**Our Sole Contention Regards the Flaws of Nuclear Energy**

The climate crisis is accelerating, and our energy choices are crucial. Clean energy is advancing rapidly, but nuclear investments risk undermining that progress. This is about more than energy—it's about the future we choose to create.

**According to Eric Beinhocker, founder and executive director of the Institute for New Economic Thinking**, the clean energy revolution is no longer a choice—it’s an inevitability, driven by unstoppable technological progress. Regardless of political leadership, the decline of fossil fuels is guaranteed. Breakthroughs in solar technology are on track to meet national energy demands b/As investors shift toward sustainable and profitable alternatives, fossil fuels will not simply decline—they will become obsolete.

Yet, **according to the Climate Action Network in 2024**, investing in nuclear energy actively undermines the transition to renewables in three critical ways, make them respond to all:

**First**, it diverts attention. Powerful nuclear lobbies often derail policy agreements that could otherwise support renewable energy, redirecting public and political focus away from achieving a 100% clean energy future.

**Second**, it drains resources. Nuclear power costs up to four times more than solar or wind, placing a heavier burden on consumers. In contrast, the affordability of renewables could lift over 12 million people out of energy poverty. Nuclear projects also suffer from chronic delays and cost overruns, with little to show for the billions spent. Even worse, the skilled labor force needed for a nuclear expansion simply doesn’t exist at the scale required.

**Finally**, nuclear energy is inflexible. Reactors are increasingly vulnerable to heatwaves, droughts, flooding, cyberattacks, and even military conflict—leaving over a third of them offline for more than half the year. Additionally, they can restrict the integration of solar and wind into the grid, crowding out cleaner and more adaptable energy sources.

We’re at a make-or-break moment. As **Dr. Jonathan Foley** noted, even the most optimistic forecasts place nuclear at least 20 years away—far too late. Small Modular Reactors (SMRs) have already burned through billions with no results. These recycled promises distract from real, ready solutions. With time running out, scientists agree: we must act now and scale renewables already available.

Nuclear energy is not a partner to renewables—it’s a competitor. **As journalist Paul Hockenos pointed out in 2022**, nuclear power is unreliable, not truly carbon-free, and requires vast amounts of land. Its fixed infrastructure makes it inherently inflexible, especially when compared to mobile and scalable solutions like wind and solar. Worse still, nuclear projects often push out renewable development, limiting the reach of clean energy solutions. In a country with limited usable land, we cannot afford to waste space or resources on obsolete models.

It’s not too late—if we act now. As **science writer Seth Borenstein said in 2023**, “humanity still has a chance.” But that chance hinges on rapidly cutting fossil fuel use and committing to a carbon-free future.

**Graeme Taylor, PhD in climate science,** warns that even a 2°C rise could trigger ocean acidification, ecosystem collapse, and food insecurity for billions. At that point, adaptation may no longer be possible. The path forward is clear: we must cut emissions swiftly—before the damage is irreversible.

A clean energy future is within reach—but only if we stop investing in outdated solutions. Nuclear is too slow, costly, and inflexible. Renewables are ready now. For a livable planet, we must act fast.

## **1NC – Tradeoff**

### **Contention One is Tradeoff**

#### **Clean energy is rapidly advancing and solves energy needs by 2035 – regardless of presidency**

**Beinhocker 25** Eric Beinhocker, 2-28-2025, "The Clean Energy Revolution Is Unstoppable", [Eric Beinhocker is a Professor of Public Policy Practice at the Blavatnik School of Government, University of Oxford. He is also the founder and Executive Director of the Institute for New Economic Thinking at the University’s Oxford Martin School. INET Oxford is an interdisciplinary research center dedicated to the goals of creating a more inclusive, just, sustainable, and prosperous economy. Beinhocker is also a Supernumerary Fellow in Economics at Oriel College and an External Professor at the Santa Fe Institute.], https://www.wsj.com/business/energy-oil/thecleanenergyrevolution-is-unstoppable-88af7ed5, DOA 3-25-2025 //RACHEL recut //cy

Since Donald Trump’s election, clean energy stocks have plummeted, major banks have pulled out of a U.N.-sponsored “net zero” climate alliance, and BP announced it is spinning off its offshore wind business to refocus on oil and gas. Markets and companies seem to be betting that Trump’s promises to stop or reverse the clean energy transition and “drill, baby, drill” will be successful.¶ But this bet is wrong. The clean energy **revolution** is being driven by fundamental technological and economic forces that are too strong to stop. **Trump’s policies** can **marginally slow progress** in the U.S. and harm the competitiveness of American companies, but they cannot halt the fundamental dynamics of technological change or save a fossil fuel industry **that will** inevitably **shrink** dramatically in the next two decades.¶ Our research shows that once new technologies become established their patterns in terms of cost are surprisingly predictable. They generally follow one of three patterns.¶ The first is a pattern where costs are volatile over days, months and years but relatively flat over longer time frames. It applies to resources extracted from the earth, like minerals and fossil fuels. The price of oil, for instance, fluctuates in response to economic and political events such as recessions, OPEC actions or Russia’s invasion of Ukraine. But coal, oil and natural gas cost roughly the same today as they did a century ago, adjusted for inflation. One reason is that even though the technology for extracting fossil fuels improves over time, the resources get harder and harder to extract as the quality of deposits declines.¶ here is a second group of technologies whose costs are also largely flat over time. For example, hydropower, whose technology can’t be mass produced because each dam is different, now costs about the same as it did 50 years ago. Nuclear power costs have also been relatively flat globally since its first commercial use in 1956, although in the U.S. nuclear costs have increased by about a factor of three. The reasons for U.S. cost increases include a lack of standardized designs, growing construction costs, increased regulatory burdens, supply-chain constraints and worker shortages.¶ A third group of technologies experience predictable long-term declines in cost and increases in performance. Computer processors are the classic example. In 1965, Gordon Moore, then the head of Intel, noticed that the density of electrical components in integrated circuits was growing at a rate of about 40% a year. He predicted this trend would continue, and Moore’s Law has held true for 60 years, enabling companies and investors to accurately forecast the cost and speed of computers many decades ahead.¶ Clean energy technologies such as **solar, wind and batteries** all follow this pattern but at different rates. Since 1990, the cost of wind power has dropped by about 4% a year, solar energy by 12% a year and lithium-ion batteries by about 12% a year. Like semiconductors, each of these technologies can be mass produced. They also benefit from advances and economies of scale in related sectors: solar photovoltaic systems from semiconductor manufacturing, wind from aerospace and batteries from consumer electronics.¶ Solar energy is **10,000 times cheaper** today than when it was first used in the U.S.’s Vanguard satellite in 1958. Using a measure of cost that accounts for reliability and flexibility on the grid, the International Energy Agency (IEA) calculates that electricity from solar power with battery storage is less expensive today than electricity from new coal-fired plants in India and new gas-fired plants in the U.S. We project that by 2050 solar energy will **cost a tenth** of what it does today, making it far cheaper than any other source of energy. ¶ At the same time, barriers to large-scale clean energy use **keep tumbling**, thanks to advances in energy storage and better grid and demand management. And **innovations** are enabling the electrification of industrial processes with enormous efficiency gains.¶ The falling price of clean energy has **accelerated** its adoption. The growth of new technologies, from railroads to mobile phones, follows what is called an S-curve. When a technology is new, it grows exponentially, but its share is tiny, so in absolute terms its growth looks almost flat. As exponential growth continues, however, its share suddenly becomes large, making its absolute growth large too, until the market eventually becomes saturated and growth starts to flatten. The result is an S-shaped adoption curve.¶ The energy provided by solar has been growing by about 30% a year for several decades. In theory, if this rate continues for just one more decade, solar power with battery storage could **supply all the world’s energy needs by** about **2035**. In reality, growth will probably slow down as the technology reaches the saturation phase in its S-curve. Still, based on historical growth and its likely S-curve pattern, we can predict that renewables, along with pre-existing hydropower and nuclear power, will largely displace fossil fuels by about 2050.¶ For decades the IEA and others have consistently overestimated the future costs of renewable energy and underestimated future rates of deployment, often by orders of magnitude. The underlying problem is a lack of awareness that technological change is not linear but exponential: A new technology is small for a long time, and then it suddenly takes over. In 2000, about 95% of American households had a landline telephone. Few would have forecast that by 2023, 75% of U.S. adults would have no landline, only a mobile phone. In just two decades, a massive, century-old industry virtually disappeared.¶ If all of this is true, is there any need for government support for clean energy? Many believe that we should just let the free market alone sort out which energy sources are best. But that would be a mistake. ¶ History shows that technology transitions often **need** a kick-start from **government**. This can take the form of support for basic and high-risk research, purchases that help new technologies reach scale, investment in infrastructure and **policies that create stability** for private capital. Such government actions have played a critical role in virtually every technological transition, from railroads to automobiles to the internet.¶ In 2021-22, Congress passed the bipartisan CHIPS Act and Infrastructure Act, plus the Biden administration’s Inflation Reduction Act (IRA), all of which provided significant funding to accelerate the development of the America’s clean energy industry. Trump has pledged to end that support. The new administration has halted disbursements of $50 billion in already approved clean energy loans and put $280 billion in loan requests under review.¶ The legality of halting a congressionally mandated program will be challenged in court, but in any case, the IRA horse is well on its way out of the barn. About $61 billion of direct IRA funding has already been spent. IRA tax credits have already attracted $215 billion in new clean energy investment and could be worth $350 billion over the next three years.¶ Ending the tax credits would be **politically difficult,** since the top 10 states for clean energy jobs include Texas, Florida, Michigan, Ohio, North Carolina and Pennsylvania—all critical states for Republicans. Trump may find himself fighting Republican governors and members of Congress to make those cuts.¶ It is **more likely that Trump** and Congress **will take actions that are politically easier,** such as ending consumer subsidies for electric vehicles or refusing to issue permits for offshore wind projects. The impact of these policy changes would be mainly to harm U.S. competitiveness. By reducing support for private investment and public infrastructure, raising hurdles for permits and slapping on tariffs, the U.S. will simply drive clean-energy investment to competitors in Europe and China.¶ Meanwhile, Trump’s promises of a fossil fuel renaissance ring hollow. U.S. oil and gas production is already at record levels, and with softening global prices, producers and investors are increasingly cautious about committing capital to expand U.S. production.¶ The energy transition is a one-way ticket. As the asset base shifts to clean energy technologies, large segments of fossil fuel demand **will permanently disappear**. Very few consumers who buy an electric vehicle will go back to fossil-fuel cars. Once utilities build cheap renewables and storage, they won’t go back to expensive coal plants. If the S-curves of clean energy continue on their paths, the fossil fuel sector will likely shrink to a niche industry supplying petrochemicals for plastics by around 2050.¶ For U.S. policymakers, supporting clean energy isn’t about climate change. It is about maintaining American economic leadership. The U.S. invented most clean-energy technologies and has world-beating capabilities in them. Thanks to smart policies and a risk-taking private sector, it has led every major technological transition of the 20th century. It should lead this one too.

#### **Nuclear energy kills renewables – diverts attention, resources, and monopolizes grids – make them answer every disad**

**CAN 24** Climate Action Network, 3-18-2024, "POSITION PAPER: The nuclear hurdle to a renewable future and fossil fuel phase-out," [Climate Action Network (CAN) Europe is Europe’s leading NGO coalition fighting dangerous climate change. We are a unique network, in which environmental and development organisations work together to issue joint lobby campaigns and maximise their impact], https://caneurope.org/position-paper-nuclear-energy/, DOA 3-25-2025 //Wenzhuo recut //cy

¶ More than three-quarters of the EU’s greenhouse gas emissions stem from our energy consumption, therefore it is vital to stop burning fossil fuels to limit temperature rise to 1.5°C, the Paris Agreement target. Together with members, and external experts, we developed our Paris Agreement compatible (PAC) energy scenario, which provides a robust, science-based pathway for Europe’s energy landscape. On the basis of this work, CAN Europe advocates for a phase-out of coal by 2030, gas by 2035, and a 100% renewables-based energy system by 2040, which requires the phase-out of nuclear power by then. ¶ The disruption of nuclear power can be observed in many countries, not only in Europe. In Dubai, at COP28, CAN was strongly opposed to and called out countries, supporting and signing the pledge led by the USA, UK, France and 18 other countries to globally triple nuclear power in the next 25 years. This goal is much higher than the high bracket of International Energy Agency (IEA) scenarios, already based on improbable hypotheses and risks to distract from the tripling of Renewable Energy capacities that was agreed by a much larger group of countries at COP28.¶ In 2023, there was an **alarming push** and a surge in support **for nuclear power** within the EU political space. This development is creating significant tension with proponents of energy sufficiency and a fully renewable energy system and marks a regressive step in efforts towards a sustainable and just energy transition. While nuclear champions claim that nuclear energy can work hand-in-hand with renewables, it is becoming increasingly clear that nuclear power acts as a significant hurdle to energy efficiency investments, the roll-out of renewables and fossil fuel phase-out in three spheres: the EU political debate, energy system planning, and decentralisation. ¶ Climate Action Network International, the global umbrella under which CAN Europe participates, with a community of almost 2000 members from civil society, in more than 130 countries, stands united in opposing new and existing nuclear power stations. In 2020, we reviewed and agreed the CAN Charta, the ‘highest’ document for all CAN members, the international secretariat and the regional nodes, and we listed under strategies “Promoting a nuclear-free future”.¶ A hurdle in the policy debate¶ The starting gun for a renewed attempt at a nuclear renaissance was the inclusion of nuclear in the EU Taxonomy in 2022, and can be seen as the nuclear lobby’s blueprint for its future ambitions – creating a large political debate using arguments of “technology neutrality” and a “level playing field” and forming alliances with fossil fuel advocates (in this case, fossil gas) in order to reduce ambition to sustainable solutions.¶ Since then, a French-led campaign, manifested through the 14 Member State “Nuclear Alliance”, coupled alongside the lobbying activities of the nuclear industry, has run roughshod through EU energy and climate policy over the last two years. Continuing the narrative of “technology neutrality” and a “level playing field”, this mission has aimed at promoting nuclear energy at the direct expense of a transition to a 100% renewable-based energy system, in legislation such as the Renewable Energy Directive, Electricity Market Design and Net Zero Industry Act.¶ Attempting to lower renewable ambition ¶ In the context of the Renewable Energy Directive (RED III) revision, France tested the waters in 2023 by calling for a low-carbon ‘weighting’ in EU renewables target in order to support a higher EU 2030 renewable energy target of 45%, where so-called ‘low carbon’ energy sources are taken into account when establishing national renewable energy targets. Though this did not see the light, a concession was won on renewable hydrogen and gained provisions to facilitate nuclear-produced hydrogen – risking further watering down a renewables-based technology pathway. ¶ The EU Commission launched its proposal for the Net Zero Industry Act (NZIA) in March 2023 as a response to the Inflation Reduction Act (IRA) of the United States. While nuclear was included as a list of technologies that were seen as making a contribution to decarbonisation, the EU Commission President, Ursula von der Leyen, refused to include it in the list of “strategic technologies”, which could receive additional support. The list was limited, as to be better targeted, at technologies such as solar, wind, energy storage, heat pumps and grid technologies. The final political agreement has led to the inclusion of “nuclear fission energy technologies” as strategic, while this debate allowed the list to become so extensive it practically loses any strategic element.¶ Delaying fossil phase out via dirty trade-offs During the Electricity Market Design reform, nuclear and fossil fuel promoters in the Parliament attempted to **derail** a deal supporting renewables and flexibility. In the Council, **due to the focus of the Nuclear** Alliance on the Contracts for Difference (supported by some coal dependent countries) the negotiations were delayed by several months and conversations redirected away from renewables, leading to a deal supporting subsidies for existing and new nuclear reactors and a prolongation of subsidies to coal power plants via capacity mechanisms. ¶ Wasting time and diverting attention As the nuclear debate **aggressively** dominates political negotiations, media, and public discourse, it **blatantly diverts critical attention from** advancing the **existing,** affordable, sustainable solutions to the energy transition. This overwhelming focus on nuclear power not only overshadows but also poses a risk of **derailing** the European **energy transition**, hindering progress towards aligning with the ambitious yet achievable goal of a **100% renewable energy** system by 2040.¶ A hurdle to a fully renewables based power system¶ CAN Europe’s assessment of the draft National Energy and Climate Plans highlights that not a single Member State plan is aligned to a 1.5ºC compatible trajectory, nor minimum EU climate and energy requirements for 2030. **Increased ambition is required** on energy efficiency, energy savings, renewables and fossil fuels phase-out, while Member States are **betting on false solutions** to the challenge at hand, such as nuclear energy. ¶ As highlighted in our NECP analysis, the EU has inadequate renewables expansion, grossly insufficient investment in energy efficiency, late coal phase-out deadlines and gas dependence, while countries such as Bulgaria, Czechia, Estonia, France, Hungary, the Netherlands, Poland, Romania and Slovenia, are considering new nuclear that might never materialise. In 2023, Sweden has revised its 2040 target for 100% renewable electricity to 100% decarbonised electricity, to allow for continued and new nuclear power, and it is now clear that it can only happen with direct state aid. Italy, which voted against nuclear power in a referendum, is now investigating future nuclear power, while delaying quitting coal by 4 years. ¶ The largest nuclear power plant in Europe, the Zaporizhzhia Nuclear Power Plant in Ukraine, is currently occupied by the Russian military and Rosatom in an active warzone, but has not prevented Ukraine from including new nuclear power in its reconstruction.¶ The Paris Agreement Compatible (PAC) scenario, on the other hand, emphasises renewables-based electrification, calling for determined and heightened attention to enable a 100% renewable-based EU energy system by 2040, and foresees no need for nuclear power in Europe.¶ Nuclear power is too expensive ¶ When compared to renewables, the latest analysis from World Nuclear Industry Status Report, using the data from Lazard, determines that the levelized cost of energy (LCOE) for new nuclear plants makes it the most expensive generator, estimated to be nearly **four times more expensive** than onshore wind, while unsubsidized solar and wind combined with energy storage (to ensure grid balancing) is always cheaper than new nuclear. When compared against energy savings, analysis by Hungarian NGO Clean Air Action Group highlights that it is more economically efficient to invest in the renovation of households to save energy than in the construction, operation, and decommissioning of a new nuclear reactor. These findings were confirmed by a separate study by Greenpeace France, that showed that by investing 52 billion euros in a mix of onshore wind infrastructure/photovoltaic panels on large roofs, it would be possible to avoid **four times** more CO2 emissions than by investing the same amount in the construction of six EPR2 nuclear reactors by 2050, while electricity production triples. By investing 85 billion euros of government subsidies in energy savings by 2033, it would be possible to avoid six times more cumulative CO2 emissions by 2050 than with the construction program of six EPR 2 reactors. This would also make it possible to lift almost 12 million people out of energy poverty in a decade.¶ Recent European projects in Slovakia, the UK, France, and Finland demonstrate the dramatic rising costs. EDF admitted that the costs for the British nuclear facility Hinkley Point C will skyrocket to 53.8 billion euros for the scheduled 3.2 GW power plant, more than twice as much as scheduled in 2015 when the plant was approved. The French project in Flamanville was originally projected to cost 3.3 billion euros when it began construction in 2007, but has since risen to 13.2 billion euros (16.87 billion euros in today’s money). The Finnish Olkiluoto-3 project 1.6GW reactor cost 3 times more than the original forecast price, reaching 11 billion euros. Slovakia’s second generation reactors Mochovce 3 and 4 ballooned costs to 6.4 billion euros from an initially estimated 2.8 billion. Slovenia’s president announced that a new 1.6GW reactor would cost 11 billion euros, following the Finnish example, demonstrating that these high prices are here to stay.¶ In order to finance new and ongoing projects, the EU has approved State Aid for nuclear, in the case of Hungary, Belgium, and the United Kingdom, while national governments seek support schemes. Despite making references to technology-neutrality, this creates an unlevel playing field slanted against renewable energy. Given the significant investment gap to achieve 2030 climate targets, and the limited fiscal space of many Member States, investments in nuclear risk **diverting precious public resources** into projects of poor value-for-money compared to alternatives in a renewables-based system, while reducing the availability of public resources for all other components of the energy transition. Such a choice would equally fail to reduce prices for consumers in the context of the current fossil fuel energy crisis. ¶ Finally, the costs would be even larger if accounting for “unpaid externalities” borne by taxpayers and the public at large, from nuclear accident risks that are impossible to insure against by private actors. The costs of decommissioning of a nuclear power plant, which can cost 1-1.5 billion euros per 1000 MW, are often borne by the public as these costs are poorly taken into account when planning a new nuclear installation. The cost associated with storing radioactive waste for hundreds of thousands of years is also often undervalued, alongside costs associated with radioactive leaks from plants or storage facilities, as demonstrated by the radioactive leaks in the UK Sellafield site, causing tension with Ireland and Norway. To lower costs, attempted lowering of safety and environmental standards can be expected, posing risks to communities, nature, and society at large, also as a burden to future generations.¶ New nuclear construction is too slow¶ A rapid transition requires the use of existing technologies and solutions which can most quickly be rolled-out such as renewables, primarily solar and wind, energy efficiency, and system flexibility. For years, new nuclear energy projects in Europe have been plagued with delays and, coupled with an untrained workforce, are unable to support the speed of decarbonisation necessary. New nuclear plants typically take 15-20 years for construction, hence failing to address immediate decarbonisation needs to 2030. Indicatively, France’s six new reactors are estimated by its network operator to enter into use in 2040-2049, much too late to have any meaningful impact on emissions reduction needed already now, with a view to pathways to 2050, and beyond, for a sustainable future. ¶ The decision to build the UK’s Hinkley Point C nuclear reactor was announced in 2007 with an operational start date of 2017, however it has been delayed several times over, and is now estimated to start in 2031. In France, the Flamanville project is 16 years into construction and hitting new delays, while Finland’s Olkiluoto took a full 18 years to come online. ¶ Nuclear does not support energy autonomy¶ Nuclear power units equally fail to pass an “energy security” test, and run counter to the RepowerEU target of enhancing Europe’s autonomy, given that more than 40% of the EU’s Uranium is imported from Russia and no EU country is currently mining uranium within its own borders . Though Kazakhstan is seen as an alternative, its uranium industry is directly tied to Rosatom. While import bans have been placed on Russian coal and liquified natural gas, and Russian oil and natural gas have been targeted, this has not been the case for uranium.¶ A hurdle to a decentralised future¶ The declaration to triple nuclear power by 2050 signed by only 22 countries, 5 of which do not have nuclear reactors, on the sidelines of COP28 describes nuclear power as “source of clean dispatchable baseload power”, a common message of the nuclear industry used to argue against a 100% renewable system and nuclear’s use as a substitute for traditional fossil fuel generation. This claim, however, is misleading and outdated.¶ Europe is moving beyond a highly centralised energy system, towards one which is decentralised, digitalised, and able to flexibly adjust to changing patterns of generation and consumption. In a 100% renewable energy system, the need for traditional “baseload” power is obsolete and with distributed energy production, in a far more interconnected European Union, security of supply is better managed.¶ Nuclear power production is not reliable¶ Nuclear power units across Europe have been proven as **unreliable** in providing power when needed. Future climatic conditions, such as **heatwaves, droughts, flooding** and rising sea-levels only increase the likelihood of future nuclear power plant disconnections and pose further security risks. In 2022, on average French nuclear reactors had 152 days with zero-production. Over half of the French nuclear reactorfleet was not available during at least one-third of the year, one-third was not available for more than half of the year, and 98% of the year 10 reactors or more did not provide any power for at least part of the day. ¶ The myth of the need for nuclear baseload has been debunked for years. The energy system can be reliably and safely managed with 100% renewables and system flexibility.¶ Blocking renewables integration into the electricity grid The inflexibility of nuclear, caused by technical limitations, safety requirements and economic factors, **prevents the feed-in of renewable electricity** into the grid, causing grid congestion and curtailment. Nuclear’s dominance over grid capacity can **block the connection of new renewable energy projects**, where even announced and then abandoned plans for a new nuclear unit can delay renewable projects connection, allowing for continued fossil fuel usage. Grid structures designed for large-scale, centralised nuclear power, make it more challenging, time-consuming and costly to introduce small-scale distributed renewable power.¶ An example can be found in Romania where Cernavodă 3 and 4 reactors have reserved grid capacity for years, blocking new renewable energy projects in the Dobrogea region, the most wind-intensive region in the country. Delayed grid investments, due to uncertainty of new nuclear units, have also meant that capacity bottlenecks exist today for renewables online. ¶ In the Netherlands, the only current nuclear power station, Borssele is competing for landing space for off-shore electricity. Post-Fukushima, renewables were blocked from connecting to the grid in Japan as the government considered restarting the reactors, despite public opposition to nuclear restarts and support for renewables. Rather than taking the opportunity to invest in grids and integrate renewables twenty years ago, Japan still heavily relies on fossil fuels today.¶ Prolonging the inevitable with nuclear extensions¶ While European governments may be tempted to prolong existing nuclear reactors beyond their original foreseen lifespans, in the context of phasing out Russian gas, costly upgrades to the ageing nuclear fleet, just like investing in new ones, risks diverting investment away from more cost-effective solutions such as renewables, energy efficiency, and system flexibility, in addition to risking lowered safety standards and security of supply as ageing increases unplanned outages. Any prolongation of existing nuclear power plant units risks the continued crowding out of renewable energy sources from the electricity grid, preventing their price-dampening effects on the market. ¶ So-called “**S**mall **M**odular **R**eactors”¶ European lawmakers are increasingly persuaded by the empty promises of Small Modular Reactors (SMRs). Argued to be more flexible, decentralised, smaller, and cheaper than existing nuclear designs, countries are wasting public resources in favour of a non-existent product, riddled with the same limitations as their predecessors, and presenting poor value-for-money compared to existing alternatives. The focus on SMRs risks delaying the development of renewable energy technologies already available at the moment, and thereby prolonging the usage of fossil fuels., ,¶ Burdened by the same high capital costs, SMRs would have to run near constantly to reduce losses, thereby further congesting the grid and making them useless in providing back-up power needed for peak hours against renewables and energy storage.¶ Nuclear energy is too risky and unsafe ¶ Nuclear technology inherently carries the risk of severe nuclear accidents with the release of large amounts of radioactivity as shown by catastrophic accidents in Fukushima or Chornobyl. **Extreme** and more frequent **weather** events due to climate change create **unprecedented** risks through storms or flooding that are not captured in planning standards for nuclear plants based on historic frequencies and severeness. Extreme weather events may also indirectly affect nuclear plants, such as breaking dams above nuclear plants or longer disconnection from electricity grids after storms. **Cyber attacks, military aggression** e.g. Russia’s occupation of the Zaporizhzhia Nuclear Power Plant, and terrorist attacks, e.g. via drone attacks, could also lead to severe accidents of nuclear plants. Nuclear waste remains a risk worldwide to the health of all living creatures, including humans, for thousands of years after its use in energy production. Management of any future storage facility would still be at risk of natural disasters and decisions of future generations, whereas currently without any long-term solutions risks are increasingly shifting to interim storage which were not planned for the current supply and length of storage. ¶ Beyond decarbonisation¶ For heightened climate ambition, renewables, energy efficiency, storage, interconnection and flexibility are best suited to make up this gap in generation and support increased renewables-based electrification, while phasing out fossil fuels in parallel. Given the poor speed and high costs of future nuclear projects, the difficulty to build several units at the same time, and the realities of SMRs, it is unlikely nuclear will be able to cover any significant part of Europe’s energy needs by 2040. ¶ The future energy system will be far more decentralised, and active consumer and flexibility oriented, which are not the ideal conditions for new nuclear plants. For these reasons stated above, it is in the nuclear industry’s interest to delay Europe’s progress and keep in place the current centralised, fossil-based energy system, jeopardising climate goals, in the hope that projects are able to materialise in the future, and to lower safety standards to reduce costs. Nuclear energy is also at odds with an energy system based on democratic ownership of energy production, as opposed to renewables.¶ A true democratic debate on nuclear has not been underway, but rather a capture by geopolitical interests and corporations. Problems in three identified spheres, the political debate, energy system planning, and decentralisation have been mapped as current and possible future areas where nuclear advocates may be actively hostile towards renewables and fossil fuel phase out. Though we must look beyond energy and decarbonisation, and have a holistic vision of nuclear power, incorporating drawbacks such as safety, waste, weapon proliferation, uranium dependency, operation in warzones and biodiversity.

#### **Try or die for renewables – nuclear is too slow.**

**Foley 24** (Dr Jonathan Foley is a renowned environmental scientist, sustainability expert and the director of Project Drawdown, the world’s leading resource for climate solutions, "New tech won’t save us from climate change. Here’s what will", BBC Science Focus Magazine, https://www.sciencefocus.com/nature/climate-change-tech-solution, 3-30-2024, DOA: 3-16-2025) //Bellaire MC

Fusion's for the future

We shouldn’t wait for fusion. Government research into fusion energy has been going on since the 1950s, with little of substance to show for it. Despite rosy hype, decades of effort and billions spent, we’re still many years away from a commercial energy source. As the wry saying goes: **fusion energy is 20 years away**… and it **always will be.** We shouldn’t **wait** for advanced nuclear power, either. Nuclear energy generation is stagnating across much of the world, hit by lengthy delays and cost overruns. Promises of better, cheaper, faster, safer nuclear power plants, repeated over decades, have **never been met.**

<<image omitted, no text deleted>>

The last hyped-up technology, the Small Modular Reactor, has recently faced embarrassing delays and failures, casting doubt on the commercial rollout of this technology. And we shouldn’t wait for industrial carbon capture techniques. After decades of work and **tens of billions of dollars spent**, such technology is still incredibly ineffective at removing carbon dioxide from the atmosphere. Projects are still laughably small, wildly expensive and consume massive amounts of energy that would be better used elsewhere. It’s unlikely that these technologies will make any real dent in the atmosphere for decades to come, if ever. Their only use, so far, is as a PR fig leaf for fossil fuel companies. In the race against climate change, it’s quite simple: **time is more important than tech.** Wishing and waiting for solutions that may never come is exactly the wrong thing to do. So, for now, we must stop dreaming about being Captain Kirk or Doctor Who, and start deploying the tools that are **available now.** There are science-backed solutions we can use today – and there’s no time to wait to see what else science fiction can conjure up at the last minute.

#### **Nuclear power is incompatible with renewables – they empirically crowd them out due to inflexibility**

**Hockenos 22** Paul Hockenos, 11-24-2022, "Why Nuclear Power and Renewables Don’t Mix," [Paul Hockenos is a Berlin-based journalist and author of Berlin Calling: A Story of Anarchy, Music, the Wall and the Birth of the New Berlin], https://energytransition.org/2022/11/why-nuclear-power-and-renewables-dont-mix/, DOA 3-26-2025 //Wenzhuo

Nuclear energy’s proponents regularly claim that among the technologies’ many benefits, it is well suited to provide round-the-clock balancing support for intermittent renewables. After all, they say, solar and wind power are weather dependent and nuclear isn’t, thus it will always be there when the sun isn’t shining and the wind is still.¶ Take this 2019 statement by the International Atomic Energy Association (IAEA): “Nuclear power can generate enormous amounts of reliable, carbon free electricity. It works day and night, at all times of the year. This stability is the reason why nuclear power has typically been used as baseload—operating continuously with little if any variation in output. Some nuclear power plants [Small Modular Reactors, SMRs], however, now contribute to the stability of electricity grids by backing up the intermittent output of renewable sources through flexible operation or load following—adjusting production as electricity demand fluctuates.”¶ Of course, in light of France’s acute energy crisis this year – currently over half of its nuclear is down – it’s hard to call nuclear power **reliable**. And there’s plenty of evidence that nuclear **isn’t carbon-free**, either. A 2014 Intergovernmental Panel on Climate Change (IPCC) report, for example, which takes into account the entire life cycle of a nuclear power plant, estimates a range of 3.7 to 110 grams of CO2 equivalent per kilowatt-hour. And the SMRs generate more CO2 during construction than those built in previous decades, due to stricter safety regulations, Ben Wealer of the German Federal Office for the Safety of Nuclear Waste Management (BASE) told Deutsche Welle.¶ But Couture, a Canadian national who has lived and worked in Berlin for over a decade, takes issue with the contention that nuclear segues well with clean energy, even the smaller SMRs. “Nuclear power and variable renewables like solar and wind are like oil and water. They **don’t mix,** at least not well,” he says.¶ Even the **SMRs** that the IAEA touts, says Couture, **do not ramp up** and down **easily**. “Nuclear is **inherently inflexible**, and to accommodate the variability of wind and solar output, what we ultimately **need is** both **flexible sources of supply,** and greater flexibility of demand. The presence of nuclear **actively hinders** both.”¶ Couture explains that they compete against each other rather than working together. Nuclear, he argues, “wants to operate **as much as possible**, while solar and wind want to be **dispatched** all the time, for the simple reason that they have a near-zero marginal cost and outprice everything else on the market. Put those two together and you have the following situation: as soon as you reach modest levels of variable renewables in the mix, one of two things starts happening: either solar and wind start pushing out the nuclear, or nuclear starts pushing out the solar and wind. Like oil and water,” he says.¶ And Couture is not alone in his analysis. A University of Sussex Business School study concludes that nuclear and renewable energy programs do not tend to co-exist well together in low-carbon energy systems but instead **crowd each other out and limit effectiveness.**¶Beleaguered France and its nuclear developer EDF, Couture underscores, is a case and point. “What many nuclear engineers, and much of EDF management, seem to have failed to appreciate is that power systems in the future need one thing, and lots of it, and that’s flexibility.” And flexibility, he says, is one thing that nuclear is ill-equipped to provide. “People who work in power markets know this,” says Couture, “but it merits underscoring: nuclear is the least flexible power source on the grid.”¶ As a result, France has one of the most inflexible power systems in the EU, and as we’ve seen recently, one of the most brittle, he says. “While other countries across Europe are making headway in increasing the flexibility of demand, accelerating the digitalization and real-time operation of the power system, including appliances, loads, and metering, France is lagging behind. EDF and its management have bequeathed an ossified, inflexible power system to future generations of French citizens, a power system that is going to be increasingly vulnerable to interruption due to maintenance- and climate-related risks and events (low water levels in rivers, lack of cooling water, brittle pipes, etc.)”¶ Keeping in mind that the average age of France’s nuclear fleet is 37 years old, Couture argues, the entire fleet is at a heightened risk of malfunction in the years ahead.¶ The inability of nuclear power to ramp down effectively to “**make room”** for cheap wind and solar is one of the main reasons why France’s own domestic renewable energy development **has lagged** its peers, and why it has only belatedly and begrudgingly allowed the expansion of interconnections with the Iberian peninsula, argues Couture. “EDF doesn’t want all this low-cost solar and wind from Spain and Portugal entering their system, and getting in the way of their nuclear fleet. It took a lot of arm-twisting and some EU funding to get a new power line built in the last year or two.”¶ Now, what does this mean for today?¶ France – and by extension, Europe’s – power supply crunch would be far less acute if France had allowed greater interconnection capacity to be developed to the Iberian peninsula, i.e. if nuclear had been able to “make more room” for wind and solar in the system, says Couture. “The inability of France’s nuclear fleet to make room for wind and solar in this way has thus exacerbated the continent-wide power supply crunch we’re now seeing. And now that the tide is going out and over half of France’s nuclear fleet is down, we can see clearly how vulnerable France’s nuclear build-out has ultimately left it.”

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#### **Else – climate change escalates – key inflection points**

**Borenstein 23** Seth Borenstein, 3-20-2023, "Humanity can still stop worst consequences of climate change, but time is running out, IPCC warns," [Borenstein is an Associated Press science writer, covering climate change, disasters, physics and other science topics. He is based in Washington, D.C.], https://www.pbs.org/newshour/science/humanity-can-still-stop-worst-consequences-of-climate-change-but-time-is-running-out-ipcc-warns, DOA 3-26-2025 //wenzhuo

BERLIN (AP) — Humanity still has a chance, close to the last one, to prevent the **worst of climate change’s** future **harms**, a top United Nations panel of scientists said Monday.¶ But doing so requires **quickly slashing carbon pollution and fossil fuel use** by nearly two-thirds by 2035, the Intergovernmental Panel on Climate Change said. The United Nations chief said it more bluntly, calling for an end to new fossil fuel exploration and rich countries quitting coal, oil and gas by 2040.¶ “Humanity is on thin ice — and that ice is melting fast,” United Nations Secretary-General Antonio Guterres said. “Our world **needs climate action** on all fronts — everything, everywhere, all at once.”¶ Stepping up his pleas for action on fossil fuels, Guterres not only called for “no new coal” but also for eliminating its use in rich countries by 2030 and poor countries by 2040. He urged **carbon-free electricity generation** in the developed world by 2035, meaning no gas-fired power plants too.¶ That date is key because nations soon have to come up with goals for pollution reduction by 2035, according to the Paris climate agreement. After contentious debate, the U.N. science panel calculated and reported that to stay under the warming limit set in Paris the world needs to cut 60% of its greenhouse gas emissions by 2035, compared with 2019, adding a new target not previously mentioned in the six reports issued since 2018.¶ “The choices and actions implemented in this **decade** will have impacts for **thousands of years**,” the report, said calling climate change “a threat to **human well-being** and planetary health.”¶ “We are not on the right track but it’s not too late,’’ said report co-author and water scientist Aditi Mukherji. “Our intention is really a message of hope, and not that of doomsday.’’¶ With the world only a few tenths of a degree away from the globally accepted goal of limiting warming to 1.5 degrees Celsius (2.7 degrees Fahrenheit) since pre-industrial times, scientists stressed a sense of urgency. The goal was adopted as part of the 2015 Paris climate agreement and the world has already warmed 1.1 degrees Celsius (2 degrees Fahrenheit).¶ This is likely the last warning the Nobel Peace Prize-winning collection of scientists will be able to make about the 1.5 mark because their next set of reports will likely come after Earth has either breached the mark or locked into exceeding it soon, several scientists, including report authors, told The Associated Press.¶ After 1.5 degrees “the **risks are starting to pile on**,” said report co-author Francis X. Johnson, a climate, land and policy scientist at the Stockholm Environment Institute. The report mentions “https://apnews.com/article/science-climate-and-environment-10b36a73b486ed5c0bde05db4151ccb0″>tipping points” around that temperature of species extinction, including coral reefs, irreversible melting of ice sheets and sea level rise on the order of several meters (several yards).¶ “The window is closing if emissions are not reduced as quickly as possible,” Johnson said in an interview. “Scientists are rather alarmed.”¶ “1.5 is a critical **critical limit**, particularly for small islands and mountain (communities) which depend on glaciers,” said Mukherji, who’s also the climate change impact platform director at the research institute CGIAR.¶ Many scientists, including at least three co-authors, said hitting 1.5 degrees is inevitable.¶ “We are pretty much locked into 1.5,” said report co-author Malte Meinshausen, a climate scientist at the University of Melbourne in Australia. “There’s very little way we will be able to avoid crossing 1.5 C sometime in the 2030s ” but the big issue is whether the temperature keeps rising from there or stabilizes.¶ Guterres insisted “the 1.5-degree limit is achievable.” Science panel chief Hoesung Lee said so far the world is far off course.¶ “This report confirms that if the current trends, current patterns of consumption and production continues, then … the global average 1.5 degrees temperature increase will be seen sometime in this decade,” Lee said.¶ Scientists emphasize that the world, civilization or humanity won’t end if and when Earth hits and passes the 1.5 degree mark. Mukherji said “it’s not as if it’s a cliff that we all fall off.” But an earlier IPCC report detailed how the harms – from coral reef extinction to Arctic sea ice absent summers to even nastier extreme weather – are much worse beyond 1.5 degrees of warming.¶ “It is certainly prudent to be planning for a future that’s warmer than 1.5 degrees,” said IPCC report review editor Steven Rose, an economist at the Electric Power Research Institute in the United States.¶ If the world continues to use all the **fossil fuel**-powered infrastructure either existing now or proposed Earth will warm **at least 2 degrees Celsius** since pre-industrial times, blowing past the 1.5 mark, the report said.¶ Because the report is based on data from a few years ago, the calculations about fossil fuel projects already in the pipeline do not include the increase in coal and natural gas use after Russia’s invasion of Ukraine, said report co-author Dipak Dasgupta, a climate economist at The Energy and Resources Institute in India. The report comes a week after the Biden Administration in the United States approved the huge Willow oil-drilling project in Alaska, which could produce up to 180,000 barrels of oil a day.¶ The report and the underlying discussions also touch on the disparity between rich nations, which caused much of the problem because carbon dioxide emissions from industrialization stay in the air for more than a century, and poorer countries that get hit harder by extreme weather.¶ If the world is to achieve its climate goals, poorer countries need a “many-fold” increase in financial help to adapt to a warmer world and switch to non-polluting energy. Countries have made financial pledges and promises of a damage compensation fund.¶ If rich countries don’t cut emissions quicker and better help victim nations adapt to future harms, “the world is relegating the least developed countries to poverty,” said Madeline Diouf Sarr, chair of a coalition of the poorest nations.¶ The report offers hope if action is taken, using the word “opportunity” nine times in a 27-page summary. Though opportunity is overshadowed by 94 uses of the word “risk.”¶ The head of the IPCC said the report contains “a message of hope in addition to those various scientific findings about the tremendous damages and also the losses that climate change has imposed on us and on the planet.”¶ “There is a pathway that we can resolve these problems, and this report provides a comprehensive overview of what actions we can take to lead us into a much better, livable future,” Lee told The Associated Press.¶ Lee was at pains to stress that it’s not the panel’s job to tell countries what they should or shouldn’t do to cap global temperature rise at 1.5 Celsius.¶ “It’s up to each government to find the best solution,” he said, adding that scientists hope those solutions will stabilize the globe’s temperature around 1.5 degrees.¶ Asked whether this would be the last report to describe ways in which 1.5 C can be achieved, Lee said it was impossible to predict what advances might be made that could keep that target alive.¶ “The possibility is still there,” he said. “It depends upon, again I want to emphasize that, the political will to achieve that goal.”¶ Activists also found grains of hope in the reports.

#### **Every degree matters: warming is anthropogenic, fast, underestimated, and carbon alone triggers self-perpetuation AND acidification.**

**Taylor et al. 24**, \*PhD, Coordinator of BEST Futures, a Research Group on Climate Science, also an Adjunct Research Fellow at the Environmental Futures Lab at Griffith University. \*\*PhD, Professor of Open Physics at the University of Cambridge, Head of the Polar Ocean Physics Group in the Department of Applied Mathematics and Theoretical Physics at the University of Cambridge. \*\*\*PhD, Assistant Professor of Agriculture and Life Sciences at Cornell University. †PhD, President of the Global Coral Reef Alliance and former Senior Scientific Affairs Officer at the United Nations Center for Science and Technology for Development. †\*PhD, Consulting Professor of Electrical Engineering at Stanford University. †\*\*PhD, Associate Professor in the Department of Statistics at the Sepuluh Institute of Technology (\*Graeme Taylor, \*\*Peter Wadhams, \*\*\*Daniele Visioni, †Tom Goreau, †\*Leslie Field, †\*\*Heri Kuswanto, 2024, “Bad Science and Good Intentions Prevent Effective Climate Action,” Earth ArXIV, https://eartharxiv.org/repository/object/6730/download/12962/)

**Every degree** of warming up to 2°C will **add** at least 1.3 meters to sea levels from accelerated ice flow into the ocean and melting from the Antarctic Ice Sheet, while **warming** between 2°C and 6°C is predicted to add 2.4 meters per degree (Garbe, Albrecht, Levermann, Donges and Winkelmann, 2020). While the IPCC Working Group III reports frequently refer to 'cost-effectiveness', the cost against which the effectiveness is being assessed never includes the cost that would arise from exceeding a climate tipping point. It should also be noted that there are no credible technological solutions for many climate change impacts: for example, the Arctic and boreal permafrost contain 1460 to 1600 Gt of organic carbon, almost twice the carbon in the atmosphere (WMO, 2020), and if gigatonnes of methane are released from melting permafrost and warming oceans, the process cannot be reversed. Fact 3.2: The deadly impacts and costs of increasingly acidifying oceans are also greatly underestimated. When carbon dioxide combines with seawater it forms carbonic acid, which makes the **ocean** more **acidic**. Since around 1850, the oceans have absorbed between a third and a half of the CO2 emitted to the atmosphere. As a result, the average pH of ocean surface waters has fallen from 8.2 to 8.1 units. This corresponds to a 30% increase in ocean acidity, a rate of change roughly 10 times faster than any time in the last 55 million years (CoastAdapt, 2017; Jiang et al., 2023). If GHG emissions continue at the current rate (the RCP8.5 trajectory), by the end of the century average pH is projected to decrease by 0.3–0.4 units (∼100%–150% increase in acidity) (Kwiatkowski et al., 2020). Increasing acidity will make it difficult for marine organisms such as corals, clams, mussels, crabs, and some plankton, to form calcium carbonate, the material used to build shells and skeletal material. The **survival** of many microscopic **marine species** will also be **threatened** (Bird, 2023). In addition, ocean acidification will disrupt pelagic **food webs** via the proliferation of toxic algal blooms (Doney et al., 2020). The increasing degradation of marine food chains will seriously damage fishing industries and tourism. **Ocean** system**s** are **not** able to **adapt** to these **rapid** changes in **acidity**—a process that **naturally** occurs over **millennia**. Declining ocean pH levels will persist as long as concentrations of atmospheric CO2 continue to rise. The stress on marine organisms will be exacerbated by rising temperatures and exposure to multiple biogeochemical changes. To avoid significant harm to critical marine ecosystems and the food security of **billions** of people, atmospheric concentrations of atmospheric **CO2** must be rapidly **reduced** to at least 320-350 ppm or less (IUCN, 2017). Fact 3.3: Virtually irreversible tipping points are already being passed. Acceleration of the rate of **climate** change is a real and **existential** risk. Climate tipping points (CTPs) are irrevocable changes in the climate, such as the melting of ice sheets, or the dieback of rainforests. These are points of **no return**: once glaciers and ecosystems like coral reefs have disappeared, they cannot be restored. For example, warming oceans make the collapse of the West Antarctic Ice Sheet unavoidable (Naughten, Holland and De Rydt, 2023). Evidence is all around us that we are nearing or have already crossed CTPs associated with critical parts of the Earth system—we see catastrophic fires in rainforests, spreading deserts, degrading ecosystems, and shrinking sea ice (e.g., Walsh, 2016; Bochow and Boers, 2023; Kim et al., 2023). Another example is rainfall in Greenland, which has increased by 33% since 1991, with flooding rain darkening and melting the ice sheet and baring rocks (Box et al., 2023). However, the accelerating rate of melt and the positive feedbacks of increasing rainfall and reducing albedo are not represented in IPCC models. Armstrong McKay and colleagues (2022) identify six **tipping points** that are **likely** to be crossed within the Paris Agreement targets of 1.5°C - 2°C of warming. **These are:** Greenland Ice Sheet collapse West Antarctic Ice Sheet collapse **Coral** reef die off at low latitudes Sudden **thawing** of permafrost in northern regions Abrupt sea **ice loss** in the Barents Sea Collapse of ocean **circulation** in the high-latitude North **Atlantic** They point out that crossing these climate tipping points can generate positive feedbacks that will increase the likelihood of crossing other CTPs. For example, Arctic permafrost may permanently thaw even if warming stays between 1.1 °C and 1.5°C. Above 1.5°C of warming, losing the permafrost becomes “likely,” and we are currently on track for 2.7°C of warming in this century. If all the permafrost thawed, emissions would be equivalent to **51 times** all GHG **emissions** in 2019. Alarmingly, the ESCIMO climate model indicates that a self-sustaining process of permafrost thaw has already begun, which suggests that the world is already past a point-of-no-return for global warming. This cycle consists of decreasing surface albedo, increasing water vapour feedback and increasing thawing of the permafrost, which releases both methane and carbon dioxide, resulting in even further temperature rises, and so on. Even after no more man-made GHG are emitted, this cycle will continue on its own until all carbon is released from permafrost and all ice is melted (Randers and Goluke, 2020). The likelihood of passing additional CTPs becomes non-negligible at ~2°C and increases greatly at ~3°C. Above 2°C the Arctic would very likely become summer ice-free, and land carbon sink-tosource transitions would become widespread. Scientists are detecting warning signs for many CTPs. For example, researchers have found an almost complete loss of stability of the Atlantic meridional overturning circulation (AMOC). These currents are already at their slowest point in at least 1,600 years, and new analysis indicates that the AMOC could collapse between 2025 and 2095, with a central estimate of 2050, if global carbon emissions are not reduced (Ditlevsen and Ditlevsen, 2023). This would have catastrophic consequences, severely disrupting the rains that billions of people depend on for food in India, South America and West Africa; increasing storms and lowering temperatures in Europe; and raising sea levels in the eastern North America (Boers, 2021) The IPCC’s highest-end GHG concentration pathway, RCP 8.5, remains close to observations in many regions and may eventuate if negative feedback loops are activated, such as emissions from melting permafrost and forest die-backs (Schwalm, Glendon and Duffy, 2020). Both of the high-emission pathways considered in the IPCC’s most recent Working Group I report contain 4°C increases in the “very likely” range for 2081 through 2100, temperatures that many scientists believe would pose a significant threat to civilization (Steel, DesRoches, Mintz-Woo, 2022). Tipping elements have been identified in all earth systems including cryosphere, ocean circulation systems and the biosphere, and a growing risk is that even if the Paris Agreement targets are met, a **cascade** of positive feedbacks could **push** the Earth System irreversibly onto a “**Hothouse Earth**” pathway (Steffen et al. 2018; Klose, Karle, Winkelmann and Donges, 2020). During the last glacial period abrupt climate changes sometimes occurred within decades, with temperatures over the Greenland ice-sheet warming by 8°C to 16°C at each event (Corrick et al., 2020).

The IPCC has been cautious in its evaluation of climate tipping points. For example, its latest report stated that there was a chance of a tipping point in the Amazon by the year 2100. However, while most studies only focus on one driver of destruction, such as climate change or deforestation, in reality ecosystems are simultaneously impacted by multiple interacting threats, e.g., water stress, degradation and pollution. Because tipping points can amplify and **accelerate** one **another**, more than a fifth of ecosystems worldwide, including the Amazon rainforest, are at **risk** of a catastrophic **breakdown** within a single **human life**time (Willcock et al., 2023). Record drought in Amazonia in 2023 suggests we are **much closer** to these thresholds than models **predict**. Fact 3.4: It is **impossible** to adapt to irreversible, catastrophic impacts like species extinction, the loss of glaciers, rising sea levels, and the release of methane from permafrost and oceans.