Net-Zero America - kentucky state report v2

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Reading guide

IN DRAFT

List of Tables

1 E- scenario - PILLAR 1: Efficiency/Electrification - Residential . . . 3
2 E- scenario - PILLAR 1: Efficiency/Electrification - Transportation . . . 3
3 E- scenario - PILLAR 2: Clean Electricity - Generating capacity . . . 3
4 E- scenario - PILLAR 2: Clean Electricity - Generation . . . 3
5 E- scenario - PILLAR 2: Clean Electricity - Transmission . . . 3
6 E- scenario - PILLAR 3: Bioenergy and Hydrogen - Bioconversion . . . 3
7 E- scenario - PILLAR 4: CO2 capture, use, storage - CO2 capture . . . 4
8 E- scenario - PILLAR 4: CO2 capture, use, storage - CO2 storage . . . 4
9 E- scenario - PILLAR 4: CO2 capture, use, storage - CO2 transportation . . . 4
10 E- scenario - IMPACTS - Jobs . . . 4
11 E- scenario - PILLAR 6: Land carbon sinks - Agriculture . . . 4
12 E- scenario - PILLAR 6: Land carbon sinks - Forests . . . 5
13 E- scenario - IMPACTS - Fossil fuel industries . . . 5
14 E- scenario - PILLAR 1: Efficiency/Electrification - Overview . . . 5
15 E- scenario - PILLAR 1: Efficiency/Electrification - Commercial . . . 5
16 E- scenario - PILLAR 1: Efficiency/Electrification - Electricity demand . . . 5
17 RE- scenario - PILLAR 1: Efficiency/Electrification - Residential . . . 6
18 RE- scenario - PILLAR 1: Efficiency/Electrification - Transportation . . . 6
19 RE- scenario - PILLAR 6: Land carbon sinks - Agriculture . . . 6
20 RE- scenario - PILLAR 6: Land carbon sinks - Forests . . . 6
21 RE- scenario - PILLAR 1: Efficiency/Electrification - Overview . . . 7
22 RE- scenario - PILLAR 1: Efficiency/Electrification - Commercial . . . 7
23 RE- scenario - PILLAR 1: Efficiency/Electrification - Electricity demand . . . 7

24 REF scenario - PILLAR 1: Efficiency/Electrification - Residential 7
25 REF scenario - PILLAR 1: Efficiency/Electrification - Transportation 7
26 REF scenario - PILLAR 6: Land carbon sinks - Agriculture 8
27 REF scenario - PILLAR 6: Land carbon sinks - Forests 8
28 REF scenario - PILLAR 1: Efficiency/Electrification - Overview 8
29 REF scenario - PILLAR 1: Efficiency/Electrification - Commercial 8
30 REF scenario - PILLAR 1: Efficiency/Electrification - Electricity demand 9
31 E+ scenario - PILLAR 2: Clean Electricity - Generating capacity 9
32 E+ scenario - PILLAR 2: Clean Electricity - Transmission 9
33 E+ scenario - PILLAR 6: Land carbon sinks - Agriculture 9
34 E+ scenario - PILLAR 6: Land carbon sinks - Forests 9
35 RE+ scenario - PILLAR 2: Clean Electricity - Generating capacity 10
36 RE+ scenario - PILLAR 2: Clean Electricity - Generation 10
37 RE+ scenario - PILLAR 3: Bioenergy and Hydrogen - Bioconversion 10
38 RE+ scenario - PILLAR 4: CO2 capture, use, storage - CO2 capture 10
39 RE+ scenario - PILLAR 4: CO2 capture, use, storage - CO2 storage 10
40 RE+ scenario - PILLAR 4: CO2 capture, use, storage - CO2 transportation 10
41 RE+ scenario - PILLAR 6: Land carbon sinks - Agriculture 10
42 RE+ scenario - PILLAR 6: Land carbon sinks - Forests 11
43 B+ scenario - PILLAR 6: Land carbon sinks - Agriculture 11
44 B+ scenario - PILLAR 6: Land carbon sinks - Forests 12

Table 1: *E- scenario - PILLAR 1: Efficiency/Electrification - Residential*

variable_name	2020	2025	2030	2035	2040	2045	2050
Residential HVAC investment in 2020s vs. REF - Cumulative 5-yr	0	3.379	3.594	0	0	0	0
Sale of space heating units by type - Electric Heat Pump	0.266	0.425	0.778	0.858	0.862	0.861	0.861
Sale of space heating units by type - Electric Resistance	0.265	0.254	0.106	0.073	0.072	0.073	0.073
Sale of space heating units by type - Fossil	0.096	0.113	0.052	0.038	0.037	0.036	0.036
Sale of space heating units by type - Gas	0.372	0.208	0.063	0.031	0.03	0.03	0.029
Sales of cooking units - Electric Resistance	0.769	0.818	0.969	0.998	1	1	1
Sales of cooking units - Gas	0.231	0.182	0.031	0.002	0	0	0
Sales of water heating units by type - Electric Heat Pump	0	0.085	0.449	0.53	0.533	0.534	0.534
Sales of water heating units by type - Electric Resistance	0.625	0.7	0.492	0.445	0.443	0.443	0.443
Sales of water heating units by type - Gas Furnace	0.342	0.192	0.036	0.002	0	0	0
Sales of water heating units by type - Other	0.033	0.024	0.024	0.024	0.024	0.024	0.024

Table 2: *E- scenario - PILLAR 1: Efficiency/Electrification - Transportation*

variable_name	2020	2025	2030	2035	2040	2045	2050
End-use technology sales by technology - HDV - diesel	0.972	0.921	0.67	0.233	0.042	0.006	0
End-use technology sales by technology - HDV - EV	0.006	0.038	0.19	0.456	0.574	0.596	0.6
End-use technology sales by technology - HDV - gasoline	0.002	0.002	0.002	0.001	0	0	0
End-use technology sales by technology - HDV - hybrid	0.001	0.001	0.001	0	0	0	0
End-use technology sales by technology - HDV - hydrogen FC	0.004	0.025	0.127	0.304	0.382	0.397	0.4
End-use technology sales by technology - HDV - other	0.015	0.012	0.011	0.006	0.002	0	0
End-use technology sales by technology - LDV - diesel	0.016	0.018	0.013	0.004	0.001	0	0
End-use technology sales by technology - LDV - EV	0.039	0.151	0.464	0.818	0.963	0.993	1
End-use technology sales by technology - LDV - gasoline	0.899	0.781	0.489	0.166	0.033	0.006	0
End-use technology sales by technology - LDV - hybrid	0.044	0.045	0.032	0.012	0.003	0.001	0
End-use technology sales by technology - LDV - hydrogen FC	0.001	0.003	0.002	0.001	0	0	0
End-use technology sales by technology - LDV - other	0.001	0.001	0.001	0	0	0	0
End-use technology sales by technology - MDV - diesel	0.647	0.597	0.423	0.144	0.026	0.004	0
End-use technology sales by technology - MDV - EV	0.008	0.051	0.253	0.608	0.765	0.795	0.8
End-use technology sales by technology - MDV - gasoline	0.337	0.333	0.255	0.093	0.018	0.003	0
End-use technology sales by technology - MDV - hybrid	0.004	0.004	0.003	0.001	0	0	0
End-use technology sales by technology - MDV - hydrogen FC	0.002	0.013	0.063	0.152	0.191	0.199	0.2
End-use technology sales by technology - MDV - other	0.003	0.003	0.002	0.001	0	0	0
Light-duty vehicle capital costs - Cumulative 5-yr	0	840286751	2146740853	3490058950	5282262995	5753931702	5483398137
Number of public EV charging plugs - DC Fast Charging	60	0	1720.3	0	7655.7	0	12398.6
Number of public EV charging plugs - L2 Charging	251	0	41378.3	0	184141	0	298223.7

Table 3: *E- scenario - PILLAR 2: Clean Electricity - Generating capacity*

variable_name	2020	2025	2030	2035	2040	2045	2050
Power generation capital investment - biomass power plant	0	0	0	0	0	0	0
Power generation capital investment - biomass w/ccu allam power plant	0	0	0	0	0	0	0
Power generation capital investment - biomass w/ccu power plant	0	0	5.142	0	0	5.505	0
Power generation capital investment - Solar PV - Base	0	0	0	0	0	0	0.071
Power generation capital investment - Solar PV - Constrained	0	0.091	0	0	0	0.132	0.08
Power generation capital investment - Wind - Constrained	0	0	0.098	0.431	0.052	0	0

Table 4: *E- scenario - PILLAR 2: Clean Electricity - Generation*

variable_name	2020	2025	2030	2035	2040	2045	2050
Power generation by technology - biomass power plant	0	0	0	0	0	0	0
Power generation by technology - biomass w/ccu allam power plant	0	0	0	0	0	0	0
Power generation by technology - biomass w/ccu power plant	0	0	5771.2	5771.2	5771.2	11949.9	11949.9

Table 5: *E- scenario - PILLAR 2: Clean Electricity - Transmission*

variable_name	2020	2025	2030	2035	2040	2045	2050
HV transmission for wind and solar - base all	0	14.836	160.443	219.307	388.779	388.779	483.83
HV transmission for wind and solar - base other intra-state	0	0	0	0.71	2.729	2.729	2.729
HV transmission for wind and solar - base spur intra-state	0	9.854	9.854	9.854	9.854	9.854	12.792
HV transmission for wind and solar - constrained all	0	30.209	351.883	642.79	786.495	821.287	821.287
HV transmission for wind and solar - constrained other intra-state	0	0	12.875	12.875	12.875	12.875	12.875
HV transmission for wind and solar - constrained spur intra-state	0	9.854	15.11	44.044	52.129	52.129	52.129

Table 6: *E- scenario - PILLAR 3: Bioenergy and Hydrogen - Bioconversion*

variable_name	2020	2025	2030	2035	2040	2045	2050
Biomass purchases	0	0	0.214	0.52	0.52	0.85	0.85
Capital investment	0	0	4.444	0	5.501	0	6.58
Number of facilities - allam power w ccu	0	0	0	0	0	0	0
Number of facilities - beccs hydrogen	0	0	0	6	6	8	8
Number of facilities - diesel	0	0	0	0	0	0	0
Number of facilities - diesel ccu	0	0	0	0	0	0	0
Number of facilities - power	0	0	0	0	0	0	0

Table 6: *E- scenario - PILLAR 3: Bioenergy and Hydrogen - Bioconversion (continued)*

variable_name	2020	2025	2030	2035	2040	2045	2050
Number of facilities - power ccu	0	0	4	4	4	9	9
Number of facilities - pyrolysis	0	0	0	0	0	0	0
Number of facilities - pyrolysis ccu	0	0	0	0	0	1	1
Number of facilities - sng	0	0	0	0	0	0	0
Number of facilities - sng ccu	0	0	0	0	0	0	0

Table 7: *E- scenario - PILLAR 4: CO2 capture, use, storage - CO2 capture*

variable_name	2025	2030	2035	2040	2045	2050
Annual - All	0	5.71	20.15	22.77	35.31	34.08
Annual - BECCS	0	5.71	13.2	13.01	21.43	21.42
Annual - Cement	0	0	0	3.32	3.42	3.53
Annual - NGCC	0	0	6.95	6.44	10.45	9.12
Cumulative - All	0	5.71	25.86	48.63	83.94	118.02
Cumulative - BECCS	0	5.71	18.91	31.92	53.35	74.77
Cumulative - Cement	0	0	0	3.32	6.74	10.27
Cumulative - NGCC	0	0	6.95	13.39	23.84	32.96

Table 8: *E- scenario - PILLAR 4: CO2 capture, use, storage - CO2 storage*

variable_name	2025	2030	2035	2040	2045	2050
Annual	0	1.1	1.76	3.61	5.16	6.52
Injection wells	0	1	4	7	12	15
Resource characterization, appraisal and permitting costs cumulative	45.77	128.16	164.77	164.77	164.77	164.77
Wells and facilities construction costs cumulative	0	30.48	118.77	211.66	353.91	439.39

Table 9: *E- scenario - PILLAR 4: CO2 capture, use, storage - CO2 transportation*

variable_name	2025	2030	2035	2040	2045	2050
CO2 pipelines - All	0	1724556.68	2884869.9	2921616.4	3764787.4	4003057.6
CO2 pipelines - Spur	0	284114.953	930032	966778.5	1809949.7	2048219.9
CO2 pipelines - Trunk	0	1440441.927	1954837.69	1954837.69	1954837.69	1954837.69

Table 10: *E- scenario - IMPACTS - Jobs*

variable_name	2020	2025	2030	2035	2040	2045	2050
Jobs by economic sector - agriculture	92.004	96.686	299.313	1155	981.652	1265.9	1042.7
Jobs by economic sector - construction	4307	3515.5	4016.1	4487.7	3984.4	3689.2	3953
Jobs by economic sector - manufacturing	4081.9	6895.1	8209.7	10971.6	10457.3	8644	10810.2
Jobs by economic sector - mining	6504.9	3343.3	2045.2	1485.2	1026	740.782	534.697
Jobs by economic sector - other	265.904	192.082	197.907	248.805	252.255	244.665	305.217
Jobs by economic sector - pipeline	389.553	383.511	484.729	427.778	316.951	311.543	352.779
Jobs by economic sector - professional	3282.1	2162.5	1905.6	2830.6	2559	2950	2893.1
Jobs by economic sector - trade	3665.5	2011.2	1575.8	1563.4	1364.3	1318.7	1275.9
Jobs by economic sector - utilities	7015.2	5255.3	5482.9	6059.5	5535.8	4636.1	4647.9
Jobs by resource sector - Biomass	275.042	295.177	795.699	3252.5	2933.4	4619.7	4463
Jobs by resource sector - CO2	0	24.209	1337.5	1451.8	1105.8	1664.1	2391.8
Jobs by resource sector - Coal	9681	3153.2	588.503	504.853	431.847	383.924	338.686
Jobs by resource sector - Grid	8090.5	5664.9	6646.3	8439.8	7291.7	6211.1	6044.9
Jobs by resource sector - Natural Gas	4405.5	4926.1	4400.5	3428.3	3561.2	2066.4	1463.8
Jobs by resource sector - Nuclear	0	0	0	0	0	0	0
Jobs by resource sector - Oil	5229.7	4580.2	3753.6	2854.9	2011.3	1414	933.247
Jobs by resource sector - Solar	1416.1	2727.4	3195.7	4630.3	4869.3	4415.4	6347
Jobs by resource sector - Wind	506.339	2484.1	3499.4	4667.1	4273.2	3026.3	3833.1
Median wages - All	54492	54997.5	55154.4	55014.5	55539.2	56203	56450.4
Required Level of Education - Associates degree or some college	9017.6	7407.9	7598.6	9006.3	8211.7	7225.8	7950.4
Required Level of Education - Bachelors degree	6023.9	4989.6	4941	5867.8	5290.2	4789.4	5164.3
Required Level of Education - Doctoral degree	185.346	139.047	127.506	161.654	143.992	148.926	150.721
Required Level of Education - High school diploma or less	12960.7	10191.1	10457.9	12880.1	11654.4	10535.2	11394.3
Required Level of Education - Masters or professional degree	1416.5	1127.6	1092.2	1313.6	1177.3	1101.6	1155.7
Wage income - All	1613243643	1312019436	1335724647	1608101874	1470601043	1337738078	1457357395

Table 11: *E- scenario - PILLAR 6: Land carbon sinks - Agriculture*

variable_name	2050
Carbon sink enhancement potential - Accelerate regeneration	169.301
Carbon sink enhancement potential - All (not counting overlap)	45172
Carbon sink enhancement potential - Avoid deforestation	2433.743
Carbon sink enhancement potential - corn-ethanol to energy grasses	-864.626
Carbon sink enhancement potential - cropland measures	-7581.672
Carbon sink enhancement potential - Extend rotation length	9591.9
Carbon sink enhancement potential - Improve plantations	83.978
Carbon sink enhancement potential - Increase retention of HWP	7774.7
Carbon sink enhancement potential - Increase trees outside forests	1616.576
Carbon sink enhancement potential - permanent conservation cover	-203.767
Carbon sink enhancement potential - Reforest cropland	2465.7
Carbon sink enhancement potential - Reforest pasture	15696.5

Table 11: *E- scenario - PILLAR 6: Land carbon sinks - Agriculture (continued)*

variable_name	2050
Carbon sink enhancement potential - Restore productivity	5339.5
Carbon sink enhancement potential - total	-8650.064
Land impacted for carbon sink enhancement - Accelerate regeneration	68.234
Land impacted for carbon sink enhancement - All (not counting overlap)	6955.7
Land impacted for carbon sink enhancement - Avoid deforestation	653.306
Land impacted for carbon sink enhancement - corn-ethanol to energy grasses	375.856
Land impacted for carbon sink enhancement - cropland measures	3437.2
Land impacted for carbon sink enhancement - Extend rotation length	5284
Land impacted for carbon sink enhancement - Improve plantations	46.673
Land impacted for carbon sink enhancement - Increase retention of HWP	1554.9
Land impacted for carbon sink enhancement - Increase trees outside forests	456.019
Land impacted for carbon sink enhancement - permanent conservation cover	370.615
Land impacted for carbon sink enhancement - Reforest cropland	820.921
Land impacted for carbon sink enhancement - Reforest pasture	1186.909
Land impacted for carbon sink enhancement - Restore productivity	3013.124
Land impacted for carbon sink enhancement - total	4183.7
Land impacted for carbon sink enhancement - Total impacted (over 30 years)	6128.5

Table 12: *E- scenario - PILLAR 6: Land carbon sinks - Forests*

variable_name	2050
Business-as-usual carbon sink - Accelerate regeneration	15.822
Business-as-usual carbon sink - Avoid deforestation	208.113
Business-as-usual carbon sink - Extend rotation length	2890.7
Business-as-usual carbon sink - Improve plantations	17.724
Business-as-usual carbon sink - Increase retention of HWP	0
Business-as-usual carbon sink - Increase trees outside forests	91.686
Business-as-usual carbon sink - Reforest cropland	93.154
Business-as-usual carbon sink - Reforest pasture	289.962
Business-as-usual carbon sink - Restore productivity	1060.7
Business-as-usual carbon sink - Total impacted (over 30 years)	93.154

Table 13: *E- scenario - IMPACTS - Fossil fuel industries*

variable_name	2020	2025	2030	2035	2040	2045	2050
Natural gas consumption	259259.6	263109.9	221786.8	177882.2	133907.1	84249.8	58433.5
Oil consumption	93386.9	88153.2	77241.1	61203.2	46051.9	34065.5	24338.8

Table 14: *E- scenario - PILLAR 1: Efficiency/Electrification - Overview*

variable_name	2020	2025	2030	2035	2040	2045	2050
Final energy demand by sector - commercial	0.119	0.118	0.113	0.105	0.099	0.097	0.097
Final energy demand by sector - industry	0.382	0.396	0.409	0.403	0.409	0.414	0.415
Final energy demand by sector - residential	0.184	0.171	0.156	0.137	0.121	0.111	0.106
Final energy demand by sector - transportation	0.426	0.391	0.344	0.288	0.236	0.205	0.193

Table 15: *E- scenario - PILLAR 1: Efficiency/Electrification - Commercial*

variable_name	2020	2025	2030	2035	2040	2045	2050
Commercial HVAC investment in 2020s - Cumulative 5-yr	0	12649523589	14338235391	0	0	0	0
Sales of cooking units - Electric Resistance	0.435	0.553	0.834	0.889	0.892	0.892	0.891
Sales of cooking units - Gas	0.565	0.447	0.166	0.111	0.108	0.108	0.108
Sales of space heating units - Electric Heat Pump	0.054	0.31	0.775	0.91	0.922	0.923	0.923
Sales of space heating units - Electric Resistance	0.031	0.042	0.045	0.059	0.062	0.062	0.062
Sales of space heating units - Fossil	0.151	0.043	0.008	0	0	0	0
Sales of space heating units - Gas Furnace	0.764	0.605	0.171	0.03	0.016	0.015	0.015
Sales of water heating units - Electric Heat Pump	0.001	0.106	0.557	0.657	0.662	0.662	0.662
Sales of water heating units - Electric Resistance	0.043	0.099	0.28	0.321	0.323	0.322	0.323
Sales of water heating units - Gas Furnace	0.944	0.779	0.147	0.006	0	0	0
Sales of water heating units - Other	0.012	0.016	0.016	0.016	0.016	0.016	0.016

Table 16: *E- scenario - PILLAR 1: Efficiency/Electrification - Electricity demand*

variable_name	2025	2030	2035	2040	2045	2050
Electricity distribution peak load (capital invested) - Cumulative 5-yr	3.259	3.362	4.909	5.184	4.053	4.161

Table 17: *RE- scenario - PILLAR 1: Efficiency/Electrification - Residential*

variable_name	2020	2025	2030	2035	2040	2045	2050
Residential HVAC investment in 2020s vs. REF - Cumulative 5-yr	0	3.332	3.22	0	0	0	0
Sale of space heating units by type - Electric Heat Pump	0.246	0.485	0.494	0.507	0.519	0.534	0.557
Sale of space heating units by type - Electric Resistance	0.273	0.233	0.229	0.222	0.213	0.199	0.176
Sale of space heating units by type - Fossil	0.099	0.092	0.078	0.071	0.069	0.068	0.069
Sale of space heating units by type - Gas	0.383	0.19	0.199	0.2	0.199	0.199	0.198
Sales of cooking units - Electric Resistance	0.766	0.766	0.766	0.766	0.766	0.766	0.766
Sales of cooking units - Gas	0.234	0.234	0.234	0.234	0.234	0.234	0.234
Sales of water heating units by type - Electric Heat Pump	0	0	0	0	0	0	0
Sales of water heating units by type - Electric Resistance	0.625	0.748	0.75	0.748	0.746	0.746	0.746
Sales of water heating units by type - Gas Furnace	0.342	0.228	0.226	0.228	0.23	0.23	0.23
Sales of water heating units by type - Other	0.033	0.024	0.024	0.024	0.024	0.024	0.024

Table 18: *RE- scenario - PILLAR 1: Efficiency/Electrification - Transportation*

variable_name	2020	2025	2030	2035	2040	2045	2050
End-use technology sales by technology - HDV - diesel	0.981	0.982	0.979	0.97	0.956	0.935	0.916
End-use technology sales by technology - HDV - EV	0	0	0	0	0	0	0
End-use technology sales by technology - HDV - gasoline	0.002	0.002	0.003	0.003	0.003	0.003	0.003
End-use technology sales by technology - HDV - hybrid	0.001	0.001	0.001	0.001	0.002	0.002	0.002
End-use technology sales by technology - HDV - hydrogen FC	0.001	0.001	0.002	0.002	0.002	0.002	0.003
End-use technology sales by technology - HDV - other	0.015	0.013	0.016	0.024	0.037	0.057	0.076
End-use technology sales by technology - LDV - diesel	0.016	0.02	0.022	0.02	0.018	0.017	0.016
End-use technology sales by technology - LDV - EV	0.035	0.056	0.064	0.078	0.095	0.11	0.122
End-use technology sales by technology - LDV - gasoline	0.903	0.867	0.846	0.827	0.807	0.787	0.772
End-use technology sales by technology - LDV - hybrid	0.044	0.053	0.064	0.07	0.076	0.082	0.086
End-use technology sales by technology - LDV - hydrogen FC	0.001	0.004	0.003	0.003	0.003	0.003	0.003
End-use technology sales by technology - LDV - other	0.001	0.001	0.001	0.001	0.001	0.001	0.001
End-use technology sales by technology - MDV - diesel	0.652	0.635	0.616	0.596	0.58	0.565	0.552
End-use technology sales by technology - MDV - EV	0	0.001	0.003	0.007	0.009	0.01	0.01
End-use technology sales by technology - MDV - gasoline	0.34	0.355	0.37	0.385	0.397	0.408	0.417
End-use technology sales by technology - MDV - hybrid	0.004	0.004	0.005	0.006	0.007	0.008	0.009
End-use technology sales by technology - MDV - hydrogen FC	0.002	0.002	0.002	0.003	0.003	0.004	0.005
End-use technology sales by technology - MDV - other	0.003	0.003	0.003	0.003	0.004	0.005	0.007

Table 19: *RE- scenario - PILLAR 6: Land carbon sinks - Agriculture*

variable_name	2020	2030	2050
Carbon sink enhancement potential - Accelerate regeneration	0	0	169.301
Carbon sink enhancement potential - All (not counting overlap)	0	0	45172
Carbon sink enhancement potential - Avoid deforestation	0	0	2433.743
Carbon sink enhancement potential - Extend rotation length	0	0	9591.9
Carbon sink enhancement potential - Improve plantations	0	0	83.978
Carbon sink enhancement potential - Increase retention of HWP	0	0	7774.7
Carbon sink enhancement potential - Increase trees outside forests	0	0	1616.576
Carbon sink enhancement potential - Reforest cropland	0	0	2465.7
Carbon sink enhancement potential - Reforest pasture	0	0	15696.5
Carbon sink enhancement potential - Restore productivity	0	0	5339.5
Land impacted for carbon sink enhancement - Accelerate regeneration	0	0	68.234
Land impacted for carbon sink enhancement - All (not counting overlap)	0	0	6955.7
Land impacted for carbon sink enhancement - Avoid deforestation	0	0	653.306
Land impacted for carbon sink enhancement - Extend rotation length	0	0	5284
Land impacted for carbon sink enhancement - Improve plantations	0	0	46.673
Land impacted for carbon sink enhancement - Increase retention of HWP	0	0	1554.9
Land impacted for carbon sink enhancement - Increase trees outside forests	0	0	456.019
Land impacted for carbon sink enhancement - Natural uptake	-13.62	-9.573	-7.758
Land impacted for carbon sink enhancement - Reforest cropland	0	0	820.921
Land impacted for carbon sink enhancement - Reforest pasture	0	0	1186.909
Land impacted for carbon sink enhancement - Restore productivity	0	0	3013.124
Land impacted for carbon sink enhancement - Retained in Hardwood Products	-1.269	-2.117	-2.228
Land impacted for carbon sink enhancement - Total	-14.889	-11.69	-9.986
Land impacted for carbon sink enhancement - Total impacted (over 30 years)	0	0	6128.5

Table 20: *RE- scenario - PILLAR 6: Land carbon sinks - Forests*

variable_name	2050
Business-as-usual carbon sink - Accelerate regeneration	15.822
Business-as-usual carbon sink - Avoid deforestation	208.113
Business-as-usual carbon sink - Extend rotation length	2890.7
Business-as-usual carbon sink - Improve plantations	17.724

Table 20: *RE- scenario - PILLAR 6: Land carbon sinks - Forests (continued)*

variable_name	2050
Business-as-usual carbon sink - Increase retention of HWP	0
Business-as-usual carbon sink - Increase trees outside forests	91.686
Business-as-usual carbon sink - Reforest cropland	93.154
Business-as-usual carbon sink - Reforest pasture	289.962
Business-as-usual carbon sink - Restore productivity	1060.7
Business-as-usual carbon sink - Total impacted (over 30 years)	93.154

Table 21: *RE- scenario - PILLAR 1: Efficiency/Electrification - Overview*

variable_name	2020	2025	2030	2035	2040	2045	2050
Final energy demand by sector - commercial	0.119	0.12	0.121	0.12	0.12	0.122	0.127
Final energy demand by sector - industry	0.382	0.406	0.427	0.438	0.455	0.47	0.488
Final energy demand by sector - residential	0.184	0.172	0.165	0.159	0.157	0.156	0.157
Final energy demand by sector - transportation	0.426	0.395	0.363	0.345	0.346	0.357	0.372

Table 22: *RE- scenario - PILLAR 1: Efficiency/Electrification - Commercial*

variable_name	2020	2025	2030	2035	2040	2045	2050
Commercial HVAC investment in 2020s - Cumulative 5-yr	0	12418889034	12935258127	0	0	0	0
Sales of cooking units - Electric Resistance	0.435	0.456	0.459	0.457	0.46	0.459	0.457
Sales of cooking units - Gas	0.565	0.544	0.541	0.543	0.54	0.541	0.543
Sales of space heating units - Electric Heat Pump	0.054	0.265	0.534	0.755	0.792	0.796	0.796
Sales of space heating units - Electric Resistance	0.031	0.05	0.091	0.15	0.183	0.188	0.189
Sales of space heating units - Fossil	0.151	0.046	0.023	0.003	0	0	0
Sales of space heating units - Gas Furnace	0.764	0.639	0.352	0.092	0.025	0.016	0.015
Sales of water heating units - Electric Heat Pump	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Sales of water heating units - Electric Resistance	0.043	0.056	0.055	0.056	0.055	0.055	0.055
Sales of water heating units - Gas Furnace	0.944	0.926	0.928	0.927	0.927	0.928	0.928
Sales of water heating units - Other	0.012	0.016	0.016	0.016	0.016	0.016	0.016

Table 23: *RE- scenario - PILLAR 1: Efficiency/Electrification - Electricity demand*

variable_name	2025	2030	2035	2040	2045	2050
Electricity distribution peak load (capital invested) - Cumulative 5-yr	3.284	3.391	4.374	4.584	4.262	4.41

Table 24: *REF scenario - PILLAR 1: Efficiency/Electrification - Residential*

variable_name	2020	2025	2030	2035	2040	2045	2050
Residential HVAC investment in 2020s vs. REF - Cumulative 5-yr	0	3.35	3.474	0	0	0	0
Sale of space heating units by type - Electric Heat Pump	0.266	0.356	0.397	0.514	0.692	0.807	0.847
Sale of space heating units by type - Electric Resistance	0.265	0.282	0.264	0.215	0.141	0.095	0.078
Sale of space heating units by type - Fossil	0.096	0.125	0.119	0.098	0.066	0.046	0.039
Sale of space heating units by type - Gas	0.372	0.236	0.22	0.174	0.101	0.053	0.036
Sales of cooking units - Electric Resistance	0.768	0.774	0.795	0.851	0.929	0.977	0.994
Sales of cooking units - Gas	0.232	0.226	0.205	0.149	0.071	0.023	0.006
Sales of water heating units by type - Electric Heat Pump	0	0.015	0.056	0.175	0.358	0.478	0.519
Sales of water heating units by type - Electric Resistance	0.625	0.74	0.718	0.648	0.543	0.475	0.451
Sales of water heating units by type - Gas Furnace	0.342	0.222	0.203	0.153	0.075	0.024	0.006
Sales of water heating units by type - Other	0.033	0.024	0.024	0.024	0.024	0.024	0.024

Table 25: *REF scenario - PILLAR 1: Efficiency/Electrification - Transportation*

variable_name	2020	2025	2030	2035	2040	2045	2050
End-use technology sales by technology - HDV - diesel	0.974	0.96	0.913	0.798	0.582	0.321	0.137
End-use technology sales by technology - HDV - EV	0.005	0.015	0.041	0.108	0.236	0.394	0.51
End-use technology sales by technology - HDV - gasoline	0.002	0.002	0.002	0.002	0.002	0.001	0.001
End-use technology sales by technology - HDV - hybrid	0.001	0.001	0.001	0.001	0.001	0.001	0
End-use technology sales by technology - HDV - hydrogen FC	0.003	0.01	0.027	0.072	0.157	0.263	0.34
End-use technology sales by technology - HDV - other	0.015	0.013	0.015	0.019	0.022	0.02	0.011
End-use technology sales by technology - LDV - diesel	0.016	0.02	0.021	0.016	0.01	0.005	0.002
End-use technology sales by technology - LDV - EV	0.019	0.047	0.118	0.258	0.483	0.72	0.875
End-use technology sales by technology - LDV - gasoline	0.918	0.875	0.797	0.667	0.463	0.249	0.11
End-use technology sales by technology - LDV - hybrid	0.046	0.054	0.06	0.055	0.041	0.024	0.012
End-use technology sales by technology - LDV - hydrogen FC	0.001	0.004	0.003	0.002	0.002	0.001	0
End-use technology sales by technology - LDV - other	0.001	0.001	0.001	0.001	0.001	0	0
End-use technology sales by technology - MDV - diesel	0.648	0.622	0.577	0.494	0.356	0.196	0.084
End-use technology sales by technology - MDV - EV	0.007	0.019	0.055	0.143	0.314	0.526	0.68
End-use technology sales by technology - MDV - gasoline	0.338	0.347	0.347	0.319	0.244	0.142	0.063
End-use technology sales by technology - MDV - hybrid	0.004	0.004	0.005	0.005	0.004	0.003	0.001
End-use technology sales by technology - MDV - hydrogen FC	0.002	0.005	0.014	0.036	0.079	0.132	0.17
End-use technology sales by technology - MDV - other	0.003	0.003	0.003	0.003	0.003	0.002	0.001
Light-duty vehicle capital costs - Cumulative 5-yr	0	0	134697109	285775517	962415370	3036860474	4421500070
Number of public EV charging plugs - DC Fast Charging	60	0	517.684	0	2828.1	0	7941.3
Number of public EV charging plugs - L2 Charging	251	0	12451.8	0	68023.1	0	191012.1

Table 26: *REF scenario - PILLAR 6: Land carbon sinks - Agriculture*

variable_name	2050
Carbon sink enhancement potential - Accelerate regeneration	169.301
Carbon sink enhancement potential - All (not counting overlap)	45172
Carbon sink enhancement potential - Avoid deforestation	2433.743
Carbon sink enhancement potential - corn-ethanol to energy grasses	-864.626
Carbon sink enhancement potential - cropland measures	-7581.672
Carbon sink enhancement potential - Extend rotation length	9591.9
Carbon sink enhancement potential - Improve plantations	83.978
Carbon sink enhancement potential - Increase retention of HWP	7774.7
Carbon sink enhancement potential - Increase trees outside forests	1616.576
Carbon sink enhancement potential - permanent conservation cover	-203.767
Carbon sink enhancement potential - Reforest cropland	2465.7
Carbon sink enhancement potential - Reforest pasture	15696.5
Carbon sink enhancement potential - Restore productivity	5339.5
Carbon sink enhancement potential - total	-8650.064
Land impacted for carbon sink enhancement - Accelerate regeneration	68.234
Land impacted for carbon sink enhancement - All (not counting overlap)	6955.7
Land impacted for carbon sink enhancement - Avoid deforestation	653.306
Land impacted for carbon sink enhancement - corn-ethanol to energy grasses	375.856
Land impacted for carbon sink enhancement - cropland measures	3437.2
Land impacted for carbon sink enhancement - Extend rotation length	5284
Land impacted for carbon sink enhancement - Improve plantations	46.673
Land impacted for carbon sink enhancement - Increase retention of HWP	1554.9
Land impacted for carbon sink enhancement - Increase trees outside forests	456.019
Land impacted for carbon sink enhancement - permanent conservation cover	370.615
Land impacted for carbon sink enhancement - Reforest cropland	820.921
Land impacted for carbon sink enhancement - Reforest pasture	1186.909
Land impacted for carbon sink enhancement - Restore productivity	3013.124
Land impacted for carbon sink enhancement - total	4183.7
Land impacted for carbon sink enhancement - Total impacted (over 30 years)	6128.5

Table 27: *REF scenario - PILLAR 6: Land carbon sinks - Forests*

variable_name	2050
Business-as-usual carbon sink - Accelerate regeneration	15.822
Business-as-usual carbon sink - Avoid deforestation	208.113
Business-as-usual carbon sink - Extend rotation length	2890.7
Business-as-usual carbon sink - Improve plantations	17.724
Business-as-usual carbon sink - Increase retention of HWP	0
Business-as-usual carbon sink - Increase trees outside forests	91.686
Business-as-usual carbon sink - Reforest cropland	93.154
Business-as-usual carbon sink - Reforest pasture	289.962
Business-as-usual carbon sink - Restore productivity	1060.7
Business-as-usual carbon sink - Total impacted (over 30 years)	93.154

Table 28: *REF scenario - PILLAR 1: Efficiency/Electrification - Overview*

variable_name	2020	2025	2030	2035	2040	2045	2050
Final energy demand by sector - commercial	0.119	0.119	0.117	0.114	0.11	0.106	0.103
Final energy demand by sector - industry	0.382	0.396	0.41	0.408	0.416	0.42	0.42
Final energy demand by sector - residential	0.184	0.172	0.163	0.153	0.142	0.129	0.118
Final energy demand by sector - transportation	0.427	0.394	0.36	0.333	0.312	0.287	0.259

Table 29: *REF scenario - PILLAR 1: Efficiency/Electrification - Commercial*

variable_name	2020	2025	2030	2035	2040	2045	2050
Commercial HVAC investment in 2020s - Cumulative 5-yr	0	12641533038	14325332201	0	0	0	0
Sales of cooking units - Electric Resistance	0.435	0.471	0.513	0.616	0.761	0.85	0.88
Sales of cooking units - Gas	0.565	0.529	0.487	0.384	0.239	0.15	0.12
Sales of space heating units - Electric Heat Pump	0.054	0.221	0.273	0.428	0.669	0.836	0.899
Sales of space heating units - Electric Resistance	0.031	0.042	0.042	0.044	0.048	0.055	0.06
Sales of space heating units - Fossil	0.151	0.05	0.046	0.034	0.016	0.005	0.001
Sales of space heating units - Gas Furnace	0.764	0.687	0.638	0.495	0.266	0.103	0.039
Sales of water heating units - Electric Heat Pump	0.001	0.02	0.071	0.218	0.445	0.593	0.644
Sales of water heating units - Electric Resistance	0.043	0.064	0.083	0.143	0.235	0.294	0.315
Sales of water heating units - Gas Furnace	0.944	0.901	0.831	0.622	0.305	0.097	0.025
Sales of water heating units - Other	0.012	0.016	0.016	0.016	0.016	0.016	0.016

Table 30: *REF scenario - PILLAR 1: Efficiency/Electrification - Electricity demand*

variable_name	2025	2030	2035	2040	2045	2050
Electricity distribution peak load (capital invested) - Cumulative 5-yr	2.714	2.753	3.261	3.355	4.247	4.437

Table 31: *E+ scenario - PILLAR 2: Clean Electricity - Generating capacity*

variable_name	2025	2030	2035	2040	2045	2050
Power generation capital investment - Solar PV - Base	0	0	0	0	0.519	5.27
Power generation capital investment - Wind - Base	0	0	0	0.302	0.116	0.175

Table 32: *E+ scenario - PILLAR 2: Clean Electricity - Transmission*

variable_name	2020	2025	2030	2035	2040	2045	2050
HV transmission for wind and solar - base all	0	68.155	290.773	462.173	653.861	953.43	2485.6
HV transmission for wind and solar - base other intra-state	0	5.399	5.399	8.128	8.128	8.128	118.548
HV transmission for wind and solar - base spur intra-state	0	9.854	9.854	9.854	26.796	120.754	357.31

Table 33: *E+ scenario - PILLAR 6: Land carbon sinks - Agriculture*

variable_name	2050
Carbon sink enhancement potential - Accelerate regeneration	169.301
Carbon sink enhancement potential - All (not counting overlap)	45172
Carbon sink enhancement potential - Avoid deforestation	2433.743
Carbon sink enhancement potential - corn-ethanol to energy grasses	-864.626
Carbon sink enhancement potential - cropland measures	-7581.672
Carbon sink enhancement potential - Extend rotation length	9591.9
Carbon sink enhancement potential - Improve plantations	83.978
Carbon sink enhancement potential - Increase retention of HWP	7774.7
Carbon sink enhancement potential - Increase trees outside forests	1616.576
Carbon sink enhancement potential - permanent conservation cover	-203.767
Carbon sink enhancement potential - Reforest cropland	2465.7
Carbon sink enhancement potential - Reforest pasture	15696.5
Carbon sink enhancement potential - Restore productivity	5339.5
Carbon sink enhancement potential - total	-8650.064
Land impacted for carbon sink enhancement - Accelerate regeneration	68.234
Land impacted for carbon sink enhancement - All (not counting overlap)	6955.7
Land impacted for carbon sink enhancement - Avoid deforestation	653.306
Land impacted for carbon sink enhancement - corn-ethanol to energy grasses	375.856
Land impacted for carbon sink enhancement - cropland measures	3437.2
Land impacted for carbon sink enhancement - Extend rotation length	5284
Land impacted for carbon sink enhancement - Improve plantations	46.673
Land impacted for carbon sink enhancement - Increase retention of HWP	1554.9
Land impacted for carbon sink enhancement - Increase trees outside forests	456.019
Land impacted for carbon sink enhancement - permanent conservation cover	370.615
Land impacted for carbon sink enhancement - Reforest cropland	820.921
Land impacted for carbon sink enhancement - Reforest pasture	1186.909
Land impacted for carbon sink enhancement - Restore productivity	3013.124
Land impacted for carbon sink enhancement - total	4183.7
Land impacted for carbon sink enhancement - Total impacted (over 30 years)	6128.5

Table 34: *E+ scenario - PILLAR 6: Land carbon sinks - Forests*

variable_name	2050
Business-as-usual carbon sink - Accelerate regeneration	15.822
Business-as-usual carbon sink - Avoid deforestation	208.113
Business-as-usual carbon sink - Extend rotation length	2890.7
Business-as-usual carbon sink - Improve plantations	17.724
Business-as-usual carbon sink - Increase retention of HWP	0
Business-as-usual carbon sink - Increase trees outside forests	91.686
Business-as-usual carbon sink - Reforest cropland	93.154
Business-as-usual carbon sink - Reforest pasture	289.962
Business-as-usual carbon sink - Restore productivity	1060.7
Business-as-usual carbon sink - Total impacted (over 30 years)	93.154

Table 35: *RE+ scenario - PILLAR 2: Clean Electricity - Generating capacity*

variable_name	2020	2025	2030	2035	2040	2045	2050
Power generation capital investment - biomass power plant	0	0	0	0	0	0	0
Power generation capital investment - biomass w/ccu allam power plant	0	0	0	0	0	0.018	0
Power generation capital investment - biomass w/ccu power plant	0	0	31.859	0	7.92	5.722	0

Table 36: *RE+ scenario - PILLAR 2: Clean Electricity - Generation*

variable_name	2020	2025	2030	2035	2040	2045	2050
Power generation by technology - biomass power plant	0	0	0	0	0	0	0
Power generation by technology - biomass w/ccu allam power plant	0	0	0	0	0	17.967	17.967
Power generation by technology - biomass w/ccu power plant	0	0	35757.1	35757.1	44646.5	51069.1	51069.1

Table 37: *RE+ scenario - PILLAR 3: Bioenergy and Hydrogen - Bioconversion*

variable_name	2020	2025	2030	2035	2040	2045	2050
Biomass purchases	0	0	2.166	2.166	2.704	3.476	3.571
Capital investment	0	0	27.537	0	6.846	0	10.209
Number of facilities - allam power w ccu	0	0	0	0	0	1	1
Number of facilities - beccs hydrogen	0	0	0	0	0	5	6
Number of facilities - diesel	0	0	0	0	0	0	0
Number of facilities - diesel ccu	0	0	0	0	0	1	1
Number of facilities - power	0	0	0	0	0	0	0
Number of facilities - power ccu	0	0	29	29	36	40	40
Number of facilities - pyrolysis	0	0	0	0	0	0	0
Number of facilities - pyrolysis ccu	0	0	0	0	0	0	0
Number of facilities - sng	0	0	0	0	0	0	0
Number of facilities - sng ccu	0	0	0	0	0	0	0

Table 38: *RE+ scenario - PILLAR 4: CO2 capture, use, storage - CO2 capture*

variable_name	2025	2030	2035	2040	2045	2050
Annual - All	0	35.4	35.37	47.49	59.7	61.18
Annual - BECCS	0	35.4	35.37	44.18	56.28	57.51
Annual - Cement	0	0	0	3.32	3.42	3.53
Annual - NGCC	0	0	0	0	0	0.14
Cumulative - All	0	35.4	70.77	118.26	177.96	239.14
Cumulative - BECCS	0	35.4	70.77	114.95	171.23	228.74
Cumulative - Cement	0	0	0	3.32	6.74	10.27
Cumulative - NGCC	0	0	0	0	0	0.14

Table 39: *RE+ scenario - PILLAR 4: CO2 capture, use, storage - CO2 storage*

variable_name	2025	2030	2035	2040	2045	2050
Annual	0	1.85	6.42	13.07	17.73	18.39
Injection wells	0	3	12	21	35	44
Resource characterization, appraisal and permitting costs cumulative	45.77	201.39	311.24	311.24	311.24	311.24
Wells and facilities construction costs cumulative	0	91.43	356.31	634.98	1061.7	1318.2

Table 40: *RE+ scenario - PILLAR 4: CO2 capture, use, storage - CO2 transportation*

variable_name	2025	2030	2035	2040	2045	2050
CO2 pipelines - All	0	3204011.1	3801622.8	4514607.2	5603196.3	6268010.4
CO2 pipelines - Spur	0	1679191.1	1678030.1	1687504.7	2776093.8	3440908
CO2 pipelines - Trunk	0	1524819.927	2123592.69	2827103.453	2827103.453	2827103.453

Table 41: *RE+ scenario - PILLAR 6: Land carbon sinks - Agriculture*

variable_name	2050
Carbon sink enhancement potential - Accelerate regeneration	169.301
Carbon sink enhancement potential - All (not counting overlap)	45172
Carbon sink enhancement potential - Avoid deforestation	2433.743
Carbon sink enhancement potential - corn-ethanol to energy grasses	-1942.516
Carbon sink enhancement potential - cropland measures	-7002.563
Carbon sink enhancement potential - Cropland to woody energy crops	0
Carbon sink enhancement potential - Extend rotation length	9591.9
Carbon sink enhancement potential - Improve plantations	83.978
Carbon sink enhancement potential - Increase retention of HWP	7774.7
Carbon sink enhancement potential - Increase trees outside forests	1616.576
Carbon sink enhancement potential - pasture to energy crops	0
Carbon sink enhancement potential - permanent conservation cover	-186.298
Carbon sink enhancement potential - Reforest cropland	2465.7
Carbon sink enhancement potential - Reforest pasture	15696.5
Carbon sink enhancement potential - Restore productivity	5339.5

Table 41: *RE+ scenario - PILLAR 6: Land carbon sinks - Agriculture (continued)*

variable_name	2050
Carbon sink enhancement potential - total	-9131.376
Land impacted for carbon sink enhancement - Accelerate regeneration	68.234
Land impacted for carbon sink enhancement - All (not counting overlap)	6955.7
Land impacted for carbon sink enhancement - Avoid deforestation	653.306
Land impacted for carbon sink enhancement - corn-ethanol to energy grasses	790.042
Land impacted for carbon sink enhancement - cropland measures	6172
Land impacted for carbon sink enhancement - Cropland to woody energy crops	184.397
Land impacted for carbon sink enhancement - Extend rotation length	5284
Land impacted for carbon sink enhancement - Improve plantations	46.673
Land impacted for carbon sink enhancement - Increase retention of HWP	1554.9
Land impacted for carbon sink enhancement - Increase trees outside forests	456.019
Land impacted for carbon sink enhancement - pasture to energy crops	863.77
Land impacted for carbon sink enhancement - permanent conservation cover	338.842
Land impacted for carbon sink enhancement - Reforest cropland	820.921
Land impacted for carbon sink enhancement - Reforest pasture	1186.909
Land impacted for carbon sink enhancement - Restore productivity	3013.124
Land impacted for carbon sink enhancement - total	8349.1
Land impacted for carbon sink enhancement - Total impacted (over 30 years)	6128.5

Table 42: *RE+ scenario - PILLAR 6: Land carbon sinks - Forests*

variable_name	2050
Business-as-usual carbon sink - Accelerate regeneration	15.822
Business-as-usual carbon sink - Avoid deforestation	208.113
Business-as-usual carbon sink - Extend rotation length	2890.7
Business-as-usual carbon sink - Improve plantations	17.724
Business-as-usual carbon sink - Increase retention of HWP	0
Business-as-usual carbon sink - Increase trees outside forests	91.686
Business-as-usual carbon sink - Reforest cropland	93.154
Business-as-usual carbon sink - Reforest pasture	289.962
Business-as-usual carbon sink - Restore productivity	1060.7
Business-as-usual carbon sink - Total impacted (over 30 years)	93.154

Table 43: *B+ scenario - PILLAR 6: Land carbon sinks - Agriculture*

variable_name	2050
Carbon sink enhancement potential - Accelerate regeneration	169.301
Carbon sink enhancement potential - All (not counting overlap)	45172
Carbon sink enhancement potential - Avoid deforestation	2433.743
Carbon sink enhancement potential - corn-ethanol to energy grasses	-864.626
Carbon sink enhancement potential - cropland measures	-7581.672
Carbon sink enhancement potential - Extend rotation length	9591.9
Carbon sink enhancement potential - Improve plantations	83.978
Carbon sink enhancement potential - Increase retention of HWP	7774.7
Carbon sink enhancement potential - Increase trees outside forests	1616.576
Carbon sink enhancement potential - permanent conservation cover	-203.767
Carbon sink enhancement potential - Reforest cropland	2465.7
Carbon sink enhancement potential - Reforest pasture	15696.5
Carbon sink enhancement potential - Restore productivity	5339.5
Carbon sink enhancement potential - total	-8650.064
Land impacted for carbon sink enhancement - Accelerate regeneration	68.234
Land impacted for carbon sink enhancement - All (not counting overlap)	6955.7
Land impacted for carbon sink enhancement - Avoid deforestation	653.306
Land impacted for carbon sink enhancement - corn-ethanol to energy grasses	375.856
Land impacted for carbon sink enhancement - cropland measures	3437.2
Land impacted for carbon sink enhancement - Extend rotation length	5284
Land impacted for carbon sink enhancement - Improve plantations	46.673
Land impacted for carbon sink enhancement - Increase retention of HWP	1554.9
Land impacted for carbon sink enhancement - Increase trees outside forests	456.019
Land impacted for carbon sink enhancement - permanent conservation cover	370.615

Table 43: *B+ scenario - PILLAR 6: Land carbon sinks - Agriculture (continued)*

variable_name	2050
Land impacted for carbon sink enhancement - Reforest cropland	820.921
Land impacted for carbon sink enhancement - Reforest pasture	1186.909
Land impacted for carbon sink enhancement - Restore productivity	3013.124
Land impacted for carbon sink enhancement - total	4183.7
Land impacted for carbon sink enhancement - Total impacted (over 30 years)	6128.5

Table 44: *B+ scenario - PILLAR 6: Land carbon sinks - Forests*

variable_name	2050
Business-as-usual carbon sink - Accelerate regeneration	15.822
Business-as-usual carbon sink - Avoid deforestation	208.113
Business-as-usual carbon sink - Extend rotation length	2890.7
Business-as-usual carbon sink - Improve plantations	17.724
Business-as-usual carbon sink - Increase retention of HWP	0
Business-as-usual carbon sink - Increase trees outside forests	91.686
Business-as-usual carbon sink - Reforest cropland	93.154
Business-as-usual carbon sink - Reforest pasture	289.962
Business-as-usual carbon sink - Restore productivity	1060.7
Business-as-usual carbon sink - Total impacted (over 30 years)	93.154