric CH4 to methanotrophic bacteria in soils. Thus, the increase in soil BD following deforestation (Figs ,,) reduces soil gas diffusivity, which reduces soil CH4 uptake or can even turn soils into net CH4 sources. Soil N availability also affects CH4 fluxes, either through inhibition by mineral N following N fertilizer application (caused by the non-specific behaviour of the CH4 monooxygenase enzyme) or because methanotrophic bacteria are N-limited.

Natural tropical ***forests*** are a significant global N2O source (approximately 27% of terrestrial biome sources), owing to fast N-cycling rates and high soil water contents. Clearing and burning of tropical ***forests*** for use as cropland can lead to transitory increases of mineral N, available C and N2O ***emissions*** that last for several days, followed by elevated N2O ***emissions*** that can last for weeks until crops start competing with N2O-producing microorganisms for available N (ref.). The progressive declines in SOC and available N during the first years following deforestation, eventually lead to lower soil N2O fluxes, especially in unfertilized ***agricultural*** systems, relative to the original ***forest***. However, the increase in soil BD following ***forest*** conversion to cropland and pastures (Fig. ,, Supplementary Fig. ) can lead to high water content in the topsoil, which enhances the likelihood of -related increases in soil N2O ***emission*** if N fertilizer is applied.

Water storage, drainage and filtration

Water storage in soils determines the water supply, which impacts the length of the growing season, and, as water drains through soil, it interacts with biogeochemically active soil components (organic matter, clay minerals), plant roots and the soil microbial community. Together, these components can alter the composition of solutes of the drained water — referred to as the soil-filtering function — and can moderate nitrate, phosphate and Al leaching, which are pollution hazards to ground and surface waters. Water storage and drainage both depend on the total porosity and pore-size distribution of the soil, which are linked to soil depth, texture, structure and BD (ref.) (Fig. ), whereas filtration is related mainly to charge characteristics (such as ECEC; Fig. ) and soil redox potential.

Natural ***forests*** on LAC soils have substantial nitrate leaching (9–10 kg N per ha per year, refs,,), owing to their large N-cycling rates, although the (AEC) of LAC subsoils (Box ) can temporarily impede nitrate leaching to groundwater, (Fig. ). Natural ***forests*** on HAC soils have lower N leaching (1–5 kg N per ha per year) and mostly as dissolved organic N (ref.) (Fig. ). P leaching is typically low, in LAC soils independent of ***land*** use due to the P sorption capacity of . Base-cation leaching is lower from natural ***forests*** on LAC soils, than on HAC soils because of reservoirs of primary minerals in the latter that releases bases through weathering (Fig. ,).

Deforestation for crops or pastures reduces the and the rooting depth, causing reduced evapotranspiration, (Fig. ,), increased drainage and, consequently, increased localized discharge to streams and rivers (for example, a 25% increase of discharge within a local watershed in the Amazon basin). In contrast, as a consequence of reduced evapotranspiration and moisture recycling, large-scale deforestation can decrease the amount of atmospheric moisture and reduce regional precipitation,. Slash-and-burn management leads to strongly elevated nitrate leaching from LAC soils (in one study, 207–344 kg nitrate-N per ha from the top 25 cm in Brazil), because of the accelerated N-mineralization and following ***forest*** clearing. However, this nitrate leaching can partly be moderated by their AEC. For example, the subsoil accumulated 345–1,875 kg nitrate-N per ha in fertilized Ferralsols (LAC soils), where the estimated nitrate-holding capacity ranged from 17 to 32 Mg N per ha (ref.). In contrast, HAC soils have low AEC, and substantial nitrate-leaching losses can occur. In LAC soils, the base cations in ashes lead to considerable leaching losses during the first year, which are only partly offset by the transitory increase in ECEC following slash-and-burn management (Supplementary Fig. ). The ECEC of HAC soils is inherently higher and not dependent on the pH (Supplementary Fig. ). Owing to decreasing SOC with age of ***land*** use (Fig. ), which influences the ECEC (Fig. ,), the ability to retain base cations in both LAC and HAC soils decreases with years. Ultimately, this leads to low base-cation leaching in LAC soils, as weathering of primary minerals is low or absent,, whereas in HAC soils, base-cation leaching remains higher, probably due to inputs from weathering.

Erosion resistance

is often reported following deforestation,, which can lead to ***removal*** of topsoil, reducing crop-production potential and lowering surface-water quality; thus, the ability of soils to resist erosion is a crucial soil function. Soil type, properties (including SOM content and BD) and geomorphological stability influence the impact of deforestation on soil erosion (Fig. ). In many soils (such as HAC soils or LAC soils with horizons that impede vertical water flow), reduced vegetation cover and a low soil-aggregate stability following slash-and-burn management in both croplands, and pastures, increase the susceptibility of surface soils to the impact of raindrops. If the reduced infiltration rates are not sufficient to drain high rainfall intensity, overland flow can occur and cause severe water erosion, especially on sloping or geomorphologically unstable areas,,. However, some deforested LAC Ferralsol or Oxisol soils are relatively resistant to water erosion. For example, in LAC soils in the Amazon, deforestation for soya bean increased BD by 25% (ref.) and corresponding water-infiltration rates decreased by almost 70% (ref.). Nevertheless, water erosion was negligible because infiltration rates remained sufficient to drain high rainfall intensity and minimize surface run-off, alongside geomorphological stability and stable microaggregates containing sesquioxides.

Serious erosion, ultimately, can ***remove*** the organic-matter-rich topsoil. In western Africa, erosion following deforestation resulted in soil textural changes (6% less sand and 40% more gravel), topsoil loss (0.04–0.06 mm per year) and a reduction in topsoil water-storage capacity of 15 mm in croplands compared with the original ***forests***. Erosion-induced translocation and burial of SOC and nutrients can be substantial — erosion-induced continental nutrient fluxes in the tropics are estimated to be ~15 Tg N per year and ~10 Tg P per year, which are on the same order of magnitude as fertilizer applications. Although SOC burial in depositional areas can contribute to long-term SOC storage, present-day erosion rates greatly surpass the rate at which soils are newly formed, making erosion one of the most destructive forms of soil degradation.

Reforestation and soil function

Regeneration of secondary ***forest*** and the recovery of dynamic soil properties and soil functions depend on the soil type, climate and former ***land***-use intensity, management or duration,. In general, the relative recovery of standing biomass on HAC soils is faster than on LAC soils — secondary ***forests*** can reach a biomass comparable with natural ***forests*** within 30 years on HAC soils (Fig. ). In contrast, a secondary ***forest*** on a LAC Ferralsol in Brazil accrues only about 26% of the mature-***forest*** biomass within 19 years. In this section, we review how changes in dynamic soil properties following reforestation affect soil functions (Figs ,).

Nutrient storage and recycling

During secondary succession, soil-nutrient storage and recycling increase with time. For example, soil mineral N levels and foliar N contents are very low in <10-year-old secondary ***forest*** following ***agricultural*** abandonment on LAC soils, and increase over decadal timescales. Although mobilization of soil organic N has also been reported as an important N source, biological N fixation appears to be the main source of N during secondary succession and strongly affects the rate at which soil N and SOC contents are restored (Fig. ,). The faster rate of N accrual in less weathered HAC soils compared with heavily weathered LAC soils, suggests that the availability of rock-derived nutrients important for N fixation (such as P and Mo) limits the rates at which N cycling is restored in LAC soils (Fig. ). Secondary ***forests*** on LAC soils possibly meet part of their N demand by accessing nitrate adsorbed in the subsoil (Fig. ), a potential N-acquisition strategy that has mostly been ignored in studies on secondary succession.

Total P stocks in soils under secondary succession appear to be relatively stable,. In LAC soils, total P is mostly in unavailable forms and mycorrhizal fungi, probably stimulate internal P recycling, a slow process that could constrain biomass accumulation in ***forest*** regrowth. This process could also cause older secondary ***forests*** on LAC soils to exhibit efficient P cycling, for example, indicated by increasing litterfall N:P ratios as secondary ***forests*** progress (Fig. ). The strong P sorption by Fe and Al (hydr)oxides in highly weathered LAC soils also contributes to the slow recovery of P cycling,. In HAC soils, chemical weathering can contribute substantially to the increase in P availability during succession. These observations could partially explain why secondary succession is faster on HAC soils compared with LAC soils.

In contrast with the slow increases in vegetation P stocks, base-cation accumulation and restoration via throughfall and litterfall in secondary ***forests*** occur remarkably quickly, and exceed the input through atmospheric deposition considerably. In Brazil, a 19-year-old secondary ***forest*** already displayed cation cycling in throughfall and litterfall comparable to that of a natural ***forest***, probably the result of the exchangeable base cations stored in soils following deforestation. For example, a degraded pasture soil contains 124 kg K per ha, 654 kg Ca per ha and 146 kg Mg per ha in the topsoil, which are sufficient to support a growing secondary ***forest***. Comparable exchangeable base-cation stocks have been reported from other studies.

Carbon storage and GHG ***emissions***

The important role of secondary ***forests*** in C storage and climate regulation is often attributed to above-ground biomass accumulation. However, secondary ***forests*** also restore SOC (Fig. ,), the rates of which appear to depend on the ***land***-use type before secondary succession, the duration and intensity of the previous ***land*** use,, and the nutrient availability for the regrowing ***forest***,,. Indeed, within a few decades, SOC stocks in the topsoils of secondary ***forests*** can be restored to levels close to those of the original ***forests***,. Restoration can take considerably longer for subsoils (Fig. ,), which is in line with recent radiocarbon measurements of deep soils.

Changes in soil CH4 fluxes during secondary succession depend mainly on soil water content and BD restoration,. In secondary ***forests***, CH4 uptake is typically higher than in the previous ***land*** uses, owing to decreases in BD and soil water content. In mature secondary ***forests***, CH4 uptake is restored to pre-clearing levels. Young secondary ***forests*** are typically N-limited and exhibit low N2O fluxes that are only a small fraction compared with those of natural ***forests***. As secondary ***forests*** progress, soil mineral N and foliar N concentrations increase, and soil N2O ***emissions*** slowly restore to pre-clearing levels as N-cycling processes recuperate, which can take 40 years or more of LAC soils,.

Water storage, drainage and filtration

During secondary succession or reforestation, the diminished water cycling between soil and vegetation following deforestation is normally reversed, exhibiting increased evapotranspiration and decreased run-off to streams (Fig. ). If soil BD following reforestation eventually decreases (although not observed within 25 years of secondary succession in the studies reviewed here; Fig. ,) and water-infiltration rates increase, total run-off will be reduced and peak run-off rates will be moderated. Overall, water will recycle more efficiently through evapotranspiration in densely vegetated secondary ***forest*** than on ***agricultural*** ***land***,.

During secondary succession, nutrients (N, P and base cations) stored in biomass and their recycling through litterfall increase,. Moreover, nutrients closely linked to accrual of SOM or redistributed by fine roots from deep-soil to topsoil depths, can also increase in availability with succession, and, hence, lead to an increase in dissolved N leaching from young to old secondary ***forests*** on LAC soils, as seen in the Amazon. However, the base-cation-rich ash inputs in pastures on LAC soils (Fig. , Supplementary Fig. ) result in high base-cation leaching; under secondary ***forests***, uptake by and litterfall from trees reequilibrate (or recycle) the base cations to the acidic condition of LAC soils, and, ultimately, decrease base-cation leaching as secondary ***forests*** regrow (Fig. ).

Erosion resistance

Reforestation increases erosion resistance, owing to the establishment of dense vegetation cover,, and the soil-aggregate stability in secondary ***forests*** improves compared with pastures and croplands. Notably, tree plantations normally have similar effects on soil erosion as secondary ***forests***, unless ***removal*** of understory vegetation in tree plantations increases soil crusting and the risk of erosion.

In summary, dynamic soil properties and soil functions are strongly affected during secondary succession, changing in ways that can promote secondary-***forest*** regrowth. Owing to their inherent difference in soil fertility, relative recovery in biomass of secondary ***forests*** on HAC soils is faster than in LAC soils (Fig. ). Regardless, important differences remain between soils under mature secondary ***forests*** and soils under old-growth ***forest***, and full restoration to the original ***forests***’ soil properties requires more than just a few decades, especially in the subsoils (Fig. ).

Long-term impacts

There is little information available on the long-term effects of deforestation on soil properties and soil functions in the tropics. Most of the studies that we discussed used , a method that is typically used for ***land*** uses that are several decades old at the maximum, as there is only limited landowner memory when collecting information such as time of clearing, management and previous ***land*** uses. Furthermore, the original reference ***land*** use (natural ***forest***) is often no longer found in the region, especially when deforestation happened several decades ago.

Studies that examine centuries-old changes normally derive information indirectly, such as from archaeological studies or from sediment cores of lakes or oceans. The Yucatán Peninsula (home to large, ancient Mayan populations) is probably one of the best-studied regions that faced substantial deforestation followed by extended periods of ***forest*** regrowth (for the past millennium, approximately). Studies show that the long-lasting effects of soil erosion associated with ancient Mayan systems can still be measured on formerly eroded hillslopes, as shown by buried soils, soil base-cation contents, 13C isotopic evidence of such as maize and evidence of young soils formed since abandonment. Furthermore, radiocarbon ages of plant waxes in sediment cores from this region suggest short turnover times of SOC associated with Mayan deforestation. Even 1,000 years of secondary succession did not recover SOC turnover times to pre-deforestation values, and the authors suggested that prolonged periods of reforestation are needed to accumulate slow-cycling SOC pools, especially in the subsoils. How general these long-term effects are is presently unclear, as the Yucatán Peninsula is dominated by HAC soils (Fig. ) and long-term SOC stabilization mechanisms in other regions dominated by LAC soils are probably quite different.

In the past decades, it has become apparent that extensive areas that are nowadays considered old-growth ***forests*** were used or modified in the past by human activity. These impacts extend to their soils: evidence of prehistoric intensive drainage systems in the Bolivian Amazon; the pre-Columbian formation of fertile soil patches rich in organic matter in parts of the Amazon basin (terra preta),; and indications of intensified weathering related to deforestation in Iron Age Central Africa. Thus, many soils under old-growth ***forests*** are probably not as ‘pristine’ as was previously believed. The soils under such ***forests*** are also witness to their remarkable resilience, once human interference is discontinued.

Perspectives

New studies that include older ***land***-use systems and deeper soil depths now demonstrate unequivocally that dynamic soil properties continue to change for several decades following deforestation. These changes are not limited to the top 0.3 m or possibly even the top 1 m (refs,) but probably reach as deep as the soil itself, easily several metres for LAC soils in the tropics. Furthermore, these changes are not limited to SOC contents but also include many other dynamic soil properties (Figs ,) and soil functions (Fig. ).

Important knowledge gaps remain. Topography and landforms, which influence water and element redistribution within a landscape, are rarely considered in studies on deforestation and reforestation,. Very little is known about the mechanisms of SOC stabilization and their interactions. Furthermore, our knowledge of soil microbially mediated and chemical processes in subsoils (especially those involving charge characteristics) is limited. Better knowledge of these processes is needed to understand and manage nutrient storage and cycling, soil C sequestration and GHG production and consumption. In addition, clay mineralogy, normally considered an inherent soil property, could be more dynamic following ***land***-use changes than commonly assumed. Tropical ***forests*** act as a biological pump, resulting in clay minerals instead of in the topsoils as the typical end product of tropical weathering,, with important implications for soil charge characteristics and associated soil functions (Fig. ).

While soil scientists have gained novel insight into the effects of deforestation and reforestation on soils in the past decades, this knowledge has often not yet reached cross-disciplinary efforts to address deforestation and reforestation in the tropics. The limited cross-disciplinary collaboration is probably best illustrated by the poor representation of soils in comprehensive simulation models. For example, in ***land*** surface models, SOC and nutrient cycling of soils in the tropics is often still based on the Century model. However, Century was developed and calibrated for soils of the Great Plains of North America, where SOC and nutrient levels and dynamics are governed by distinctly different climate, vegetation and parent material than in the tropics.

Nevertheless, substantial advances have been made in understanding the long-term impacts of tropical ***land***-use change on soils. Interdisciplinary deforestation studies that include soil as an important provider of ecosystem functions, and as a moderator of ecological shifts following deforestation have started to emerge. In one notable study, agronomic experiments are related to nutrient depletion following deforestation. Studies of the ancient Mayan region, where ancient erosion patterns are moderating modern tree distribution and where radiocarbon ages of plant waxes in sediment cores are connected to SOC stability, give exciting new insights.

Finally, we put forward some recommendations based on our emerging understanding of the long-term effects of deforestation and reforestation on dynamic soil properties and functions. First, investigations in deforested or reforested soils should include subsoils (and the full soil profile when possible) and ***land***-use systems that are several decades old, and have a stronger focus on reforested soils, which are studied less than deforested soils (Supplemental Table ). Soils should also be better represented in ***land*** surface models — for example, there are now better estimates of SOC turnover rates,, including from subsoils based on radiocarbon measurements, than the default values given by models such as the Century model. Second, almost all available data in our Review originated from studies using space-for-time substitution, and there are no long-term longitudinal experiments on deforestation and reforestation that include soil processes and functions. Such studies would greatly enhance our understanding on dynamic changes in vegetation–soil interactions. Third, there is a need for multi-taxa analyses of soil biological communities (macrofauna, microfauna and microbial composition) with their linkages to soil properties and functions, based on comparable experimental designs, which are particularly missing for reforestation. Such investigation is ongoing in ***forest***-to-plantation conversions in Indonesia, and now also includes plantation-management practices, although relating soil biological changes to soil functions is still not fully explored. Finally, basic soil physical, chemical and biological data should be placed in online data repositories alongside their publication. Although increasingly required by journals, such data deposition is not yet the standard. Given the critical role that soils play following deforestation and secondary succession, and the potential consequences for society (Box ), it is imperative that soil scientific knowledge is better communicated to colleagues in other disciplines, such as ecologists, anthropologists, climatologists, archaeologists and economists.

Box 2 Societal impacts of soil management

In the tropics, ***forests*** and savannah are cleared for ***agriculture*** (despite increases in productivity of tropical ***agriculture*** in the past decades), owing to policies addressing ***land***-ownership redistribution, transmigration and other social issues. Many of these permanent ***agricultural*** systems lead to decreases in dynamic soil properties and functions, which can, ultimately, lead to marginal crop yields and severe ***land*** degradation. Soil organic matter (SOM) could be ***targeted*** to counteract such declines, as it is the only dynamic soil property that is central to all soil functions and processes. The highest SOM losses occur in croplands, followed by tree cash crop plantations, pastures and agroforestry. Improved SOM management in croplands can include minimal tillage,, inclusion of a fallow and/or legume rotation, and return of mulch or crop residues without burning. Maintenance of understory vegetation helps to maintain SOM levels in monoculture tree plantations, as does the return of organic waste. In pastures, improved SOM management includes the use of deep-rooting grass species, often in combination with legumes, and appropriate animal stocking rates adjusted to pasture productivity. The resilience of diverse agroforestry systems against SOM losses, is likely the result of a combination of organic inputs near homesteads, diverse plant life forms that increase nutrient-use efficiencies, permanent rooting systems and the inclusion of N-fixing trees. Thus, the ***agricultural*** techniques for improved management exist. However, farmers are more likely to plant trees or invest in improved SOM and nutrient management if they have a secure tenure, access to markets to sell their produce, access to knowledge and the financial means to make their management profitable. Policies that support these prerequisites are critical steps towards better adjusted ***land***-use systems in the tropics.

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**Notes**

Supplementary informationSupplementary information is available for this paper at [*https://doi.org/10.1038/s43017-020-0091-5.Peer*](https://doi.org/10.1038/s43017-020-0091-5.Peer) review informationNature Reviews Earth & Environment thanks Mark Bonner, Gervasio Piñeiro and the other, anonymous, reviewer(s) for their contribution to the peer review of this work.Publisher’s noteSpringer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

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[***Three-quarters of the eco-friendly Generation Z 'are disgusted by lab-grown meat' and say they would NOT eat it***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:60ST-WTK1-F021-617X-00000-00&context=1516831)

MailOnline

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**Section:** SCIENCE; Version:1

**Length:** 1544 words

**Byline:** Ian Randall For Mailonline

**Body**

* Experts polled 227 Gen Z Australians about their feelings on meat alternatives

1. They found that 72 per cent had reservations about switching to synthetic meat
2. Yet 41 per cent also said that they saw lab-grown meat as a potential future food
3. Experts say moving away from livestock farming would benefit the environment

Almost three-in-four members of Australia's Gen Z are 'disgusted' by the idea of lab-grown meat and said they would not eat it instead of animal products, a study found.

Synthetic, lab-grown - or 'cultured' - meat is grown in dishes from samples of real animal cells, instead of being sourced from the slaughter of livestock.

Experts believe that a move away from traditional meat production is necessary, given animal welfare concerns and the environmental impact of livestock farming.

A recent study argued that a broad switch to plant-based proteins could ***remove*** 16 years' worth of atmospheric CO2 ***emissions*** by 2050 by restoring native vegetation.

Accordingly, many Gen Z and millennials are understood to have taken up veganism or vegetarianism to help mitigate climate change and minimise animal suffering.

However, the survey of 227 Gen Z Australians found that as many as 72 per cent have reservations about eating cultured meat over its animal-derived forebear.

Nevertheless, 41 per cent of those polled also said that they saw synthetic meat as having the potential to be a viable nutritional source in the future.

GEN Z'S THOUGHTS ON LAB-GROWN MEAT

Dr Bogueva and colleagues surveyed 227 Australians aged from 18-25 about their thoughts on lab-grown meat.

35 per cent rejected cultured meat and insects, but accepted plant-based alternatives because they felt they were 'more natural' and are 'normal'.

28 per cent said they would or might accept lab-grown meat in the future.

17 per cent rejected all meat alternatives, reporting they felt that cultured meat was 'chemically produced' and 'heavily processed'.

11 per cent also rejected all meat alternatives, but expressed a preference for consuming more fruits and vegetables instead.

9 per cent said that they would accept edible bugs, but rejected lab-grown meat for being 'too artificial' and 'not natural like insects'.

The team also found, however, that 41 per cent Gen Z believe that lab-grown meat can be a viable nutritional source, given the need to improve animal welfare and to transition to more sustainable food options.

Generation Z - those born between the years of 1995-2015 - make up around 25 per cent of the current UK population and some 2 billion people worldwide - make them a consumer segment manufacturers must reckon with.

For the world to reap the environmental and animal welfare benefits of cultured meat - over livestock farming - in the future, Gen Z must be sold on the concept of lab-grown meat.

Despite expressing concern over the treatment of animals in meat production and the environmental impact of the industry, experts found that nearly three-quarters of Generation Z are not ready to accept cultured meat into their diets.

However, the researchers also found that 41 per cent of Gen Z do believe that lab-grown meat can be a viable nutritional source, given the need to both improve animal welfare and to transition to more sustainable food options in the future.

'Our research has found that Generation Z - those aged between 18 and 25 - are concerned about the environment and animal welfare,' said paper author and food sustainability expert Diana Bogueva of the University of Sydney.

'Yet most are not ready to accept cultured meat and view it with disgust,' she added.

'In-vitro meat and other alternatives are important as they can help to reduce greenhouse ***emissions*** and lead to better animal welfare conditions.'

'However, if cultured meat is to replace livestock-based proteins, it will have to emotionally and intellectually appeal to the Gen Z consumers.'

'It may be through its physical appearance, but what seems to be more important is transparency around its environmental and other benefits.'

In their study, Dr Bogueva and colleagues polled 227 Australians aged from 18-25 about their demographics and dietary preferences - including their thoughts on real meat, cultured meat and other alternatives like plant proteins and insects.

The survey revealed that although 59 per cent of participants were concerned about the environmental impact of traditional livestock farming, many were unclear on what such entailed and did not understand the associated resource depletion.

Respondents also expressed several concerns around the consumption of cultured meat, including around an anticipated taste or disgust, health and safety - and whether it is a more sustainable option than other alternatives.

Societal concerns were also prevalent among the participants' responses, with many expressing concerns that eating cultured meat would be in conflict with perceptions of gender and national identity.

'Gen Z value Australia's reputation as a supplier of quality livestock and meat, and many view traditional meat eating as being closely tied to concepts of masculinity and Australian cultural identity,' Dr Bogueva explained.

Others polled reported being concerned about animal welfare, whereas some viewed cultured meat as a conspiracy orchestrated by the rich and powerful - and were determined not to be convinced to consume it.

'Generation Z are also unsure whether cultured meat is actually more environmentally sustainable, described by several respondents as potentially "resource consuming" and not being "environmentally friendly",' said Dr Bogueva.

'The respondents were effectively divided into two groups: the "against" described cultured meat as "another thing our generation has to worry about" and questioned the motivations of those developing it.'

Meanwhile, she added, 'supporters described it as "money invested for a good cause" and "a smart move" by people who are "advanced thinkers".'

'This generation has vast information at its fingertips but is still concerned that they will be left with the legacy of exploitative capitalism that benefits only a few at the expense of many.'

'They have witnessed such behaviour resulting in climate change and are now afraid that a similar scenario may develop in relation to food - particularly as investors are pursuing broader adoption of cultured meat.'

The full findings of the study were published in the journal Frontiers in Nutrition.

EATING LENTILS, BEANS AND NUTS INSTEAD OF MEAT AND DAIRY' COULD ***REMOVE*** 16 YEARS' WORTH OF CO2 ***EMISSIONS*** BY 2050

Switching from eating '***land***-hungry' meat and dairy produce to foodstuffs like beans, lentils and nuts could ***remove*** 16 years' worth of CO2 ***emissions*** by 2050, experts said.

Researchers from the US calculated that broad uptake of such plant-based protein alternatives could free up ***land*** to support more ecosystems that absorb carbon.

At present, around 83 per cent of the world's ***agricultural*** ***land*** is given over to meat and dairy-based production - much of which only produce low yields.

Reducing this figure, the team said, is a better way to combat climate change than waiting for 'unproven' large-scale technologies like atmospheric CO2 extractors.

'The greatest potential for ***forest*** regrowth, and the climate benefits it entails, exists in high- and upper-middle income countries,' said paper author and environmental scientist Matthew Hayek of New York University,

These, he added, are 'places where scaling back on ***land***-hungry meat and dairy would have relatively minor impacts on food security.'

In the study, Professor Hayek and colleagues mapped out the areas of the globe where ***land*** use for animal-sourced food production has squeezed out native vegetation, such as ***forests***.

This allowed the team to determine where a shift in our diets to more plant-based foodstuffs could allow natural ecosystems to be restored - helping to offset global carbon dioxide ***emissions*** in the process.

'We only mapped areas where seeds could disperse naturally, growing and multiplying into dense, biodiverse ***forests*** and other ecosystems that work to ***remove*** carbon dioxide for us,' Professor Hayek said.

'Our results revealed over 7 million square kilometres where ***forests*** would be wet enough to regrow and thrive naturally, collectively an area the size of Russia.'

The team concluded that - if the demand for ***land*** for meat production could be drastically lowered - vegetation regrowth in these locations could help to sequester around 9-16 year's worth of fossil fuel ***emissions*** by the middle of century.

This would effectively double the planet's so-called 'carbon budget' - the amount of fossil fuels ***emissions*** we can afford to release before we reach the threshold temperature rise of 2.7°F (1.5°C) above pre-industrial levels.

Exceeding this limit is expected to result in a significant rise in the number of severe impacts from climate change - including droughts and sea level rise.

'We can think of shifting our eating habits toward ***land***-friendly diets as a supplement to shifting energy, rather than a substitute,' Professor Hayek said.

'Restoring native ***forests*** could buy some much-needed time for countries to transition their energy grids to renewable, fossil-free infrastructure.'

**Load-Date:** September 8, 2020

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[***Sustainable farming needs reform and new blood; Letters***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:62DT-HKT1-DYTY-C15G-00000-00&context=1516831)

Financial Times (London, England)

April 12, 2021 Monday

Edition 1, Asian Edition

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**Section:** LETTERS; Pg. 20

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**Body**

Your editorial on the purchase by Bill Gates and other billionaires of vast swaths of farmland tries to justify it by claiming that "farmers are getting older and many in the next generation have little interest in taking over" (FT View, April 3). Having retired after 50 years as a working farmer I can assure you there are plenty of enthusiastic young people both in the UK and around the world who are quite desperate for the chance to run their own farming business.

Two entirely artificial factors have created this injustice; first are the huge loopholes in inheritance tax and capital gains tax "rollover relief" which actively force ***land*** into the hands of the ultra-wealthy and existing large landowners, pricing it beyond the reach of the young. Second has been the ***removal*** of secure long-term ***agricultural*** tenancies which has positively encouraged the large-scale, short-term, extractive exploitation of the soil on which our lives and those of our children utterly depend.

There is a fundamental difference between the benign natural, living carbon cycles of pastoral farming, trees, crops and soils and the deadly one-way ***emissions*** from fossils buried for millions of years. The naive belief that planting ***forests*** will magically "offset" these toxins is tantamount to the medieval market in religious indulgences. If allowed, intelligent, ecologically aware young people could free us from the devastation of the Gates generation's chemical-intensive agribusiness and restore the ruined soil's ability not only to store carbon through sustainable regenerative and organic techniques, maintain a beautiful human-scale and wildlifefilled countryside, but also grow natural, healthy food in place of the processed junk which is making us sick and obese.

Aidan Harrison Morpeth, Northumberland, UK

**Load-Date:** April 11, 2021

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[***Manulife sets out net zero road map***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:62M7-K2J1-DXSP-90M7-00000-00&context=1516831)

Institutional Asset Manager

May 7, 2021 Friday 09:38 AM GMT

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**Length:** 1047 words

**Byline:** Clara Dijkstra

**Body**

Manulife sets out net zero road map Submitted 07/05/2021 - 9:38am

Manulife has announced a net zero ***emissions*** commitment to support climate goals worldwide, recognising the important role 37,000 employees, 118,000 agents, and over a trillion dollars in assets under management and administration can play in global climate solutions.

€œThrough the commitments we've set out today, we are accelerating work to reduce our own ***emissions*** and build a portfolio of climate-smart investments,€ says Roy Gori, President and CEO, Manulife. €œIn making clear commitments on climate, we are setting a robust plan for our operations and our own investments. We are actively developing innovative products and services designed to contribute towards the urgent, global fight against climate change.€

Manulife is also taking another important step to underscore its commitment to build a greener, better future for all. Members of the executive leadership team currently have performance goals linked to diversity, equity, and inclusion, employee engagement, and leadership accountability. Beginning this year, goals linked to Manulife's climate action plan will also be included.

Rooted in its mission€”Decisions Made Easier. Lives Made Better.€”Manulife's journey to net zero focuses on three areas: Operations: Substantially reducing ***emissions*** to lessen our footprintInvestments: Actively investing for a sustainable futureProducts and Services:  Developing innovative solutions that contribute to climate change mitigation and resilience.

Manulife is net zero in its operations, due to the carbon ***removals*** from its substantial owned and operated ***forests*** and farmland outweighing its company-wide operational ***emissions***. Manulife is committing to reduce absolute scope 1 and 2 ***emissions*** 35 per cent by 2035. The Company will take steps such as enhanced efficiency measures, fuel switching, and use of onsite renewables in our buildings to achieve this ***target***.

Manulife is now committing to steer its own investment portfolio to net zero by 2050, acknowledging the important role continued progress on financed ***emissions*** will have on its enterprise-wide climate impact. To establish a strategy for Manulife's financed ***emissions*** net zero ambition, the Company is taking a sector-based approach, focusing first on the heavy emitting industries, such as power generation, to establish near term ***emissions*** reduction ***targets***.

€œOur approach is centred on two core principles. First, that there is an immediate need to take action on climate change today; and second, that our actions result in real change versus create the perception of change,€ says Sarah Chapman, Global Chief Sustainability Officer, Manulife. €œAccelerated decarbonisation of Manulife's portfolio is a top priority for achieving our 2050 ambition.€

To ensure these ***targets*** have a meaningful impact, Manulife has committed to the Science Based ***Targets*** initiative to guide the Company's ***target*** setting, measurement, and progress reporting. Manulife will also continue to grow its significant $39.8 billion portfolio of green investments, such as renewable energy and energy-efficient real estate. This balanced approach will ensure its investments will be meaningful in contributing to global efforts to limit global temperatures.

Recognising the benefits of a transition to a net zero world and a healthier planet, Manulife will continue to develop and tailor our products and services to empower customers to make their own sustainable choices and build resilience in the face of climate change. Through the expertise of its global asset management business, Manulife Investment Management will also continue to scale the integration of ESG through products and services offered to customers. As a strong steward, Manulife Investment Management is focused on the long term, prioritising sustainability, and expanding the view of what matters beyond financial value.

As part of this commitment to stewardship, Manulife Investment Management will continue to give clients sustainable investing options, such as the Manulife Investment Management Sustainable Asia Bond strategy and Global Climate strategy.

Additionally, as one of the world's largest timber and ***agriculture*** investment managers, Manulife Investment Management believes sustainably managed ***forests*** and farms are a critical part of the climate solution, with immense benefits for health and wealth. The Company will continue its focus on providing nature-based solutions to mitigate climate change. It will accelerate development of products that amplify the benefits of ***forests*** and farms, developing products for investors interested in nature-based solutions that capture even more carbon per dollar invested.

As a global life and health insurer, Manulife is exploring the connections between the planet's health and human health, to understand the impact climate change may have on its policyholders. Joining many of its global peers, the Company has been an active contributor in the Geneva Association Task Force to develop and hone climate risk assessment methodologies and tools for the insurance industry. Internal product and insurance risk management teams have been conducting extensive research and analysis of the impacts of climate change, such as on vector-borne diseases, extreme weather events, and increased temperatures, on morbidity and mortality, to inform decisions related to our life insurance underwriting assumptions. As it learns more, Manulife will continue to design and tailor products around the health and resilience of its customers.

Manulife is collaborating with industry peers and climate-related multi-stakeholder initiatives in order to progress on its journey to net zero. Building on existing engagements with Climate Action 100-plus as one of their founding members, the Office of the Superintendent of Financial Institutions (OSFI), the Bank of Canada climate scenario project, and others, Manulife will continue to collaborate with industry leaders to develop methodologies and approaches to accounting for and transitioning to net zero investment portfolios and products.

  Like this article? Tags

**Load-Date:** May 7, 2021

**End of Document**



[***Nestlé sets carbon target for KitKat: ‘We are reducing and removing emissions to reach carbon neutrality by 2025’***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:62GV-M5D1-JC6M-X2T3-00000-00&context=1516831)

FoodNavigator.com

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**Section:** BUSINESS

**Length:** 677 words

**Byline:** Flora Southey, , [*Flora*](mailto:Flora)

**Body**

Over the next four years, Nestlé will be working within and outside of its value chain to reduce and ***remove*** ***emissions*** related to its KitKat brand. The goal, a company spokesperson explained, is carbon neutrality.

Nestlé-owned KitKat has pledged to become carbon neutral by 2025. To do this, the brand will be reducing ***emissions*** internally and ***removing*** ***emissions*** externally.

“We’re setting up new products to reduce ***emissions*** without our value chain (insetting), building on existing work like planting shade trees,” ​a Nestlé spokesperson told FoodNavigator.

“At the same time, we’re investing in external projects to ***remove*** ***emissions*** (offsetting). This will involve both new and exciting projects, all the while using the best external benchmarks like [carbon offset standard] Gold Standard to ensure genuine compensation.” ​

KitKat is measuring its current footprint data via a partnership with climate change and sustainability consultancy the Carbon Trust. The process, which includes measuring Scope 1, 2 and 3 ***emissions***, will be completed later this year.

Spotlight on cocoa and milk ​

The dairy industry is responsible for a significant amount of greenhouse gas (GHG) ***emissions***, largely due the production of livestock feed and methane production.

Cocoa’s carbon footprint is also far from negligible. According to Dave Reay’s 2019 publication Climate-Smart Food​, an average 40g bar of milk chocolate carries a carbon footprint of around 200g. This rises nearer to 300g for a bar of dark chocolate, due to the extra cocoa it contains.

It is unsurprising, therefore, that most of KitKat’s ***emissions*** occur when producing its ingredients, like cocoa and milk.

The brand aims to reduce these ***emissions*** ‘as much as possible’ through initiatives like restoring ***forests*** and supporting a transition to regenerative ***agriculture***. One such initiative will see Nestlé help farmers plant five million shade trees where it sources its cocoa by 2025.

Manufacturing and distribution​

KitKat will also look further down its supply chain to include manufacturing and distribution in its aim of reducing ***emissions*** generated by more than 50%.

Accelerating the transition to renewable electricity is one area in which Nestlé is working to reduce KitKat’s environmental footprint. At its factories, the company has already reduced the energy required to produce KitKat by more than 40% per tonne of product since 2000.

Renewable electricity is being used at some KitKat manufacturing sites, and Nestlé said it will continue to find new ways to ‘end dependency on fossil fuels’ and ultimately, use 100% renewable energy for all KitKat factories before the end of 2025.

For any ***emissions*** that cannot be eliminated, Nestlé will invest in offsetting based on ‘natural’ climate solutions.

Will we see carbon labels on-pack?​

The Carbon Trust has teamed up with other food companies, such as meat alternative brand Quorn, to provide carbon footprint data. In Quorn’s case, the brand is using the data to introduce carbon labelling on-pack for some of its product.

Should we expect to see similar carbon labels on KitKats? “We can’t confirm how we will communicate the CO₂e numbers for KitKat just yet,” ​the spokesperson told this publication, “we will agree on this as part of the verification process with the Carbon Trust.”​

Concerning KitKat’s communication about its progress towards climate neutrality, the spokesperson said Nestlé will update on its progress over the next four years by providing tangible examples of its work. “We will do this across a variety of owned brand assets.” ​

KitKat is not the first Nestlé brand to commit to carbon neutrality. Garden Gourmet and Nespresso have pledged to achieve this goal by 2022. Nestlé will make its global water category carbon neutral by 2025, prioritising international brands Perrier, S.Pellegrino, Acqua Panna and Vittel to achieve carbon neutrality by 2022.

The company told us it expects more brands to follow suit, which aligns with Nestlé’s commitment to reaching net zero ***emissions*** by ‘no later than 2050’, throughout its value chain.

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**Load-Date:** April 21, 2021

**End of Document**



[***Congressman Panetta, Colleagues Introduce Bipartisan, Bicameral Legislation to Plant 1.2 Billion Trees on National Forests***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:627R-F6B1-JDG9-Y147-00000-00&context=1516831)

Impact News Service

March 18, 2021 Thursday

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**Length:** 1391 words

**Body**

Washington: Office of the MP Jimmy Panetta has issued the following news release:

Today, Congressman Jimmy Panetta (D-Carmel Valley) along with Congressman Mike Simpson (R-ID-02) and Senators Debbie Stabenow (D-Mich.), Chairwoman of the U.S Senate Committee on ***Agriculture***, Nutrition, and Forestry, and Rob Portman (R-Ohio) introduced the bipartisan Repairing Existing Public ***Land*** by Adding Necessary Trees Act, known as the REPLANT Act, to help the U.S ***Forest*** Service plant 1.2 billion trees on national ***forests*** and create nearly 49,000 jobs over the next ten years.

“After last year’s deadly and destructive wildfires, we were left with ***forests*** that were burnt and barren and an overwhelming backlog of federal reforestation projects,” said Congressman Panetta. “The REPLANT Act would mandate federal funding for the Reforestation Trust Fund so that we can decrease that backlog by significantly increasing the resources needed to plant more trees in burn scarred areas. That type of reforestation is needed to protect our communities from post wild-fire mudslides, sequester some of our carbon ***emissions***, provide critical wildlife habitats, improve downstream drinking water quality, and restore our nation’s precious public ***lands*** for generations to come. ”

“In Idaho, we are blessed with an abundance of ***forests***,” said Congressman Simpson. “However with ***forests*** comes wildfires, and from wildfires you lose precious natural resources such as trees. Through the Reforestation Trust Fund we can replant these trees in our national ***forests***, without using taxpayer funds. This will benefit our environment through carbon sequestration, our economy through job creation in rural communities, and recreation all across the country. This bill has broad bipartisan and bicameral support and from a diverse group of stakeholders who are on the ground replanting our national ***forests***. ”

“Restoring our national ***forests*** will not only support our hunting, fishing, and outdoor recreation economies, it’s also part of the solution to the climate crisis,” said Senator Stabenow. “Planting trees is a cost-effective way to draw carbon out of the air, restore our public ***lands***, and create jobs. ”

“I am pleased to join my colleagues in the Senate and House in introducing this bipartisan, bicameral legislation to address the reforestation needs within our national ***forests***. This legislation provides a wide range of benefits, including improving our environment by sequestering carbon dioxide, reinvigorating ecosystems, and supporting wildlife that depend on healthy ***forests***, while also creating nearly 49,000 jobs and expanding recreation opportunities on national forestland. I urge my colleagues to join us in supporting this common sense, bipartisan legislation to address the replanting needs across our nation’s ***forests***,” said Senator Portman.

From destructive wildfires to invasive pests and disease, national ***forests*** across the country are in desperate need of reforestation efforts. The demand for reforestation has vastly outpaced the current funding available, which has contributed to a backlog of nearly 2 million acres in need of restoration. Each year, only 15 percent of the national ***forest*** tree planting backlog is addressed.

The REPLANT Act quadruples investments to support reforestation projects on national ***forests***. The bill ***removes*** the current funding cap of $30 million per year in the Reforestation Trust Fund, making an average of $123 million annually available for reforestation in national ***forests***. The bill only uses funds that are already being collected through tariffs on foreign wood products – it does not change the list of products, increase the tariffs, or use taxpayer funds.

The bill also directs the ***Forest*** Service to develop a 10-year plan and cost estimate to address the backlog of replanting needs on national ***forest*** ***land*** by 2031. It also prioritizes ***land*** in need of reforestation due to natural disasters that are unlikely to naturally regrow on their own.

The REPLANT Act will help reforest 4.1 million acres by planting 1.2 billion trees over the next 10 years. Planting these trees will help address the climate crisis by sequestering 758 million metric tons of carbon over their lifetimes, which is equivalent to avoiding the use of 85.3 billion gallons of gasoline. Reforestation also improves soil health and protects wildlife habitats for hunting and fishing. It also strengthens our economy by creating jobs. A report completed by American ***Forests*** found that the REPLANT Act would create nearly 49,000 jobs over the next 10 years.

In addition to Sen. Stabenow, Sen. Portman, Rep. Panetta, and Rep. Simpson, the bill is cosponsored by Sen. Jeanne Shaheen, Sen. Shelley Moore Capito, Sen. Michael Bennet, Sen. Roger Marshall, Sen. Martin Heinrich, Rep. Kim Schrier, Rep. Doug LaMalfa, Rep. Abigail Spanberger, Rep. Brian Fitzpatrick, Rep. Salud Carbajal, Rep. Paul Tonko, Rep. Mark Takano, and Rep. Debbie Dingell.

This legislation is supported by: American ***Forests***, Trust for Public ***Land***, BPC Action, The ***Forest*** Stewards Guild, National Audubon Society, The Nature Conservancy, National Wildlife Federation, Outdoor Recreation Roundtable, The Longleaf Alliance, Evangelical Environmental Network, Green ***Forests*** Work, Lyme Timber, REI, Salesforce, the Congressional Sportsmen’s Foundation and many others.

“Reforestation of our Nation’s national ***forest*** ***lands*** is a major mechanism to deliver increased carbon capture in U.S For far too long we have not be able to adequately support these efforts yet our national ***forests*** protect watersheds, provide critical wildlife habitat, and provide recreation opportunities for millions. They also are key economic drivers for rural communities across our country,” said Peter Stein, Managing Director, Lyme Timber Company. “Our ***forests*** are under increasing threats of devastating wildfires that are burning hotter, over a wider area, and occurring more often. The REPLANT legislation provides critical funding at the right scale to reforest damaged national ***forest*** ***land*** that is not able to regrow on its own. This is critical legislation for rural communities and we thank the bipartisan Members for their leadership on this important issue. ”

“Americans need their National ***Forests*** more than ever. Our ***forests*** create jobs, provide clean water, and combat climate change by sequestering millions of tons of carbon. Yet, millions of acres are being ravaged by climate-change induced wildfires, droughts, pests. With an antiquated cap on the Reforestation Trust Fund, the ***Forest*** Service is falling behind in restoring our ***forests*** and only addressing a fraction of our tree planting needs,” said Jad Daley, President and CEO of American ***Forests***. “The REPLANT Act will turn that around and give the ***forest*** service access to the funds necessary to catch up and keep up with growing reforestation need. Over the next decade, this bill will allow the ***Forest*** Service to plant 1.2 billion trees, reforest more than 4 million acres, and create nearly 49,000 green jobs. ”

“REI Co-op proudly supports the REPLANT Act to increase reforestation efforts on our public ***lands***. This commonsense, bipartisan legislation will not only increase carbon sequestration in our national ***forests***, but will enhance recreation opportunities, create jobs and revitalize local economies across the country. We look forward to supporting the passage of this critical legislation that harnesses the power of our national ***forests***,” said Taldi Harrison, REI Co-op Government Affairs.

'After a year in which the U.S lost millions of acres of ***forest*** to wildfire, the REPLANT Act would put trees in the ground in our national ***forests*** to help fight climate change while also creating jobs. This bipartisan legislation is needed urgently, and Salesforce is proud to support it,' said Joel Elliott, Director of Federal Affairs at Salesforce.

“By ***removing*** the $30 million cap on the Reforestation Trust Fund, the REPLANT Act will provide much needed financial resources to better manage our nation’s ***forests*** to enhance habitat for fish and wildlife while providing quality access opportunities for America’s sportsmen and women. This bipartisan legislation is widely supported by the sporting-conservation community, and we are excited to see it reintroduced,” said Congressional Sportsmen’s Foundation President Jeff Crane.

**Load-Date:** March 19, 2021

**End of Document**



[***Forestry - all eyes on the future***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:611N-S0S1-F0JC-M3S4-00000-00&context=1516831)

The Scottish Farmer

October 2020

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**Length:** 1056 words

**Byline:** [*Gordon Davidson*](http://Gordon Davidson)

**Body**

FORESTRY AND wood is a thriving £1 billion industry in Scotland in 2020 - but trees take a long time to grow and the eyes of a ***forester*** are always on the future.

Edinburgh-based trade body Confor represents 1500 businesses across the UK and has a global perspective on the benefits of tree planting, ***forest*** management and wood use. Here, Confor's chief executive Stuart Goodall, explains why #TheFutureIsForestry in five key dates.

2021

COP26 summit - putting Scotland on the global map

The environmental super-summit COP26 was due to take place in Glasgow next month (November), and offered amazing opportunities to put Scotland's significant climate change ambitions on the international map.

Covid-19 has pushed the event back into late 2021, with the summit now likely to be on a smaller scale than initially planned. However, it's vital Scotland does not also scale back its ambition to tackle the climate emergency. So far it has been a global leader, with the Climate Change (Scotland) Act 2009 setting world-leading standards and The Climate Change (***Emissions*** Reduction ***Targets***) (Scotland) Act 2019, putting Scotland's path to net zero ahead of the rest of the UK (see below).

Scotland has also been ahead of the game in realising there are limits to taking actions to reduce ***emissions***, and understanding the need to pursue policies which ***remove*** atmospheric carbon - including tree planting.

2024/25

Meeting Scotland's tree planting ***targets***

Scotland plants more than 80% of new UK woodland every year. It exceeded its 2018-19 tree planting ***target*** of 10,000 hectares of new woodland per year, planting 11,200 hectares - around half of that was planted areas of 50 hectares or less, including many Scottish farms. In 2019-20, just under 11,000 hectares were planted in Scotland, but the ***target*** of 12,000 hectares in 2020-21 looks likely to be met thanks to a strong pipeline of applications.

One farmer who benefited was Tom Pate, who manages Middleton Farm near Kirriemuir, Angus. Felling existing trees and selling them commanded a higher price than expected and he was able to link up different patches of woodland when he re-planted. This created more commercially viable blocks of woodland, with other parcels replanted to retain the aesthetic value of the farm. In addition, 130 hectares of new woodland were created on poorer-quality grazing ***land***, with grants available to pay for planting and fencing.

Mr Pate described forestry as 'historically a headache but now the catalyst to rejuvenate the farm'. One spin-off benefit was using space between fenced-off areas of trees to create a herd of 200 deer for venison, in addition to retaining sheep grazing.

In September, the Scottish Government increased its annual new planting ***target*** for 2024-25 from 15,000 to 18,000 hectares.

2030s/40s

Plugging the timber gap

Scotland is heading for a 'timber gap', as a result of the drop-off in tree planting in the 1990s and early 2000s. Despite increased planting in recent years, a shortfall of wood is forecast in the late 2030s and 2040s. Short rotation forestry (SRF), with trees planted and harvested in 8-20, rather than 30+ years, is one potential solution being examined to help plug the gap.

Unlike 'conventional' forestry, SRF need not be a permanent ***land***-use. Added to its shorter rotation length, this means it could be attractive to farmers, including tenant farmers, as a means to develop additional income streams and contribute to decarbonising ***agriculture*** - at a time when farmers want guaranteed post-CAP funding and are under pressure to reduce ***emissions***.

The wood produced from SRF is not strong enough for construction, but can support a range of uses, including board factories (making products used for flooring and household units), firewood, wood chips and pellets, and potentially as a replacement for chemicals, textiles and many other products.

2045

Net zero

Scotland is more ambitious than the UK in its efforts to reduce carbon ***emissions***, with a ***target*** of 2045 against the UK's 2050 for 'net zero' - the date by which total greenhouse gas ***emissions*** would be equal to or less than ***emissions*** removed from the environment. With ***emissions*** reductions from existing industry only able to deliver finite benefits, the focus is on ***removing*** atmospheric carbon, with forestry a vital contributor. Scotland has always linked planting ***targets*** clearly to climate change ambitions and understands the multiple benefits of modern forestry. In many industries, increased economic activity has a negative environmental impact. The forestry and wood industry can deliver economic, environmental (and social) benefits simultaneously - because growing trees soak up carbon from the atmosphere, and carbon can then be stored in wood products.

2050

Global timber demand quadruples

The World Bank has estimated global demand for wood could quadruple by 2050. At the moment, the UK is the world's second largest net importer of wood after China - with 80% of the wood used for UK domestic consumption imported. This is a stark figure and can put pressure on fragile ***forests*** overseas and encourage illegal logging. An investigation by environmental charity Earthsight found up to 40% of wood sold to the European Union from Ukraine was illegally cut. Confor is urging the Scottish and UK governments to 'Think Global, Plant Local' and take more long-term responsibility for producing the timber we use. It welcomes the increased the ***target*** for the use of Scottish wood in construction from 2.2 million cubic meters (2018) to 2.6 million cubic meters in 2021/2022.

Confor is involved in Wood CO2ts less, a campaign to highlight the benefits of using more wood in place of more CO2-intensive materials like concrete and steel. A European analysis of the impact of using wood instead of concrete suggested an average reduction of 2.1 tons of CO2 ***emissions*** per 1 ton of wood products used, while an average timber frame home locks up 5 tonnes of carbon, about three years of an average person's carbon footprint.

Are you interested in tree planting?

Search for the Forestry Grant Scheme, administered by Scottish Forestry and the Scottish Government, a one-stop shop for all forestry-related grant support:

[*https://www.ruralpayments.org/topics/all-schemes/forestry-grant-scheme/woodland-creation/*](https://www.ruralpayments.org/topics/all-schemes/forestry-grant-scheme/woodland-creation/)

or contact Confor for advice - 0131 240 1410 or [*www.confor.org.uk*](http://www.confor.org.uk)

**Load-Date:** October 10, 2020

**End of Document**



[***5 facts you might not know about why forest biodiversity matters***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:624K-W9R1-F0YC-N0NH-00000-00&context=1516831)

Impact News Service

March 4, 2021 Thursday

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**Length:** 908 words

**Body**

Cologny: World Economic Forum has issued the following press release:

March 3 is World Wildlife Day and this year’s theme is ***Forests*** and Livelihoods: Sustaining People and Planet. Up to 350 million people living in or near ***forests*** rely on their ecosystem services for their most basic needs. Almost half of all cancer drugs are based on a naturally-derived ingredient. A UK-sized area of ***forest*** was lost every year from 2014 to 2018.

The Earth’s ***forests*** are some of the richest and most biodiverse habitats we have.

Not only do they serve as important carbon sinks, but up to 350 million people living in or near them rely on their ecosystems for a range of basic needs, from food and shelter, to energy and medicine.

March 3 is World Wildlife Day and this year's theme is ***Forests*** and Livelihoods: Sustaining People and Planet. The theme is focused on ***forest*** biodiversity - a ***forest***'s many life forms and ecological roles. The observance this year is a reminder of the critical impact ***forests*** have in our lives.Have you read?

Scientists say this 'super plant' could help soak up pollution on busy roads The world has lost one-third of its ***forests***, but an end to deforestation is possible This root vegetable could help alleviate hunger and end soil erosion. Here’s how

With that in mind, here are five facts about the roles ***forests*** play in sustaining the health of people and the planet.

1. Primary ***forest*** is still disappearing

Globally, a UK-sized area of tropical ***forest*** was lost every year between 2014 and 2018, on average, according to a report from the New York Declaration on ***Forests*** (NYDF). And data from Global ***Forest*** Watch suggests that we lost a football pitch of primary rainforest every 6 seconds in 2019. The same data showed that primary ***forest*** loss was 2.8% higher in 2019 than in 2018, and has remained high for the last two decades.Tropical primary ***forest*** loss, 2002-2019Major losses.Image: World Resources Institute

2. Soil is key to healthy ***forests*** - and a healthy planet

Just one teaspoon of healthy soil is home to more living organisms than there are people on the planet. These microscopic organisms are the building blocks that enable the vast trees and everything else within ***forest*** ecosystems to thrive. Without healthy soil, life would struggle. There is also more carbon in ***forest*** soils in Great Britain than in the trees themselves, so if we look after the soil, the soil will help to look after the ***forests***. In this way, ***forests*** can be an important tool in reducing atmospheric carbon and a route to mitigating climate change.How does the World Economic Forum encourage biological diversity?How does the World Economic Forum encourage biological diversity?

In the last 100 years, more than 90 percent of crop varieties have disappeared from farmers’ fields, and all of the world’s 17 main fishing grounds are now being fished at or above their sustainable limits.

These trends have reduced diversity in our diets, which is directly linked to diseases or health risk factors, such as diabetes, obesity and malnutrition.

One initiative which is bringing a renewed focus on biological diversity is the Tropical ***Forest*** Alliance.

This global public-private partnership is working on ***removing*** deforestation from four global commodity supply chains – palm oil, beef, soy, and pulp and paper.

The Alliance includes businesses, governments, civil society, indigenous people and communities, and international organizations.

Enquire to become a member or partner of the Forum and help stop deforestation linked to supply chains.

3. The green desert effect and ***forest*** complexity

***Forest*** ecosystems are diverse and complex – simply planting trees won’t automatically create healthy ***forest*** biomes. In fact, new ***forests*** can become green deserts, with low levels of biodiversity, according to a 2010 study by two US academics. Those experts found that planting trees on degraded ***lands*** is likely to have a greater positive effect on biodiversity, especially if indigenous tree species are used. In existing ***forests***, grasslands, and shrublands, such benefits are likely to be less pronounced.

4. Growing ***emissions*** problems

Global annual tropical tree losses between 2014 and 2018 have been responsible for 4.7 gigatons CO2 ***emissions*** per year, according to the NYDF report. That equates to more than all the CO2 ***emissions*** from the European Union’s member states in 2017.

But it’s not just tropical ***forest*** that should capture our attention. Mangroves and peatlands are also being lost as ***land*** is given over to farming. Together with ***agriculture***’s effects on tropical ***forest*** areas, this destruction is contributing around 13% of total human CO2 ***emissions*** and is exacerbating the effects of climate change, according to the World Economic Forum’s Nature Risk Rising: Why the Crisis Engulfing Nature Matters for Business and the Economy report.

5. Nature’s medicine cabinet

There are currently 107 Amazonian species endangered by the ongoing loss of biodiversity. That includes several that are important to the pharmaceutical industry, such as the cinchona tree, the source of the malaria drug quinine. At the heart of a substantial number of key advances in drug therapies lies a continued reliance on the natural world. This can be seen in the field of cancer treatment in particular, where 75% of approved anti-tumour pharmaceuticals are non-synthetic. More precisely, almost half (48.6%) are either natural products or were directly derived from natural sources.

**Load-Date:** March 4, 2021

**End of Document**



[***-Cornell University: Green practices can negate climate emissions on NY farms***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:60KG-8TN1-F0K1-N0N9-00000-00&context=1516831)

ENP Newswire

August 14, 2020 Friday

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**Length:** 792 words

**Body**

New York ***agriculture*** has the capacity to mitigate its own greenhouse gas (GHG) ***emissions***, two Cornell researchers say in a state-funded report commissioned by the New York State Department of ***Agriculture*** and Markets.

The 65-page report, New York ***Agriculture*** and Climate Change: Key Opportunities for Mitigation, Resilience, and Adaptation, provides a scientific assessment of opportunities and barriers supporting climate adaptation and mitigation practices on New York's farms.

Cornell impacting New York State

It comes on the heels of the Climate Leadership and Community Protection Act, which Gov. Andrew Cuomo signed into law last year. The law mandates that all sectors of society mitigate 40% of GHG ***emissions*** by 2030, and 85% by 2050.

'This report provides a pathway for farmers, policymakers and citizens to increase productivity and the greenhouse gas mitigation of the ***land*** while also attempting to ensure a less variable climate for future farmers,' said Jenifer Wightman, a research associate in the Soil and Crop Sciences Section of the School of Integrative Plant Science, in the College of ***Agriculture*** and Life Sciences, and the report's first author.

'In an industrialized state like New York, we need every sector to step up and make a contribution to mitigating climate change,' said co-author Peter Woodbury, senior research associate in the Soil and Crop Sciences Section. 'There's the opportunity to do that with ***agriculture*** and forestry while also getting other benefits' such as improved profitability and cleaner air and water, he said.

Though people mostly focus on carbon ***emissions***, the authors said it's important to account for three greenhouse gases produced on farms: carbon dioxide, methane and nitrous oxide.

'It's not commonly known, but methane and nitrous oxide account for 75% of ***agricultural*** ***emissions***,' Wightman said, noting that methane is 84 times more potent than carbon dioxide as a GHG, and nitrous oxide is 264 times more potent, making them important mitigation ***targets***.

The report identified practices that ***remove*** GHGs more permanently from the atmosphere, as opposed to temporary fixes. Planting trees, the researchers wrote, can sequester carbon for hundreds of years if harvested for building materials that store carbon for the life of the structure.

'Because climate change is a 100-, 300-, 1,000-year project,' Wightman said, 'we want to make sure that we're supporting projects that lead to permanent greenhouse gas ***emission*** reductions and aren't just temporary.'

The report includes a table that ranks 13 mitigation opportunities based on the scale at which they could be implemented, and whether they met important criteria. These standards were summed up by the acronym SMART - for 'services' or co-benefits of an action; whether a strategy is 'measurable,' 'achievable' and 'realistic' to implement; and whether the action provides a more permanent mitigation 'time' frame.

The top five SMART mitigation actions were:

Manure storage cover and flare: Storage units improve water quality by reducing manure spreading in winter months, but they create methane. By adding a cover to collect the methane and adding a flare, the methane can be destroyed. These systems last up to 20 years, cost $ 300,000 and ***remove*** large amounts of methane making it an inexpensive GHG mitigation for society, though it is a high cost per individual farm;

Nitrogen management: Nitrogen inputs help plants grow, but ineffective use results in nitrous oxide ***emissions***. Improving nitrogen use saves money, can increase yields and reduce ammonia and nitrous oxide ***emissions***;

Livestock feed management: Increasing feed efficiency can reduce cow methane ***emissions***, decrease feed costs while increasing milk produced and decrease manure, all of which lessens GHG ***emissions***;

Woodland management: More than 21% (approximately 1.4 million acres) of farmlands are wooded. By protecting, maintaining and managing woodlands, farms can conserve and enhance this important New York state carbon sink while generating valuable hard wood timber to support retirement or a child's college education; and

Activation of underutilized ***lands***: About 1.7 million acres of underutilized or former farm ***land*** in New York state could be used for bioenergy production, solar arrays and/or growing new ***forests*** - all of which offer diverse mechanisms of GHG mitigation and rural economic development.

Wightman and Woodbury have also authored a companion report, 'Sources and Sinks of Major Greenhouse Gases associated with New York State's Natural and Working ***Lands***: ***Forests***, Farms, and Wetlands' (2020), commissioned by the New York State Energy Research and Development Authority.

[Editorial queries for this story should be sent to [*newswire@enpublishing.co.uk*](mailto:newswire@enpublishing.co.uk) ]

**Load-Date:** August 14, 2020

**End of Document**



[***The battle for a greener economy***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:62GS-C511-JCBW-N3T4-00000-00&context=1516831)

Belfast Telegraph

April 21, 2021 Wednesday

Edition 1, National Edition

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**Section:** SUSTAINABILITY;NEWS; Pg. 2

**Length:** 827 words

**Body**

Sustainability, in essence, is about trying not to deplete the earth's natural resources in order to maintain an ecological balance. Everyone from the individual to big business can take steps to preserve the environment and safeguard priceless natural resources for future generations.

One of the key battlefronts is greenhouse gas ***emissions*** (carbon dioxide, nitrous oxide and methane) which contribute to global warming. The Intergovernmental Panel on Climate Change (IPCC) predicts we will see more extreme weather events across the world from floods to droughts to the recent wildfires in Australia and California unless action is taken.

The growing impetus for change among all sectors, from governments down, means everyone has a role in the drive to reduce greenhouse gases (GHG). Belfast's new Glider and hydrogen fuel cell buses are the route to the future - in fact you will not be able to buy a new petrol or diesel car by 2030. The UK's commitment to keeping global warming under 2 degrees, which it signed up to in the 2016 Paris Agreement, has the government aiming for net zero on all greenhouse gases by 2050 - that means not creating more GHGs than it can ***remove***. Just this week the UK Government announced it would aim to cut carbon dioxide by 78% by 2035 compared with 1990 levels, an increase from the current ***target*** of a 68% reduction by 2030.

The other side of the coin from cutting ***emissions*** is ***removing*** CO2 from the atmosphere. It can be absorbed by natural 'sinks' - primarily oceans, ***forests***, plants and soil - and technology is catching up. The UK government says it will invest £800m in greenhouse gas ***removal*** technologies, especially carbon capture and storage (CCS) sites, which it's reckoned can capture 90% of industrial ***emissions*** from fossil fuels.

THE HOME FRONT As far as local efforts go, Business in the Commu- nity is championing a Climate Action Pledge, inviting firms to commit to cut their GHG ***emissions*** by 50% or 30% by 2030.

March saw the NI Assembly introduce its first Climate Change Bill, drafted by Climate Coalition NI, with support from most of the parties. Its aims include a binding ***target*** of net zero carbon ***emissions*** by 2045 and establishing a Northern Ireland Climate Commissioner and Northern Ireland Climate Offices.

According to an Assembly briefing paper, Northern Ireland and Net Zero, ***emissions*** have fallen since the base year, 1990, especially in the energy supply, waste management and residential sectors, driven by improvements in energy efficiency, switching from coal to natural gas, and the introduction of methane capture and oxidation systems in landfill management. However, there were increases in transport and ***agriculture***.

The Strategic Energy Framework for 2010 and 2020 has surpassed its 40% ***target*** for electricity consumption from renewable energy at 47.7%, however, it has fallen short of its ***target*** of 10% heat consumption from renewable generation. A new Energy Strategy, possibly up to 2050, is imminent.

With 27% of all GHG ***emissions*** in Northern Ireland from our livestock-based ***agriculture***, compared to 10% in the rest of the UK, there is pressure on the farming sector to adopt low carbon practices. Afforestation, agroforestry and peatland restoration all have a crucial role to play, according to the UK Climate Change Committee (CCC). WAYS FORWARD Some measures identified by the CCC for Northern Ireland, noted in the briefing, include: ›› Developing a route to market for low-cost intermittent renewables, in particular onshore wind; ›› Replacing the farm CAP payments with those linked to ***agricultural*** ***emissions*** reductions and sequestration; ››Increasing tree planting; ›› Incentivising homeowners to install low-carbon heaters and replace oil boilers with heat pumps; ››Developing policy for delivering energy efficient improvements in homes ***targeted*** at low income households; and ›› Assisting in more rapid deployment of electric vehicles.

As for the power sector, Northern Ireland is a member of the all-island Integrated Single Electricity Market (I-SEM). The CCC states that energy policy must enable an efficient, low carbon interconnected energy market to operate on both sides of the border.

Michael Scott, managing director of firmus energy, told Ulster Business recently of its three phase plan for a greener economy, beginning with seeing more households switch to natural gas.

"Phase two will see the facilitation of Biomethane being injected into the existing gas network along with the introduction of compressed natural gas for commercial vehicles," he said. "Phase three will be about facilitating the injection of a blend of hydrogen into the existing network before moving towards a full hydrogen economy and net-zero carbon ***emissions*** for

Northern Ireland."

There is hope with countries like Bhutan showing the possibilities. It has over 70% tree cover and uses only hydro-power, so absorbs more CO2 than it emits, giving it the enviable label of being carbon negative.

**Graphic**

Electric cars will be the norm by 2030

**Load-Date:** April 21, 2021

**End of Document**



[***Grant Opens Door to Find Ways to Improve Our Land, Water and Economy***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:612P-18B1-F0YC-N21P-00000-00&context=1516831)

Impact News Service

October 14, 2020 Wednesday

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**Length:** 567 words

**Body**

Arlington, Virginia: The Nature Conservancy has issued the following press release:

Actions that create healthy soil for ***agriculture***, clean air to breathe and that prevent severe wildfires that send dangerous smoke into the atmosphere are universal and immediate goals. Yet climate change looms large, threatening our health and economy. Thanks to a United States Climate Alliance grant, new doors will open to meet ambitious greenhouse gas (GHG) reduction goals in New Mexico and Colorado.

The Nature Conservancy (TNC) in New Mexico and Colorado, along with New Mexico’s Department of ***Agriculture*** (NMDA) and Energy, Minerals & Natural Resources Department, are collaborating on a project that will improve working ***lands*** – ranches, farms and productive ***forests*** – for generations to come.

“We have a long way to go and not very much time,” said New Mexico Gov. Michelle Lujan Grisham. “Our planet, and our state’s priceless natural resources, require diligent and science-driven action. With aggressive clean energy goals, we’re on our way. And when the stakes are this high, every step in the right direction is meaningful.”

How will the partners accomplish this? First, we need science. Using publicly available data, remote sensing, and advanced climate modelling, TNC will generate estimates of carbon reductions through ***agricultural*** practices, ***forest*** management and avoided ***land*** conversion. Then, a broad group of stakeholders will develop and vet scenarios.

“By quantifying the potential to reduce greenhouse gas ***emissions***, we can develop and promote practices and policy that will create a cleaner and stronger economy,” added Nina Carranco, TNC’s director of external affairs in New Mexico. “Natural climate solutions will play a key role as they draw on the power of nature to ***remove*** carbon dioxide from the atmosphere and store it in healthy soils and ***forests***.”

“This grant aligns with our Healthy Soil Program, which supports improved watersheds, reduced soil erosion, and increased climate resilience,” says Jeff Witte, New Mexico’s secretary of ***agriculture***. “The grant also provides an opportunity for us to work together with our Colorado neighbors to determine what we can all do to reduce greenhouse gas ***emissions***. Whether it’s working with another state, or our continued participation on the Natural and Working ***Lands*** Climate Action Team, partnerships are important to NMDA’s mission of working cooperatively with both public and private sectors.”

“New Mexico has ambitious plans to cut greenhouse gas ***emissions*** in multiple sectors and reliable data is the basis for all our work,” said Energy, Minerals and Natural Resources Department Cabinet Secretary Sarah Cottrell Propst. “This partnership between state agencies and non-governmental organizations is necessary to provide the scientific basis for measuring the contributions of natural climate solutions such as voluntary changes in ***agricultural*** practices, avoidance of mega-fires, and ***land*** protections that reduce carbon ***emissions***.”

Both Colorado and New Mexico have adopted bold greenhouse gas reduction goals. In January 2019, New Mexico Governor Michelle Lujan Grisham set a bold energy and climate agenda for the state to reduce greenhouse gas (GHG) ***emissions*** by at least 45% by 2030 compared to 2005 levels In May 2019, Colorado Governor Jared Polis signed the ambitious Climate Action Plan to Reduce Pollution by at least 50% by 2030.

**Load-Date:** October 15, 2020

**End of Document**



[***Pacific Women lead the region in combating deforestation and forest degradation***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:60G2-4W01-JDG9-Y4JY-00000-00&context=1516831)

Impact News Service

July 28, 2020 Tuesday

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**Length:** 1066 words

**Body**

Caledonia: Pacific Community has issued the following press release:

Demand for economic development, demand for logs and timber outside the region and the demand for ***land*** for food security and ***agricultural*** expansion are the main drivers of deforestation and ***forest*** degradation in the Pacific.

To combat these drivers of deforestation, the Pacific Heads of Forestry in 2009 recommended the development of the Reducing ***Emissions*** from Deforestation and ***forest*** Degradation (REDD+) regional policy framework.

After multisectoral consultations with stakeholders the REDD+ programme was endorsed by the Pacific Ministers for ***Agriculture*** and Forestry in 2012, which was supported by its development partners the Pacific Community (SPC) and the German Agency for International Cooperation (GIZ).

This project proved to have numerous benefits to Pacific Island Countries, firstly, because it helped PICs to meet carbon reduction ***targets*** set out by the United Nations Framework Convention on Climate Change (UNFCCC), but more importantly, the REDD+ initiative provided an opportunity to the region to create and export their carbon assets along with timber. Carbon assets refers to the potential of greenhouse gas ***emission*** reductions that a project is able to generate and sell.Accordingly, REDD+ activities in the larger Melanesian countries encompass an opportunity to access a significant source of foreign exchange earnings. Countries that have small areas of ***forest*** cover with high local importance for supporting the well-being of local communities can benefit from REDD+ project approaches for protecting and enhancing these areas (management of watersheds, coastal protection, ﬂood mitigation). These ***forest*** ecosystem services are commonly underestimated in the national accounts of small Pacific Island countries and territories.

What role do women play in combating Pacific’s deforestation reduction efforts?

In the REDD+ project at LRD, women make up 20% of the entire team, however the work, leadership and support for women in this field is increasing.

One inspiring example of women leading forestry projects in the region is Adi Loraini Baleilomaloma-Kasainaseva, a Forestry Technician at ***Land*** Resources Division (LRD) of the Pacific Community (SPC).

Loraini works under LRD’s Pillar 2 that is responsible for stainable ***Forest*** and Landscape Management and currently leads two projects: the REDD+ project and ***Land*** Use Planning of the Ridge to Reef project.

“As a forestry technician, the work that I do is basically community consultations with our project sights and carry out national ***forest*** inventories, I do policy review and strategy review for our countries, especially sustainable ***forest*** management policies and also drafting of guidelines for countries in areas of management for their mangroves or ***forests***,” Loraini explained.

According to Loraini, there were some challenges she encountered when she started working in this field, one of which was not knowing what would working in a forestry sector require.

“There was not much awareness on what forestry was before I joined, because my background is in Geography and ***Land*** Management at University level. So, this job brought me on the side of working with policies and FAO UNREDD Project. Some of the ground work that I did was under the Regional REDD+ Program which required me to do national ***forest*** inventory for Wallis, where I had to design and actually go out in the ***forest*** and do those measurements and tracking through hard terrains to do those work.”

However, Loraini overcame her challenges using one simple trick and that is proper communication and the willingness to learn.

“I think it is really important to communicate with your teams, if there are things that you cannot do or you feel there are things out in the field you are not comfortable doing you will have to let your team know before you actually go. Also, I have a great support system from my senior male colleagues who have showed me the ropes on forestry and ***land*** use planning in the Pacific region.”

“So its basically the passion for your work, if you love to go out to the ***forest*** and dealing with natural resources and the people, then you wouldn’t have any problems even if you are a male or female.”

Loraini is one of the few female Forestry Technicians in the Pacific who carries out ***forest*** inventory that feed’s into UNFCCC’s reports on carbon stock and forestry resources. Collecting this sort of data on forestry resources helps governments determine what developments they could implement in the future without affecting the ***forest*** resources.

The proud ***Forest*** technician explained that she never aspired to become a ***Forest*** Technician because there was not much awareness about this field at secondary school level.

“From secondary school we were asked if we want to become a lawyer, teacher and then you have subjects that does not really go into forestry. We have ***agriculture*** that covers a bit of forestry, we have Geography which is general but not much on Forestry as a subject on its own. I think more awareness is needed at secondary school level so that youths know that there are schools out there and Universities out there that actually offer a bachelor’s degree in ***Forest*** Management. But studying Environmental science, Geography and ***Land*** Management etc, can also get you into the field of Forestry depending on project needs, because forestry is not only about trees, it is about the network of people and fauna that use these resources, the river systems that can be affected if you ***remove*** all trees, the development activities that impact ***forest*** areas, production and exports of ***forest*** products, the policies and management strategies that needs to be drafted to protect the ***forest*** and so on, ”

Loraini, through her project, is not only able to expand her knowledge and experience as a Forestry Technician, but also able to help Pacific Island Countries to achieve their REDD+ goals and at the same time help vulnerable communities to manage their ***forest*** resources.

Loraini’s advice to women and girls who want to join Forestry:

“Trees are fundamental in maintaining our natural ecosystems and our natural resources from the ridge to the reef. If you are passionate about the sustainable management and conservation of our unique natural resources, protecting our valuable resources that we have, then forestry is one of the areas you could go into.”

**Load-Date:** July 29, 2020

**End of Document**



[***Shaheen & Hassan Join Bipartisan Push to Support Renewable Energy & New Hampshire’s Forest Products Industry***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:62H2-9KX1-F0YC-N3P8-00000-00&context=1516831)

Impact News Service

April 22, 2021 Thursday

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**Length:** 848 words

**Body**

Washington: Office of the Senator Maggie Hassan has issued the following news release:

U.S Senators Jeanne Shaheen (D-NH) and Maggie Hassan (D-NH) helped reintroduce bipartisan legislation that would incentivize the use of energy efficient biomass heaters in homes and businesses instead of relying on fossil fuel energy. The updated Biomass Thermal Utilization (BTU) Act would amend the federal tax code to incentivize the use of energy efficient wood boilers, stoves and heaters through tax credits for capital costs incurred in commercial and industrial installations. The bill will also extend the residential credit passed last year through 2028.

“As we pursue meaningful action to combat the effects of climate change, it’s imperative that our response plan prioritizes ways to improve energy efficiency and utilize home-grown renewable energy. Transitioning away from fossil fuels toward energy efficient biomass heaters to warm our homes and businesses is a common sense way to make that happen,” said Shaheen. “This bill ensures biomass thermal energy technologies are taxed the same as other forms of renewable energy, ***removing*** cost barriers and supporting our ***forest*** industry. This is particularly important for New Hampshire’s North Country. I’ll always work in the Senate to find innovative ways to use our natural resources to meet our energy needs and support our local economies. ”

“Expanding the use of biomass heaters will help support New Hampshire’s renewable fuel industry, while also moving our country closer toward becoming energy independent,” Senator Hassan said. “I am glad to introduce this bipartisan bill to help encourage homes and businesses across New Hampshire to become less dependent on fossil fuels. ”

Many other forms of renewable or efficient energy have been eligible for tax credits for a number of years, and the Biomass Thermal Utilization (BTU) Act seeks to achieve parity between those systems and thermal biomass systems. By offering these incentives, the legislation would encourage people and businesses to upgrade away from oil boilers to efficient wood-pellet boilers.

Specifically, the BTU Act would:

Underscore that heat from biomass is an underutilized energy source in the United States. Add biomass fuel property to the list of existing technologies that qualify for the business investment tax credit (IRC section 48) at an initial rate of 30 percent before expiring at the end of 2028. To qualify, the biomass fuel property must operate at a thermal efficiency rate of at least 75 percent and be used to either heat space within the dwelling or heat water. Restore the existing residential renewable energy investment tax credit for residential wood heating systems (IRC section 25) to 30 percent, and extend it through 2028.

Senator Shaheen has long advocated for America’s ***forests*** and initiatives that would survey and repurpose biomass for clean energy initiatives. In the funding bill for fiscal year 2021, Shaheen secured $5 million for the USDA ***Agriculture***’s Community Wood Energy Program (CWEP), a competitive grant program that aims to assist with the costs of installing high-efficiency, biomass-fueled energy systems. Shaheen’s bipartisan legislation with Senator Susan Collins (R-ME) – the Community Wood Energy Innovation Act – was included in the Farm bill signed into law in 2018. Their bipartisan bill expands eligibility for CWEP, incentivizes investments in energy-efficient wood energy systems and supports facilities that repurpose low-grade, low-value wood that would otherwise be sent to landfills.

Shaheen recently reintroduced the ***Forest*** Incentives Program Act with Senator Shelley Moore Capito (R-WV) to help landowners make ***forest*** management more affordable and provide them with sustainable options to preserve their ***land***. She also reintroduced bipartisan legislation with Senator John Thune (R-SD) requiring the Environmental Protection Agency (EPA) to act on languishing applications under the renewable fuel standard (RFS), including moving forward with allowing renewable electricity made from biomass to qualify if it is used to power electric vehicles. This would level the playing field among fuel sources, and enable biomass power plants to generate and sell credits under the RFS program to refiners that must meet national renewable fuel ***targets***.

Senator Hassan is working to reduce carbon ***emissions***, and recently led her colleagues in reintroducing bipartisan legislation to support and expand programs such as the Regional Greenhouse Gas Initiative (RGGI), a collaborative effort across states including New Hampshire that uses market-based tools to reduce greenhouse gas ***emissions*** from the power sector. Senators Hassan and Shaheen also worked to pass into law bipartisan legislation to permanently fund the ***Land*** and Water Conservation Fund and provide mandatory funding for deferred maintenance on public ***lands***. The ***Land*** and Water Conservation Fund helps preserve and maintain critical ***lands*** for national parks, ***forests***, wildlife refuges and recreational areas in New Hampshire and across the country.

**Load-Date:** April 22, 2021

**End of Document**



[***Everyday shopping from brands like Heinz and Yakult helps destroy rainforests, report claims***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:61WF-KCS1-DY4H-K2V0-00000-00&context=1516831)

The Independent (United Kingdom)

January 29, 2021 Friday 11:18 PM GMT

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**Section:** CLIMATE,NEWS; Version:4

**Length:** 994 words

**Byline:** Jane Dalton

**Highlight:** Big companies and lenders 'failing to halt loss of vital tree cover', contributing to nature and climate crises

**Body**

Shoppers are unknowingly fuelling the destruction of tropical [*rainforests*](https://www.independent.co.uk/topic/rainforests) , as companies produce millions of everyday products linked to [*deforestation*](https://www.independent.co.uk/topic/deforestation) , a report claims.

Brands including Kraft [*Heinz*](https://www.independent.co.uk/topic/heinz) , [*Starbucks*](https://www.independent.co.uk/topic/starbucks) , Yakult and Rachel's Organic buy large amounts of products such as [*soya*](https://www.independent.co.uk/topic/soya) to feed [*animals*](https://www.independent.co.uk/topic/animals) - for which swathes of tropical ***forests*** are cleared.

And nearly 100 major financial institutions, including Blackrock, are ignoring tropical deforestation in their public policies, while providing $2.7 trillion (£2 trillion) that risks fuelling the climate and [*biodiversity crisis*](https://www.independent.co.uk/topic/biodiversity-crisis) , the analysis says.

Every six seconds an area of rainforest the size of a football pitch is destroyed to produce commodities such as soya, [*beef*](https://www.independent.co.uk/topic/beef) , [*palm oil*](https://www.independent.co.uk/topic/palm-oil) , leather, timber and paper, according to environmental organisation Global Canopy.

Destroying these ***forests*** is one of the biggest causes of the twin climate and biodiversity crises.

The charity's annual [***Forest*** *500 Report*](http://www.forest500.org/) looked at 350 companies worldwide that produce, trade or use the largest amounts of those products, and their lenders, and ranked them by their relevant policies.

It found that 107 companies whose products use meat, fish, [*dairy*](https://www.independent.co.uk/topic/dairy) and eggs failed to recognise their links to deforestation through the soya they bought for animal feed.

They included Kraft Heinz, which produces cheeses and creams, and Starbucks, which uses millions of gallons of milk a year.

Almost 80 per cent of the world's soya crops are fed to livestock in the meat and dairy industries, experts have estimated.

The researchers said neither Yakult nor Groupe Lactalis, which owns Rachel's Organic, had any promises to end deforestation; Kraft Heinz had no deforestation pledges for soya, beef or pulp and paper; and Starbucks had no deforestation policy for soya.

Overall, a third of the companies driving trade in these commodities have made no public promises to avoid deforestation, the study said.

By contrast, companies that have published a deforestation policy for the commodities they use include Unilever, Marks and Spencer, Sainsbury's and Morrison's.

Global Canopy also examined the policies of the institutions financing the big brands through bonds, loans and shareholdings worth $5.5 trillion (£4 trillion). And it found 95 top banks and lenders had not published any policies to ensure the companies were not adding to deforestation.

They include four of the world's biggest asset managers such as BlackRock, according to the report.

Niki Mardas, executive director of Global Canopy, said: "There is no solution to climate change without a solution to deforestation. Yet a great majority of the world's largest financial institutions are looking the other way on this vital issue.

"Some are making big announcements on climate change, while failing even to have a deforestation policy in place.

"This doesn't add up, and it sends a terrible message to the market. Strong policies are a basic first step, setting clear expectations for the companies they finance, and demonstrating a strategic approach to the climate and nature crisis."

Deforestation and ***land*** use change are major contributors of damaging greenhouse gas ***emissions***, according to the UN's Intergovernmental Panel on Climate Change. It says about 23 per cent of global human-caused carbon dioxide ***emissions*** come from ***agriculture***, forestry and other ***land*** uses, and ***land*** use change, such as clearing ***forests*** to make way for farms, drives these ***emissions***.

The Intergovernmental Science-Policy Platform on Biodiversity has [*previously reported*](https://www.independent.co.uk/environment/un-nature-biodiversity-report-2019-humans-animals-earth-paris-a8899926.html) that changing ***land*** and sea use is the biggest factor behind the biodiversity crisis.

In the 2014 New York Declaration on ***Forests***, governments and companies pledged to ***remove*** deforestation from their supply chains by 2020. But since then, average tropical ***forest*** loss has accelerated by 44 per cent, Climate Focus says, with an area larger than the UK lost each year, mostly because of ***agricultural*** expansion.

In a new YouGov survey for WWF, more than two-thirds - 68 per cent - of people supported setting a ***target*** date in UK law to eradicate all deforestation from supply chains, with 4 per cent opposing the idea.

More than three-quarters of people (77 per cent) said they did not want products they buy to contribute to deforestation abroad.

A spokesman for Kraft Heinz said its environmental social governance report sets out commitments, including sourcing palm oil that is 100 per cent certified sustainable and traceable to the mill by next year.

"Our partnership with the Rainforest Alliance has included an expanded ***forest*** risk commodities supply chain assessment to include soy, which is helping to determine next steps. Kraft Heinz remains dedicated to responsible sourcing and related impacts in critical areas including deforestation."

A statement from Yakult said that "protecting the Earth's environment is one of the most important missions we all share and we aim to demonstrate our commitment through all our activities", adding: "We will continue to work on reducing the impact of the group on the environment, while also striving to improve the manner in which we publicise information related to these efforts."

Blackrock referred to documents it has on sustainable ***agriculture*** and palm oil, adding: "We ask companies to disclose any initiatives and externally developed codes of conduct to which they adhere, and to report on outcomes." A document on its plans for this year also says Blackrock will ask companies to show plans to align their business with the global goal of net-zero greenhouse gas ***emissions*** by 2050.

The Independent has also asked Lactalis and Starbucks to comment but had not heard back before publication.

Read More

[*UK government 'mulling ban on soya linked to illegal deforestation'*](https://www.independent.co.uk/climate-change/news/soya-ban-uk-deforestation-amazon-b1788950.html)

[*Warring Amazon tribes unite against Bolsonaro's rainforest plans*](https://www.independent.co.uk/news/world/americas/amazon-crisis-brazil-tribes-bolsonaro-rainforest-xiangu-river-a9089716.html)

[*Banks urged to combat deforestation and halt biodiversity crisis*](https://www.independent.co.uk/news/business/banks-deforestation-soy-cattle-timber-b1785600.html)

[*Greenpeace video exposes deforestation impact of meat production*](https://www.independent.co.uk/environment/greenpeace-uk-video-deforestation-meat-production-theres-a-monster-in-my-kitchen-b1204944.html)

**Load-Date:** August 3, 2021

**End of Document**



[***Sens. Braun, Coons introduce bipartisan climate legislation to support global Trillion Trees initiative & combat deforestation***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:61GN-DF71-F0YC-N021-00000-00&context=1516831)

Impact News Service

December 9, 2020 Wednesday

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**Length:** 2073 words

**Body**

Washington: Office of the Senator Christopher Coons has issued the following news release:

Today, U.S Senators Mike Braun (R-Ind.) and Chris Coons (D-Del.), co-chairs of the bipartisan Senate Climate Solutions Caucus, introduced legislation to support U.S leadership in reducing carbon in the atmosphere by restoring and conserving ***forests***, grasslands, wetlands, and coastal habitats. Senators Todd Young (R-Ind.) and Angus King (I-Maine) cosponsored the bill.

“As a lifelong conservationist, I believe that Trillion Trees is a common sense proposal to help improve our ***land***, water, soil, and air, without imposing onerous Washington regulations,” said Senator Braun. “I am proud to come together with my colleagues on this bipartisan solution to help advance a key objective that President Trump called for in his State of the Union Address. ”

“The wildfires and severe storms we’ve experienced this year are a devastating reminder of how climate change is impacting our ***lands*** – and a clear signal that we need to act now to protect them for future generations,” said Senator Coons. “***Removing*** carbon from the atmosphere is one of the many critical steps we should take to mitigate climate risks. I’m glad to work with this bipartisan group of senators to invest in a solution that will benefit the health of people and ecosystems around the world. ”

“I have long held the position that we can protect our environment without harming our economy, and this legislation is one example of the type of action we can take to reduce ***emissions*** and protect our natural resources while creating new economic opportunities,” said Senator Young.

“We just lived through the hottest November on record; every year that carbon levels increase, temperatures increase and it gets harder to stabilize our planet’s climate future,” said Senator King. “Without action, climate change’s effects on our planet will grow more and more dangerous, fueling extreme weather events and endangering lives across the globe. Today’s bipartisan proposal recognizes the immense value of our working ***forests*** in this climate fight, and is a commonsense step in the right direction, calling for our nation to lead in efforts to preserve ecosystems that ***remove*** carbon from the atmosphere. We can’t delay any longer; we need to start working now, on a bipartisan basis, to address this crisis and protect our environment for future generations. ”

In advance of the UN Decade on Ecosystem Restoration from 2021 to 2030, the World Economic Forum launched the global One Trillion Trees initiative, 1t.org The Trillion Trees and Natural Carbon Storage Act would allow the United States to take a leadership role in supporting this effort to store carbon, promote biodiversity, and end deforestation at home and abroad.

“Meeting the challenge of climate change demands a range of solutions. This bill signals the U.S is ready to lead in marshaling a key part of the solution set -- the substantial power of natural and working ***lands***, especially ***forests***, to increase carbon sequestration. We’re pleased to see this important first step. ” – Lynn Scarlett, Chief External Affairs Officer, The Nature Conservancy

“Any serious proposal to act on climate must include natural solutions — healthy ***forests***, grasslands, wetlands, and coastal ecosystems — that sequester carbon and bolster resilience through ecologically appropriate reforestation and restoration. We’re proud to work with our good friends Senators Chris Coons, Mike Braun, Todd Young, and Angus King on this forward-thinking, bipartisan effort to help address climate change by tapping natural ecosystems and their ability to store carbon and make communities safer. ” – Collin O’Mara, president and CEO of the National Wildlife Federation

“Sens. Braun (R-IN) and Coons’ (D-DE) Trillion Trees and Natural Carbon Storage Act would provide important innovative policies that advance conservation and ecological restoration while bolstering rural economies. The bill establishes science-based objectives for increasing the net carbon stock across U.S ***forests***, grasslands, wetlands, and coastal ecosystems. This legislation is a great bipartisan step in conserving and restoring our nation’s ***forest*** and will help expand our natural carbon markets. ” – Michele Stockwell, Executive Director, BPC Action

'Natural solutions are a crucial part of effective climate policy. The Trillion Trees and Natural Carbon Storage Act will expand the carbon sequestration capacity of America's ***forests*** and grow the use of embodied carbon building materials. The American Conservation Coalition thanks Senators Braun, Coons, Young, and King for their strong leadership on this important bill.' – Quill Robinson, Vice President of Government Affairs, American Conservation Coalition

“The American ***Forest*** Foundation applauds Senator Braun and Senator Coons for legislative efforts to unlock the carbon potential on private forestland. Family ***forest*** holdings make up 36% of all U.S ***forests***. Providing resources to enable family ***forest*** landowners to enter carbon markets will allow them to both improve their ***forests*** and sequester carbon at scale. ” – Tom Martin, President and CEO of the American ***Forest*** Foundation

“While our ***forests*** provide a habitat for the birds we love, they do so much more for the survival of our planet. Trees, as well as other existing natural resources, provide some of the first lines of defense against pollution that contributes to climate change. By investing in our ***forests***, we’re also investing in our future. ” – Michael Obeiter, senior director of federal climate strategy at the National Audubon Society

“It’s critical for the U.S to take a global leadership role in promoting sound ***land***-use management and to encourage other donor nations to follow. Trillion Trees provides the basis for a foundational structure for extraordinary progress in the developing world in terms of trees for water, people, ***agriculture***, industry, biodiversity, and demonstrable carbon offsets – all of which will improve lives and livelihoods around the world. ” – David H. Barron, Chairman, The ICCF Group

“We thank Senator Braun for his leadership, together with Senators Coons, Young, and King in recognizing the role of ***forests*** and ***forest*** products as a natural climate solution. As a private ***forest*** owner himself, Senator Braun’s first-hand experience and leadership is vital to ensuring that policy supports healthy markets, working ***forests*** and ***forests*** products – as three vital and interconnected parts to climate mitigation, ***forest*** health and resilience. We look forward to working with the Senators to advance this important objective. ” – Dave Tenny, President & CEO of the National Alliance of ***Forest*** Owners

“On the heels of a record-breaking fire season at home and abroad—and due to unrelenting deforestation around the world—the plight of our ***forests*** has never been more dire. Conserving and restoring natural habitats such as ***forests***, grasslands, and wetlands are critical to addressing the intertwined crises of climate change and nature loss and to ensuring ***forest***-dependent communities and Indigenous peoples thrive. The Trillion Trees and Natural Carbon Storage Act provides a path for us to come together in a bipartisan manner to tackle these challenges. As the enormity of the climate crisis grows each day, it is imperative that we take a holistic view in our response and that the United States displays leadership on cutting carbon ***emissions*** at every level. Safeguarding our valuable ***lands*** and ***forests*** is an important part of the solution. As a new administration and Congress gear up to tackle a variety of environmental issues, acting on climate and protecting ***forests*** and nature are obvious priorities and opportunities. ” – Kerry Cesareo, Senior Vice President, ***Forests***, World Wildlife Fund

“Citizens for Responsible Energy Solutions (CRES) applauds the bipartisan efforts of Senators Mike Braun (R-IN), Chris Coons (D-DE), Todd Young (R-IN) and Angus King (I-ME) for introducing the Trillion Trees and Natural Carbon Solutions Act, legislation that supports sound ***forest*** management practices to reduce carbon in our atmosphere for generations to come. Reforestation and conservation are central to a clean environment and economic growth. So, too, are incentives that help landowners practice sustainable forestry and reduce and sequester carbon ***emissions***. By encouraging international cooperation to conserve our global resources, the Trillion Trees and Natural Carbon Solutions Act asserts U.S leadership in the fight to improve air quality and protect our ***forests*** and coastal habitats worldwide. CRES commends Sens. Braun, Coons and Young for championing this legislation in the Senate and for their work to bring forth commonsense solutions that will encourage a cleaner future for our nation and the world. ” – CRES Executive Director Heather Reams

“The National Association of State Foresters (NASF) applauds the efforts of Senators Mike Braun, Chris Coons, Todd Young, and Angus King on the introduction of the Trillion Trees And Natural Carbon Storage Act. This bill recognizes ***forests*** and ***forest*** carbon markets for what they are: sustainable solutions to climate change. Trees built America. They clean our water and air. They provide us with spaces to recreate and homes for millions of wildlife species to thrive. They also have the capacity to sequester tremendous volumes of carbon. Most (nearly two-thirds) of America’s ***forests*** are privately owned. These private landowners need economic incentives to retain ownership of their forestland, as well as professional expertise to effectively manage their ***forests***. This bill would create a federal loan guarantee program, providing the requisite access to established environmental marketplaces where forestland owners can sell the carbon credits they produce. As public ***land*** managers and the primary deliverers of assistance to private forestland owners, state forestry agencies need every tool available to actively manage public ***forests*** and address boundary-less ***forest*** threats like wildfire, pests, and disease. ***Forest*** carbon markets are one of these essential tools and should be included in any and all climate change solutions proposed by Congress. NASF looks forward to continuing its work with Senator Braun and other congressional leaders to develop bipartisan climate change solutions that enhance public benefits from all ***forests***. ” – NASF President and Arkansas State ***Forester*** Joe Fox

“Fighting climate change requires a powerful tool: nature itself. This scientifically robust bill puts the U.S on a path to unlock the potential of nature-based climate solutions. The window of opportunity for bipartisan climate action opens wider every day. The time to act is now, and EDF congratulates Sens. Braun and Coons on their efforts to work collaboratively and effectively.' — Elizabeth Gore, Senior Vice President of Political Affairs, Environmental Defense Fund

The Trillion Trees and Natural Carbon Storage Act:

Creates the International ***Forest*** Foundation, a nonprofit organization, to encourage and accept donations in support of international reforestation, restoration, and deforestation prevention efforts. Authorizes $10 million for USDA ***Forest*** Nursery Revival programs to ensure that the supply of seeds and saplings allows for increased domestic planting. Engages America’s allies in conservation by authorizing the Secretary of State and USAID to increase their ***forest*** management cooperation efforts with other nations in order to better promote reforestation and sustainable ***land*** use management abroad. Amends existing international conservation programs to explicitly include carbon sequestration and ***forest*** management among the list of approved technical assistance categories. Makes it easier for private landowners to participate in carbon credit markets by authorizing USDA to provide loan guarantees for related projects. Requires that USDA establish objectives for increasing the net carbon stock of American ***forests***, grasslands, wetlands, and coastal blue carbon habitats.

This legislation is supported by The Nature Conservancy, National Wildlife Federation, Environmental Defense Fund, World Wildlife Fund, National Audubon Society, Bipartisan Policy Center, American ***Forest*** Foundation, American Conservation Coalition, National Association of State Foresters, Conservation International, and Citizens for Responsible Energy Solutions.

**Load-Date:** December 10, 2020

**End of Document**



[***Mondelēz plants more than 2.2m non-cocoa trees to help restore ecosystems on cocoa farms***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:62JJ-CMG1-DYNP-M0MT-00000-00&context=1516831)

ConfectioneryNews.com

April 29, 2021 Thursday 4:27 PM GMT+1

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**Length:** 1071 words

**Byline:** Anthony Myers, , [*Anthony*](mailto:Anthony)

**Body**

In its latest Cocoa & ***Forests*** Initiative (CFI) Annual Report, Mondelēz International said it has distributed 712,771 trees across Ghana and Cote d’Ivoire in the from October 2019 to September 2020, with a total of 975,848 trees planted as part of its CFI commitment since 2018, bringing the global total to 2.2 million trees.

The confectionery giant has been one of the driving forces behind cocoa sustainability over the past decade and was one of the founders, three years ago, of the CFI, a coalition of 35 leading cocoa and chocolate companies and the governments of Cote d’Ivoire and Ghana that have joined together in to end deforestation and restore ***forest*** areas.

Carbon measurements​

Mondelēz International has also announced a new partnership with sustainability consultancy South Pole to develop a tool to estimate the possible carbon impact of its cocoa sustainability programme, ​Cocoa Life, in relation to interventions on farm and ***forests***.

 The tool is in its initial stages but Cedric van Cutsem, Associate Director Cocoa Life, Operations, Mondelēz International said the company is encouraged by the tool’s detailed analysis of the environment so far.

“We need to measure whatever we do because it's only by measuring that we can understand the impact we have. And now, carbon being so important to us with our public commitments, it was critical to start to work on a system with a tool that would allow us to translate the Cocoa Life interventions into carbon measurement.​

“Our Initial findings are very encouraging so far, but we thought it was still a bit too early to share because it still requires a bit of peer review - and we would really appreciate, inputs from any stakeholders who can come and help us improve the model​.”

The new tool will assesses the carbon reductions that have been delivered historically, as well as the ones that can be achieved over the mid-to-long-term and uses farm-level activities, changes over a period of time, and outcomes specific to cocoa farming to estimate greenhouse gas (GHG)/carbon impacts.

We need to measure whatever we do because it's only by measuring that we can understand the impact we have -- Cedric van Cutsem​

In its report, Mondelēz says: “Our initial estimations show promising signs of our programme having had the potential to reduce carbon ***emissions***, and we’re currently validating these findings. The calculations look at 2018 to 2020 and include the measurement of both carbon reduction and ***removal*** interventions​.”

Dominique Gangneux, Principal Scientist, South Pole said: “We have partnered with Mondelez International to help rapidly scale up the company’s carbon impact and the value its Cocoa Life Programme creates through interventions at farm, community, and ***forest*** levels​.”

Payment for Environmental Services (PES)​

Another area pioneered by Mondelēz is the Payment for Environmental Services (PES) offering farmers economic incentives for environmental action.

After some initial tweaks, van Cutsem said that in 2020, Mondelēz got to a place where it is partnering with Barry Callebaut to do more PES to support agroforestry in Cote d’Ivoire.

“We also secured some funding from Partnership for ***Forest*** to help us accelerate in 2021, which is also a strong signal of trust we're getting from other stakeholders to continue and we have started to roll out PES in Ghana and, and even in Indonesia​.”

Farm productivity​

The CFI progress report states that productivity on a pilot project on Cooca Life farms in Ghana has risen to 618 kg cocoa per hectare from baseline value of 349 kg per hectare. However, the report says not all farms have responded equally and the company is trying to understand why some farms did not improve as expected.

Van Cutsem believes that after spending time supporting and training farmers and working with them on the ground the one-size-fits-all approach does not work.

“You cannot train a farmer if he has a 2-hectares plot and a baseline productivity of 300 kilos per hectare, you cannot train that farmer the same way that you train his neighbour who might have 6 hectares and a productivity of 600 kilos.​

"As an industry it took us to a debate around the need to have more profiling or more segmentation of farmers and really adapt the training in the content and the services to the right farmers.​

"That's something we've been working on for quite some time and we also innovated through this ***Targeted*** GAP (Good ***Agricultural*** Practices) approach that we mention in the CFI report.”​

Cocoa Life​

On Cocoa Life's ***targets***, van Cutsem remains upbeat:  “Beyond the financial investment which we committed to … we did say we will also reach 200,000 smallholders across the six countries​.

“We're now around 180,000, we still have two years to go, so I'm really confident, we will meet that ***target***, maybe even exceed it, I hope.​

"We also said, we will then have an impact on 1 million people considering an average household of five people per farmer. I'm confident we'll get there.​

"The other public commitment we have is that by 2025 will have our chocolate source as Cocoa Life … we are already very close to 70% and I'm very confident. We'll get there by 2025.”​

In the foreword to the report, Cathy Pieters, Senior Director Sustainable Ingredients & Cocoa Life, at Mondelēz International said: “We believe conserving the ***land*** and ***forests*** is a promise to future generations. 2020 spotlighted the interconnectivity between the health of people and planet, and the world took note of the crucial role ***forests*** play in protecting both, today and in the future, by acting as a first line of defence against climate change and future pandemics. It is this interconnectivity that cements the importance of holistic strategies. Our cocoa sustainability programme, Cocoa Life, which ensures our chocolate’s essential ingredient is made right, has always been built on a holistic approach​.”

Pieters said in her foreword that the key learning from the past 12 months is that to “truly reduce deforestation in the cocoa supply chain and tackle climate change, all private and public sector actors must work together …. We will continue to invest into innovative programmes and partnerships to ensure we tackle deforestation and conserve and restore ***forests*** in cocoa-growing areas​”.

* Listen to the full interview with Cedric on our special exclusive podcast.​

1. Listen to the full interview with Cedric on our special exclusive podcast.​

**Load-Date:** April 29, 2021

**End of Document**



[***Net zero emissions in agriculture***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:619Y-2MW1-F0YC-N2PG-00000-00&context=1516831)

Impact Financial News

November 17, 2020 Tuesday

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**Length:** 1008 words

**Body**

Islington, London: Knowledge Transfer Network Limited has issued the following press release:

With the UK on a mission to reach net zero ***emissions*** by 2050, the AgriFood sector is rising to the challenge.

At KTN, we are supporting companies and researchers to help drive net zero innovation. In this article we look into possible areas for innovation and highlight some examples.

At the UN General Assembly in New York recently (22 September 2020) China committed to reduce its ***emissions*** to net zero by 2060, bringing the focus of net zero ***emissions*** to the forefront once again. China joins 20 other countries on a path to net zero including the UK, that has set a legal ***target*** of net zero ***emissions*** by 2050. These are challenging ***targets*** that are needed to mitigate climate change and related impacts such as the frequency and severity of extreme weather conditions. However, a report published in June this year by the Committee on Climate Change (CCC) has highlighted that the UK is at risk of failing to reach this ***target***.

Becoming net zero means that any ***emissions*** produced must be offset with schemes that ***remove*** them from the atmosphere such as planting trees and carbon capture and storage. There are two routes to net zero that work in tandem that are reducing and ***removing*** GHGs. In the report published by the CCC, they outlined five investment priorities for reaching the goal of net zero, one of these is moving towards a circular economy. A circular economy is the continual use of resources, eliminating waste from the economic system. To achieve this, a business will need to look at all their waste products and create innovative ideas to reduce or reuse them. This may sound like a big undertaking but if these by-products that are produced can be turned into a marketable product there can be economic as well as ecological benefits.

***Agriculture*** has a big role to play in the UK’s journey to Net Zero. UK ***agriculture*** is currently a contributor of GHG ***emissions***, contributing 10% of the UK total. It also has significant potential for offsetting ***emissions*** through carbon capture turning CO2 into food, fibre and fuel. The National Farmers Union (NFU) set an even greater ***target*** to reach net-zero GHG ***emissions*** across the whole of ***agriculture*** in England and Wales by 2040.

There are six key areas in which ***agriculture*** can lead the way for the UK to reach its net zero ***emissions*** ***target*** and we have discussed them below with some examples of innovations that could help us get there.

Carbon Storage

***Land*** management is an effective way to increase carbon storage. Changes in the use of ***land*** such as growing hedgerows and woodland can help capture more carbon, and strategies such as minimising cultivation and restoration of carbon rich soil such as peatland can reduce carbon release. The government plans to implement an Environmental ***Land*** Management (ELM) scheme at the end of 2024 to replace the current EU schemes. This will help support farmers in reaching net zero by encouraging them to adopt environmentally sustainable farming and forestry practices and pay for large-scale ***land*** transformational projects such as restoring peatland. Peat is the biggest store of carbon in the UK as well as creating 18.5 million tonnes of GHG ***emissions*** per year. Restoring these ***lands*** is a low-cost fast way to reduce ***emissions***.

Agroforestry also has the potential for mitigating ***emissions***. Currently tree cover accounts for 13% of total ***land*** use in the UK storing around 3781 million tonnes, just over eight times the UK’s annual ***emissions***. The recommendation from the CCC is to increase this to 17-19%. Agroforestry could provide a potential opportunity to combine tree production with ***agriculture***. However, there is currently little agroforestry in the UK, or related R&D about how UK farmers could successfully implement such systems. The main barrier to ***land*** conversion to Agroforestry is the financial impact of the cost of the establishment to the loss of income from livestock or crops. This can be mitigated by research into potentially profitable options such as fruit or nut trees and support packages that help with the upfront costs and lag time before the new system is profitable. One example of an agroforestry system from elsewhere in the world is Carbon Neutral Brazilian Beef, an integrated crop-livestock-***forest*** system (ICLF) to help mitigate GHG ***emissions*** in beef production in Brazil.

Another area of carbon storage that is gaining traction is seaweed farming. Seaweed offers a new area of carbon storage without clearing or converting ***land***. It is also a low input system as it does not need fresh water, fertilisers or pesticides. As well as creating a carbon sink it also has an economic value as the harvested seaweed can be made into food products for humans and animals and food packaging, replacing plastics.

Novel production systems

Vertical farming is also being developed as an alternative to traditional ***agriculture***, with the potential to increase output per ***land*** area. Vertical farming not only reduces the ***land*** needed to produce food but also significantly reduces other inputs such as water and pesticides. It also has the potential to reduce transport ***emissions*** and food waste as it enables produce to be grown locally and on-demand. The James Hutton Institute in Scotland, together with Intelligent Growth Solutions Ltd have created a vertical farming system designed to overcome the main barriers currently facing this technology; the cost of power and labour and the ability to produce at scale consistently. The vertical farming business InFarm secured UKRI funding of over £3 million to upscale their vertical farming that can be used in supermarkets. Its ‘instore farm’ uses less ***land***, 95% less water, 75% less fertilizer and zero pesticides compared to conventional ***agriculture***. These farms are cloud-connected so can be remotely controlled. Being a controlled system means that they can maximise the productivity of the plant through a range of monitoring sensors and are not affected by adverse weather patterns.

**Load-Date:** November 18, 2020

**End of Document**



[***Bennet Joins Colleagues in Calling for Investments in Natural Infrastructure Restoration, Resilience in American Jobs Plan***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:6324-BD01-F0YC-N3Y1-00000-00&context=1516831)

Impact News Service

July 1, 2021 Thursday

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**Length:** 2509 words

**Body**

Washington: Office of the Senator Michael Bennet has issued the following news release:

Colorado U.S Senator Michael Bennet, chair of the U.S Senate Committee on ***Agriculture***, Nutrition, and Forestry’s Subcommittee on Conservation, Climate, Forestry, and Natural Resources, joined a group of Democratic senators in calling on Senate Leadership to prioritize the historic investments proposed in President Joe Biden’s American Jobs Plan for natural infrastructure restoration, resilience, and reclamation.

In a letter to Majority Leader Chuck Schumer (D-N.Y ), Senate Energy and Natural Resources Committee Chairman Joe Manchin (D-W. Va.) and Ranking Member John Barrasso (R-Wyo.), Bennet and the senators express that these “investments will create millions of desperately needed good jobs all across the country, while making communities safer and healthier. ”

Bennet and the senators state that by investing “~$200 billion in natural infrastructure restoration and resilience, we will create more than 3.5 million good jobs over five years—in many of the exact places where unemployment is highest. ”

Bennet and his colleagues are encouraging the inclusion of the following restoration and resilience priorities in the final package:

$87 billion to bolster resilience to wildfire and drought and restore public ***lands***; $10 billion for the creation of a new Civilian Climate Corps; $55 billion to bolster resilience to hurricanes, flooding, earthquakes, and other hazards; $28.3 billion to restore imperiled fish and wildlife habitat; $29.5 billion to reclaim degraded ***lands***; $53.5 billion to increase resilience of working ***lands*** and position ***agriculture*** to lead the shift to net-zero ***emissions***; $9 billion to rebuild outdoor recreation infrastructure; and - support for compliance and permitting.

Earlier this year, Bennet introduced the Outdoor Restoration Partnership Act to make a $60 billion investment in ***forest*** and watershed restoration to build climate resilience across the West. This will restore fish and wildlife habitat, expand outdoor access, and create millions of jobs in the process.

In addition to Bennet, the letter was signed by U.S Senators Martin Heinrich (D-N.M ), Chris Coons (D-Del.), Tina Smith (D-Minn.), Dianne Feinstein (D-Calif.), Ron Wyden (D-Ore.), Ben Ray Luján (D-N.M ), Chris Van Hollen (D-Md.), Gary Peters (D-Mich.), Debbie Stabenow (D-Mich.), Alex Padilla (D-Calif.), and Cory Booker (D-N.J ).

The full text of the letter is available HERE and below.

Dear Leader Schumer,

As we take up President Biden’s American Jobs Plan, much of the focus will rightly be on the transformational investments proposed for transportation, clean energy, water infrastructure, broadband, buildings, manufacturing, and innovation. We must also prioritize the historic investments President Biden proposed in natural infrastructure restoration, resilience, and reclamation that will create millions of desperately needed good jobs all across the country, while making our communities safer and healthier.

By investing ~$200 billion in natural infrastructure restoration and resilience, we will create more than 3.5 million good jobs over five years—in many of the exact places where unemployment is highest—at a highly cost-effectively rate because much of the investment goes towards labor, rather than materials and equipment. Restoration and resilience investments will also help confront the climate crisis by naturally sequestering more carbon and bolstering community resilience to wildfires, hurricanes, and flooding; advance environmental justice by ***removing*** pollution from our air, water, and soils; creating jobs in rural communities by improving productivity of working ***lands*** and growing the outdoor recreation economy; and recover imperiled wildlife species by restoring degraded habitat. In doing so, we will support workers in industries and regions affected disproportionally by the pandemic, such as ***agriculture***, forestry, ranching, energy, and tourism.

The priorities identified in this letter align with the President’s Plan and will create millions of jobs starting immediately, while reducing taxpayer liabilities and reducing our long-term debt. Many recommendations execute existing “NEPA-ready” plans and authorized projects that are already vetted and approved, but currently unfunded, to allow work to start quickly. We also encourage increased funding for compliance and permitting offices of Federal agencies to expedite project delivery without undermining careful environmental review, as well as delivering direct resources to States, Territories, local governments, and Tribes, suspending and reducing non-Federal match requirements, and preventing rescissions.

We encourage the inclusion of the following restoration and resilience priorities in the final package:

Civilian Climate Corps ($10 billion)

Fund $10 billion to employ a new, diverse generation of Americans to work conserving our public ***lands***, waters, and our nation’s ***forests***, while bolstering community resilience, and advancing environmental justice, all while placing good-paying union jobs within reach for more Americans (DOI, USDA, CNCS).

Bolster Resilience to Wildfire and Drought & Restore Public ***Lands*** ($87 billion)

Fund $33.8 billion for restoring, reforesting, and improving resilience of the National ***Forest*** System by implementing National ***Forest*** Plans and National Grassland Plans and accelerating Collaborative ***Forest*** Landscape Restoration, Vegetation & Watershed Management, Wildlife & Fisheries Habitat Management, Hazardous Fuels, ***Forest*** Products, and Reforestation Trust Fund, including improvements proposed by the REPLANT Act (USFS). Fund $5 billion for implementing the National Cohesive Wildland Fire Management Strategy on Federal, State, Tribal, and private ***lands*** (USFS, BLM, BIA, NPS, FWS, DOD, DHS). Fund $6.5 billion for ***Forest*** Restoration and Hazardous Fuels Management, and reduction of fire risks on Bureau of ***Land*** Management ***lands*** (BLM). Fund $6 billion for Rangeland Management and restoration of sagebrush steppe and grasslands, ***removal*** of invasive vegetation, water resources resilience, and research on Bureau of ***Land*** Management and Tribal ***lands*** (BLM, BIA). Fund $5 billion for improving wildfire preparedness in vulnerable communities through Community Wildfire Defense Grants, Assistance to Firefighters Grants, and Fire Protection and Safety Grants (FEMA). Fund $7.2 billion for ***Forest*** Health Management Federal and Cooperative (State, Tribal, Private), including implementation State ***Forest*** Action Plans (USFS). Fund $8.2 billion for State Fire Assistance (USFS). Fund $5.2 billion for Capital Improvement and Maintenance, including the Legacy Roads and Trails Program, which would address failing roads, improve public safety, reconnect fragmented wildlife habitat, expand recreation, reduce flooding, and improve water quality (USFS). Fund $640 million for the Urban & Community Forestry Program, which creates jobs in establishing, restoring, and sustaining community ***forests*** (USFS). Fund $2 billion for the National Fire Capacity program, which helps the ***Forest*** Service implement FireWise, to prevent, mitigate, and respond to wildfire around homes and businesses on private ***land*** (USFS). Fund $2 billion for the Building Resilient Infrastructure and Communities (BRIC) program to improve resiliency for communities impacted by wildfire (FEMA). Fund an additional $3.5 billion for the U.S ***Forest*** Service and $2 billion for the U.S Bureau of ***Land*** Management to support science-based projects aimed at improving ***forest*** health and reducing the risk of catastrophic wildfire (USFS, BLM).

Bolster Resilience to Hurricanes, Flooding, Earthquakes, and Other Hazards ($55 billion)

Fund $36.5 billion for implementation of ecological restoration plans and authorized projects, such as the Great Lakes, Chesapeake Bay, Everglades, Mississippi River and Delta, Gulf Coast, San Francisco Bay, Delaware River, Missouri River, Ohio River, Colorado River, Rio Grande, Columbia River Basin, Puget Sound and the Comprehensive Conservation Management Plans of National Estuary Programs (ACE, EPA, FWS). Fund $6.5 billion for resilience programs at FEMA and HUD, including FEMA’s Building Resilient Infrastructure and Communities program and HUD’s Community Development Block Grant program, to create jobs and bolster community resilience by investing in pre-disaster mitigation, especially natural infrastructure solutions like floodplain restoration. Funds should also be allocated to accelerate flood mapping to inform strategic infrastructure investments and development decisions (FEMA, HUD). Fund $10 billion for NOAA habitat and resiliency grants to create jobs restoring wetlands, dunes, reefs, marshes, kelp ***forests***, and mangroves and other living shorelines to reduce flood risks, create habitat, and restart tourism (NOAA). Fund $1.5 billion for the General Services Administration to address seismic risk and infrastructure that is deemed “Exceptionally High Risk. ” Fund an additional $500 million for Tribal drinking water infrastructure repairs, prioritizing Tribal communities that have underfunded drinking water systems causing health and safety emergencies.

Restore Imperiled Fish and Wildlife Habitat ($28.3 billion)

Fund $14 billion over 10 years for enacting the State, Territorial, and Tribal Wildlife Action Plans (Recovering America’s Wildlife Act) to restore habitat for Species of Greatest Conservation Need (FWS). Fund $3.5 billion for implementing Federal Recovery Plans for Endangered and Threatened Species, through FWS Ecological Services and Cooperative Endangered Species Conservation grants, to create near-term habitat restoration jobs and reduce regulatory uncertainty (FWS). Fund $2 billion for bird conservation initiatives, including Migratory Bird Joint Venture implementation plans, Neotropical Migratory Bird Conservation Act grants, Fish and Wildlife Conservation Act, and the Urban Bird Treaty program, to restore wetlands, grasslands, shrublands, saline lakes, ***forests***, shorelines, and other habitat in priority conservation areas (FWS). Fund $3 billion for implementing the National Fish Habitat Action Plan, reconnecting aquatic habitat through the National Fish Passage Program, restoring cold water systems, addressing invasive species, and eliminating the maintenance backlog of the National Fish Hatchery System and State and Tribal hatcheries (FWS). Fund $1.5 billion for implementing National Wildlife Refuge Comprehensive Conservation Plans. Fund $1 billion for National Marine Fisheries Service and the Species Recovery Grants to accelerate the recovery of marine mammals, sea turtles, and other endangered species (NOAA). Fund $1 billion for wildlife crossings to reduce wildlife-vehicle collisions and reconnect habitat for terrestrial/aquatic species (DOT) and State and Tribal Wildlife Movement Grants to restore and reconnect habitat through voluntary projects on public, private, and Tribal ***lands*** (FWS). Fund $750 million for managing and eradicating wildlife diseases by rebuilding the National Wildlife Health Center (USGS), the National Wildlife Research Center (APHIS), regional and State Wildlife Disease Cooperatives, incentivizing diagnostic laboratories to work on wildlife diseases, and funding research to manage and prevent the spread of potential zoonotic diseases, such as white-nose syndrome and chronic wasting disease (USGS, FWS, APHIS, BIA). Help restore and improve rangeland health by providing an additional $150 million for the North American Waterfowl Management and Joint Ventures program and $150 million for the U.S Fish and Wildlife Partners for Fish and Wildlife (FWS). Fund $1 billion for the Department of Energy to begin a collaborative process with the States and Tribes of reevaluating the Bonneville Power Authority endangered species programs.

Reclaim Degraded ***Lands*** ($29.5 billion)

Fund $16 billion for the cleanup, reclamation, and restoration of abandoned coal, hard rock, and uranium mines, and on Federal, State, Tribal, and private ***lands*** (BLM). Fund $8 billion for plugging and reclaiming thousands of orphaned onshore oil and gas wells on Federal, State, Tribal and private ***lands*** (BLM). Fund $5 billion for the remediation and redevelopment of brownfield and Superfund sites. Fund $1.5 billion for Appalachian Regional Commission priority restoration/revitalization projects. Support coal workers by enacting the Black Lung Benefits Disability Trust Fund Solvency Act and Protection of Social Security Benefits Restoration Act.

Increase Resilience of Working ***Lands*** and Position ***Agriculture*** to Lead the Shift to Net-Zero ***Emissions*** ($53.5 billion)

Fund $50 billion for bolstering resilience, sequestering carbon, accelerating restoration, and supporting farmers and ranchers through the: Environmental Quality Incentive Program, Regional Conservation Partnership Program, ***Agricultural*** Conservation Easement Program, Healthy ***Forest*** Reserve Program, Conservation Stewardship Program (NRCS); incentive payments for Conservation Reserve Program signups (FSA); and the Watershed Protection and Flood Prevention Program, Watershed Rehabilitation Program, and Emergency Watershed Protection Program (NRCS). Fund $2.5 billion for grasslands restoration, management, and conservation by enacting the North American Grasslands Conservation Act (FWS). Fund $1 billion for wetland restoration and conservation through the North American Wetlands Conservation Act (FWS). Support voluntary climate stewardship practices on over 100 million acres of farmland by providing supplemental funding for USDA working ***lands*** conservation program (USDA).

Rebuild Outdoor Recreation Infrastructure ($9 billion)

Fund $4 billion for building and repairing State, local, and Tribal outdoor recreational infrastructure and improving accessibility through block grants for States, cities/counties, and Tribes to implement Comprehensive Outdoor Recreation Plans, the Urban Parks and Recreation Recovery Program, Outdoor Recreation Legacy Partnership program, and municipal recreation infrastructure (NPS). Fund $2.5 billion for repairing infrastructure within State and Tribal Wildlife Management Areas and other State and Tribal natural resource infrastructure (FWS). Fund $1.5 billion for implementing management and recreation plans for National Park units (NPS). Fund $1 billion for improving recreational infrastructure of the Bureau of ***Land*** Management, Army Corps, Bureau of Reclamation, Bureau of Indian Affairs, and ***Forest*** Service (BLM, ACE, BOR, BIA, USFS). Increase access to public ***lands*** through expanding and investing in programs like Every Kid Outdoors and the Outdoor Recreation Legacy Partnership.

Support for Compliance and Permitting

It is critical to increase funding for compliance and permitting offices of Federal agencies to expedite project delivery without undermining careful environmental review and protections for environmental justice communities.

We stand ready to work with you to advance these critical investments as part of the American Jobs Plan.

**Load-Date:** July 2, 2021

**End of Document**



[***Radionuclides from the Fukushima Daiichi Nuclear Power Plant in terrestrial systems***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:693W-H851-F129-P0H8-00000-00&context=1516831)

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**Body**

Introduction

Nuclear power generated 2,563 TWh of electricity worldwide in 2018, with low greenhouse-gas ***emissions*** and little air pollution as by-products. However, environmental pollution by nuclear radioactive materials, especially during uncontrolled-release events, can have devastating consequences. The March 2011 large-scale nuclear accident at the Fukushima Daiichi Nuclear Power Plant (FDNPP) in Japan released 520 PBq of radionuclides excluding noble gases–, such as radiocaesium (137Cs, 134Cs), radioiodine (131I), radiostrontium and uranium, among others, to the atmosphere. This release spread radioactive onto the ocean and throughout the Fukushima region, including 10 PBq of 137Cs and 120 PBq of 131I (ref.) (Fig. ). Of the radionuclides, 137Cs had the most substantial long-term impact on terrestrial contamination and human health released by the FDNPP accident, owing to its high release rate and relatively long half-life (30.1 years),. Therefore, it is particularly important to understand the fate and dynamics of the fallout 137Cs (refs–).

137Cs deposition and ***land***-use type in the 80-km radius from the FDNPP.

The Fukushima Daiichi Nuclear Power Plant (FDNPP) is located on the east coast of Fukushima Prefecture, Japan (grey area in the inset map of Japan). a | 137Cs deposition density within 80 km of the FDNPP, based on airborne monitoring calibrated by the soil sampling of 2,200 points,. The area with a deposition above 1,480 kBq m−2 is bordered by a thin white line and is mostly to the north-west of the FDNPP. b | ***Land*** use within 80 km of the FDNPP, including a small urban area (in grey) around the FDNPP, which is surrounded mainly by dense ***forest*** (dark green) and paddy fields (light blue). The area surrounded by a red dotted line is designated as a special decontamination area. In this area, decontamination activities were carried out by the Japanese Ministry of the Environment. In both panels, the Abukuma River basin is enclosed by a black dotted line.

The atmospheric release, of 137Cs and direct release of radioactively contaminated water from the power plant into the ocean are both well understood. Similarly, the oceanic transport and redistribution of 137Cs after the FDNPP accident were intensively monitored and modelled,. In seafloor sediments surrounding Fukushima, the activity concentrations of 137Cs declined rapidly due to sediment transport and dilution in the ocean. Indeed, 16–19 PBq of 137Cs was released to the marine environment through atmospheric deposition and direct discharge, and 137Cs activity concentrations decreased due to the dilution effect from the mixing of the contaminated seawater with low 137Cs oceanic water during the 8 years following the accident.

The impact of FDNPP radionuclide fallout in the terrestrial environment is less well known than in the marine environment. Indeed, the terrestrial post-accident ‘self-cleaning’ (ref.) and rapid reduction of exposed radioactivity has surprised researchers, as it was assumed that, based on observations made after the Chernobyl Nuclear Power Plant (CNPP) accident in Ukraine, the reduction of the exposed radioactivity in the environment would take much longer. The 1986 CNPP accident is the only other accident rated at the maximum level on the International Nuclear Event Scale. While dissolved 137Cs activity concentrations decreased rapidly in European rivers and lakes within several months after the CNPP accident, a second, much slower rate of decline followed,. This long-term slow decline of 137Cs in catchment soils and water caused 137Cs to persist in freshwater fish in Norway and the United Kingdom for several decades after the accident. However, differences between the radionuclide composition, post-accident environmental recovery efforts and local environmental factors led the terrestrial areas impacted by the FDNPP to recover more quickly than expected.

In this Review, we discuss the fate of the radionuclide fallout — notably of 137Cs — on Japan after the FDNPP accident. We examine the downwards migration of 137Cs through ***forests*** and soil, remobilization from hillslopes and transport through rivers, and the factors that influenced the radionuclide movement. The environmental recovery of the impacted region post-accident is compared with that after the CNPP accident. Finally, we highlight some of the scientific lessons learned from continual monitoring and emphasize the importance of maintaining these lessons and data for future researchers.

Environmental distribution of 137Cs

Following the FDNPP accident, 2.7 PBq of 137Cs was deposited onto the terrestrial environment, 67% of which fell out onto ***forests***, 10% onto paddy fields, 7.4% onto cultivated areas and grasslands, and 5.0% onto urban areas (Figs ,). Although wet deposition (associated with rainfall and snowfall) accounted for 98% of the total deposition,, dry deposition (interception of gases phases under gravity, diffusion processes or by turbulent transfer) dominated along the coastline around the FDNPP,. Approximately 80% of the total 137Cs deposition onto ***land*** surface occurred within the combined catchment areas of the Abukuma River (the largest river in the region) and small coastal rivers located in the 80-km radius area from the FDNPP (for a total area of 9,862 km2). Of this ***land***, 3,900 km2 was contaminated by at least 100 kBq m−2 of 137Cs fallout and 254 km2 was subjected to severe 137Cs fallout of at least 1,480 kBq m−2 (ref.) (Fig. ).

Migration and monitoring of 137Cs in the terrestrial environment.

After the 2011 nuclear accident in Fukushima, Japan, 137Cs was deposited on ***forested*** areas, ***agricultural*** ***land***, grassland, paddy fields, and urban and residential areas. After deposition, 137Cs migrated through soil and into rivers. Some of the 137Cs in rivers was discharged into the ocean, including approximately 10 TBq of 137Cs that was discharged from the Abukuma River basin to the Pacific Ocean between June 2011 and March 2017. In the years following the accident, there was extensive monitoring, including soil, groundwater and river water monitoring. The arrows in the figure represent 137Cs transfer.

***Forested*** areas

***Forested*** areas experienced most of the FDNPP 137Cs fallout in the terrestrial environment — 2,600 km2 of ***forest*** received 137Cs fallout greater than 100 kBq m−2 (refs,). Some of this fallout was deposited directly onto the ***forest*** floor, but in evergreen ***forests*** (such as those dominated by Japanese cedar), 60–90% of the deposited 137Cs was intercepted by tree canopies– (Fig. ). Washing experiments of the contaminated foliage and branch wood showed that 50–60% of the intercepted 137Cs was firmly fixed on the tree biomass. However, only 10–25% of the 137Cs was intercepted by the canopy in deciduous broadleaf ***forests*** (such as those dominated by Japanese oak), as the fallout period occurred prior to canopy regrowth, (Fig. ). These variations in radionuclide interception resulted in a wide range of contamination levels in ***forest*** components and accumulated radiation doses to human and ***forest*** wildlife–.

137Cs distribution and transfer in ***forests***.

a | Initial fallout in cedar ***forests***. During the initial fallout in 2011, 442 kBq m−2 137Cs was deposited onto experimental Japanese cedar ***forests*** in Yamakiya district, Kawamata town of Fukushima Prefecture, most of which was intercepted by the cedar needles and branches. The values without units show 137Cs inventories (kBq m−2) in each component, whereas the percentages in parentheses denote inventory ratio to total atmospheric fallout deposited on the ***forest*** following the accident. b | 137Cs inventory in the cedar ***forest*** in 2018. Most of the 137Cs had migrated to the soil via litterfall, throughfall and stemflow. The numbers next to the arrows indicate downwards (from the canopy to the ***forest*** floor) and upwards (from the soil to trees) migration flux of 137Cs inventory (kBq m−2), where the percentage values for throughfall, stemflow and litterfall represent the contribution of each pathway to the total downwards transfer of 137Cs. c | Temporal changes in the 137Cs inventory of the experimental Japanese cedar ***forests*** in kBq m−2 after the accident,,,,,,. d | Initial fallout in broadleaf ***forests***. In an experimental Japanese broadleaf (oak) ***forest*** at the same site, 451 kBq m−2 137Cs was deposited, with most of the 137Cs reaching the litter layer. e | 137Cs inventory in the oak ***forest*** in 2018. Like in the cedar ***forest***, the most 137Cs was present in the soil layer, with notable activity concentrations in the parts of trees. f | Temporal changes in the 137Cs inventory of the experimental Japanese oak ***forests*** in kBq m−2. The 137Cs transfer between compartments ‘canopy’, ‘wood’ and ‘soil’ was calculated based on the temporal trends of activity concentrations and inventories in each ***forest*** component. The data are derived from the intensive field observations at the experimental ***forest***, regarding the transfer from the canopy to the ***forest*** floor via hydrological and biological pathways–,,,, the temporal changes of 137Cs inventories in different parts of tree components and the distribution of 137Cs in the organic and mineral soil layers,.

The distribution of 137Cs within ***forests*** changed significantly within the first year after the fallout (referred to here as the first phase), (Fig. ). During this phase, 137Cs was transported from the canopy to the ***forest*** floor through hydrological,,,– and biological processes–,,. Hydrological pathways such as and were initially the most important in transporting 137Cs and were responsible for 70% of the total flux from the canopy to the ***forest*** floor in the first year, mostly (>80%) in the dissolved form. Whereas 137Cs from the contaminated ***forest*** leached efficiently to throughfall during the early phase of contamination, the leaching rate of 137Cs from the canopy to throughfall decreased over time, owing mainly to the internalization of surface contamination by the trees. In these early stages of deposition, 137Cs accumulated mainly in the organic matter at the surface of the ***forest*** floor, before migrating deeper into the subsoil.

Around one year after the fallout (referred to here as the second phase), played an increasing role in the migration of 137Cs from the canopy to the ***forest*** floor,,,. Owing to the combination of throughfall, stemflow, litterfall and , the contamination of trees as a whole decreased during the 8 years of observation after the accident,,. 137Cs activity concentrations in foliage, which was initially the most highly contaminated part of the trees, decreased faster than the contamination of perennial parts of the trees, such as wood and bark, (Fig. ). Indeed, in some trees, such as the Japanese oak, wood contamination showed an increasing trend after the accident–. For Japanese cedar (a coniferous tree), the initial increasing trend in 137Cs activity concentrations in the wood was followed by stabilization or a slight decrease 4–5 years after the accident.

The continuous, intensive monitoring of 137Cs distribution and its transfer in several ***forests*** in Fukushima revealed detailed post-depositional redistribution of 137Cs in ***forest*** ecosystems. The 137Cs activity concentration of the above-ground vegetation in an evergreen coniferous ***forest*** decreased to less than 3 % of initial levels due to the processes in the 8 years after the accident (Fig. ,). Over the same period, the loss of 137Cs from the canopy to the ***forest*** floor and uptake from root to tree reached quasi-equilibrium conditions (Fig. ). Canopy contamination decreased more slowly in a deciduous ***forest***,,, where the canopy and tree trunks retained 11% of the total 137Cs inventory 8 years after the accident (Fig. ,). Root uptake of 137Cs from soil to tree organs coincided with deposition onto the ***forest*** floor, but the impact of root uptake was masked by the rapid reduction of canopy contamination and direct uptake from foliage and bark surfaces during the first year after the initial deposition (Fig. ). Nevertheless, once the 137Cs loss from the contaminated canopy decreased several years after the fallout, the 137Cs inventory in stem wood tended to increase, possibly due to root uptake,. This later uptake implies that the deciduous trees and ecosystems are slower to reduce their levels of radioactive contamination relative to evergreen ***forests***.

Continuous monitoring of the depth distribution of 137Cs in ***forest*** soil showed that 137Cs activity concentrations were greatest in the litter layer for 2–3 years after fallout and then in the uppermost mineral soil layer on the ***forest*** floor, relating to the downwards migration of 137Cs from decomposing organic matter on the ***forest*** floor–. The percentages of 137Cs inventory in 0–2 cm of soil increased from 18% in 2011 to 48% in 2015 (ref.). Downwards migration of 137Cs from the uppermost soil layer to subsoil occurs slowly over the timescale of decades,,, although the continuous input of 137Cs to the ***forest*** floor from litterfall can cause the downwards migration of 137Cs in ***forest*** soil to appear slower (Fig. ).

The loss of contaminants deposited on ***forest*** catchment occurs through erosion of sediment and organic matter through the groundwater-fed headwater streams, (Fig. ), which had an annual discharge flux 137Cs of less than 0.3% of the initial fallout to the catchment area,–. Lateral transport of litterfall led 137Cs to also accumulate at the bottom of hillslopes — litter 137Cs activity concentrations along a steep hillslope were found to be 2.4–2.7 times greater than those of deposited organic matter under stream water in both Japanese coniferous and deciduous ***forests***. Such transport of 137Cs along ***forest*** hillslopes to riparian areas downhill could enhance 137Cs discharge from the ***forested*** area through drainage. In the experimental ***forested*** headwater catchment at Yamakiya, Japan, the 137Cs activity concentrations of litter layers were in the range 37–150 kBq kg−1 (ref.), with activity concentrations of 0.01 Bq l−1 to 0.1 Bq l−1 for the mobile 137Cs (ref.) stored in the litter leachate in the upper soil layer of the ***forest*** hillslope–. During storm events, the saturated zone of the soil expands upslope into the area covered by thick, 137Cs-contaminated organic layers, potentially leading to the temporary increase of the activity concentration of dissolved 137Cs in stream water observed at the beginning of a rainstorm,. Despite the differences between the first and second phases of depuration in the vegetation and litter layer, the efficiency of 137Cs ***removal*** from the ***forested*** catchment as a whole likely has not changed, and ***forested*** areas can, thus, act as a long-term source of dissolved 137Cs in river waters,. Overall, some litter-bound 137Cs was transported downslope, but as it can be discharged only through stream riparian zones,, the 137Cs fallout in ***forest*** ecosystems largely have not been transported out of the system.

Farmlands and grasslands

Approximately 40% of the 900 km2 of farmlands and grasslands shown in Fig.  received over 100 kBq m−2 of 137Cs, for a total of 0.16 PBq of 137Cs. The 137Cs was deposited onto both vegetation, where it adhered to leaves and was eventually transferred to surface soils,, and directly onto the soil, where it was first retained in the upper several centimetres and then migrated to deeper layers. In July 2011, for example, 71%, 21% and 7% of 137Cs in a meadow was present in the soil, litter and standing dead material, respectively. Between July 2011 and January 2012, the percentage of 137Cs retained in litter relative to the total 137Cs inventory in soil dropped from 19% to 0.8% in a pasture and from 69% to 14% in a meadow. Notably in farmland, the 137Cs activity concentration in the tillage layer was relatively uniform with the depth of tillage. In general, the 137Cs migration into deeper soil depended on soil characteristics such as porosity, particle-size distribution and 137Cs interception potential,–.

From the soil, 137Cs was transferred to vegetation via plant uptake, the ratio of which depends on the plant species and soil properties such as soil pH and cation-exchange capacity. The transfer factors (137Cs activity concentration in ***agricultural*** products divided by 137Cs activity concentration in dry soil) of various ***agricultural*** products have been intensively investigated and published,. For example, transfer factors of edible parts in 24 vegetables ranged from 0.0001 to 0.0054 in a series of test cultivations. The application of potassium is an effective measure to regulate the uptake of 137Cs by plants for both farmland and grassland–.

The lateral movement of 137Cs from the soil layer was driven by water and sediment movement,, which was influenced by the erosivity of rainfall, erodibility of soil, slope gradient and length, vegetation cover and vertical distribution of 137Cs in soil. The 137Cs wash-off from farmland and grassland, therefore, differed, and the activity concentration of 137Cs in sediments eroded from farmlands (typically cultivated to the depth of 15 cm) was low and homogeneous compared with those from uncultivated farmland, owing to soil mixing by tillage,. The tillage resulted in an approximately 60% decrease in 137Cs activity concentrations in eroded sediments in a cultivated farmland compared with an adjacent uncultivated farmland Despite the low 137Cs activity concentration of eroded sediments, soil erosion was enhanced by tillage, so that up to 15% of the initially deposited 137Cs in a cultivated farmland was lost through run-off in 3 years during 2011–2014 (ref.). In contrast, there was generally little lateral movement of 137Cs in grasslands owing to permanent vegetation cover, which reduces surface run-off and soil erosion,. Annual grassland 137Cs losses due to wash-off ranged from 0.0029 to 0.067% per year, given an annual rainfall of 1,200–1,600 mm (ref.). Overall, the activity concentration in soil lost from grasslands showed huge variability and no significant decreasing trend over the observation period (2011–2014). 137Cs washed off from farmland and grassland is transported to the rivers, where can be transported into the ocean, though a large part of ***agricultural*** ***land*** is poorly connected to the rivers, so the export into rivers is expected to be smaller.

Paddy fields

Approximately 37% of the paddy fields within the 80-km-radius zone of the FDNPP received over 100 kBq m−2 of 137Cs fallout (Fig. ). At the time of the accident, paddy fields were not irrigated, so most of the 137Cs deposited on the ground was retained in the upper several centimetres of soil initially, as reported in other undisturbed fields,. However, 137Cs is mixed into the top 20 cm of paddy soil every year during soil puddling (the mixing of soil and irrigation water), rice planting and cultivation under flooding conditions from spring to early autumn,–, leading to an activity-concentration decrease in the upper centimetre of soil. For example, 137Cs activity concentration in the top 4 cm of soil decreased from 3,200 Bq kg−1 to 2,400 Bq kg−1 during the observation period from 2012 to 2014 (ref.).

After the initial fallout, there were main two routes for 137Cs movement into and out of paddy fields: irrigation water inflow and discharge. The 137Cs input to the paddy with irrigation water, which is drawn from streams, rivers and ponds, was negligible compared with the 137Cs inventory of the soil, and contributed only 0.03–0.75% of the total 137Cs in the paddy fields,,. Discharge of 137Cs from paddy fields was caused by flooding related to puddling of paddy soil and rainfall, enforced drainage before rice planting and harvesting, and wash-off due to rainfall. During the irrigation period, 0.67–7.3% of total 137Cs in the paddy fields in 2011 and 0.0025–0.063% in 2013 and 2014 was discharged,,, with the puddling of paddy soil sometimes accounting for over 90% of the total annual 137Cs discharge, especially in the first puddling after the fallout. Subsequent 137Cs discharge varied with the rainfall event and paddy maintenance.

Urban areas

Approximately 37% of the impacted urban areas (which were 7.9% of the area within 80 km of the FDNPP) received over 100 kBq m−2 of 137Cs deposition (Fig. ). Urbanized areas comprise diverse components such as paved grounds, roofs, walls and permeable ground, and the activity per unit area varied across these components, owing to the differences in initial run-off and the following wash-off effects. For example, 137Cs inventories of the paved ground and other building surfaces were 20% and less than 1% of that of permeable fields, respectively, 4 years after the FDNPP accident. Indeed, in permeable fields such as a grassland in a residential area, 137Cs migrated into the soil without 137Cs loss due to run-off associated with precipitation–. In contrast, impermeable surfaces such as paved grounds and roofs retained 137Cs on their surface upon deposition,, but a large proportion of the 137Cs was removed by the initial run-off and the following wash-off associated with precipitation, and was transported into river systems directly or via wastewater-treatment plants, (Fig. ). The rapid ***removal*** of 137Cs from urban surfaces is consistent with those observed after the CNPP accident–.

The 137Cs activity concentration of sludge in wastewater-treatment plants was highest during the initial period. In the case of a catchment in Fukushima city, which had a catchment area of 41 km2 and 137Cs deposition density of approximately 300 kBq m−2, 137Cs activity in dewatered sludge ranged from 467 to 6,158 Bq kg−1 from the end of April to July 2011 (refs,). The 137Cs activity concentration decreased over the first year post-accident by about one order of magnitude, (a rate faster than those observed in other ***land*** uses), further demonstrating the rapid initial ***removal*** of 137Cs from urban areas,. Although there is no quantitative information on the rate of 137Cs loss from the various urban compartments or urban catchment, early ***removal*** of 137Cs from urban areas implies that there was a large initial migration of 137Cs from the urban area into river systems, with less migration as time proceeded.

Environmental migration of 137Cs

After deposition onto ***forests*** and the ground, radionuclides migrated through the soil and to and through rivers, and eventually into the ocean (Fig. ). Approximately 10 TBq of 137Cs was discharged from the Abukuma River basin to the Pacific Ocean between June 2011 and March 2017, corresponding to 4.8% of the initial deposition,. As 13% of the initial deposition physically decayed in the period, 82% of the 137Cs was retained in the catchment.

Migration through soil

Most of the fallout 137Cs deposited on the soil surface was present in the upper 5 cm of soil,,, where it was sorbed by clay minerals, (Fig. –). Generally, the initial distribution was influenced by the first rainfall post-accident, but was not substantially impacted by subsequent heavy rainfall. However, convective transport by flowing water, diffusive movement within the fluid, physical mixing and erosion of soil particles, and bioturbation caused slight migration of 137Cs in the soils,. Furthermore, many studies have shown that the chemical form of 137Cs, soil texture, organic matter and water permeability would have strongly influenced the distribution and migration of 137Cs in soils,, although few studies have quantified the downwards migration through continuous field monitoring.

Temporal changes in the vertical distributions and relaxation mass depth of 137Cs activity concentrations.

a | Temporal changes of 137Cs activity concentrations (kBq kg−1 soil) in ***forest*** soils plotted by depth (cm) and mass depth (g cm−2) for the years 2011, 2013 and 2015. Litter layers are shown as brown bars. Relaxation mass depths β (g cm−2) are labelled with a black arrow and their corresponding values. b | Temporal changes of 137Cs activity concentrations and β in abandoned paddy field soils plotted by depth and mass depth for the years 2011, 2012 and 2014. c | Temporal changes of 137Cs activity concentrations and β in cultivated paddy field soils plotted by depth and mass depth for the years 2012, 2013 and 2014. d | Scatter diagram of β in ***lands*** with various uses in Fukushima post-accident, with values from three soil types in grasslands and abandoned farmlands impacted by the Chernobyl Nuclear Power Plant (CNPP) accident for comparison. With time post-accident, 137Cs generally migrated deeper into the soil and β increased. The migration rates and soil profiles differed between ***land*** uses and anthropogenic activities. Blue circles are urban ***lands***, (number of sites, n = 55–83, β = 0.33t + 0.86, r = 0.99, P < 0.0001), red diamonds are abandoned paddy fields (n = 1, β = 1.3t + 0.72, r = 0.93, P < 0.01), orange squares are cultivated paddy fields (n = 1, β = 0.56t + 6.95, r = 0.82, P = 0.18), yellow squares are abandoned pasture and farmlands (n = 3, β = 0.09t + 1.17, r = 0.21, P = 0.73), green triangles are ***forest*** sites (n = 3, β = 0.04t + 0.53, r = 0.56, P = 0.09), white squares are CNPP-impacted sandy loam and loamy soils– (n = 2–4, β = 0.37t + 2.40, r = 0.72, P = 0.28), black diamonds are CNPP-impacted loamy sand and sandy soils (n = 1–7, β = 0.29t + 1.76, r = 0.89, P < 0.05) and grey circles are CNPP-impacted organic soils, (n = 1–3, β = 0.36t + 0.10, r = 0.87, P = 0.06). Error bars represent standard deviations, solid lines represent significant correlations with time and dotted lines represent non-significant correlations with time. The β values were calculated without litter layers.

As was observed in the environment, the 137Cs rapidly migrated from the litter layer to the mineral soil surface in ***forest*** sites (Fig. ). However, the downwards migration of 137Cs from the surface soil layer (0–5 cm) to deeper soil layers was slower in ***forests*** than in other ***land*** uses, and the , β, apparently did not change substantially over time because of continuous input from the litter layer (green line in Fig. ; see for calculations of β). Downwards migration of fallout 137Cs was fastest in abandoned paddy fields (red line in Fig. ), where the 137Cs activity concentration in the upper 10 cm of soil was fairly homogeneous by 3 years after the fallout (Fig. ). This increase in β contributes to a decrease in the (as 137Cs in the top few centimetres of soil contributes most of the air dose) but also reduces the efficiency of decontamination efforts, which typically involve scraping off the top 5 cm of soil. For example, approximately a third of the original fallout 137Cs remained after decontamination attempts removed the top 5 cm of soil in an abandoned paddy field in 2015 (ref.). The downwards migration (mixing) of 137Cs in cultivated paddy-field soils also occurred in the years following the accident (Fig. ). Indeed, the residence half-life of 137Cs in the ploughed layer of paddy fields is estimated to be 9–24 years. The values of β in urban sites revealed a linear increase of approximately 0.3 g cm−2 per year (blue line in Fig. , based on an average of 55–83 sites for each year post-accident).

137Cs continues to migrate downwards in mineral soils, affecting the air dose. However, the percentage of 137Cs inventory in soils deeper than 10 cm is still small, at less than 10% as of 2017 (ref.). As downwards migration is likely continue, long-term future monitoring will be required.

Transport into rivers

Erosion and run-off of sediments and soils transported 137Cs into rivers (Fig. ), which was measured as Sc (m2 kg−1), the 137Cs activity concentrations in transported sediments (Bq kg−1) normalized by local 137Cs inventory at the time of initial deposition (Bq m−2) after the accident,,. The amount of 137Cs transported varied between ***land***-use types and with time after the accident. For example, Sc values for paddy-field experimental plots were 0.15 m2 kg−1 initially and drastically decreased with time to 0.016 m2 kg−1 by 2018 (Fig. ). The decrease was most notable during the first year and slower in subsequent years; recent data show no declining trend. In contrast, the Sc of grasslands and cultivated farmlands did not show a significant decrease with time,. In the farmlands, the Sc values were low, ranging from 0.0021 to 0.040 m2 kg−1 (average of 0.015 m2 kg−1), which is attributed to the redistribution of 137Cs to deeper soils during ploughing. Grassland Sc values were more variable owing to erosion, ranging from 0.0018 to 0.15 m2 kg−1 (average of 0.031 m2 kg−1),, and the overall amount transported was low.

Temporal trends in 137Cs Sc values.

Sc (m2 kg−1) is the normalized 137Cs activity concentration in transported sediment and is obtained by dividing the 137Cs activity concentration in sediment (Bq kg−1) by the initial 137Cs deposition on the plot or catchment of interest (Bq m−2). Data for paddy fields until the third year after the accident were derived from ref. and those in subsequent years were derived from ref. based on measurements of 137Cs activity concentration in a turbid water paddy field at paddling periods. Data for cultivated farmland and grassland were derived from refs,. The data for ***forested*** catchments until 2.5 years after the accident were derived from the Koutaishi site and those in subsequent years were derived from the Setohachi site in ref.. Data for urban catchments were derived from ref.. Temporal trends of Sc at the years since the FDNPP accident (t, year) were expressed by the following equations; Sc = 12e−18t + 0.030e−1.3t + 0.021e−0.031t for paddy fields, Sc = 0.068e−0.25t for ***forested*** catchments and Sc = 0.19e−0.40t for urban catchments.

Notably, the Sc values for paddy fields showed larger values (maximum of 0.15 m2 kg−1) than other ***land*** uses in the initial period and decreased one order of magnitude during the initial half-year after the accident (during the first phase) (Fig. ). The following period (the second phase) showed a slower decrease in Sc with time down to 0.016 m2 kg−1 in 2018, but the decrease was still at a faster rate than that observed for other ***land*** uses. Compared with other ***land*** uses, paddy-field discharges had a marked impact on 137Cs in downstream water bodies during the first phase,,. Although no substantial discharge into rivers was reported during the second phase,, the suspended sediment discharged from paddy fields is often described as being transported directly to the river (100% sediment connectivity), indicating the continuing importance of paddy fields to the downstream transport of 137Cs through rivers. Decontamination by scraping the surface soil — the most effective measure for reducing the activity contamination of 137Cs discharged — was widely conducted, even within the evacuation zone (Box ). In one case study, surface ***removal*** reduced the 137Cs activity concentration in paddy soil to about 3% of the initial value. These activities reduced the contribution of paddy fields to 137Cs in river systems,.

Both ***forested*** and urban catchments were sources of 137Cs into rivers, with Sc values of 0.0031 to 0.064 m2 kg−1 (mean of 0.030 m2 kg−1) and 0.034 to 0.26 m2 kg−1 (mean of 0.083 m2 kg−1), respectively, from 1.5 to 4 years post-accident (3.6 and 1.7 times higher than the Sc values of paddy fields). Sc values in the urban catchment decreased with a rate of 0.40 year−1 during 2012–2015, and a rapid decrease was found during 2012–2013. By contrast, Sc values in the ***forested*** catchment showed a decrease with a rate of 0.25 year−1 during 2012–2016.

Wastewater treatment plant sludge values suggest that there was a rapid decline in the run-off Sc from urban areas, similar to that of paddy fields,. The relatively high Sc in urban areas can be attributed to decontamination activities, such as road-dust sweeping and brushing, resulting in preferential transport of sediment with a high 137Cs activity concentration, though the detailed processes are not fully understood. Similarly, rapid decreases of Sc values in the paddy fields and the urban catchments in the first 2 years and slight decreases in the subsequent years were found. Together, these results point to the conclusion that catchments highly affected by human activities showed a rapid reduction of 137Cs activity concentration in suspended sediment in river water.

Box 1 Decontamination

Decontamination of areas impacted by radionuclide fallout was undertaken after the Fukushima Daiichi Nuclear Power Plant accident to reduce public exposure. In the Fukushima Decontamination Pilot Project, conducted from 2011 to 2012, decontamination measures were tested to explore technical feasibility, efficiency and costs. The Japanese Ministry of the Environment established decontamination guidelines based on the results of the project at the end of 2011 and provided an update in 2013 (ref.).

Decontamination focused on residential areas such as buildings, roads, ***agricultural*** fields, bare ground in urban areas and ***forests*** adjacent to houses. In general, decontamination of impermeable surfaces (such as building surfaces and asphalt roads) included the manual ***removal*** of surface sediments, wiping, brushing, high-pressure water washing and scraping, with the appropriate methods untaken in stages that depend on decontamination efficiency. Decontamination methods in ***agricultural*** fields included scraping off the surface soil and deep ploughing. For trees within 20 m of residential areas, their bark was washed and branches pruned.

The decontamination efficiency depended upon the objects to be decontaminated and the methodology used. The Decontamination Pilot Project reported that decontamination reduced 20–70% of the air-dose rate at 1 m above ground in ***agricultural*** fields and 40–95% of the rate on asphalt pavement. Soil scraping also showed relatively high air-dose reduction efficiency among the decontamination methods.

Decontamination outside of the evacuation zone was completed by 19 March, 2018 (ref.). The decontaminated areas were more than 41,000, 12,000 and 15,000 ha for ***agricultural*** fields, ***forests*** and roads, respectively, over Fukushima and surrounding prefectures. The total volume of soil and waste collected during decontamination was estimated at around 14 million m3 (ref.).

| **Objects or areas** | **Components** | **Methods** |
| --- | --- | --- |
| Artificial structures | Buildings and others (such as fences) | ***Removal*** of surface sediment; brushing |
| Yards | Scraping off surface soil |  |
| Roads | Paved surfaces | Sweeping road dust; washing using water jet or brushing; surface scraping or ***removal*** |
| Unpaved surfaces | Topsoil stripping; reversal tillage; covering using clean soil |  |
| Bare ground | Playgrounds and ***agricultural*** fields | Topsoil stripping; reversal tillage for fields with <5 kBq kg?1 of 134+137Cs; deep tillage for fields cultivated before decontamination |
| Vegetation | Lawns | Deep mowing or ***removal*** with soil |
| Trees | Branch trimming; trunk washing |  |
| ***Forest*** and ***forest*** floor | Litter and surface soil ***removal***, |  |

Riverine transport

137Cs was present in rivers and other water bodies as dissolved ions (which are relatively easily absorbed by plants and aquatic organisms) and sorbed to (including 0–46% of total suspended particles as Cs microparticles)–. ***Land*** use in the river catchment had the greatest influence on the distribution and activity concentration of both dissolved and particulate 137Cs (refs,), but whereas catchment-soil type was an important factor impacting dissolved 137Cs, precipitation and slope significantly influenced particulate 137Cs. For example, a large rainfall event caused by Typhoon Roke in September 2011 resulted in substantial flooding, which significantly increased the riverine flux of particulate 137Cs (refs–). Additionally, particulate 137Cs activity concentrations are affected by the presence of suspended fine particles such as silt and clay, which adsorb 137Cs more efficiently than coarse particles such as sand,, and by the organic-matter contents of suspended particles, as higher contents adsorbed more 137Cs (ref.). In the Abukuma River between June 2011 and August 2015, more than 96.5% of 137Cs was transported in the particulate form, owing to a high activity concentration of sediment run-off caused by the steep mountains and heavy rainfall.

Most of the 137Cs associated with riverine suspended particles was eventually transported into the ocean and little was redeposited. However, fine sediment can be deposited on the riverbanks after storm events — the percentage of 137Cs deposited on the riverbank was estimated to be 0.77% of the total flux in the lower reaches of the Abukuma River after a typhoon in September 2011 (ref.), and a typhoon in 2013 caused a 15% and 18% increase in the 137Cs deposition and the air-dose rate,, respectively. Similarly, exceptional deposition has been reported along riverbeds during large flood events when water levels drop, as well as in large lakes and reservoirs — over 70% of 137Cs was retained in the case of Ogaki Dam,.

One week after the accident, 70 ± 10 Bq l−1 of total 137Cs (the sum of dissolved and suspended forms) was found in the river water in a small tributary of the Abukuma River in Fukushima city. Across the catchment, the activity concentration of dissolved 137Cs continuously decreased relative to the initial deposition,,,,– (Fig. ). The dissolved 137Cs activity concentration in rivers decreased proportionally with the decrease in particulate 137Cs, indicating that 137Cs fixation to mineral particles is not the primary cause of the decline in the activity concentration of 137Cs in Fukushima rivers. If the amount of 137Cs irreversibly adsorbed to the particles had increased, the ratio of particulate to dissolved 137Cs (defined as , a solid–liquid distribution coefficient) should have increased with time, which was not observed.

137Cs activity concentrations in rivers impacted by the FDNPP accident.

a | Activity concentrations of dissolved 137Cs normalized by the initial deposition density, θ, in rivers affected by the Fukushima Daiichi Nuclear Power Plant (FDNPP) accident,,,,–. The black dotted line at the top shows the decrease in θ due to the physical decay of 137Cs, the grey dashed lines are the upper and lower limits of the range in European rivers after the 1986 Chernobyl Nuclear Power Plant (CNPP) accident and the blue dotted line shows the decline of θ in the Pripyat River after the CNPP accident (θ = 0.41e−13t + 0.041e−0.43t + 0.0023e−0.043t),. The range of θ in Japanese rivers after the FDNPP accident is lower than that of European rivers after the CNPP accident. b | Activity concentrations of particulate 137Cs normalized by the initial deposition density C′(t) in rivers affected by the FDNPP accident,. The black dotted line shows the decrease in C′(t) due to the physical decay of 137Cs only. The grey curve indicates a double exponential equation fitted by all observed data at 29 monitoring sites C′(t) = 0.40e−3.6t + 0.062e−0.29t (P < 0.001), including rivers in both ***forested*** catchments (19 rivers, plotted in purple) and catchments with more than 30% of ***land*** used for paddy fields, farmland and urban areas (referred to as PFU; 10 rivers, plotted in yellow). The PFU river line is plotted as C′(t) = 1.5e−4.5t + 0.090e−0.36t (P < 0.001) and that of the ***forested*** area as C′(t) = 0.059e−0.26t (P < 0.001). The blue dotted curve shows the decline of activity concentrations of suspended 137Cs in the Pripyat River after the CNPP accidentC′(t) = 1.1e−2.3t + 0.26e−0.36t (P < 0.01). The initial decline rate averaged over the 29 river sites in Fukushima was faster than that in the Pripyat River. The shaded areas indicate the 95% confidence intervals of the regression curves. c | Quarterly loss of 137Cs (flux of 137Cs normalized by the initial deposition in the watershed) between June 2011 and March 2017 (refs,). The yellow and purple lines indicate averaged values at monitoring sites with over 30% coverage of PFU and ***forested*** areas, respectively, with shaded areas representing the ranges in the loss of 137Cs from the watersheds. Two sites with over 30% PFU were monitored from June 2011 through September 2012 and eight from October 2012 through March 2017. Four ***forested*** sites were monitored from June 2011 through September 2012 and nine from October 2012 through March 2017. Sites where there is a large reservoir lake in the watershed were excluded from the plot.

A six-year intensive continuous monitoring of the particulate 137Cs activity concentrations in rivers at 30 sites within 80 km of the FDNPP indicated an activity concentration decline in two phases,: the first year post-accident and years 1–6 post-accident. In the first phase, the particulate 137Cs activity concentration quickly decreased, dropping to approximately 10 % of the initial value, with the rate of decline varying amongst catchments (Fig. ). In catchments with more than 30% of ***land*** use related to human activities (paddy fields, farmlands and urban areas, referred to here as PFU), which have a higher run-off than ***forested*** areas, there is a rapid decline of 137Cs activity concentrations (yellow line in Fig. ). River catchments with low fractions of PFU (such as those with high ***forest*** cover) showed no such decline (purple line in Fig. ). The Abukuma River basin, for instance, has a high ***land***-use coverage related to PFU (30%) and a high initial rate of decline in 137Cs activity concentrations (2.9 year−1). The rate of particulate 137Cs decline in the second phase was between 0.06 and 0.66 year−1 (an average of 0.34 year−1), similar to those measured in reservoir lake sediments (0.33 and 0.44 year−1),, and the activity concentration was about 2% of the initial value by 6 years after the accident (Fig. ). The rate of decline was not correlated with catchment ***land*** use.

Based on the loss of particulate 137Cs from the catchment (calculated by dividing the quarterly 137Cs fluxes by the initial deposition in the watershed), only approximately 3% of the fallout 137Cs was transported from the Abukuma River watershed to the Pacific Ocean between June 2011 and March 2017 (refs,). Half of this 137Cs (1.5% of the total fallout) was lost within the first phase (June 2011 to Mar 2012), owing to high initial 137Cs activity concentration and a heavy-rainfall event caused by Typhoon Roke in September 2011 (ref.). The flux was also affected by the upstream ***land*** use, and the primary sources of 137Cs in the first phase were estimated to be the PFU areas (Fig. ). Indeed, 85% of the 137Cs transported from the Abukuma River into the ocean was of PFU origin, despite comprising only 38% of the ***land*** coverage. In the second phase, the loss of 137Cs from the upstream PFU decreased (Fig. ), as did the overall 137Cs flux from rivers into the ocean.

The high percentage of anthropogenic ***land*** use is likely responsible for the quick environmental recovery of the river water in Fukushima. The slowing decline of riverine 137Cs implies that ***forests*** store 137Cs over the long term, and the relative importance in 137Cs storage increases with time. Similarly, despite the declining riverine 137Cs activity concentrations after 2012 (refs,), the relative importance of riverine 137Cs fluxes into the ocean increases over time, as the direct release from the FDNPP decreases at a faster rate.

Other radionuclides

In addition to 137Cs, the FDNPP accident released substantial amounts of other radionuclides, such as activation (239Np and 59Fe) and fission products (131I, 134Cs (133Cs), 110mAg (109Ag), 132Te, 132I, 140Ba, 140La, 91Sr, 91Y, 95Zr and 95Nb), as well as 6,000–12,000 PBq of 133Xe (refs,), 43 TBq of 89Sr, 3 TBq of 90Sr (ref.), 3.9 MBq of total U and 0.023 TBq of 239+240Pu (ref.). Notably, the rapid decay of short-lived radionuclides such as 131I and 132Te/132I reduced total radiation sources by 15% in the first month.

Some fallout radionuclides (besides 137Cs) were detected in soil samples one month after the accident. For instance, high deposition densities of 129mTe and 110mAg were observed north-west of the FDNPP site. Environmental data show fairly consistent ratios between 137Cs and 129mTe or 132Te, indicating that Cs and Te behave in the same way. The ratio of 110mAg to 137Cs is several factors higher in the north-west region near the FDNPP. Although radioiodine (131I and 129I) was highly concentrated north-west of the FDNPP,,, and the deposition density of 131I above 3 MBq m−2 was distributed up to approximately 20 km north-west of the FDNPP as of 2 April 2011(ref.), it was also concentrated south of the FDNPP. The difference between the radioiodine and 137Cs patterns is possibly the result of differences in the ways these materials settle out of the air. Moreover, in the highly contaminated soils from the Mano catchment (north-west Fukushima), the proportion of Pu originating from the FDNPP was very low (<7.0 ± 4.5% of the total Pu present), suggesting a low deposition of FDNPP-derived Pu in this area relative to the global fallout.

Compared with 137Cs activity concentrations, 90Sr activity concentrations were generally 3–4 orders of magnitude lower — 90Sr:137Cs ranged from 10−2 to 10−4 in surface soils within the 50-km-radius area from the FDNPP. Specifically, there was a maximum deposition density of 5.7 × 103 Bq m−2 90Sr (ref.) and activity concentration of 90Sr in soil samples ranging from 0.2 to 23.4 Bq kg−1 (refs–), which are similar to the background level (0.2 to 17.7 Bq kg−1). Therefore, these radionuclides have a very small impact on the terrestrial environment of Fukushima.

Soil profiles indicate that 90Sr, 129I and 131I migrated downwards more quickly than 137Cs (refs,,,). 90Sr:137Cs in soil samples increased with depth by up to one order of magnitude by 2013 and 2014 (in other words, the downwards migration of 90Sr was much higher than that of 137Cs). The downwards migration rate of 129I was approximately four times faster than 137Cs in the same place, due to lower Kd values. Although the initial depth profile of 131I was similar to 137Cs (ref.), the subsequent downwards migration rate of 131I was slightly higher. In contrast, 110mAg was used in the sediment fingerprinting in a different area impacted by fallout, because of the similarities to 137C in terms of its depth profile, downwards immobility and Kd values,,.

Relatively long-lived radionuclides, including 90Sr, 129I and 3H, were observed in rainwater, river water and groundwater after the FDNPP accident from 2011 to 2013 (refs,,–). For instance, the Niida River had an estimated particulate 129I flux of 7.6–9.0 kBq month−1 during September and October 2013 (ref.), corresponding to around one 129I for every million 137Cs. In 2011, groundwater samples taken in the Yamakiya district slightly exceeded the natural background level of 3H after the FDNPP accident, and riverine 3H activity concentrations were still higher than the background level in 2012 (ref.); activity concentration decreased with time in both places.

Comparison with Chernobyl

Natural comparisons have been drawn between the impacts of the accidents at the CNPP and the FDNPP. Overall, the FDNPP accident was less environmentally impactful than the CNPP accident — a total activity of 5,300 PBq (excluding noble gases) was released during the latter, compared with 520 PBq by the FDNPP. In particular, the CNPP accident released very highly radioactive fuel particles (mainly uranium dioxide) with refractory and intermediate volatility elements. Furthermore, an estimated 85 PBq (ref.) of 137Cs was deposited on ***land*** by the CNPP accident, including over 1,480 kBq m−2 onto 2,800 km2 (an area 11 times larger than the area around Fukushima with over 1,480 kBq m−2) and over 100 kBq m−2 onto 25,000 km2 (ref.). Large-scale decontamination efforts after the FDNPP accident (Box ) also influenced the differences in the environmental impacts of the accidents. The comparisons between the CNPP and the FDNPP accidents here focus on 137Cs.

Initial interception of the atmospherically deposited 137Cs by ***forest*** canopies was similar between ***forests*** affected by the CNPP and the FDNPP accidents,,–, and was mainly controlled by the biomass of the trees present. This similarity suggests that the interception in both evergreen coniferous and deciduous ***forests*** is controlled by similar processes. The site-specific conditions, such as tree species, were less critical than ***forest*** density or the presence or absence of leaves (for deciduous tree species).

In both accidents, after initial interception, fallout 137Cs was removed by rainwash and litterfall. The (Teff) of canopy 137Cs during the first phase post-accident were similar for FDNPP-affected Japanese cedar (Teff: 87 days) and CNPP-affected Norway spruce (Teff: 97 days). However, half-lives for the second phase were likely slower for Japanese cedar (Teff: 490~780 days), than Norway spruce (Teff: 195 days),. Experimental quantification of radiocaesium loss from the contaminated canopy reported that 134Cs leaching by rainwash depended on the frequency of rainfall episodes during the sampling period. The observed slower loss rate of canopy 137Cs in Fukushima could be attributed to greater closed canopy coverage owing to the greater needle biomass (4.0 kg m−2) and longer needle longevity (that is, dead needles remained in the canopy) of Japanese cedar than Norway spruce,.

Japanese red pine in Fukushima and CNPP-affected Scots pine ***forest*** in Finland have similar needle biomass (0.4–0.5 kg m−2 and 0.91 kg m−1, respectively) and had similar canopy 137Cs Teff during the second phase (510 days and 530 days, respectively),. In deciduous broad-leaved ***forests*** (such as ones dominated by Konara oak) in Fukushima, the Teff of the canopy 137Cs of the second phase was in the range 390~1,200 days (refs,). Despite the absence of direct deposition onto foliage, some data indicated that the deciduous broad-leaved stand showed a longer effective half-life of canopy 137Cs than Norway spruce in the Chernobyl-affected area. Due to larger amount of rainfall, the depuration rate of 137Cs trapped in the canopy of trees during the first phase was faster in Fukushima, but was often slower during the second phase in many tree species with larger biomass, such as Japanese cedar.

The longer 137Cs Teff of the Fukushima ***forest*** resulted in prolonged 137Cs deposition flux onto the ***forest*** floor over a long time period and maintained the apparent slower downwards migration rate of 137Cs observed in Japanese ***forest*** soils, compared with ***forest*** soils impacted by the CNPP accident (Fig. ). In both cases, fallout 137Cs flowed to streams, but the fallout-normalized activity concentration of both particulate and dissolved 137Cs in Fukushima streams was much lower than in those impacted by the CNPP. For example, the 137Cs activity concentrations of suspended sediment in ***forested*** headwater catchments were, on average, one order of magnitude lower than those of the Pripyat River near Chernobyl (Fig. ). Dissolved 137Cs activity concentrations were approximately two orders of magnitude lower in Fukushima versus the Pripyat River, and at least one order of magnitude in larger ***forested*** catchments, (Fig. ).

These differences in relative 137Cs discharge from ***forested*** areas between the two regions can be explained by different topography and rainfall, as Fukushima has steeper topography and more run-off. Thus, Fukushima rivers transported more 137Cs-bound suspended particles than Chernobyl-affected rivers. The particulate fraction in Fukushima exceeded 95%, typically greater than 98% (ref.), whereas it was around 33% in the Pripyat River. Additionally, the lower activity concentration of the dissolved 137Cs (high Kd values),,,, possibly due to a higher run-off in Fukushima, also contributes to these differences.

Like the rivers in Fukushima, the particulate 137Cs activity concentration in Pripyat River declined relative to the initial deposition (Fig. ), although the rate of decline in Fukushima was approximately 1.6 times higher than that of the Pripyat River in the first phase post-accident. The difference in the decline rate was smaller in the second phase and, by 6 years post-accident, the C′ (particulate 137Cs activity concentration relative to initial deposition) in rivers in Fukushima was about 40% of the Pripyat River (Fig. ). After the CNPP accident, the dissolved 137Cs activity concentration in 25 European rivers declined in three exponential components, but the dissolved 137Cs activity concentration normalized by the initial deposition, θ, varied by about two orders of magnitude (shaded area in Fig.). The θ values of Japanese rivers tended to be one or two orders of magnitude lower than the lowest European rivers. This difference suggests that Japanese rivers recovered from 137Cs more quickly (Fig. ), although the differences were also impacted by the higher Kd values (indicating that particulate 137Cs did not easily dissolve) of the Japanese rivers. In European rivers, the coverage of inland water (ponds, lakes and wetlands) showed the most significant positive correlation with θ (ref.), but the coverage of residential areas and the higher dissolved-ion concentrations, represented as the electrical conductivity of river water, positively correlate with θ in Japanese rivers,, suggesting that lower ion concentration in river waters due to high relief and higher run-off by monsoonal climate can also be responsible for the lower dissolved 137Cs in rivers.

Three main mechanisms have been proposed to contribute to the decline in dissolved 137Cs of the river waters: loss of 137Cs activity from the catchment; vertical 137Cs migration to deeper layers of soil; and slow chemical fixation of 137Cs to soil particles. As the loss of 137Cs in Fukushima catchments was low (4.8% in 6 years), the first mechanism likely played little role in the dissolved 137Cs declines there,. Instead, downwards 137Cs migration could be responsible for the dissolved 137Cs decline in Fukushima rivers. The differences between 137Cs in cultivated versus abandoned paddy field surface soils (3.4 kBq kg−1 in cultivated soils in 2012 versus 23 kBq kg−1 in abandoned paddy soils in 2011, Fig. ,) and the correspondence between the declines in 137Cs in suspended sediment (blue dots, Fig. ) and particulate 137Cs in rivers with high PFU cover (Fig. ) both point to this mechanism being the most influential. In contrast, gradual chemical fixation of 137Cs (the third mechanism) is likely responsible for the decline of dissolved 137Cs in the Pripyat River. This fixation is indicated by the observed slightly faster rate of decline in dissolved 137Cs than the rate of particulate 137Cs decline (in other words, Kd was increasing over time) (Fig. ,).

Overall, the terrestrial environment and rivers experienced a rapid reduction of the exposed radioactivity in Fukushima, but ***forests*** followed a trajectory similar to that of the CNPP-impacted ***forests***. Anthropogenic activities in Fukushima, such as rice and vegetable cultivation and residential activities in the upstream area, have led to a rapid decline in the activity concentration of 137Cs of surface soils, relative to CNPP-impacted soils. Differences in geographic and meteorological factors, such as rainfall, storm events, run-off and topography, also influenced the differences in environmental recovery from 137Cs between the two major accidents.

Broader impacts

Detailed monitoring and analysis of 137Cs dynamics in Fukushima undertaken following the FDNPP accident revealed the gradual transferral of fallout 137Cs in soil and water to the ecosystem. The International Atomic Energy Agency (IAEA) working group on ‘Modelling and Data for Radiological Impact Assessments’ (MODARIA) summarized the dataset to simulate radionuclide transfer in the environment and to assess exposure levels of the public and in the environment, and these transfer parameters are summarized in a IAEA Technical Report. After the FDNPP accident, the transfer data of many types of crops and animals were available from the early stages of contamination.

In Fukushima, leafy vegetables were contaminated by 137Cs and 131I immediately after the accident, followed by a declining trend in activity concentrations, and found to be similar to the reported values. The brown rice was also contaminated by 137Cs, with a transfer rate three to four times higher than the pre-accident level in the first years after the accident. However, these rates rapidly returned to the same level as before the FDNPP accident in the third year post-accident. Japanese tea plants were contaminated by the translocation of 137Cs deposited onto old leaves and twigs into new leaves, but 137Cs levels in new tea leaves did eventually decline, similar to what was observed after the CNPP accident. The transfer of 137Cs to wild animals and subsequent decline were also generally similar to these seen after the CNPP accident, although sika deer in Japan did not decline during the period 2011–2015 (ref.).

In a notable example of the transfer of radionuclides through the ecosystem after the FDNPP accident, the activity concentration of 137Cs in freshwater fish, is highly correlated with the activity concentration of dissolved 137Cs in the water,. As dissolved riverine 137Cs declines, which is related to the decrease in the 137Cs activity concentrations of suspended particles, and leaf litter in streams, so should the 137Cs activity concentrations in fish. Indeed, the activity concentration of 137Cs in fish is expected to continue to decline in Fukushima, rather than experiencing the longer-term persistent contamination that occurred in European freshwater fish after the CNPP accident,.

Overall, these examples and the discussion here highlight that 137Cs transfer in terrestrial areas is not a simple chemical process but also involves hydrological processes and material cycles.

Future perspectives

Recently, owing to strong demand to reduce greenhouse-gas ***emissions*** and for air-pollution measures, a growing number of nuclear power reactors are in operation and under construction in Asia, especially in China. Against the background of the rapid expansion of nuclear power, Fukushima environmental monitoring data have a critical bearing on future contingency and remediation planning to tackle fallout contamination of populated areas. An enormous amount of data has been obtained from the Fukushima nuclear accident. However, emergency environmental data is often regarded as only useful to inform the public until radiation levels return to allowable levels, and publically available data published on governmental websites post-accident are being lost. Some of the environmental data collected in response to the FDNPP accident are available through the Database for Radioactive Substance Monitoring Data (maintained by the Japan Atomic Energy Agency) and CRiED (maintained by the University of Tsukuba), but with the passage of time since the accident, it is increasingly difficult to obtain the budget for the continued archiving and reporting of these data.

The IAEA has updated countermeasures guidelines, including the Manual on Sampling Methods, to account for lessons learned from the FDNPP accident. However, each country must formulate a feasible and concrete sampling and measurement protocol, taking the FDNPP lessons into consideration. Immediately after the Fukushima accident, an interdisciplinary group of scientists was formed and members from the fields of nuclear physics, radiochemistry, geochemistry, atmospheric science and hydrology collaborated with the government,,. This group was able to sample soil quickly after the accident, providing key data on the initial contamination levels and subsequent environmental recovery. To prepare for possible nuclear emergencies, we hope that national and local governments will take on the challenge of establishing cross-sectoral cooperation between departments responsible for air and water monitoring and ***agriculture***, beyond just the nuclear power sector. In such a case, the information should be thoroughly disclosed and a series of checks should be in place.

In Fukushima, decontamination for environmental restoration was effective in reducing air doses, but it was also costly. Moreover, a greater emphasis was placed on relieving the anxiety of the residents, rather than on scientific evidence for the establishment of decontamination ***targets*** and areas. In this respect, international joint research bodies will be needed to implement sufficient and effective measures, referring to Fukushima’s lessons.

Long-term environmental monitoring in Fukushima should continue and be supported by the Japanese government, although there is no financial prospect for such activities at present. Examples should be taken from the international joint studies between the United Kingdom, France, Norway, Germany, Japan and others that have continued in the 30 years after the CNPP accident. During this extended monitoring period, various environmental events such as wildfires, have occurred in areas affected by the CNPP accident, and further migration of radionuclides has occurred as a result of these events. Fukushima has high rainfall, dense ***forests***, paddy fields and other ***land*** uses not found in Chernobyl, as well as a high possibility of landslides triggering large sediment outflow. Therefore, it is essential to study the future migration of radionuclides, especially in order to assess the effects of the accident in East Asia.

The comprehensive datasets acquired in response to the FDNPP accident have the potential to advance the understanding of Earth and environmental sciences, both basic and applied, beyond the impacts of this single event. For example, the combined use of natural tracers such as 210Pbex (ref.) and 7Be (ref.), with stable isotopes, and these data could lead to advances in tracing the transport and fate of radioactive materials. The dense and continuous monitoring network established following the accident also provides opportunity for validation of natural radionuclides as tracers of sediment sources and for mass budgeting, evaluation of the behaviour of substances and pollutants from various sources and organisms at local scales and prediction of the response of material circulation to global environmental changes.

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**Notes**

Supplementary informationSupplementary information is available for this paper at [*https://doi.org/10.1038/s43017-020-0099-x.Peer*](https://doi.org/10.1038/s43017-020-0099-x.Peer) review informationNature Reviews Earth & Environment thanks Georg Steinhauser and the other, anonymous, reviewer(s) for their contribution to the peer review of this work.Publisher’s noteSpringer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.Related linksCRiED database:[*http://www.ied.tsukuba.ac.jp/database/ISET-R*](http://www.ied.tsukuba.ac.jp/database/ISET-R) project:[*http://www.ied.tsukuba.ac.jp/hydrogeo/isetr/ISETRen/indexEN.htmlIAEA*](http://www.ied.tsukuba.ac.jp/hydrogeo/isetr/ISETRen/indexEN.htmlIAEA) MODARIA II programme:[*https://www-ns.iaea.org/projects/modaria/modaria2.asp?s=8&l=129JAEA*](https://www-ns.iaea.org/projects/modaria/modaria2.asp?s=8&l=129JAEA) Database for Radioactive Substance Monitoring Data:[*https://emdb.jaea.go.jp/emdb/en/*](https://emdb.jaea.go.jp/emdb/en/)

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[***Congressman Panetta Introduces Bipartisan Legislation to Restore America’s National Forests***](https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:60GP-P2M1-F0YC-N03T-00000-00&context=1516831)

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**Body**

Washington: Office of the MP Jimmy Panetta has issued the following news release:

Today, Congressman Jimmy Panetta (D-CA), Congressman Mike Simpson (R-ID), Congresswoman Kim Schrier, M.D (D-WA), and Congressman Doug LaMalfa (R-CA) introduced the Repairing Existing Public ***Land*** by Adding Necessary Trees Act or the REPLANT Act, legislation to expand funding for the U.S forestland damaged by events such as wildfires, insects and disease, while creating more than 48,000 jobs over the next ten years. Companion legislation was introduced in the Senate by Senator Tom Udall (D-NM), Senator Rob Portman (R-OH), and Senator Debbie Stabenow (D-MI).

To address the ***Forest*** Service’s reforestation backlog, the bill ***removes*** the current $30 million annual funding cap for the Reforestation Trust Fund, the primary source of funding for USFS’s replanting needs, making an average of $123 million annually available for reforestation in National ***Forests***. In addition, the REPLANT Act will direct USFS to quantify the backlog of replanting needs, reduce delays by expanding stewardship contracting, and encourage state and Tribal partnerships. Among other associated activities, reforestation includes planting tree seedlings on ***forests*** that are unlikely to regenerate on their own in order to reestablish native plants and ensure the health of ecosystems and wildlife that depend on ***forests***. Replanting ***forests*** is an effective way to create jobs in rural America, support natural ecosystems and improve natural carbon sequestration. Estimates show that the REPLANT Act would help plant 410,000 acres, or 123 million trees annually, for a total of 4.1 million acres (1.23 billion trees) over the next ten years. That’s the equivalent of sequestering 75 million metric tons of carbon dioxide, or avoiding the use of 8.5 billion gallons of gasoline, in a decade.

“Due to funding shortages and federal limitations, each year our federal government fails to plant an adequate amount of trees. Such little investment in reforestation by our federal government has led to significant challenges within our public ***lands***, including wildfires, invasive species, diseases, and climate change. By lifting the cap on the Reforestation Trust Fund, we will be able to plant hundreds of millions of trees over the next decade, while creating sustainable jobs and sequestering as much as 800 million tons of carbon ***emissions***,” said Congressman Panetta. “Our bipartisan legislation will help to provide wildlife with critical habitat, improve downstream drinking water quality, and restore our public ***lands*** for generations to come.”

“In Idaho, we are blessed with an abundance of ***forests***,” said Congressman Simpson. “However with ***forests*** comes wildfires, and from wildfires you lose precious natural resources such as trees. Through the Reforestation Trust Fund we can replant these trees in our national ***forests***, without using taxpayer funds. This will benefit our environment through carbon sequestration, our economy through job creation in rural communities, and recreation all across the country. I am pleased this bill has the support of Secretary Perdue and a bipartisan, bicameral, and diverse group of stakeholders who are on the ground replanting our national ***forests***.”

“Washington’s ***forests*** are threatened by drought, pestilence, and extreme wildfire events, much of that related to climate change,” said Congresswoman Schrier. “This is deeply concerning because trees are vital to keeping our air clean and sequestering carbon dioxide. Their roots are critical to maintaining good water quality for fish and wildlife ecosystems. Replanting trees will help slow the effects of a warming climate, and protect our pristine Northwest environment for generations to come.”

“Year after year, wildfires decimate our national ***forests***, and the resulting burn scars have made portions of our ***forests*** uninhabitable for wildlife and unenjoyable for recreators,” said Congressman LaMalfa. “The REPLANT Act is a commonsense proposal that prioritizes reforestation in our disaster-stricken areas, saving our ***forests***' ecosystems and creating rural jobs in a cost-effective way. I’m glad to sponsor this bipartisan legislation to protect the health of our ***forests***.”

“America’s national ***forests*** are some of our greatest natural resources. Investing in them is more urgent than ever, given the rising toll from wildfire damage, insects and disease,” said Senator Udall, the ranking member of the Senate Appropriations Subcommittee on Interior, Environment, and Related Agencies. “Reforestation supports species diversity by providing wildlife with habitat improves air and water quality, and supports jobs in local communities. And in the fight against climate change and disappearing natural habitats, re-growing our ***forests*** is a cost-effective and powerful tool. I am proud to expand funding for this bipartisan legislation that lives up to our responsibility to conserve our nation’s natural gifts for future generations.”

“I am pleased to join Senators Udall and Stabenow and Reps. Panetta, Simpson, Schrier, and LaMalfa in introducing this bipartisan legislation to address the reforestation needs within our national ***forests***. This legislation provides a wide range of benefits, including improving our environment by sequestering carbon dioxide and reinvigorating the ecosystems and native plant and animal species that depend on healthy ***forests***, while also creating jobs and recreation opportunities on our forestland. I urge my colleagues to join us in supporting this common-sense, bipartisan legislation to address the replanting needs across our nation’s ***forests***,” said Senator Portman.

“Restoring our national ***forests*** will not only improve water quality and create new habitats for hunting and fishing, it’s also part of the solution to combat the climate crisis,” said Stabenow, the ranking member of the U.S Senate Committee on ***Agriculture***, Nutrition, and Forestry. “Supporting reforestation is a cost-effective way to draw carbon pollution out of air, while restoring our public ***lands***.”

USFS has estimated that in FY 2018, 80 percent of its reforestation needs were attributed to wildfires. One recent study found that tree mortality caused by insects and diseases alone—which impacts less acreage than wildfires—released 6 million tons of carbon, the equivalent of tailpipe ***emissions*** from 4.4 million cars.

With only approximately 15 percent of the national ***forest*** tree planting backlog addressed each year at current funding levels, this legislation will help provide much-needed resources to the ***Forest*** Service to address reforestation needs. Funding for the Reforestation Trust Fund comes from tariffs levied on wood products entering the United States.

According to American ***Forests***, U.S national ***forests*** currently offset 14-15 percent of total U.S carbon ***emissions***. In addition to restoring ***forest*** health across the country, the legislation will support rural employment and enhance recreational opportunities within national ***forests***.

The REPLANT Act has received widespread support from a variety of groups including American ***Forests***, The National Wildlife Federation, The Nature Conservancy, Evangelical Environmental Network, The Audubon Society, The ***Forest*** Stewards Guild, Green ***Forests*** Work, the Trust for Public ***Land***, the Bipartisan Policy Center, Longleaf Alliance, and the Outdoor Recreation Roundtable.

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