



# Net-Zero America - ohio state report

2021-03-15

These data underlie graphs and tables presented in the Princeton Net-Zero America study:

E. Larson, C. Greig, J. Jenkins, E. Mayfield, A. Pascale, C. Zhang, J. Drossman, R. Williams, S. Pacala, R. Socolow, EJ Baik, R. Birdsey, R. Duke, R. Jones, B. Haley, E. Leslie, K. Paustian, and A. Swan, Net-Zero America: Potential Pathways, Infrastructure, and Impacts, interim report, Princeton University, Princeton, NJ, December 15, 2020. Report available at <https://netzeroamerica.princeton.edu>.

## Notes

- These data are all data from the study available at <https://netzeroamerica.princeton.edu>.
- The Net-Zero America study describes five pathways to reach net-zero emissions and one “no new policies” reference scenario. In this document, state-level results are grouped by scenario. For some scenarios, the study generated national, but not state-level results.
- Within results for a given scenario, data tables are organized into corresponding sections of the full net-zero study (e.g., Pillar 1, Pillar 2, etc.)
- For Pillar 6 (Land sinks), values shown are maximum carbon storage potentials.

## Data by category and subcategory

1	E+ scenario - PILLAR 1: Efficiency/Electrification - Commercial . . . . .	1
2	E+ scenario - PILLAR 1: Efficiency/Electrification - Electricity demand . . . .	1
3	E+ scenario - PILLAR 1: Efficiency/Electrification - Overview . . . . .	1
4	E+ scenario - PILLAR 1: Efficiency/Electrification - Residential . . . . .	1
5	E+ scenario - PILLAR 1: Efficiency/Electrification - Transportation . . . . .	2
6	E+ scenario - PILLAR 2: Clean Electricity - Generating capacity . . . . .	2
7	E+ scenario - PILLAR 2: Clean Electricity - Generation . . . . .	3
8	E+ scenario - PILLAR 3: Clean fuels - Bioenergy . . . . .	3
9	E+ scenario - PILLAR 4: CCUS - CO2 capture . . . . .	3
10	E+ scenario - PILLAR 4: CCUS - CO2 pipelines . . . . .	3
11	E+ scenario - PILLAR 4: CCUS - CO2 storage . . . . .	4
12	E+ scenario - PILLAR 6: Land sinks - Agriculture . . . . .	4
13	E+ scenario - PILLAR 6: Land sinks - Forests . . . . .	5
14	E+ scenario - IMPACTS - Fossil fuel industries . . . . .	7
15	E+ scenario - IMPACTS - Health . . . . .	7
16	E+ scenario - IMPACTS - Jobs . . . . .	7
17	E- scenario - PILLAR 1: Efficiency/Electrification - Commercial . . . . .	9
18	E- scenario - PILLAR 1: Efficiency/Electrification - Electricity demand . . . .	9
19	E- scenario - PILLAR 1: Efficiency/Electrification - Overview . . . . .	9
20	E- scenario - PILLAR 1: Efficiency/Electrification - Residential . . . . .	9
21	E- scenario - PILLAR 1: Efficiency/Electrification - Transportation . . . . .	10
22	E- scenario - PILLAR 6: Land sinks - Agriculture . . . . .	10
23	E- scenario - PILLAR 6: Land sinks - Forests . . . . .	11
24	E- scenario - IMPACTS - Health . . . . .	13
25	E+RE+ scenario - PILLAR 1: Efficiency/Electrification - Commercial . . . . .	14
26	E+RE+ scenario - PILLAR 1: Efficiency/Electrification - Electricity demand . .	14
27	E+RE+ scenario - PILLAR 1: Efficiency/Electrification - Overview . . . . .	14
28	E+RE+ scenario - PILLAR 1: Efficiency/Electrification - Residential . . . . .	14
29	E+RE+ scenario - PILLAR 1: Efficiency/Electrification - Transportation . . . .	15
30	E+RE+ scenario - PILLAR 2: Clean Electricity - Generating capacity . . . . .	15
31	E+RE+ scenario - PILLAR 2: Clean Electricity - Generation . . . . .	15
32	E+RE+ scenario - PILLAR 6: Land sinks - Agriculture . . . . .	16
33	E+RE+ scenario - PILLAR 6: Land sinks - Forests . . . . .	16
34	E+RE+ scenario - IMPACTS - Health . . . . .	19
35	E+RE- scenario - PILLAR 1: Efficiency/Electrification - Commercial . . . . .	19
36	E+RE- scenario - PILLAR 1: Efficiency/Electrification - Electricity demand . .	19
37	E+RE- scenario - PILLAR 1: Efficiency/Electrification - Overview . . . . .	19
38	E+RE- scenario - PILLAR 1: Efficiency/Electrification - Residential . . . . .	20
39	E+RE- scenario - PILLAR 1: Efficiency/Electrification - Transportation . . . .	20
40	E+RE- scenario - PILLAR 2: Clean Electricity - Generating capacity . . . . .	21
41	E+RE- scenario - PILLAR 2: Clean Electricity - Generation . . . . .	21
42	E+RE- scenario - PILLAR 6: Land sinks - Agriculture . . . . .	21
43	E+RE- scenario - PILLAR 6: Land sinks - Forests . . . . .	22

44	E+RE- scenario - IMPACTS - Health . . . . .	24
45	E-B+ scenario - PILLAR 1: Efficiency/Electrification - Commercial . . . . .	25
46	E-B+ scenario - PILLAR 1: Efficiency/Electrification - Electricity demand . . . . .	25
47	E-B+ scenario - PILLAR 1: Efficiency/Electrification - Overview . . . . .	25
48	E-B+ scenario - PILLAR 1: Efficiency/Electrification - Residential . . . . .	25
49	E-B+ scenario - PILLAR 1: Efficiency/Electrification - Transportation . . . . .	26
50	E-B+ scenario - PILLAR 2: Clean Electricity - Generating capacity . . . . .	26
51	E-B+ scenario - PILLAR 2: Clean Electricity - Generation . . . . .	26
52	E-B+ scenario - PILLAR 3: Clean fuels - Bioenergy . . . . .	26
53	E-B+ scenario - PILLAR 4: CCUS - CO2 capture . . . . .	27
54	E-B+ scenario - PILLAR 4: CCUS - CO2 pipelines . . . . .	27
55	E-B+ scenario - PILLAR 4: CCUS - CO2 storage . . . . .	27
56	E-B+ scenario - PILLAR 6: Land sinks - Agriculture . . . . .	27
57	E-B+ scenario - PILLAR 6: Land sinks - Forests . . . . .	29
58	E-B+ scenario - IMPACTS - Health . . . . .	31
59	REF scenario - PILLAR 1: Efficiency/Electrification - Commercial . . . . .	31
60	REF scenario - PILLAR 1: Efficiency/Electrification - Electricity demand . . . . .	32
61	REF scenario - PILLAR 1: Efficiency/Electrification - Overview . . . . .	32
62	REF scenario - PILLAR 1: Efficiency/Electrification - Residential . . . . .	32
63	REF scenario - PILLAR 1: Efficiency/Electrification - Transportation . . . . .	32
64	REF scenario - PILLAR 6: Land sinks - Forests . . . . .	33
65	REF scenario - PILLAR 6: Land sinks - Forests - REF only . . . . .	35
66	REF scenario - IMPACTS - Health . . . . .	35

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

Item	2020	2025	2030	2035	2040	2045	2050
Commercial HVAC investment in 2020s - Cumulative 5-yr (million \$2018)		36,680	40,065				
Sales of cooking units - Electric Resistance (%)	41	54.2	82.9	88.6	88.9	88.9	88.9
Sales of cooking units - Gas (%)	59	45.8	17.1	11.4	11.1	11.1	11.1
Sales of space heating units - Electric Heat Pump (%)	1.41	8.43	35.7	81.1	89	89.5	89.5
Sales of space heating units - Electric Resistance (%)	4.39	3.49	5.31	9.37	10.1	10.2	10.2
Sales of space heating units - Fossil (%)	5.44	2.58	0.487	0.021	0	0	0
Sales of space heating units - Gas Furnace (%)	88.8	85.5	58.5	9.54	0.892	0.356	0.356
Sales of water heating units - Electric Heat Pump (%)	0.454	2.53	19.6	46.2	50.8	51.1	51.1
Sales of water heating units - Electric Resistance (%)	4.26	4.67	18.3	43.9	48.4	48.7	48.7
Sales of water heating units - Gas Furnace (%)	95	92.6	61.9	9.69	0.569	0	0
Sales of water heating units - Other (%)	0.252	0.187	0.187	0.189	0.188	0.188	0.189

Table 2: *E+ scenario - PILLAR 1: Efficiency/Electrification - Electricity demand*

Item	2020	2025	2030	2035	2040	2045	2050
Electricity distribution capital invested - Cumulative 5-yr (billion \$2018)		6.24	6.43	13.3	14.2	13.1	13.8

Table 3: *E+ scenario - PILLAR 1: Efficiency/Electrification - Overview*

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Commercial (PJ)	372	366	351	325	295	272	261
Final energy use - Industry (PJ)	602	619	627	629	639	647	652
Final energy use - Residential (PJ)	555	515	478	416	348	297	264
Final energy use - Transportation (PJ)	952	886	773	638	516	442	411

Table 4: *E+ scenario - PILLAR 1: Efficiency/Electrification - Residential*

Item	2020	2025	2030	2035	2040	2045	2050
Residential HVAC investment in 2020s vs. REF - Cumulative 5-yr (billion \$2018)		9.7	12.8				
Sales of cooking units - Electric Resistance (%)	61.8	69.9	94.9	99.7	100	100	100
Sales of cooking units - Gas (%)	38.2	30.1	5.14	0.259	0	0	0
Sales of space heating units - Electric Heat Pump (%)	5.51	13.7	41.4	84.2	91.7	92.1	91.9
Sales of space heating units - Electric Resistance (%)	15.4	21.4	16.1	7.17	5.54	5.47	5.69
Sales of space heating units - Fossil (%)	5.05	8.47	5.81	2.79	2.31	2.27	2.21
Sales of space heating units - Gas (%)	74	56.5	36.7	5.84	0.489	0.156	0.159
Sales of water heating units - Electric Heat Pump (%)	0	1.79	15.1	34.7	38	38.3	38.3
Sales of water heating units - Electric Resistance (%)	32.2	48.8	51.7	60	61.5	61.6	61.5
Sales of water heating units - Gas Furnace (%)	67.7	49.3	33	5.17	0.303	0	0
Sales of water heating units - Other (%)	0.083	0.169	0.17	0.17	0.168	0.168	0.17

Table 5: *E+ scenario - PILLAR 1: Efficiency/Electrification - Transportation*

Item	2020	2025	2030	2035	2040	2045	2050
Light-duty vehicle capital costs - Cumulative 5-yr (million \$2018)		2,095	5,367	8,700	13,178	14,344	13,675
Public EV charging plugs - DC Fast (1000 units)	0.326		3.65		16		25.9
Public EV charging plugs - L2 (1000 units)	1.06		87.7		386		624
Vehicle sales - Heavy-duty - diesel (%)	97.2	92.1	67	23.3	4.22	0.628	0
Vehicle sales - Heavy-duty - EV (%)	0.588	3.81	19	45.6	57.4	59.6	60
Vehicle sales - Heavy-duty - gasoline (%)	0.227	0.227	0.176	0.066	0.013	0.002	0
Vehicle sales - Heavy-duty - hybrid (%)	0.082	0.09	0.077	0.031	0.007	0.001	0
Vehicle sales - Heavy-duty - hydrogen FC (%)	0.392	2.54	12.7	30.4	38.2	39.7	40
Vehicle sales - Heavy-duty - other (%)	1.5	1.23	1.07	0.568	0.163	0.038	0
Vehicle sales - Light-duty - diesel (%)	1.4	1.68	1.2	0.382	0.072	0.013	0
Vehicle sales - Light-duty - EV (%)	4.42	16.7	48.8	82.7	96.4	99.3	100
Vehicle sales - Light-duty - gasoline (%)	89.1	76.3	46.4	15.6	3.17	0.586	0
Vehicle sales - Light-duty - hybrid (%)	4.91	4.9	3.38	1.24	0.304	0.067	0
Vehicle sales - Light-duty - hydrogen FC (%)	0.11	0.331	0.191	0.059	0.012	0.002	0
Vehicle sales - Light-duty - other (%)	0.095	0.091	0.058	0.02	0.004	0.001	0
Vehicle sales - Medium-duty - diesel (%)	64.7	59.7	42.3	14.4	2.59	0.384	0
Vehicle sales - Medium-duty - EV (%)	0.784	5.07	25.3	60.8	76.5	79.5	80
Vehicle sales - Medium-duty - gasoline (%)	33.7	33.3	25.5	9.32	1.77	0.277	0
Vehicle sales - Medium-duty - hybrid (%)	0.363	0.402	0.341	0.14	0.03	0.005	0
Vehicle sales - Medium-duty - hydrogen FC (%)	0.196	1.27	6.33	15.2	19.1	19.9	20
Vehicle sales - Medium-duty - other (%)	0.253	0.255	0.205	0.083	0.019	0.004	0

Table 6: *E+ scenario - PILLAR 2: Clean Electricity - Generating capacity*

Item	2020	2025	2030	2035	2040	2045	2050
Capital invested - Biomass power plant (billion \$2018)	0	0	0	0	0	0	0
Capital invested - Biomass w/ccu allam power plant (billion \$2018)	0	0	0	0	0	0	0
Capital invested - Biomass w/ccu power plant (billion \$2018)	0	0	0	0	0	0	0
Capital invested - Solar PV - Base (billion \$2018)		0	0.621	12.5	9.71	12.6	4.83
Capital invested - Solar PV - Constrained (billion \$2018)		1.55	0.276	10.4	9.72	11.5	5.9
Capital invested - Wind - Base (billion \$2018)		0	5.07	13.6	21.4	2.52	3.08
Capital invested - Wind - Constrained (billion \$2018)		0	12.9	11.3	0	0	0.2
Installed renewables - OffshoreWind - Base land use assumptions (MW)	0	0	0	0	0	0	0
Installed renewables - OffshoreWind - Constrained land use assumptions (MW)	0	0	0	0	0	0	0
Installed renewables - Rooftop PV (MW)	152	228	303	401	518	653	807
Installed renewables - Solar - Base land use assumptions (MW)	820	820	1,428	14,669	25,604	40,600	46,709
Installed renewables - Solar - Constrained land use assumptions (MW)	751	751	2,585	13,936	27,481	42,657	51,286
Installed renewables - Wind - Base land use assumptions (MW)	827	827	4,636	15,584	33,653	35,902	38,809
Installed renewables - Wind - Constrained land use assumptions (MW)	827	827	9,867	19,628	19,628	19,628	19,628

Table 7: *E+ scenario - PILLAR 2: Clean Electricity - Generation*

Item	2020	2025	2030	2035	2040	2045	2050
Biomass power plant (GWh)	0	0	0	0	0	0	0
Biomass w/ccu allam power plant (GWh)	0	0	0	0	0	0	0
Biomass w/ccu power plant (GWh)	0	0	0	0	0	0	0
OffshoreWind - Base land use assumptions (GWh)	0	0	0	0	0	0	0
OffshoreWind - Constrained land use assumptions (GWh)	0	0	0	0	0	0	0
Solar - Base land use assumptions (GWh)	1,454	1,454	2,369	22,189	38,393	60,473	69,347
Solar - Constrained land use assumptions (GWh)	1,334	1,334	4,096	21,004	41,108	63,417	76,016
Wind - Base land use assumptions (GWh)	2,973	2,973	14,885	48,163	98,677	104,614	112,056
Wind - Constrained land use assumptions (GWh)	2,973	2,973	28,568	53,532	53,532	53,532	53,532

Table 8: *E+ scenario - PILLAR 3: Clean fuels - Bioenergy*

Item	2020	2025	2030	2035	2040	2045	2050
Biomass purchases (million \$2018/year)		0	0	0	0	402	1,858
Conversion capital investment - Cumulative 5-yr (million \$2018)		0	0	0	0	6,167	22,362
Number of facilities - Allam power w ccu (quantity)	0	0	0	0	0	0	0
Number of facilities - Beccs hydrogen (quantity)	0	0	0	0	0	7	30
Number of facilities - Diesel (quantity)	0	0	0	0	0	0	0
Number of facilities - Diesel ccu (quantity)	0	0	0	0	0	0	0
Number of facilities - Power (quantity)	0	0	0	0	0	0	0
Number of facilities - Power ccu (quantity)	0	0	0	0	0	0	0
Number of facilities - Pyrolysis (quantity)	0	0	0	0	0	0	0
Number of facilities - Pyrolysis ccu (quantity)	0	0	0	0	0	0	0
Number of facilities - Sng (quantity)	0	0	0	0	0	0	0
Number of facilities - Sng ccu (quantity)	0	0	0	0	0	0	0

Table 9: *E+ scenario - PILLAR 4: CCUS - CO2 capture*

Item	2020	2025	2030	2035	2040	2045	2050
Annual - All (MMT)		0	0	0	0	793	36.7
Annual - BECCS (MMT)		0	0	0	0	793	36.7
Annual - Cement and lime (MMT)		0	0	0	0	0	0
Annual - NGCC (MMT)		0	0	0	0	0	0
Cumulative - All (MMT)		0	0	0	0	793	44.6
Cumulative - BECCS (MMT)		0	0	0	0	793	44.6
Cumulative - Cement and lime (MMT)		0	0	0	0	0	0
Cumulative - NGCC (MMT)		0	0	0	0	0	0

Table 10: *E+ scenario - PILLAR 4: CCUS - CO2 pipelines*

Item	2020	2025	2030	2035	2040	2045	2050
All (km)		0	477	477	477	778	2,027
Cumulative investment - All (million \$2018)		0	1,555	1,555	1,555	1,905	3,017
Cumulative investment - Spur (million \$2018)		0	0	0	0	350	1,462
Cumulative investment - Trunk (million \$2018)		0	1,555	1,555	1,555	1,555	1,555
Spur (km)		0	0	0	0	301	1,550
Trunk (km)		0	477	477	477	477	477

Table 11: E+ scenario - PILLAR 4: CCUS - CO2 storage

Item	2020	2025	2030	2035	2040	2045	2050
CO2 storage (MMT)		0	0	0	0	0	0
Injection wells (wells)		0	0	0	0	0	0
Resource characterization, appraisal, permitting costs (million \$2020)		0	0	0	0	0	0
Wells and facilities construction costs (million \$2020)		0	0	0	0	0	0

Table 12: E+ scenario - PILLAR 6: Land sinks - Agriculture

Item	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - Aggressive deployment - Corn-ethanol to energy grasses (1000 tCO2e/y)							-1,255
Carbon sink potential - Aggressive deployment - Cropland measures (1000 tCO2e/y)							-5,463
Carbon sink potential - Aggressive deployment - Permanent conservation cover (1000 tCO2e/y)							-214
Carbon sink potential - Aggressive deployment - Total (1000 tCO2e/y)							-6,932
Carbon sink potential - Moderate deployment - Corn-ethanol to energy grasses (1000 tCO2e/y)							-1,255
Carbon sink potential - Moderate deployment - Cropland measures (1000 tCO2e/y)							-2,883
Carbon sink potential - Moderate deployment - Permanent conservation cover (1000 tCO2e/y)							-107
Carbon sink potential - Moderate deployment - Total (1000 tCO2e/y)							-4,245
Land impacted for carbon sink - Aggressive deployment - Corn-ethanol to energy grasses (1000 hectares)							523
Land impacted for carbon sink - Aggressive deployment - Cropland measures (1000 hectares)							3,526
Land impacted for carbon sink - Aggressive deployment - Permanent conservation cover (1000 hectares)							390
Land impacted for carbon sink - Aggressive deployment - Total (1000 hectares)							4,439
Land impacted for carbon sink - Moderate deployment - Corn-ethanol to energy grasses (1000 hectares)							523
Land impacted for carbon sink - Moderate deployment - Cropland measures (1000 hectares)							1,861
Land impacted for carbon sink - Moderate deployment - Permanent conservation cover (1000 hectares)							195
Land impacted for carbon sink - Moderate deployment - Total (1000 hectares)							2,578

Table 13: *E+ scenario - PILLAR 6: Land sinks - Forests*

Item	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - High - Accelerate regeneration (1000 tCO <sub>2</sub> e/y)							-180
Carbon sink potential - High - All (not counting overlap) (1000 tCO <sub>2</sub> e/y)							-21,474
Carbon sink potential - High - Avoid deforestation (1000 tCO <sub>2</sub> e/y)							-3,130
Carbon sink potential - High - Extend rotation length (1000 tCO <sub>2</sub> e/y)							-3,434
Carbon sink potential - High - Improve plantations (1000 tCO <sub>2</sub> e/y)							-219
Carbon sink potential - High - Increase retention of HWP (1000 tCO <sub>2</sub> e/y)							-4,749
Carbon sink potential - High - Increase trees outside forests (1000 tCO <sub>2</sub> e/y)							-1,920
Carbon sink potential - High - Reforest cropland (1000 tCO <sub>2</sub> e/y)							-1,166
Carbon sink potential - High - Reforest pasture (1000 tCO <sub>2</sub> e/y)							-4,605
Carbon sink potential - High - Restore productivity (1000 tCO <sub>2</sub> e/y)							-2,070
Carbon sink potential - Low - Accelerate regeneration (1000 tCO <sub>2</sub> e/y)							-90.3
Carbon sink potential - Low - All (not counting overlap) (1000 tCO <sub>2</sub> e/y)							-5,927
Carbon sink potential - Low - Avoid deforestation (1000 tCO <sub>2</sub> e/y)							-522
Carbon sink potential - Low - Extend rotation length (1000 tCO <sub>2</sub> e/y)							-1,319
Carbon sink potential - Low - Improve plantations (1000 tCO <sub>2</sub> e/y)							-112
Carbon sink potential - Low - Increase retention of HWP (1000 tCO <sub>2</sub> e/y)							-1,583
Carbon sink potential - Low - Increase trees outside forests (1000 tCO <sub>2</sub> e/y)							-672
Carbon sink potential - Low - Reforest cropland (1000 tCO <sub>2</sub> e/y)							-583
Carbon sink potential - Low - Reforest pasture (1000 tCO <sub>2</sub> e/y)							-349
Carbon sink potential - Low - Restore productivity (1000 tCO <sub>2</sub> e/y)							-698
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO <sub>2</sub> e/y)							-135
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO <sub>2</sub> e/y)							-13,699
Carbon sink potential - Mid - Avoid deforestation (1000 tCO <sub>2</sub> e/y)							-1,826
Carbon sink potential - Mid - Extend rotation length (1000 tCO <sub>2</sub> e/y)							-2,377
Carbon sink potential - Mid - Improve plantations (1000 tCO <sub>2</sub> e/y)							-163
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO <sub>2</sub> e/y)							-3,166
Carbon sink potential - Mid - Increase trees outside forests (1000 tCO <sub>2</sub> e/y)							-1,296
Carbon sink potential - Mid - Reforest cropland (1000 tCO <sub>2</sub> e/y)							-874
Carbon sink potential - Mid - Reforest pasture (1000 tCO <sub>2</sub> e/y)							-2,477
Carbon sink potential - Mid - Restore productivity (1000 tCO <sub>2</sub> e/y)							-1,384



Table 13: *E+ scenario - PILLAR 6: Land sinks - Forests (continued)*

Item	2020	2025	2030	2035	2040	2045	2050
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)							29.5
Land impacted for carbon sink potential - High - Avoid deforestation (over 30 years) (1000 hectares)							424
Land impacted for carbon sink potential - High - Extend rotation length (1000 hectares)							1,751
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)							80.7
Land impacted for carbon sink potential - High - Increase retention of HWP (1000 hectares)							0
Land impacted for carbon sink potential - High - Increase trees outside forests (1000 hectares)							182
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)							77.1
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)							131
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)							686
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)							3,362
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)							14.7
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)							398
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)							671
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)							40.4
Land impacted for carbon sink potential - Low - Increase retention of HWP (1000 hectares)							0
Land impacted for carbon sink potential - Low - Increase trees outside forests (1000 hectares)							96
Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares)							38.5
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)							22.7
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)							415
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)							1,696
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)							22.1

Table 13: *E+ scenario - PILLAR 6: Land sinks - Forests (continued)*

Item	2020	2025	2030	2035	2040	2045	2050
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)							411
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)							1,211
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)							60.8
Land impacted for carbon sink potential - Mid - Increase retention of HWP (1000 hectares)							0
Land impacted for carbon sink potential - Mid - Increase trees outside forests (1000 hectares)							139
Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares)							57.8
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)							164
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)							836
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)							2,902

Table 14: *E+ scenario - IMPACTS - Fossil fuel industries*

Item	2020	2025	2030	2035	2040	2045	2050
Natural gas consumption - Annual (tcf)		882	743	596	449	282	196
Natural gas consumption - Cumulative (tcf)							17,958
Natural gas production - Annual (tcf)		2,865	2,708	2,358	1,994	1,581	1,228
Oil consumption - Annual (million bbls)		183	157	120	85.6	58.3	37
Oil consumption - Cumulative (million bbls)							3,717
Oil production - Annual (million bbls)		30.1	30.2	30.2	23.9	19.4	12.9

Table 15: *E+ scenario - IMPACTS - Health*

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal (million 2019\$)		2,185	5.74	5.72	5.49	4.18	0.407
Monetary damages from air pollution - Natural Gas (million 2019\$)		382	309	197	163	88.6	34.3
Monetary damages from air pollution - Transportation (million 2019\$)		3,979	3,697	2,802	1,624	753	313
Premature deaths from air pollution - Coal (deaths)		247	0.648	0.646	0.62	0.473	0.046
Premature deaths from air pollution - Natural Gas (deaths)		43.2	34.9	22.2	18.4	10	3.88
Premature deaths from air pollution - Transportation (deaths)		448	416	315	183	84.6	35.2

Table 16: *E+ scenario - IMPACTS - Jobs*

Item	2020	2025	2030	2035	2040	2045	2050
By economic sector - Agriculture (jobs)		991	1,049	946	522	572	1,838
By economic sector - Construction (jobs)		9,969	11,487	23,730	28,313	28,695	27,060
By economic sector - Manufacturing (jobs)		18,228	21,175	27,550	26,341	21,459	26,714
By economic sector - Mining (jobs)		11,133	8,438	6,292	4,037	2,522	1,363

Table 16: E+ scenario - IMPACTS - Jobs (continued)

Item	2020	2025	2030	2035	2040	2045	2050
By economic sector - Other (jobs)		431	631	2,989	3,778	4,619	4,316
By economic sector - Pipeline (jobs)		1,603	1,561	1,101	823	555	476
By economic sector - Professional (jobs)		5,422	5,881	12,178	16,070	16,982	18,364
By economic sector - Trade (jobs)		5,336	5,040	8,351	9,996	10,432	10,368
By economic sector - Utilities (jobs)		12,259	12,458	19,950	24,333	23,209	23,300
By education level - All sectors - Associates degree or some college (jobs)		19,760	20,727	32,380	36,393	34,853	36,016
By education level - All sectors - Bachelors degree (jobs)		14,492	14,596	21,253	23,462	22,280	23,250
By education level - All sectors - Doctoral degree (jobs)		420	419	681	807	810	847
By education level - All sectors - High school diploma or less (jobs)		27,390	28,670	43,786	47,886	45,610	47,970
By education level - All sectors - Masters or professional degree (jobs)		3,311	3,307	4,987	5,665	5,492	5,715
By resource sector - Biomass (jobs)		2,429	2,442	2,131	1,241	2,132	8,003
By resource sector - CO2 (jobs)		0	1,539	0	0	131	1,132
By resource sector - Coal (jobs)		1,710	216	18	13.3	10.4	8.76
By resource sector - Grid (jobs)		10,491	12,032	29,799	39,082	39,898	42,049
By resource sector - Natural Gas (jobs)		18,143	15,108	12,583	10,498	6,865	3,994
By resource sector - Nuclear (jobs)		662	651	641	631	366	0
By resource sector - Oil (jobs)		19,280	16,571	13,779	9,722	6,954	4,254
By resource sector - Solar (jobs)		6,458	8,175	23,990	24,898	28,191	28,184
By resource sector - Wind (jobs)		6,200	10,985	20,146	28,128	24,499	26,172
Median wages - Annual - All (\$2019 per job)		59,967	60,097	60,244	61,374	62,277	62,669
On-Site or In-Plant Training - Total jobs - 1 to 4 years (jobs)		10,393	10,820	16,714	18,681	17,853	18,325
On-Site or In-Plant Training - Total jobs - 4 to 10 years (jobs)		3,916	4,051	6,532	7,521	7,323	7,285
On-Site or In-Plant Training - Total jobs - None (jobs)		10,491	10,907	16,728	18,591	17,806	18,682
On-Site or In-Plant Training - Total jobs - Over 10 years (jobs)		516	548	872	993	954	981
On-Site or In-Plant Training - Total jobs - Up to 1 year (jobs)		40,057	41,394	62,240	68,427	65,110	68,525
On-the-Job Training - All sectors - 1 to 4 years (jobs)		13,258	13,803	21,420	24,058	23,014	23,535
On-the-Job Training - All sectors - 4 to 10 years (jobs)		3,634	3,793	6,314	7,357	7,217	7,153
On-the-Job Training - All sectors - None (jobs)		3,513	3,596	5,508	6,090	5,862	6,104
On-the-Job Training - All sectors - Over 10 years (jobs)		661	703	1,062	1,150	1,074	1,115
On-the-Job Training - All sectors - Up to 1 year (jobs)		44,308	45,825	68,782	75,558	71,879	75,890
Related work experience - All sectors - 1 to 4 years (jobs)		23,759	24,437	36,940	40,984	39,168	40,692
Related work experience - All sectors - 4 to 10 years (jobs)		15,181	15,678	23,869	26,667	25,442	26,263
Related work experience - All sectors - None (jobs)		9,280	9,636	14,744	16,343	15,666	16,368
Related work experience - All sectors - Over 10 years (jobs)		4,310	4,458	6,604	7,250	6,813	7,112
Related work experience - All sectors - Up to 1 year (jobs)		12,843	13,510	20,929	22,969	21,957	23,363
Wage income - All (million \$2019)		3,920	4,070	6,211	7,010	6,792	7,132

Table 17: E- scenario - PILLAR 1: Efficiency/Electrification - Commercial

Item	2020	2025	2030	2035	2040	2045	2050
Commercial HVAC investment in 2020s - Cumulative 5-yr (million \$2018)		36,676	40,057				
Sales of cooking units - Electric Resistance (%)	41	45.8	49.8	60.5	75.4	84.5	87.7
Sales of cooking units - Gas (%)	59	54.2	50.2	39.5	24.6	15.5	12.3
Sales of space heating units - Electric Heat Pump (%)	1.41	6.26	9.41	19.5	41.8	67.8	82.5
Sales of space heating units - Electric Resistance (%)	4.39	3.42	3.62	4.32	6.06	8.25	9.52
Sales of space heating units - Fossil (%)	5.44	2.99	2.75	2.06	1.03	0.337	0.088
Sales of space heating units - Gas Furnace (%)	88.8	87.3	84.2	74.1	51.1	23.6	7.9
Sales of water heating units - Electric Heat Pump (%)	0.454	1.05	3.02	9.27	22.8	38.3	47
Sales of water heating units - Electric Resistance (%)	4.26	3.81	5.35	10.5	22.3	36.6	44.8
Sales of water heating units - Gas Furnace (%)	95	94.9	91.4	80	54.7	25	8.07
Sales of water heating units - Other (%)	0.252	0.187	0.187	0.189	0.188	0.188	0.189

Table 18: E- scenario - PILLAR 1: Efficiency/Electrification - Electricity demand

Item	2020	2025	2030	2035	2040	2045	2050
Electricity distribution capital invested - Cumulative 5-yr (billion \$2018)		5.04	5.08	6.88	7.14	11.1	11.9

Table 19: E- scenario - PILLAR 1: Efficiency/Electrification - Overview

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Commercial (PJ)	372	367	358	350	337	320	302
Final energy use - Industry (PJ)	602	620	630	637	652	659	663
Final energy use - Residential (PJ)	555	516	488	461	427	383	335
Final energy use - Transportation (PJ)	954	894	812	747	696	637	566

Table 20: E- scenario - PILLAR 1: Efficiency/Electrification - Residential

Item	2020	2025	2030	2035	2040	2045	2050
Residential HVAC investment in 2020s vs. REF - Cumulative 5-yr (billion \$2018)		9.67	12.6				
Sales of cooking units - Electric Resistance (%)	61.7	62.7	66.2	75.4	88.3	96.2	99
Sales of cooking units - Gas (%)	38.3	37.3	33.8	24.6	11.7	3.78	1.02
Sales of space heating units - Electric Heat Pump (%)	5.51	11.2	14.4	24.6	46.6	71.6	85.5
Sales of space heating units - Electric Resistance (%)	15.4	21.8	21.1	19.1	14.6	9.52	6.85
Sales of space heating units - Fossil (%)	5.05	8.79	8.51	7.56	5.72	3.8	2.74
Sales of space heating units - Gas (%)	74	58.2	56	48.7	33.1	15.1	4.95
Sales of water heating units - Electric Heat Pump (%)	0	0.549	2.08	6.92	17.2	28.8	35.3
Sales of water heating units - Electric Resistance (%)	32.2	48.8	49	50.1	53.4	57.7	60.3
Sales of water heating units - Gas Furnace (%)	67.7	50.5	48.8	42.8	29.2	13.3	4.31
Sales of water heating units - Other (%)	0.083	0.169	0.17	0.171	0.17	0.17	0.17

Table 21: E- scenario - PILLAR 1: Efficiency/Electrification - Transportation

Item	2020	2025	2030	2035	2040	2045	2050
Light-duty vehicle capital costs - Cumulative 5-yr (million \$2018)		0	338	712	2,404	7,567	11,023
Public EV charging plugs - DC Fast (1000 units)	0.326		1.12		5.95		16.6
Public EV charging plugs - L2 (1000 units)	1.06		27		143		400
Vehicle sales - Heavy-duty - diesel (%)	97.4	96	91.3	79.8	58.2	32.1	13.7
Vehicle sales - Heavy-duty - EV (%)	0.498	1.45	4.11	10.8	23.6	39.5	51
Vehicle sales - Heavy-duty - gasoline (%)	0.228	0.236	0.239	0.225	0.179	0.109	0.051
Vehicle sales - Heavy-duty - hybrid (%)	0.083	0.094	0.104	0.107	0.092	0.06	0.03
Vehicle sales - Heavy-duty - hydrogen FC (%)	0.332	0.969	2.74	7.17	15.7	26.3	34
Vehicle sales - Heavy-duty - other (%)	1.5	1.28	1.46	1.95	2.25	1.96	1.14
Vehicle sales - Light-duty - diesel (%)	1.41	1.85	2.03	1.61	1.02	0.519	0.223
Vehicle sales - Light-duty - EV (%)	2.06	5.07	12.6	27.1	49.7	72.9	87.9
Vehicle sales - Light-duty - gasoline (%)	91.2	86.7	78.4	65.1	44.7	23.9	10.6
Vehicle sales - Light-duty - hybrid (%)	5.1	5.88	6.55	5.89	4.34	2.52	1.21
Vehicle sales - Light-duty - hydrogen FC (%)	0.112	0.376	0.317	0.239	0.168	0.092	0.043
Vehicle sales - Light-duty - other (%)	0.096	0.1	0.09	0.078	0.056	0.03	0.014
Vehicle sales - Medium-duty - diesel (%)	64.8	62.2	57.7	49.4	35.6	19.6	8.37
Vehicle sales - Medium-duty - EV (%)	0.664	1.94	5.49	14.3	31.4	52.6	68
Vehicle sales - Medium-duty - gasoline (%)	33.8	34.7	34.7	31.9	24.4	14.2	6.33
Vehicle sales - Medium-duty - hybrid (%)	0.363	0.418	0.464	0.478	0.414	0.275	0.141
Vehicle sales - Medium-duty - hydrogen FC (%)	0.166	0.485	1.37	3.58	7.86	13.2	17
Vehicle sales - Medium-duty - other (%)	0.253	0.266	0.279	0.286	0.258	0.184	0.102

Table 22: E- scenario - PILLAR 6: Land sinks - Agriculture

Item	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - Aggressive deployment - Corn-ethanol to energy grasses (1000 tCO2e/y)							-1,255
Carbon sink potential - Aggressive deployment - Cropland measures (1000 tCO2e/y)							-5,463
Carbon sink potential - Aggressive deployment - Permanent conservation cover (1000 tCO2e/y)							-214
Carbon sink potential - Aggressive deployment - Total (1000 tCO2e/y)							-6,932
Carbon sink potential - Moderate deployment - Corn-ethanol to energy grasses (1000 tCO2e/y)							-1,255
Carbon sink potential - Moderate deployment - Cropland measures (1000 tCO2e/y)							-2,883
Carbon sink potential - Moderate deployment - Permanent conservation cover (1000 tCO2e/y)							-107
Carbon sink potential - Moderate deployment - Total (1000 tCO2e/y)							-4,245
Land impacted for carbon sink - Aggressive deployment - Corn-ethanol to energy grasses (1000 hectares)							523
Land impacted for carbon sink - Aggressive deployment - Cropland measures (1000 hectares)							3,526
Land impacted for carbon sink - Aggressive deployment - Permanent conservation cover (1000 hectares)							390

Table 22: E- scenario - PILLAR 6: Land sinks - Agriculture (continued)

Item	2020	2025	2030	2035	2040	2045	2050
Land impacted for carbon sink - Aggressive deployment - Total (1000 hectares)							4,439
Land impacted for carbon sink - Moderate deployment - Corn-ethanol to energy grasses (1000 hectares)							523
Land impacted for carbon sink - Moderate deployment - Cropland measures (1000 hectares)							1,861
Land impacted for carbon sink - Moderate deployment - Permanent conservation cover (1000 hectares)							195
Land impacted for carbon sink - Moderate deployment - Total (1000 hectares)							2,578

Table 23: E- scenario - PILLAR 6: Land sinks - Forests

Item	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - High - Accelerate regeneration (1000 tCO <sub>2</sub> e/y)							-180
Carbon sink potential - High - All (not counting overlap) (1000 tCO <sub>2</sub> e/y)							-21,474
Carbon sink potential - High - Avoid deforestation (1000 tCO <sub>2</sub> e/y)							-3,130
Carbon sink potential - High - Extend rotation length (1000 tCO <sub>2</sub> e/y)							-3,434
Carbon sink potential - High - Improve plantations (1000 tCO <sub>2</sub> e/y)							-219
Carbon sink potential - High - Increase retention of HWP (1000 tCO <sub>2</sub> e/y)							-4,749
Carbon sink potential - High - Increase trees outside forests (1000 tCO <sub>2</sub> e/y)							-1,920
Carbon sink potential - High - Reforest cropland (1000 tCO <sub>2</sub> e/y)							-1,166
Carbon sink potential - High - Reforest pasture (1000 tCO <sub>2</sub> e/y)							-4,605
Carbon sink potential - High - Restore productivity (1000 tCO <sub>2</sub> e/y)							-2,070
Carbon sink potential - Low - Accelerate regeneration (1000 tCO <sub>2</sub> e/y)							-90.3
Carbon sink potential - Low - All (not counting overlap) (1000 tCO <sub>2</sub> e/y)							-5,927
Carbon sink potential - Low - Avoid deforestation (1000 tCO <sub>2</sub> e/y)							-522
Carbon sink potential - Low - Extend rotation length (1000 tCO <sub>2</sub> e/y)							-1,319
Carbon sink potential - Low - Improve plantations (1000 tCO <sub>2</sub> e/y)							-112
Carbon sink potential - Low - Increase retention of HWP (1000 tCO <sub>2</sub> e/y)							-1,583
Carbon sink potential - Low - Increase trees outside forests (1000 tCO <sub>2</sub> e/y)							-672
Carbon sink potential - Low - Reforest cropland (1000 tCO <sub>2</sub> e/y)							-583
Carbon sink potential - Low - Reforest pasture (1000 tCO <sub>2</sub> e/y)							-349
Carbon sink potential - Low - Restore productivity (1000 tCO <sub>2</sub> e/y)							-698
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO <sub>2</sub> e/y)							-135

Table 23: E- scenario - PILLAR 6: Land sinks - Forests (continued)

Item	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO <sub>2</sub> e/y)							-13,699
Carbon sink potential - Mid - Avoid deforestation (1000 tCO <sub>2</sub> e/y)							-1,826
Carbon sink potential - Mid - Extend rotation length (1000 tCO <sub>2</sub> e/y)							-2,377
Carbon sink potential - Mid - Improve plantations (1000 tCO <sub>2</sub> e/y)							-163
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO <sub>2</sub> e/y)							-3,166
Carbon sink potential - Mid - Increase trees outside forests (1000 tCO <sub>2</sub> e/y)							-1,296
Carbon sink potential - Mid - Reforest cropland (1000 tCO <sub>2</sub> e/y)							-874
Carbon sink potential - Mid - Reforest pasture (1000 tCO <sub>2</sub> e/y)							-2,477
Carbon sink potential - Mid - Restore productivity (1000 tCO <sub>2</sub> e/y)							-1,384
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)							29.5
Land impacted for carbon sink potential - High - Avoid deforestation (over 30 years) (1000 hectares)							424
Land impacted for carbon sink potential - High - Extend rotation length (1000 hectares)							1,751
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)							80.7
Land impacted for carbon sink potential - High - Increase retention of HWP (1000 hectares)							0
Land impacted for carbon sink potential - High - Increase trees outside forests (1000 hectares)							182
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)							77.1
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)							131
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)							686
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)							3,362
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)							14.7
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)							398
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)							671
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)							40.4
Land impacted for carbon sink potential - Low - Increase retention of HWP (1000 hectares)							0

Table 23: E- scenario - PILLAR 6: Land sinks - Forests (continued)

Item	2020	2025	2030	2035	2040	2045	2050
Land impacted for carbon sink potential - Low - Increase trees outside forests (1000 hectares)							96
Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares)							38.5
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)							22.7
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)							415
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)							1,696
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)							22.1
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)							411
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)							1,211
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)							60.8
Land impacted for carbon sink potential - Mid - Increase retention of HWP (1000 hectares)							0
Land impacted for carbon sink potential - Mid - Increase trees outside forests (1000 hectares)							139
Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares)							57.8
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)							164
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)							836
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)							2,902

Table 24: E- scenario - IMPACTS - Health

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal (million 2019\$)		2,185	5.74	5.72	5.49	4.18	0.407
Monetary damages from air pollution - Natural Gas (million 2019\$)		350	226	86.9	38.1	12.7	7.67
Monetary damages from air pollution - Transportation (million 2019\$)		4,048	4,080	3,966	3,572	2,847	1,959
Premature deaths from air pollution - Coal (deaths)		247	0.648	0.646	0.62	0.473	0.046
Premature deaths from air pollution - Natural Gas (deaths)		39.5	25.5	9.81	4.31	1.44	0.866
Premature deaths from air pollution - Transportation (deaths)		455	459	446	402	320	220



Table 25: *E+RE+ scenario - PILLAR 1: Efficiency/Electrification - Commercial*

Item	2020	2025	2030	2035	2040	2045	2050
Commercial HVAC investment in 2020s - Cumulative 5-yr (million \$2018)		36,680	40,065				
Sales of cooking units - Electric Resistance (%)	41	54.2	82.9	88.6	88.9	88.9	88.9
Sales of cooking units - Gas (%)	59	45.8	17.1	11.4	11.1	11.1	11.1
Sales of space heating units - Electric Heat Pump (%)	1.41	8.43	35.7	81.1	89	89.5	89.5
Sales of space heating units - Electric Resistance (%)	4.39	3.49	5.31	9.37	10.1	10.2	10.2
Sales of space heating units - Fossil (%)	5.44	2.58	0.487	0.021	0	0	0
Sales of space heating units - Gas Furnace (%)	88.8	85.5	58.5	9.54	0.892	0.356	0.356
Sales of water heating units - Electric Heat Pump (%)	0.454	2.53	19.6	46.2	50.8	51.1	51.1
Sales of water heating units - Electric Resistance (%)	4.26	4.67	18.3	43.9	48.4	48.7	48.7
Sales of water heating units - Gas Furnace (%)	95	92.6	61.9	9.69	0.569	0	0
Sales of water heating units - Other (%)	0.252	0.187	0.187	0.189	0.188	0.188	0.189

Table 26: *E+RE+ scenario - PILLAR 1: Efficiency/Electrification - Electricity demand*

Item	2020	2025	2030	2035	2040	2045	2050
Electricity distribution capital invested - Cumulative 5-yr (billion \$2018)		6.24	6.43	13.3	14.2	13.1	13.8

Table 27: *E+RE+ scenario - PILLAR 1: Efficiency/Electrification - Overview*

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Commercial (PJ)	372	366	351	325	295	272	261
Final energy use - Industry (PJ)	602	619	627	629	639	647	652
Final energy use - Residential (PJ)	555	515	478	416	348	297	264
Final energy use - Transportation (PJ)	952	886	773	638	516	442	411

Table 28: *E+RE+ scenario - PILLAR 1: Efficiency/Electrification - Residential*

Item	2020	2025	2030	2035	2040	2045	2050
Residential HVAC investment in 2020s vs. REF - Cumulative 5-yr (billion \$2018)		9.7	12.8				
Sales of cooking units - Electric Resistance (%)	61.8	69.9	94.9	99.7	100	100	100
Sales of cooking units - Gas (%)	38.2	30.1	5.14	0.259	0	0	0
Sales of space heating units - Electric Heat Pump (%)	5.51	13.7	41.4	84.2	91.7	92.1	91.9
Sales of space heating units - Electric Resistance (%)	15.4	21.4	16.1	7.17	5.54	5.47	5.69
Sales of space heating units - Fossil (%)	5.05	8.47	5.81	2.79	2.31	2.27	2.21
Sales of space heating units - Gas (%)	74	56.5	36.7	5.84	0.489	0.156	0.159
Sales of water heating units - Electric Heat Pump (%)	0	1.79	15.1	34.7	38	38.3	38.3
Sales of water heating units - Electric Resistance (%)	32.2	48.8	51.7	60	61.5	61.6	61.5
Sales of water heating units - Gas Furnace (%)	67.7	49.3	33	5.17	0.303	0	0
Sales of water heating units - Other (%)	0.083	0.169	0.17	0.17	0.168	0.168	0.17

Table 29: *E+RE+ scenario - PILLAR 1: Efficiency/Electrification - Transportation*

Item	2020	2025	2030	2035	2040	2045	2050
Light-duty vehicle capital costs - Cumulative 5-yr (million \$2018)		2,095	5,367	8,700	13,178	14,344	13,675
Public EV charging plugs - DC Fast (1000 units)	0.326		3.65		16		25.9
Public EV charging plugs - L2 (1000 units)	1.06		87.7		386		624
Vehicle sales - Heavy-duty - diesel (%)	97.2	92.1	67	23.3	4.22	0.628	0
Vehicle sales - Heavy-duty - EV (%)	0.588	3.81	19	45.6	57.4	59.6	60
Vehicle sales - Heavy-duty - gasoline (%)	0.227	0.227	0.176	0.066	0.013	0.002	0
Vehicle sales - Heavy-duty - hybrid (%)	0.082	0.09	0.077	0.031	0.007	0.001	0
Vehicle sales - Heavy-duty - hydrogen FC (%)	0.392	2.54	12.7	30.4	38.2	39.7	40
Vehicle sales - Heavy-duty - other (%)	1.5	1.23	1.07	0.568	0.163	0.038	0
Vehicle sales - Light-duty - diesel (%)	1.4	1.68	1.2	0.382	0.072	0.013	0
Vehicle sales - Light-duty - EV (%)	4.42	16.7	48.8	82.7	96.4	99.3	100
Vehicle sales - Light-duty - gasoline (%)	89.1	76.3	46.4	15.6	3.17	0.586	0
Vehicle sales - Light-duty - hybrid (%)	4.91	4.9	3.38	1.24	0.304	0.067	0
Vehicle sales - Light-duty - hydrogen FC (%)	0.11	0.331	0.191	0.059	0.012	0.002	0
Vehicle sales - Light-duty - other (%)	0.095	0.091	0.058	0.02	0.004	0.001	0
Vehicle sales - Medium-duty - diesel (%)	64.7	59.7	42.3	14.4	2.59	0.384	0
Vehicle sales - Medium-duty - EV (%)	0.784	5.07	25.3	60.8	76.5	79.5	80
Vehicle sales - Medium-duty - gasoline (%)	33.7	33.3	25.5	9.32	1.77	0.277	0
Vehicle sales - Medium-duty - hybrid (%)	0.363	0.402	0.341	0.14	0.03	0.005	0
Vehicle sales - Medium-duty - hydrogen FC (%)	0.196	1.27	6.33	15.2	19.1	19.9	20
Vehicle sales - Medium-duty - other (%)	0.253	0.255	0.205	0.083	0.019	0.004	0

Table 30: *E+RE+ scenario - PILLAR 2: Clean Electricity - Generating capacity*

Item	2020	2025	2030	2035	2040	2045	2050
Capital invested - Solar PV - Base (billion \$2018)		1.49	2.39	24.4	14.9	8.53	10.3
Capital invested - Wind - Base (billion \$2018)		0	11.4	22	18.4	0.135	0
Installed renewables - OffshoreWind - Base land use assumptions (MW)	0	0	0	0	0	0	0
Installed renewables - OffshoreWind - Constrained land use assumptions (MW)	0	0	0	0	0	0	0
Installed renewables - Solar - Base land use assumptions (MW)	820	2,125	4,465	30,363	47,114	57,295	70,300
Installed renewables - Solar - Constrained land use assumptions (MW)	1,640	2,450	11,765	59,848	82,550	87,433	124,198
Installed renewables - Wind - Base land use assumptions (MW)	827	827	9,413	27,115	42,706	42,827	42,827
Installed renewables - Wind - Constrained land use assumptions (MW)	1,654	1,654	36,590	39,256	39,256	39,256	90,057

Table 31: *E+RE+ scenario - PILLAR 2: Clean Electricity - Generation*

Item	2020	2025	2030	2035	2040	2045	2050
OffshoreWind - Base land use assumptions (GWh)	0	0	0	0	0	0	0
OffshoreWind - Constrained land use assumptions (GWh)	0	0	0	0	0	0	0
Solar - Base land use assumptions (GWh)	1,454	3,430	6,952	45,355	69,898	84,697	104,264
Solar - Constrained land use assumptions (GWh)	2,908	4,131	18,119	88,835	121,824	128,925	184,223
Wind - Base land use assumptions (GWh)	2,973	2,973	29,483	80,929	121,652	121,927	121,927
Wind - Constrained land use assumptions (GWh)	5,947	5,947	100,657	107,064	107,064	107,064	258,045

Table 32: *E+RE+ scenario - PILLAR 6: Land sinks - Agriculture*

Item	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - Aggressive deployment - Corn-ethanol to energy grasses (1000 tCO <sub>2</sub> e/y)							-1,255
Carbon sink potential - Aggressive deployment - Cropland measures (1000 tCO <sub>2</sub> e/y)							-5,463
Carbon sink potential - Aggressive deployment - Permanent conservation cover (1000 tCO <sub>2</sub> e/y)							-214
Carbon sink potential - Aggressive deployment - Total (1000 tCO <sub>2</sub> e/y)							-6,932
Carbon sink potential - Moderate deployment - Corn-ethanol to energy grasses (1000 tCO <sub>2</sub> e/y)							-1,255
Carbon sink potential - Moderate deployment - Cropland measures (1000 tCO <sub>2</sub> e/y)							-2,883
Carbon sink potential - Moderate deployment - Permanent conservation cover (1000 tCO <sub>2</sub> e/y)							-107
Carbon sink potential - Moderate deployment - Total (1000 tCO <sub>2</sub> e/y)							-4,245
Land impacted for carbon sink - Aggressive deployment - Corn-ethanol to energy grasses (1000 hectares)							523
Land impacted for carbon sink - Aggressive deployment - Cropland measures (1000 hectares)							3,526
Land impacted for carbon sink - Aggressive deployment - Permanent conservation cover (1000 hectares)							390
Land impacted for carbon sink - Aggressive deployment - Total (1000 hectares)							4,439
Land impacted for carbon sink - Moderate deployment - Corn-ethanol to energy grasses (1000 hectares)							523
Land impacted for carbon sink - Moderate deployment - Cropland measures (1000 hectares)							1,861
Land impacted for carbon sink - Moderate deployment - Permanent conservation cover (1000 hectares)							195
Land impacted for carbon sink - Moderate deployment - Total (1000 hectares)							2,578

Table 33: *E+RE+ scenario - PILLAR 6: Land sinks - Forests*

Item	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - High - Accelerate regeneration (1000 tCO <sub>2</sub> e/y)							-180
Carbon sink potential - High - All (not counting overlap) (1000 tCO <sub>2</sub> e/y)							-21,474
Carbon sink potential - High - Avoid deforestation (1000 tCO <sub>2</sub> e/y)							-3,130
Carbon sink potential - High - Extend rotation length (1000 tCO <sub>2</sub> e/y)							-3,434
Carbon sink potential - High - Improve plantations (1000 tCO <sub>2</sub> e/y)							-219
Carbon sink potential - High - Increase retention of HWP (1000 tCO <sub>2</sub> e/y)							-4,749

Table 33: E+RE+ scenario - PILLAR 6: Land sinks - Forests (continued)

Item	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - High - Increase trees outside forests (1000 tCO <sub>2</sub> e/y)							-1,920
Carbon sink potential - High - Reforest cropland (1000 tCO <sub>2</sub> e/y)							-1,166
Carbon sink potential - High - Reforest pasture (1000 tCO <sub>2</sub> e/y)							-4,605
Carbon sink potential - High - Restore productivity (1000 tCO <sub>2</sub> e/y)							-2,070
Carbon sink potential - Low - Accelerate regeneration (1000 tCO <sub>2</sub> e/y)							-90.3
Carbon sink potential - Low - All (not counting overlap) (1000 tCO <sub>2</sub> e/y)							-5,927
Carbon sink potential - Low - Avoid deforestation (1000 tCO <sub>2</sub> e/y)							-522
Carbon sink potential - Low - Extend rotation length (1000 tCO <sub>2</sub> e/y)							-1,319
Carbon sink potential - Low - Improve plantations (1000 tCO <sub>2</sub> e/y)							-112
Carbon sink potential - Low - Increase retention of HWP (1000 tCO <sub>2</sub> e/y)							-1,583
Carbon sink potential - Low - Increase trees outside forests (1000 tCO <sub>2</sub> e/y)							-672
Carbon sink potential - Low - Reforest cropland (1000 tCO <sub>2</sub> e/y)							-583
Carbon sink potential - Low - Reforest pasture (1000 tCO <sub>2</sub> e/y)							-349
Carbon sink potential - Low - Restore productivity (1000 tCO <sub>2</sub> e/y)							-698
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO <sub>2</sub> e/y)							-135
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO <sub>2</sub> e/y)							-13,699
Carbon sink potential - Mid - Avoid deforestation (1000 tCO <sub>2</sub> e/y)							-1,826
Carbon sink potential - Mid - Extend rotation length (1000 tCO <sub>2</sub> e/y)							-2,377
Carbon sink potential - Mid - Improve plantations (1000 tCO <sub>2</sub> e/y)							-163
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO <sub>2</sub> e/y)							-3,166
Carbon sink potential - Mid - Increase trees outside forests (1000 tCO <sub>2</sub> e/y)							-1,296
Carbon sink potential - Mid - Reforest cropland (1000 tCO <sub>2</sub> e/y)							-874
Carbon sink potential - Mid - Reforest pasture (1000 tCO <sub>2</sub> e/y)							-2,477
Carbon sink potential - Mid - Restore productivity (1000 tCO <sub>2</sub> e/y)							-1,384
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)							29.5
Land impacted for carbon sink potential - High - Avoid deforestation (over 30 years) (1000 hectares)							424
Land impacted for carbon sink potential - High - Extend rotation length (1000 hectares)							1,751
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)							80.7

Table 33: *E+RE+ scenario - PILLAR 6: Land sinks - Forests (continued)*

Item	2020	2025	2030	2035	2040	2045	2050
Land impacted for carbon sink potential - High - Increase retention of HWP (1000 hectares)							0
Land impacted for carbon sink potential - High - Increase trees outside forests (1000 hectares)							182
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)							77.1
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)							131
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)							686
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)							3,362
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)							14.7
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)							398
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)							671
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)							40.4
Land impacted for carbon sink potential - Low - Increase retention of HWP (1000 hectares)							0
Land impacted for carbon sink potential - Low - Increase trees outside forests (1000 hectares)							96
Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares)							38.5
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)							22.7
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)							415
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)							1,696
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)							22.1
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)							411
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)							1,211
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)							60.8
Land impacted for carbon sink potential - Mid - Increase retention of HWP (1000 hectares)							0
Land impacted for carbon sink potential - Mid - Increase trees outside forests (1000 hectares)							139

Table 33: *E+RE+ scenario - PILLAR 6: Land sinks - Forests (continued)*

Item	2020	2025	2030	2035	2040	2045	2050
Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares)							57.8
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)							164
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)							836
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)							2,902

Table 34: *E+RE+ scenario - IMPACTS - Health*

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal (million 2019\$)		2,185	5.74	5.72	5.49	4.18	0.407
Monetary damages from air pollution - Natural Gas (million 2019\$)		316	231	136	90.6	30.2	7.22
Monetary damages from air pollution - Transportation (million 2019\$)		3,979	3,697	2,802	1,624	753	313
Premature deaths from air pollution - Coal (deaths)		247	0.648	0.646	0.62	0.473	0.046
Premature deaths from air pollution - Natural Gas (deaths)		35.7	26	15.4	10.2	3.41	0.815
Premature deaths from air pollution - Transportation (deaths)		448	416	315	183	84.6	35.2

Table 35: *E+RE- scenario - PILLAR 1: Efficiency/Electrification - Commercial*

Item	2020	2025	2030	2035	2040	2045	2050
Commercial HVAC investment in 2020s - Cumulative 5-yr (million \$2018)		36,680	40,065				
Sales of cooking units - Electric Resistance (%)	41	54.2	82.9	88.6	88.9	88.9	88.9
Sales of cooking units - Gas (%)	59	45.8	17.1	11.4	11.1	11.1	11.1
Sales of space heating units - Electric Heat Pump (%)	1.41	8.43	35.7	81.1	89	89.5	89.5
Sales of space heating units - Electric Resistance (%)	4.39	3.49	5.31	9.37	10.1	10.2	10.2
Sales of space heating units - Fossil (%)	5.44	2.58	0.487	0.021	0	0	0
Sales of space heating units - Gas Furnace (%)	88.8	85.5	58.5	9.54	0.892	0.356	0.356
Sales of water heating units - Electric Heat Pump (%)	0.454	2.53	19.6	46.2	50.8	51.1	51.1
Sales of water heating units - Electric Resistance (%)	4.26	4.67	18.3	43.9	48.4	48.7	48.7
Sales of water heating units - Gas Furnace (%)	95	92.6	61.9	9.69	0.569	0	0
Sales of water heating units - Other (%)	0.252	0.187	0.187	0.189	0.188	0.188	0.189

Table 36: *E+RE- scenario - PILLAR 1: Efficiency/Electrification - Electricity demand*

Item	2020	2025	2030	2035	2040	2045	2050
Electricity distribution capital invested - Cumulative 5-yr (billion \$2018)		6.24	6.43	13.3	14.2	13.1	13.8

Table 37: *E+RE- scenario - PILLAR 1: Efficiency/Electrification - Overview*

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Commercial (PJ)	372	366	351	325	295	272	261

Table 37: E+RE- scenario - PILLAR 1: Efficiency/Electrification - Overview (continued)

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Industry (PJ)	602	619	627	629	639	647	652
Final energy use - Residential (PJ)	555	515	478	416	348	297	264
Final energy use - Transportation (PJ)	952	886	773	638	516	442	411

Table 38: E+RE- scenario - PILLAR 1: Efficiency/Electrification - Residential

Item	2020	2025	2030	2035	2040	2045	2050
Residential HVAC investment in 2020s vs. REF - Cumulative 5-yr (billion \$2018)		9.7	12.8				
Sales of cooking units - Electric Resistance (%)	61.8	69.9	94.9	99.7	100	100	100
Sales of cooking units - Gas (%)	38.2	30.1	5.14	0.259	0	0	0
Sales of space heating units - Electric Heat Pump (%)	5.51	13.7	41.4	84.2	91.7	92.1	91.9
Sales of space heating units - Electric Resistance (%)	15.4	21.4	16.1	7.17	5.54	5.47	5.69
Sales of space heating units - Fossil (%)	5.05	8.47	5.81	2.79	2.31	2.27	2.21
Sales of space heating units - Gas (%)	74	56.5	36.7	5.84	0.489	0.156	0.159
Sales of water heating units - Electric Heat Pump (%)	0	1.79	15.1	34.7	38	38.3	38.3
Sales of water heating units - Electric Resistance (%)	32.2	48.8	51.7	60	61.5	61.6	61.5
Sales of water heating units - Gas Furnace (%)	67.7	49.3	33	5.17	0.303	0	0
Sales of water heating units - Other (%)	0.083	0.169	0.17	0.17	0.168	0.168	0.17

Table 39: E+RE- scenario - PILLAR 1: Efficiency/Electrification - Transportation

Item	2020	2025	2030	2035	2040	2045	2050
Light-duty vehicle capital costs - Cumulative 5-yr (million \$2018)		2,095	5,367	8,700	13,178	14,344	13,675
Public EV charging plugs - DC Fast (1000 units)	0.326		3.65		16		25.9
Public EV charging plugs - L2 (1000 units)	1.06		87.7		386		624
Vehicle sales - Heavy-duty - diesel (%)	97.2	92.1	67	23.3	4.22	0.628	0
Vehicle sales - Heavy-duty - EV (%)	0.588	3.81	19	45.6	57.4	59.6	60
Vehicle sales - Heavy-duty - gasoline (%)	0.227	0.227	0.176	0.066	0.013	0.002	0
Vehicle sales - Heavy-duty - hybrid (%)	0.082	0.09	0.077	0.031	0.007	0.001	0
Vehicle sales - Heavy-duty - hydrogen FC (%)	0.392	2.54	12.7	30.4	38.2	39.7	40
Vehicle sales - Heavy-duty - other (%)	1.5	1.23	1.07	0.568	0.163	0.038	0
Vehicle sales - Light-duty - diesel (%)	1.4	1.68	1.2	0.382	0.072	0.013	0
Vehicle sales - Light-duty - EV (%)	4.42	16.7	48.8	82.7	96.4	99.3	100
Vehicle sales - Light-duty - gasoline (%)	89.1	76.3	46.4	15.6	3.17	0.586	0
Vehicle sales - Light-duty - hybrid (%)	4.91	4.9	3.38	1.24	0.304	0.067	0
Vehicle sales - Light-duty - hydrogen FC (%)	0.11	0.331	0.191	0.059	0.012	0.002	0
Vehicle sales - Light-duty - other (%)	0.095	0.091	0.058	0.02	0.004	0.001	0
Vehicle sales - Medium-duty - diesel (%)	64.7	59.7	42.3	14.4	2.59	0.384	0
Vehicle sales - Medium-duty - EV (%)	0.784	5.07	25.3	60.8	76.5	79.5	80
Vehicle sales - Medium-duty - gasoline (%)	33.7	33.3	25.5	9.32	1.77	0.277	0
Vehicle sales - Medium-duty - hybrid (%)	0.363	0.402	0.341	0.14	0.03	0.005	0
Vehicle sales - Medium-duty - hydrogen FC (%)	0.196	1.27	6.33	15.2	19.1	19.9	20
Vehicle sales - Medium-duty - other (%)	0.253	0.255	0.205	0.083	0.019	0.004	0

Table 40: *E+RE- scenario - PILLAR 2: Clean Electricity - Generating capacity*

Item	2020	2025	2030	2035	2040	2045	2050
Capital invested - Solar PV - Base (billion \$2018)		0	0	0.381	0.599	1.35	0
Capital invested - Solar PV - Constrained (billion \$2018)		0	0	0.265	2.47	1.43	0
Capital invested - Wind - Base (billion \$2018)		0	0.252	0	0.132	0	0.036
Capital invested - Wind - Constrained (billion \$2018)		0	0.873	0	0.71	0.217	0.157
Installed renewables - OffshoreWind - Base land use assumptions (MW)	0	0	0	0	0	0	0
Installed renewables - OffshoreWind - Constrained land use assumptions (MW)	0	0	0	0	0	0	0
Installed renewables - Solar - Base land use assumptions (MW)	820	820	820	1,225	1,900	3,509	3,509
Installed renewables - Solar - Constrained land use assumptions (MW)	820	820	820	1,101	3,880	5,590	5,590
Installed renewables - Wind - Base land use assumptions (MW)	827	827	1,016	1,016	1,127	1,127	1,162
Installed renewables - Wind - Constrained land use assumptions (MW)	827	827	1,482	1,482	2,083	2,277	2,425

Table 41: *E+RE- scenario - PILLAR 2: Clean Electricity - Generation*

Item	2020	2025	2030	2035	2040	2045	2050
OffshoreWind - Base land use assumptions (GWh)	0	0	0	0	0	0	0
OffshoreWind - Constrained land use assumptions (GWh)	0	0	0	0	0	0	0
Solar - Base land use assumptions (GWh)	1,454	1,454	1,454	2,065	3,079	5,499	5,499
Solar - Constrained land use assumptions (GWh)	1,454	1,454	1,454	1,879	6,066	8,628	8,628
Wind - Base land use assumptions (GWh)	2,973	2,973	3,579	3,579	3,937	3,937	4,045
Wind - Constrained land use assumptions (GWh)	2,973	2,973	4,979	4,979	6,794	7,356	7,799

Table 42: *E+RE- scenario - PILLAR 6: Land sinks - Agriculture*

Item	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - Aggressive deployment - Corn-ethanol to energy grasses (1000 tCO2e/y)							-1,255
Carbon sink potential - Aggressive deployment - Cropland measures (1000 tCO2e/y)							-5,463
Carbon sink potential - Aggressive deployment - Permanent conservation cover (1000 tCO2e/y)							-214
Carbon sink potential - Aggressive deployment - Total (1000 tCO2e/y)							-6,932
Carbon sink potential - Moderate deployment - Corn-ethanol to energy grasses (1000 tCO2e/y)							-1,255
Carbon sink potential - Moderate deployment - Cropland measures (1000 tCO2e/y)							-2,883
Carbon sink potential - Moderate deployment - Permanent conservation cover (1000 tCO2e/y)							-107
Carbon sink potential - Moderate deployment - Total (1000 tCO2e/y)							-4,245



Table 42: *E+RE- scenario - PILLAR 6: Land sinks - Agriculture (continued)*

Item	2020	2025	2030	2035	2040	2045	2050
Land impacted for carbon sink - Aggressive deployment - Corn-ethanol to energy grasses (1000 hectares)							523
Land impacted for carbon sink - Aggressive deployment - Cropland measures (1000 hectares)							3,526
Land impacted for carbon sink - Aggressive deployment - Permanent conservation cover (1000 hectares)							390
Land impacted for carbon sink - Aggressive deployment - Total (1000 hectares)							4,439
Land impacted for carbon sink - Moderate deployment - Corn-ethanol to energy grasses (1000 hectares)							523
Land impacted for carbon sink - Moderate deployment - Cropland measures (1000 hectares)							1,861
Land impacted for carbon sink - Moderate deployment - Permanent conservation cover (1000 hectares)							195
Land impacted for carbon sink - Moderate deployment - Total (1000 hectares)							2,578

Table 43: *E+RE- scenario - PILLAR 6: Land sinks - Forests*

Item	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - High - Accelerate regeneration (1000 tCO <sub>2</sub> e/y)							-180
Carbon sink potential - High - All (not counting overlap) (1000 tCO <sub>2</sub> e/y)							-21,474
Carbon sink potential - High - Avoid deforestation (1000 tCO <sub>2</sub> e/y)							-3,130
Carbon sink potential - High - Extend rotation length (1000 tCO <sub>2</sub> e/y)							-3,434
Carbon sink potential - High - Improve plantations (1000 tCO <sub>2</sub> e/y)							-219
Carbon sink potential - High - Increase retention of HWP (1000 tCO <sub>2</sub> e/y)							-4,749
Carbon sink potential - High - Increase trees outside forests (1000 tCO <sub>2</sub> e/y)							-1,920
Carbon sink potential - High - Reforest cropland (1000 tCO <sub>2</sub> e/y)							-1,166
Carbon sink potential - High - Reforest pasture (1000 tCO <sub>2</sub> e/y)							-4,605
Carbon sink potential - High - Restore productivity (1000 tCO <sub>2</sub> e/y)							-2,070
Carbon sink potential - Low - Accelerate regeneration (1000 tCO <sub>2</sub> e/y)							-90.3
Carbon sink potential - Low - All (not counting overlap) (1000 tCO <sub>2</sub> e/y)							-5,927
Carbon sink potential - Low - Avoid deforestation (1000 tCO <sub>2</sub> e/y)							-522
Carbon sink potential - Low - Extend rotation length (1000 tCO <sub>2</sub> e/y)							-1,319
Carbon sink potential - Low - Improve plantations (1000 tCO <sub>2</sub> e/y)							-112
Carbon sink potential - Low - Increase retention of HWP (1000 tCO <sub>2</sub> e/y)							-1,583
Carbon sink potential - Low - Increase trees outside forests (1000 tCO <sub>2</sub> e/y)							-672

Table 43: E+RE- scenario - PILLAR 6: Land sinks - Forests (continued)

Item	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - Low - Reforest cropland (1000 tCO <sub>2</sub> e/y)							-583
Carbon sink potential - Low - Reforest pasture (1000 tCO <sub>2</sub> e/y)							-349
Carbon sink potential - Low - Restore productivity (1000 tCO <sub>2</sub> e/y)							-698
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO <sub>2</sub> e/y)							-135
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO <sub>2</sub> e/y)							-13,699
Carbon sink potential - Mid - Avoid deforestation (1000 tCO <sub>2</sub> e/y)							-1,826
Carbon sink potential - Mid - Extend rotation length (1000 tCO <sub>2</sub> e/y)							-2,377
Carbon sink potential - Mid - Improve plantations (1000 tCO <sub>2</sub> e/y)							-163
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO <sub>2</sub> e/y)							-3,166
Carbon sink potential - Mid - Increase trees outside forests (1000 tCO <sub>2</sub> e/y)							-1,296
Carbon sink potential - Mid - Reforest cropland (1000 tCO <sub>2</sub> e/y)							-874
Carbon sink potential - Mid - Reforest pasture (1000 tCO <sub>2</sub> e/y)							-2,477
Carbon sink potential - Mid - Restore productivity (1000 tCO <sub>2</sub> e/y)							-1,384
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)							29.5
Land impacted for carbon sink potential - High - Avoid deforestation (over 30 years) (1000 hectares)							424
Land impacted for carbon sink potential - High - Extend rotation length (1000 hectares)							1,751
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)							80.7
Land impacted for carbon sink potential - High - Increase retention of HWP (1000 hectares)							0
Land impacted for carbon sink potential - High - Increase trees outside forests (1000 hectares)							182
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)							77.1
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)							131
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)							686
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)							3,362
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)							14.7
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)							398

Table 43: *E+RE- scenario - PILLAR 6: Land sinks - Forests (continued)*

Item	2020	2025	2030	2035	2040	2045	2050
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)							671
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)							40.4
Land impacted for carbon sink potential - Low - Increase retention of HWP (1000 hectares)							0
Land impacted for carbon sink potential - Low - Increase trees outside forests (1000 hectares)							96
Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares)							38.5
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)							22.7
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)							415
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)							1,696
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)							22.1
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)							411
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)							1,211
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)							60.8
Land impacted for carbon sink potential - Mid - Increase retention of HWP (1000 hectares)							0
Land impacted for carbon sink potential - Mid - Increase trees outside forests (1000 hectares)							139
Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares)							57.8
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)							164
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)							836
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)							2,902

Table 44: *E+RE- scenario - IMPACTS - Health*

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal (million 2019\$)		2,185	5.74	5.72	5.49	4.18	0.407
Monetary damages from air pollution - Natural Gas (million 2019\$)		358	286	365	271	94.9	28.9
Monetary damages from air pollution - Transportation (million 2019\$)		3,979	3,697	2,802	1,624	753	313
Premature deaths from air pollution - Coal (deaths)		247	0.648	0.646	0.62	0.473	0.046

Table 44: *E+RE- scenario - IMPACTS - Health (continued)*

Item	2020	2025	2030	2035	2040	2045	2050
Premature deaths from air pollution - Natural Gas (deaths)		40.4	32.3	41.2	30.5	10.7	3.26
Premature deaths from air pollution - Transportation (deaths)		448	416	315	183	84.6	35.2

Table 45: *E-B+ scenario - PILLAR 1: Efficiency/Electrification - Commercial*

Item	2020	2025	2030	2035	2040	2045	2050
Commercial HVAC investment in 2020s - Cumulative 5-yr (million \$2018)		36,676	40,057				
Sales of cooking units - Electric Resistance (%)	41	45.8	49.8	60.5	75.4	84.5	87.7
Sales of cooking units - Gas (%)	59	54.2	50.2	39.5	24.6	15.5	12.3
Sales of space heating units - Electric Heat Pump (%)	1.41	6.26	9.41	19.5	41.8	67.8	82.5
Sales of space heating units - Electric Resistance (%)	4.39	3.42	3.62	4.32	6.06	8.25	9.52
Sales of space heating units - Fossil (%)	5.44	2.99	2.75	2.06	1.03	0.337	0.088
Sales of space heating units - Gas Furnace (%)	88.8	87.3	84.2	74.1	51.1	23.6	7.9
Sales of water heating units - Electric Heat Pump (%)	0.454	1.05	3.02	9.27	22.8	38.3	47
Sales of water heating units - Electric Resistance (%)	4.26	3.81	5.35	10.5	22.3	36.6	44.8
Sales of water heating units - Gas Furnace (%)	95	94.9	91.4	80	54.7	25	8.07
Sales of water heating units - Other (%)	0.252	0.187	0.187	0.189	0.188	0.188	0.189

Table 46: *E-B+ scenario - PILLAR 1: Efficiency/Electrification - Electricity demand*

Item	2020	2025	2030	2035	2040	2045	2050
Electricity distribution capital invested - Cumulative 5-yr (billion \$2018)		5.04	5.08	6.88	7.14	11.1	11.9

Table 47: *E-B+ scenario - PILLAR 1: Efficiency/Electrification - Overview*

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Commercial (PJ)	372	367	358	350	337	320	302
Final energy use - Industry (PJ)	602	620	630	637	652	659	663
Final energy use - Residential (PJ)	555	516	488	461	427	383	335
Final energy use - Transportation (PJ)	954	894	812	747	696	637	566

Table 48: *E-B+ scenario - PILLAR 1: Efficiency/Electrification - Residential*

Item	2020	2025	2030	2035	2040	2045	2050
Residential HVAC investment in 2020s vs. REF - Cumulative 5-yr (billion \$2018)		9.67	12.6				
Sales of cooking units - Electric Resistance (%)	61.7	62.7	66.2	75.4	88.3	96.2	99
Sales of cooking units - Gas (%)	38.3	37.3	33.8	24.6	11.7	3.78	1.02
Sales of space heating units - Electric Heat Pump (%)	5.51	11.2	14.4	24.6	46.6	71.6	85.5
Sales of space heating units - Electric Resistance (%)	15.4	21.8	21.1	19.1	14.6	9.52	6.85
Sales of space heating units - Fossil (%)	5.05	8.79	8.51	7.56	5.72	3.8	2.74
Sales of space heating units - Gas (%)	74	58.2	56	48.7	33.1	15.1	4.95
Sales of water heating units - Electric Heat Pump (%)	0	0.549	2.08	6.92	17.2	28.8	35.3
Sales of water heating units - Electric Resistance (%)	32.2	48.8	49	50.1	53.4	57.7	60.3

Table 48: E-B+ scenario - PILLAR 1: Efficiency/Electrification - Residential (continued)

Item	2020	2025	2030	2035	2040	2045	2050
Sales of water heating units - Gas Furnace (%)	67.7	50.5	48.8	42.8	29.2	13.3	4.31
Sales of water heating units - Other (%)	0.083	0.169	0.17	0.171	0.17	0.17	0.17

Table 49: E-B+ scenario - PILLAR 1: Efficiency/Electrification - Transportation

Item	2020	2025	2030	2035	2040	2045	2050
Light-duty vehicle capital costs - Cumulative 5-yr (million \$2018)		0	338	712	2,404	7,567	11,023
Public EV charging plugs - DC Fast (1000 units)	0.326		1.12		5.95		16.6
Public EV charging plugs - L2 (1000 units)	1.06		27		143		400
Vehicle sales - Heavy-duty - diesel (%)	97.4	96	91.3	79.8	58.2	32.1	13.7
Vehicle sales - Heavy-duty - EV (%)	0.498	1.45	4.11	10.8	23.6	39.5	51
Vehicle sales - Heavy-duty - gasoline (%)	0.228	0.236	0.239	0.225	0.179	0.109	0.051
Vehicle sales - Heavy-duty - hybrid (%)	0.083	0.094	0.104	0.107	0.092	0.06	0.03
Vehicle sales - Heavy-duty - hydrogen FC (%)	0.332	0.969	2.74	7.17	15.7	26.3	34
Vehicle sales - Heavy-duty - other (%)	1.5	1.28	1.46	1.95	2.25	1.96	1.14
Vehicle sales - Light-duty - diesel (%)	1.41	1.85	2.03	1.61	1.02	0.519	0.223
Vehicle sales - Light-duty - EV (%)	2.06	5.07	12.6	27.1	49.7	72.9	87.9
Vehicle sales - Light-duty - gasoline (%)	91.2	86.7	78.4	65.1	44.7	23.9	10.6
Vehicle sales - Light-duty - hybrid (%)	5.1	5.88	6.55	5.89	4.34	2.52	1.21
Vehicle sales - Light-duty - hydrogen FC (%)	0.112	0.376	0.317	0.239	0.168	0.092	0.043
Vehicle sales - Light-duty - other (%)	0.096	0.1	0.09	0.078	0.056	0.03	0.014
Vehicle sales - Medium-duty - diesel (%)	64.8	62.2	57.7	49.4	35.6	19.6	8.37
Vehicle sales - Medium-duty - EV (%)	0.664	1.94	5.49	14.3	31.4	52.6	68
Vehicle sales - Medium-duty - gasoline (%)	33.8	34.7	34.7	31.9	24.4	14.2	6.33
Vehicle sales - Medium-duty - hybrid (%)	0.363	0.418	0.464	0.478	0.414	0.275	0.141
Vehicle sales - Medium-duty - hydrogen FC (%)	0.166	0.485	1.37	3.58	7.86	13.2	17
Vehicle sales - Medium-duty - other (%)	0.253	0.266	0.279	0.286	0.258	0.184	0.102

Table 50: E-B+ scenario - PILLAR 2: Clean Electricity - Generating capacity

Item	2020	2025	2030	2035	2040	2045	2050
Capital invested - Biomass power plant (billion \$2018)	0	0	0	0	0	0	0
Capital invested - Biomass w/ccu allam power plant (billion \$2018)	0	0	0	0	0	0	0
Capital invested - Biomass w/ccu power plant (billion \$2018)	0	0	0	0	0	0	0

Table 51: E-B+ scenario - PILLAR 2: Clean Electricity - Generation

Item	2020	2025	2030	2035	2040	2045	2050
Biomass power plant (GWh)	0	0	0	0	0	0	0
Biomass w/ccu allam power plant (GWh)	0	0	0	0	0	0	0
Biomass w/ccu power plant (GWh)	0	0	0	0	0	0.179	0.179

Table 52: E-B+ scenario - PILLAR 3: Clean fuels - Bioenergy

Item	2020	2025	2030	2035	2040	2045	2050
Biomass purchases (million \$2018/year)		0	0	0	0	1,897	5,611
Conversion capital investment - Cumulative 5-yr (million \$2018)		0	0	0	0	19,240	37,955
Number of facilities - Allam power w ccu (quantity)	0	0	0	0	0	0	0

Table 52: E-B+ scenario - PILLAR 3: Clean fuels - Bioenergy (continued)

Item	2020	2025	2030	2035	2040	2045	2050
Number of facilities - Beccs hydrogen (quantity)	0	0	0	0	0	23	65
Number of facilities - Diesel (quantity)	0	0	0	0	0	0	0
Number of facilities - Diesel ccu (quantity)	0	0	0	0	0	1	2
Number of facilities - Power (quantity)	0	0	0	0	0	0	0
Number of facilities - Power ccu (quantity)	0	0	0	0	0	1	1
Number of facilities - Pyrolysis (quantity)	0	0	0	0	0	0	0
Number of facilities - Pyrolysis ccu (quantity)	0	0	0	0	0	1	2
Number of facilities - Sng (quantity)	0	0	0	0	0	0	0
Number of facilities - Sng ccu (quantity)	0	0	0	0	0	0	1

Table 53: E-B+ scenario - PILLAR 4: CCUS - CO2 capture

Item	2020	2025	2030	2035	2040	2045	2050
Annual - All (MMT)		0	0	0	0	24.7	72.9
Annual - BECCS (MMT)		0	0	0	0	24.7	72.9
Annual - Cement and lime (MMT)		0	0	0	0	0	0
Annual - NGCC (MMT)		0	0	0	0	0	0
Cumulative - All (MMT)		0	0	0	0	24.7	97.6
Cumulative - BECCS (MMT)		0	0	0	0	24.7	97.6
Cumulative - Cement and lime (MMT)		0	0	0	0	0	0
Cumulative - NGCC (MMT)		0	0	0	0	0	0

Table 54: E-B+ scenario - PILLAR 4: CCUS - CO2 pipelines

Item	2020	2025	2030	2035	2040	2045	2050
All (km)		0	477	477	477	1,409	3,066
Cumulative investment - All (million \$2018)		0	1,555	1,555	1,555	3,014	4,988
Cumulative investment - Spur (million \$2018)		0	0	0	0	1,080	3,054
Cumulative investment - Trunk (million \$2018)		0	1,555	1,555	1,555	1,934	1,934
Spur (km)		0	0	0	0	932	2,589
Trunk (km)		0	477	477	477	477	477

Table 55: E-B+ scenario - PILLAR 4: CCUS - CO2 storage

Item	2020	2025	2030	2035	2040	2045	2050
CO2 storage (MMT)		0	0	0	0	0	0
Injection wells (wells)		0	0	0	0	0	0
Resource characterization, appraisal, permitting costs (million \$2020)		0	0	0	0	0	0
Wells and facilities construction costs (million \$2020)		0	0	0	0	0	0

Table 56: E-B+ scenario - PILLAR 6: Land sinks - Agriculture

Item	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - Aggressive deployment - Corn-ethanol to energy grasses (1000 tCO2e/y)							-1,772
Carbon sink potential - Aggressive deployment - Cropland measures (1000 tCO2e/y)							-4,907
Carbon sink potential - Aggressive deployment - Cropland to woody energy crops (1000 tCO2e/y)							0

Table 56: E-B+ scenario - PILLAR 6: Land sinks - Agriculture (continued)

Item	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - Aggressive deployment - Pasture to energy crops (1000 tCO2e/y)							0
Carbon sink potential - Aggressive deployment - Permanent conservation cover (1000 tCO2e/y)							-193
Carbon sink potential - Aggressive deployment - Total (1000 tCO2e/y)							-6,872
Carbon sink potential - Moderate deployment - Corn-ethanol to energy grasses (1000 tCO2e/y)							-1,772
Carbon sink potential - Moderate deployment - Cropland measures (1000 tCO2e/y)							-2,589
Carbon sink potential - Moderate deployment - Cropland to woody energy crops (1000 tCO2e/y)							0
Carbon sink potential - Moderate deployment - Pasture to energy crops (1000 tCO2e/y)							0
Carbon sink potential - Moderate deployment - Permanent conservation cover (1000 tCO2e/y)							-96.4
Carbon sink potential - Moderate deployment - Total (1000 tCO2e/y)							-4,458
Land impacted for carbon sink - Aggressive deployment - Corn-ethanol to energy grasses (1000 hectares)							903
Land impacted for carbon sink - Aggressive deployment - Cropland measures (1000 hectares)							7,832
Land impacted for carbon sink - Aggressive deployment - Cropland to woody energy crops (1000 hectares)							166
Land impacted for carbon sink - Aggressive deployment - Pasture to energy crops (1000 hectares)							129
Land impacted for carbon sink - Aggressive deployment - Permanent conservation cover (1000 hectares)							351
Land impacted for carbon sink - Aggressive deployment - Total (1000 hectares)							9,381
Land impacted for carbon sink - Moderate deployment - Corn-ethanol to energy grasses (1000 hectares)							903
Land impacted for carbon sink - Moderate deployment - Cropland measures (1000 hectares)							1,674
Land impacted for carbon sink - Moderate deployment - Cropland to woody energy crops (1000 hectares)							166
Land impacted for carbon sink - Moderate deployment - Pasture to energy crops (1000 hectares)							129
Land impacted for carbon sink - Moderate deployment - Permanent conservation cover (1000 hectares)							175
Land impacted for carbon sink - Moderate deployment - Total (1000 hectares)							3,047

Table 57: *E-B+ scenario - PILLAR 6: Land sinks - Forests*

Item	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - High - Accelerate regeneration (1000 tCO <sub>2</sub> e/y)							-180
Carbon sink potential - High - All (not counting overlap) (1000 tCO <sub>2</sub> e/y)							-21,474
Carbon sink potential - High - Avoid deforestation (1000 tCO <sub>2</sub> e/y)							-3,130
Carbon sink potential - High - Extend rotation length (1000 tCO <sub>2</sub> e/y)							-3,434
Carbon sink potential - High - Improve plantations (1000 tCO <sub>2</sub> e/y)							-219
Carbon sink potential - High - Increase retention of HWP (1000 tCO <sub>2</sub> e/y)							-4,749
Carbon sink potential - High - Increase trees outside forests (1000 tCO <sub>2</sub> e/y)							-1,920
Carbon sink potential - High - Reforest cropland (1000 tCO <sub>2</sub> e/y)							-1,166
Carbon sink potential - High - Reforest pasture (1000 tCO <sub>2</sub> e/y)							-4,605
Carbon sink potential - High - Restore productivity (1000 tCO <sub>2</sub> e/y)							-2,070
Carbon sink potential - Low - Accelerate regeneration (1000 tCO <sub>2</sub> e/y)							-90.3
Carbon sink potential - Low - All (not counting overlap) (1000 tCO <sub>2</sub> e/y)							-5,927
Carbon sink potential - Low - Avoid deforestation (1000 tCO <sub>2</sub> e/y)							-522
Carbon sink potential - Low - Extend rotation length (1000 tCO <sub>2</sub> e/y)							-1,319
Carbon sink potential - Low - Improve plantations (1000 tCO <sub>2</sub> e/y)							-112
Carbon sink potential - Low - Increase retention of HWP (1000 tCO <sub>2</sub> e/y)							-1,583
Carbon sink potential - Low - Increase trees outside forests (1000 tCO <sub>2</sub> e/y)							-672
Carbon sink potential - Low - Reforest cropland (1000 tCO <sub>2</sub> e/y)							-583
Carbon sink potential - Low - Reforest pasture (1000 tCO <sub>2</sub> e/y)							-349
Carbon sink potential - Low - Restore productivity (1000 tCO <sub>2</sub> e/y)							-698
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO <sub>2</sub> e/y)							-135
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO <sub>2</sub> e/y)							-13,699
Carbon sink potential - Mid - Avoid deforestation (1000 tCO <sub>2</sub> e/y)							-1,826
Carbon sink potential - Mid - Extend rotation length (1000 tCO <sub>2</sub> e/y)							-2,377
Carbon sink potential - Mid - Improve plantations (1000 tCO <sub>2</sub> e/y)							-163
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO <sub>2</sub> e/y)							-3,166
Carbon sink potential - Mid - Increase trees outside forests (1000 tCO <sub>2</sub> e/y)							-1,296
Carbon sink potential - Mid - Reforest cropland (1000 tCO <sub>2</sub> e/y)							-874
Carbon sink potential - Mid - Reforest pasture (1000 tCO <sub>2</sub> e/y)							-2,477
Carbon sink potential - Mid - Restore productivity (1000 tCO <sub>2</sub> e/y)							-1,384



Table 57: E-B+ scenario - PILLAR 6: Land sinks - Forests (continued)

Item	2020	2025	2030	2035	2040	2045	2050
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)							29.5
Land impacted for carbon sink potential - High - Avoid deforestation (over 30 years) (1000 hectares)							424
Land impacted for carbon sink potential - High - Extend rotation length (1000 hectares)							1,751
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)							80.7
Land impacted for carbon sink potential - High - Increase retention of HWP (1000 hectares)							0
Land impacted for carbon sink potential - High - Increase trees outside forests (1000 hectares)							182
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)							77.1
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)							131
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)							686
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)							3,362
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)							14.7
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)							398
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)							671
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)							40.4
Land impacted for carbon sink potential - Low - Increase retention of HWP (1000 hectares)							0
Land impacted for carbon sink potential - Low - Increase trees outside forests (1000 hectares)							96
Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares)							38.5
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)							22.7
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)							415
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)							1,696
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)							22.1

Table 57: E-B+ scenario - PILLAR 6: Land sinks - Forests (continued)

Item	2020	2025	2030	2035	2040	2045	2050
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)							411
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)							1,211
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)							60.8
Land impacted for carbon sink potential - Mid - Increase retention of HWP (1000 hectares)							0
Land impacted for carbon sink potential - Mid - Increase trees outside forests (1000 hectares)							139
Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares)							57.8
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)							164
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)							836
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)							2,902

Table 58: E-B+ scenario - IMPACTS - Health

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal (million 2019\$)		2,185	5.74	5.72	5.49	4.18	0.407
Monetary damages from air pollution - Natural Gas (million 2019\$)		339	196	109	70.8	36.1	11.7
Monetary damages from air pollution - Transportation (million 2019\$)		4,048	4,080	3,966	3,572	2,847	1,959
Premature deaths from air pollution - Coal (deaths)		247	0.648	0.646	0.62	0.473	0.046
Premature deaths from air pollution - Natural Gas (deaths)		38.3	22.1	12.3	7.99	4.07	1.32
Premature deaths from air pollution - Transportation (deaths)		455	459	446	402	320	220

Table 59: REF scenario - PILLAR 1: Efficiency/Electrification - Commercial

Item	2020	2025	2030	2035	2040	2045	2050
Commercial HVAC investment in 2020s - Cumulative 5-yr (million \$2018)		36,280	37,607				
Sales of cooking units - Electric Resistance (%)	41	44.2	44.3	44.3	44.3	44.4	44.5
Sales of cooking units - Gas (%)	59	55.8	55.7	55.7	55.7	55.6	55.5
Sales of space heating units - Electric Heat Pump (%)	1.41	12.6	44.7	71.1	75.4	75.9	75.9
Sales of space heating units - Electric Resistance (%)	4.39	4.3	8.91	17.1	22.8	23.6	23.7
Sales of space heating units - Fossil (%)	5.44	2.76	1.39	0.243	0.027	0.001	0
Sales of space heating units - Gas Furnace (%)	88.8	80.4	45	11.5	1.77	0.436	0.356
Sales of water heating units - Electric Heat Pump (%)	0.454	0.344	0.348	0.348	0.342	0.344	0.345
Sales of water heating units - Electric Resistance (%)	4.26	3.24	3.2	3.21	3.19	3.18	3.18

Table 59: REF scenario - PILLAR 1: Efficiency/Electrification - Commercial (continued)

Item	2020	2025	2030	2035	2040	2045	2050
Sales of water heating units - Gas Furnace (%)	95	96.2	96.3	96.3	96.3	96.3	96.3
Sales of water heating units - Other (%)	0.252	0.187	0.187	0.189	0.188	0.188	0.189

Table 60: REF scenario - PILLAR 1: Efficiency/Electrification - Electricity demand

Item	2020	2025	2030	2035	2040	2045	2050
Electricity distribution capital invested - Cumulative 5-yr (billion \$2018)		5.42	5.51	10.6	11.3	10.6	11.1

Table 61: REF scenario - PILLAR 1: Efficiency/Electrification - Overview

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Commercial (PJ)	372	372	369	360	351	351	360
Final energy use - Industry (PJ)	602	634	654	668	689	709	731
Final energy use - Residential (PJ)	555	517	496	481	472	466	461
Final energy use - Transportation (PJ)	953	894	818	774	775	799	830

Table 62: REF scenario - PILLAR 1: Efficiency/Electrification - Residential

Item	2020	2025	2030	2035	2040	2045	2050
Residential HVAC investment in 2020s vs. REF - Cumulative 5-yr (billion \$2018)		9.28	9.99				
Sales of cooking units - Electric Resistance (%)	61.3	61.3	61.3	61.3	61.3	61.3	61.3
Sales of cooking units - Gas (%)	38.7	38.7	38.7	38.7	38.7	38.7	38.7
Sales of space heating units - Electric Heat Pump (%)	4.34	15.8	16.3	17.1	17.8	18.6	19.7
Sales of space heating units - Electric Resistance (%)	15.7	20.7	20.5	20.2	19.5	18.6	17.7
Sales of space heating units - Fossil (%)	5.21	7.94	7.37	6.96	6.98	7	6.99
Sales of space heating units - Gas (%)	74.7	55.6	55.9	55.8	55.7	55.8	55.7
Sales of water heating units - Electric Heat Pump (%)	0	0	0	0	0	0	0
Sales of water heating units - Electric Resistance (%)	32.2	48.7	48.5	48.4	48.4	48.3	48.2
Sales of water heating units - Gas Furnace (%)	67.7	51.2	51.4	51.4	51.5	51.6	51.6
Sales of water heating units - Other (%)	0.083	0.169	0.171	0.171	0.171	0.172	0.172

Table 63: REF scenario - PILLAR 1: Efficiency/Electrification - Transportation

Item	2020	2025	2030	2035	2040	2045	2050
Vehicle sales - Heavy-duty - diesel (%)	98.1	98.2	97.9	97	95.6	93.5	91.6
Vehicle sales - Heavy-duty - EV (%)	0	0	0	0	0	0	0
Vehicle sales - Heavy-duty - gasoline (%)	0.229	0.242	0.257	0.274	0.294	0.317	0.343
Vehicle sales - Heavy-duty - hybrid (%)	0.083	0.096	0.112	0.13	0.15	0.174	0.202
Vehicle sales - Heavy-duty - hydrogen FC (%)	0.119	0.138	0.16	0.186	0.216	0.25	0.29
Vehicle sales - Heavy-duty - other (%)	1.51	1.31	1.57	2.37	3.69	5.71	7.57
Vehicle sales - Light-duty - diesel (%)	1.4	1.84	2.16	2.01	1.81	1.68	1.6
Vehicle sales - Light-duty - EV (%)	4.06	6.25	7.06	8.72	10.6	12.1	13.3
Vehicle sales - Light-duty - gasoline (%)	89.4	85.7	83.3	81.3	79.2	77.2	75.7
Vehicle sales - Light-duty - hybrid (%)	4.93	5.76	7	7.56	8.09	8.59	8.95
Vehicle sales - Light-duty - hydrogen FC (%)	0.11	0.371	0.337	0.297	0.293	0.293	0.303
Vehicle sales - Light-duty - other (%)	0.095	0.099	0.095	0.096	0.095	0.094	0.096
Vehicle sales - Medium-duty - diesel (%)	65.2	63.5	61.6	59.6	58	56.5	55.2
Vehicle sales - Medium-duty - EV (%)	0.027	0.105	0.329	0.671	0.895	0.973	0.993
Vehicle sales - Medium-duty - gasoline (%)	34	35.5	37	38.5	39.7	40.8	41.7

Table 63: REF scenario - PILLAR 1: Efficiency/Electrification - Transportation (continued)

Item	2020	2025	2030	2035	2040	2045	2050
Vehicle sales - Medium-duty - hybrid (%)	0.365	0.427	0.496	0.577	0.674	0.793	0.929
Vehicle sales - Medium-duty - hydrogen FC (%)	0.175	0.208	0.242	0.285	0.339	0.409	0.487
Vehicle sales - Medium-duty - other (%)	0.255	0.271	0.298	0.345	0.42	0.528	0.671

Table 64: REF scenario - PILLAR 6: Land sinks - Forests

Item	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - High - Accelerate regeneration (1000 tCO2e/y)							-180
Carbon sink potential - High - All (not counting overlap) (1000 tCO2e/y)							-21,474
Carbon sink potential - High - Avoid deforestation (1000 tCO2e/y)							-3,130
Carbon sink potential - High - Extend rotation length (1000 tCO2e/y)							-3,434
Carbon sink potential - High - Improve plantations (1000 tCO2e/y)							-219
Carbon sink potential - High - Increase retention of HWP (1000 tCO2e/y)							-4,749
Carbon sink potential - High - Increase trees outside forests (1000 tCO2e/y)							-1,920
Carbon sink potential - High - Reforest cropland (1000 tCO2e/y)							-1,166
Carbon sink potential - High - Reforest pasture (1000 tCO2e/y)							-4,605
Carbon sink potential - High - Restore productivity (1000 tCO2e/y)							-2,070
Carbon sink potential - Low - Accelerate regeneration (1000 tCO2e/y)							-90.3
Carbon sink potential - Low - All (not counting overlap) (1000 tCO2e/y)							-5,927
Carbon sink potential - Low - Avoid deforestation (1000 tCO2e/y)							-522
Carbon sink potential - Low - Extend rotation length (1000 tCO2e/y)							-1,319
Carbon sink potential - Low - Improve plantations (1000 tCO2e/y)							-112
Carbon sink potential - Low - Increase retention of HWP (1000 tCO2e/y)							-1,583
Carbon sink potential - Low - Increase trees outside forests (1000 tCO2e/y)							-672
Carbon sink potential - Low - Reforest cropland (1000 tCO2e/y)							-583
Carbon sink potential - Low - Reforest pasture (1000 tCO2e/y)							-349
Carbon sink potential - Low - Restore productivity (1000 tCO2e/y)							-698
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO2e/y)							-135
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO2e/y)							-13,699
Carbon sink potential - Mid - Avoid deforestation (1000 tCO2e/y)							-1,826
Carbon sink potential - Mid - Extend rotation length (1000 tCO2e/y)							-2,377
Carbon sink potential - Mid - Improve plantations (1000 tCO2e/y)							-163
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO2e/y)							-3,166

Table 64: REF scenario - PILLAR 6: Land sinks - Forests (continued)

Item	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - Mid - Increase trees outside forests (1000 tCO <sub>2</sub> e/y)							-1,296
Carbon sink potential - Mid - Reforest cropland (1000 tCO <sub>2</sub> e/y)							-874
Carbon sink potential - Mid - Reforest pasture (1000 tCO <sub>2</sub> e/y)							-2,477
Carbon sink potential - Mid - Restore productivity (1000 tCO <sub>2</sub> e/y)							-1,384
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)							29.5
Land impacted for carbon sink potential - High - Avoid deforestation (over 30 years) (1000 hectares)							424
Land impacted for carbon sink potential - High - Extend rotation length (1000 hectares)							1,751
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)							80.7
Land impacted for carbon sink potential - High - Increase retention of HWP (1000 hectares)							0
Land impacted for carbon sink potential - High - Increase trees outside forests (1000 hectares)							182
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)							77.1
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)							131
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)							686
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)							3,362
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)							14.7
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)							398
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)							671
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)							40.4
Land impacted for carbon sink potential - Low - Increase retention of HWP (1000 hectares)							0
Land impacted for carbon sink potential - Low - Increase trees outside forests (1000 hectares)							96
Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares)							38.5
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)							22.7
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)							415

Table 64: REF scenario - PILLAR 6: Land sinks - Forests (continued)

Item	2020	2025	2030	2035	2040	2045	2050
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)							1,696
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)							22.1
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)							411
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)							1,211
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)							60.8
Land impacted for carbon sink potential - Mid - Increase retention of HWP (1000 hectares)							0
Land impacted for carbon sink potential - Mid - Increase trees outside forests (1000 hectares)							139
Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares)							57.8
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)							164
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)							836
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)							2,902

Table 65: REF scenario - PILLAR 6: Land sinks - Forests - REF only

Item	2020	2025	2030	2035	2040	2045	2050
Business-as-usual carbon sink - Natural uptake (Mt CO <sub>2</sub> e/y)	0.94		-7.03				-6.29
Business-as-usual carbon sink - Retained in Hardwood Products (Mt CO <sub>2</sub> e/y)	-1.29		-2.32				-2.42
Business-as-usual carbon sink - Total (Mt CO <sub>2</sub> e/y)	-0.352		-9.35				-8.7

Table 66: REF scenario - IMPACTS - Health

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal (million 2019\$)		5,580	3,705	3,251	3,017	2,925	2,742
Monetary damages from air pollution - Natural Gas (million 2019\$)		287	334	430	450	426	367
Monetary damages from air pollution - Transportation (million 2019\$)		4,043	4,133	4,226	4,344	4,463	4,584
Premature deaths from air pollution - Coal (deaths)		630	419	367	341	330	310
Premature deaths from air pollution - Natural Gas (deaths)		32.4	37.8	48.5	50.8	48	41.5
Premature deaths from air pollution - Transportation (deaths)		455	465	475	489	502	516