



# Net-Zero America - minnesota state report

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

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## 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.

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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)		15,866	17,271				
Sales of cooking units - Electric Resistance (%)	44.8	57.1	84	89.3	89.6	89.6	89.6
Sales of cooking units - Gas (%)	55.2	42.9	16	10.7	10.4	10.4	10.4
Sales of space heating units - Electric Heat Pump (%)	1.8	6.82	26.5	71.8	85.3	86.8	86.9
Sales of space heating units - Electric Resistance (%)	3.09	5.73	8.18	11.9	12.6	12.6	12.6
Sales of space heating units - Fossil (%)	4.77	2.09	0.407	0.017	0	0	0
Sales of space heating units - Gas Furnace (%)	90.3	85.4	64.9	16.3	2.07	0.546	0.457
Sales of water heating units - Electric Heat Pump (%)	0.491	1.66	12.6	38.5	46.3	47.1	47.2
Sales of water heating units - Electric Resistance (%)	4.33	7.76	18.5	43.6	51.2	52.1	52.2
Sales of water heating units - Gas Furnace (%)	94.1	89.6	68.2	17.2	1.81	0.101	0
Sales of water heating units - Other (%)	1.03	0.934	0.727	0.678	0.674	0.676	0.676

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)		3.87	3.99	7.91	8.48	7.13	7.47

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

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Commercial (PJ)	221	216	207	194	179	168	160
Final energy use - Industry (PJ)	391	405	406	401	400	399	401
Final energy use - Residential (PJ)	296	280	265	236	202	173	153
Final energy use - Transportation (PJ)	552	519	460	389	325	285	269

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)		4.14	4.85				
Sales of cooking units - Electric Resistance (%)	58.9	67.6	94.5	99.7	100	100	100
Sales of cooking units - Gas (%)	41.1	32.4	5.54	0.279	0	0	0
Sales of space heating units - Electric Heat Pump (%)	3.41	7.97	30.9	76.7	90.3	91.9	91.7
Sales of space heating units - Electric Resistance (%)	9.83	13.9	11.3	5.52	3.76	3.59	3.79
Sales of space heating units - Fossil (%)	8.97	15.5	11.4	5.34	3.47	3.15	3.18
Sales of space heating units - Gas (%)	77.8	62.6	46.3	12.4	2.5	1.41	1.31
Sales of water heating units - Electric Heat Pump (%)	0	0.704	9.95	31.7	37.9	38.6	38.6
Sales of water heating units - Electric Resistance (%)	20.7	35.3	41.3	56	60.8	61.3	61.3
Sales of water heating units - Gas Furnace (%)	79.2	64	48.7	12.3	1.29	0.072	0
Sales of water heating units - Other (%)	0.018	0.021	0.021	0.021	0.02	0.02	0.02

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)		1,035	2,659	4,300	6,517	7,089	6,761
Public EV charging plugs - DC Fast (1000 units)	0.168		1.92		8.36		13.5
Public EV charging plugs - L2 (1000 units)	0.739		46.2		201		325
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 (%)	1.59	1.85	1.27	0.408	0.075	0.013	0
Vehicle sales - Light-duty - EV (%)	3.78	14.8	45.8	81.6	96.3	99.3	100
Vehicle sales - Light-duty - gasoline (%)	90.1	78.5	49.5	16.8	3.32	0.591	0
Vehicle sales - Light-duty - hybrid (%)	4.29	4.45	3.17	1.18	0.287	0.062	0
Vehicle sales - Light-duty - hydrogen FC (%)	0.111	0.342	0.206	0.064	0.013	0.002	0
Vehicle sales - Light-duty - other (%)	0.103	0.1	0.065	0.023	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	0.049	0.493	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	0	0	0	0
Capital invested - Solar PV - Constrained (billion \$2018)		0.395	0	0	0	0	0
Capital invested - Wind - Base (billion \$2018)		11.3	7.51	14.5	14.5	18.7	27.2
Capital invested - Wind - Constrained (billion \$2018)		2.2	2.94	6.21	4.37	4.58	5.58
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)	114	204	260	347	460	594	751
Installed renewables - Solar - Base land use assumptions (MW)	312	312	312	312	312	312	312
Installed renewables - Solar - Constrained land use assumptions (MW)	80	80	80	80	80	80	80
Installed renewables - Wind - Base land use assumptions (MW)	4,989	12,681	18,318	30,015	42,271	58,936	84,661
Installed renewables - Wind - Constrained land use assumptions (MW)	4,989	5,969	8,262	13,014	16,884	20,901	26,441

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

Item	2020	2025	2030	2035	2040	2045	2050
Biomass power plant (GWh)	0	93.4	1,062	1,062	1,062	1,062	1,062
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)	558	558	558	558	558	558	558
Solar - Constrained land use assumptions (GWh)	148	148	148	148	148	148	148
Wind - Base land use assumptions (GWh)	20,531	48,195	68,014	108,212	149,718	205,466	290,764
Wind - Constrained land use assumptions (GWh)	20,531	23,945	31,665	47,316	59,631	72,336	89,178

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

Item	2020	2025	2030	2035	2040	2045	2050
Biomass purchases (million \$2018/year)		27.2	161	399	483	1,328	4,925
Conversion capital investment - Cumulative 5-yr (million \$2018)		53.2	550	3,269	1,168	11,639	78,446
Number of facilities - Allam power w ccu (quantity)	0	0	0	0	0	0	0
Number of facilities - Beccs hydrogen (quantity)	0	0	0	3	5	20	24
Number of facilities - Diesel (quantity)	0	0	0	1	1	1	2
Number of facilities - Diesel ccu (quantity)	0	0	0	0	0	0	1
Number of facilities - Power (quantity)	0	1	1	1	1	1	1
Number of facilities - Power ccu (quantity)	0	0	0	0	0	0	0
Number of facilities - Pyrolysis (quantity)	0	0	0	1	1	1	7
Number of facilities - Pyrolysis ccu (quantity)	0	0	0	0	0	0	45
Number of facilities - Sng (quantity)	0	1	1	1	1	1	2
Number of facilities - Sng ccu (quantity)	0	0	0	0	0	0	1

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

Item	2020	2025	2030	2035	2040	2045	2050
Annual - All (MMT)		0	0	4.17	5.67	20.6	58.9
Annual - BECCS (MMT)		0	0	4.17	5.67	20.6	58.9
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	4.17	9.84	30.5	89.4
Cumulative - BECCS (MMT)		0	0	4.17	9.84	30.5	89.4
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	0	105	245	422	4,209
Cumulative investment - All (million \$2018)		0	0	459	564	713	3,731
Cumulative investment - Spur (million \$2018)		0	0	22.3	127	275	3,294
Cumulative investment - Trunk (million \$2018)		0	0	437	437	437	437
Spur (km)		0	0	16.7	157	334	4,121
Trunk (km)		0	0	88.1	88.1	88.1	88.1

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)							-2,423
Carbon sink potential - Aggressive deployment - Cropland measures (1000 tCO2e/y)							-13,821
Carbon sink potential - Aggressive deployment - Permanent conservation cover (1000 tCO2e/y)							-414
Carbon sink potential - Aggressive deployment - Total (1000 tCO2e/y)							-16,658
Carbon sink potential - Moderate deployment - Corn-ethanol to energy grasses (1000 tCO2e/y)							-2,423
Carbon sink potential - Moderate deployment - Cropland measures (1000 tCO2e/y)							-7,283
Carbon sink potential - Moderate deployment - Permanent conservation cover (1000 tCO2e/y)							-207
Carbon sink potential - Moderate deployment - Total (1000 tCO2e/y)							-9,914
Land impacted for carbon sink - Aggressive deployment - Corn-ethanol to energy grasses (1000 hectares)							1,097
Land impacted for carbon sink - Aggressive deployment - Cropland measures (1000 hectares)							6,974
Land impacted for carbon sink - Aggressive deployment - Permanent conservation cover (1000 hectares)							753
Land impacted for carbon sink - Aggressive deployment - Total (1000 hectares)							8,824
Land impacted for carbon sink - Moderate deployment - Corn-ethanol to energy grasses (1000 hectares)							1,097
Land impacted for carbon sink - Moderate deployment - Cropland measures (1000 hectares)							3,675
Land impacted for carbon sink - Moderate deployment - Permanent conservation cover (1000 hectares)							376
Land impacted for carbon sink - Moderate deployment - Total (1000 hectares)							5,149

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

Item	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - High - Accelerate regeneration (1000 tCO2e/y)							-479
Carbon sink potential - High - All (not counting overlap) (1000 tCO2e/y)							-40,029
Carbon sink potential - High - Avoid deforestation (1000 tCO2e/y)							-1,871
Carbon sink potential - High - Extend rotation length (1000 tCO2e/y)							-8,507
Carbon sink potential - High - Improve plantations (1000 tCO2e/y)							-793
Carbon sink potential - High - Increase retention of HWP (1000 tCO2e/y)							-4,667
Carbon sink potential - High - Increase trees outside forests (1000 tCO2e/y)							-3,012
Carbon sink potential - High - Reforest cropland (1000 tCO2e/y)							-8,069
Carbon sink potential - High - Reforest pasture (1000 tCO2e/y)							-8,313
Carbon sink potential - High - Restore productivity (1000 tCO2e/y)							-4,318
Carbon sink potential - Low - Accelerate regeneration (1000 tCO2e/y)							-240
Carbon sink potential - Low - All (not counting overlap) (1000 tCO2e/y)							-12,952
Carbon sink potential - Low - Avoid deforestation (1000 tCO2e/y)							-312
Carbon sink potential - Low - Extend rotation length (1000 tCO2e/y)							-3,267
Carbon sink potential - Low - Improve plantations (1000 tCO2e/y)							-404
Carbon sink potential - Low - Increase retention of HWP (1000 tCO2e/y)							-1,556
Carbon sink potential - Low - Increase trees outside forests (1000 tCO2e/y)							-1,054
Carbon sink potential - Low - Reforest cropland (1000 tCO2e/y)							-4,034
Carbon sink potential - Low - Reforest pasture (1000 tCO2e/y)							-630
Carbon sink potential - Low - Restore productivity (1000 tCO2e/y)							-1,455
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO2e/y)							-359
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO2e/y)							-26,484
Carbon sink potential - Mid - Avoid deforestation (1000 tCO2e/y)							-1,091
Carbon sink potential - Mid - Extend rotation length (1000 tCO2e/y)							-5,887
Carbon sink potential - Mid - Improve plantations (1000 tCO2e/y)							-591
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO2e/y)							-3,112
Carbon sink potential - Mid - Increase trees outside forests (1000 tCO2e/y)							-2,033
Carbon sink potential - Mid - Reforest cropland (1000 tCO2e/y)							-6,052
Carbon sink potential - Mid - Reforest pasture (1000 tCO2e/y)							-4,472
Carbon sink potential - Mid - Restore productivity (1000 tCO2e/y)							-2,887



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)							78.3
Land impacted for carbon sink potential - High - Avoid deforestation (over 30 years) (1000 hectares)							253
Land impacted for carbon sink potential - High - Extend rotation length (1000 hectares)							4,338
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)							292
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)							286
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)							533
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)							236
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)							1,431
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)							7,449
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)							39.1
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)							238
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)							1,662
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)							146
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)							151
Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares)							267
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)							40.9
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)							866
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)							3,409
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)							58.7

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)							246
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)							3,000
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)							220
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)							218
Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares)							400
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)							296
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)							1,744
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)							6,183

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

Item	2020	2025	2030	2035	2040	2045	2050
Natural gas consumption - Annual (tcf)		380	320	257	193	122	84.3
Natural gas consumption - Cumulative (tcf)							7,731
Natural gas production - Annual (tcf)		0	0	0	0	0	0
Oil consumption - Annual (million bbls)		107	95.7	78.2	61.9	49	39.2
Oil consumption - Cumulative (million bbls)							2,407
Oil production - Annual (million bbls)		0	0	0	0	0	0

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

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal (million 2019\$)		289	0.208	0.199	0.163	0.109	0.003
Monetary damages from air pollution - Natural Gas (million 2019\$)		104	66.9	30.5	19.8	14.9	7.09
Monetary damages from air pollution - Transportation (million 2019\$)		1,518	1,442	1,116	659	315	138
Premature deaths from air pollution - Coal (deaths)		32.6	0.024	0.023	0.018	0.012	0
Premature deaths from air pollution - Natural Gas (deaths)		11.8	7.55	3.44	2.24	1.68	0.801
Premature deaths from air pollution - Transportation (deaths)		171	162	126	74.2	35.4	15.6

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

Item	2020	2025	2030	2035	2040	2045	2050
By economic sector - Agriculture (jobs)		2,172	2,429	2,657	1,770	1,636	4,380
By economic sector - Construction (jobs)		10,124	10,809	15,600	19,028	23,443	33,116
By economic sector - Manufacturing (jobs)		8,752	10,321	13,567	13,228	11,761	17,131
By economic sector - Mining (jobs)		2,121	1,497	1,016	663	417	271

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

Item	2020	2025	2030	2035	2040	2045	2050
By economic sector - Other (jobs)		751	858	1,350	1,780	2,340	3,371
By economic sector - Pipeline (jobs)		486	417	391	259	181	534
By economic sector - Professional (jobs)		6,640	7,484	10,912	13,467	18,109	28,926
By economic sector - Trade (jobs)		4,469	4,542	5,998	7,142	9,205	13,772
By economic sector - Utilities (jobs)		9,756	10,126	14,670	18,330	23,000	32,692
By education level - All sectors - Associates degree or some college (jobs)		13,638	14,676	20,444	23,899	28,615	41,887
By education level - All sectors - Bachelors degree (jobs)		9,291	9,907	13,443	15,505	18,797	28,216
By education level - All sectors - Doctoral degree (jobs)		335	364	503	596	772	1,209
By education level - All sectors - High school diploma or less (jobs)		19,727	21,094	28,418	31,738	37,020	55,459
By education level - All sectors - Masters or professional degree (jobs)		2,278	2,443	3,353	3,929	4,889	7,423
By resource sector - Biomass (jobs)		5,397	5,727	6,357	4,618	6,060	19,035
By resource sector - CO2 (jobs)		0	0	457	14.3	21.8	3,367
By resource sector - Coal (jobs)		886	204	0	0	0	0
By resource sector - Grid (jobs)		13,435	14,668	24,240	32,876	41,812	57,453
By resource sector - Natural Gas (jobs)		4,133	3,754	3,166	2,912	2,869	2,726
By resource sector - Nuclear (jobs)		944	929	539	0	0	0
By resource sector - Oil (jobs)		4,752	3,903	2,946	2,166	1,601	1,202
By resource sector - Solar (jobs)		3,438	3,703	5,325	5,610	5,112	7,367
By resource sector - Wind (jobs)		12,284	15,595	23,130	27,470	32,617	43,043
Median wages - Annual - All (\$2019 per job)		64,390	65,103	66,419	68,261	70,124	70,957
On-Site or In-Plant Training - Total jobs - 1 to 4 years (jobs)		7,058	7,563	10,490	12,238	14,649	21,412
On-Site or In-Plant Training - Total jobs - 4 to 10 years (jobs)		2,856	3,032	4,259	5,094	6,257	9,110
On-Site or In-Plant Training - Total jobs - None (jobs)		7,342	7,905	10,796	12,338	14,747	22,096
On-Site or In-Plant Training - Total jobs - Over 10 years (jobs)		383	412	575	673	807	1,183
On-Site or In-Plant Training - Total jobs - Up to 1 year (jobs)		27,631	29,572	40,040	45,324	53,633	80,393
On-the-Job Training - All sectors - 1 to 4 years (jobs)		9,006	9,657	13,459	15,799	18,988	27,670
On-the-Job Training - All sectors - 4 to 10 years (jobs)		2,755	2,933	4,163	5,023	6,197	8,987
On-the-Job Training - All sectors - None (jobs)		2,482	2,637	3,546	4,018	4,797	7,213
On-the-Job Training - All sectors - Over 10 years (jobs)		434	469	635	713	819	1,193
On-the-Job Training - All sectors - Up to 1 year (jobs)		30,593	32,787	44,357	50,113	59,292	89,131
Related work experience - All sectors - 1 to 4 years (jobs)		15,942	17,056	23,387	27,004	32,414	48,164
Related work experience - All sectors - 4 to 10 years (jobs)		10,218	10,940	15,102	17,592	21,172	31,213
Related work experience - All sectors - None (jobs)		6,610	7,062	9,597	10,909	12,948	19,374
Related work experience - All sectors - Over 10 years (jobs)		2,758	2,965	4,063	4,673	5,532	8,132
Related work experience - All sectors - Up to 1 year (jobs)		9,742	10,459	14,011	15,489	18,027	27,312
Wage income - All (million \$2019)		2,915	3,157	4,395	5,165	6,318	9,523

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)		15,866	17,291				
Sales of cooking units - Electric Resistance (%)	44.8	49.3	53.1	63	76.9	85.5	88.5
Sales of cooking units - Gas (%)	55.2	50.7	46.9	37	23.1	14.5	11.5
Sales of space heating units - Electric Heat Pump (%)	1.8	5.6	6.81	10.6	19.8	32.1	40.2
Sales of space heating units - Electric Resistance (%)	3.09	5.44	5.57	6.02	6.98	8.07	8.69
Sales of space heating units - Fossil (%)	4.77	2.45	2.43	2.18	1.78	1.47	1.36
Sales of space heating units - Gas Furnace (%)	90.3	86.5	85.2	81.2	71.4	58.3	49.7
Sales of water heating units - Electric Heat Pump (%)	0.491	1.03	1.71	3.92	9.33	16.6	21.3
Sales of water heating units - Electric Resistance (%)	4.33	7.15	7.85	9.96	15.2	22.3	26.9
Sales of water heating units - Gas Furnace (%)	94.1	90.8	89.5	85.2	74.6	60.3	50.9
Sales of water heating units - Other (%)	1.03	0.978	0.967	0.931	0.876	0.845	0.834

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)		3.06	3.08	4.07	4.2	6.25	6.61

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

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Commercial (PJ)	221	216	210	204	198	192	187
Final energy use - Industry (PJ)	391	406	408	408	409	409	410
Final energy use - Residential (PJ)	296	280	269	259	249	237	223
Final energy use - Transportation (PJ)	552	523	479	445	418	387	350

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)		4.12	4.74				
Sales of cooking units - Electric Resistance (%)	58.7	59.8	63.6	73.5	87.4	95.9	98.9
Sales of cooking units - Gas (%)	41.3	40.2	36.4	26.5	12.6	4.07	1.1
Sales of space heating units - Electric Heat Pump (%)	3.41	6.07	7.47	11.9	22.3	35.6	44
Sales of space heating units - Electric Resistance (%)	9.83	14.1	13.8	13.3	12.1	10.4	9.55
Sales of space heating units - Fossil (%)	8.97	16.1	15.9	15.1	13.3	11.3	10.2
Sales of space heating units - Gas (%)	77.8	63.8	62.8	59.6	52.3	42.7	36.3
Sales of water heating units - Electric Heat Pump (%)	0	0.188	0.757	2.61	7.15	13.2	17.1
Sales of water heating units - Electric Resistance (%)	20.7	35	35.3	36.5	39.6	43.7	46.5
Sales of water heating units - Gas Furnace (%)	79.2	64.8	63.9	60.9	53.3	43.1	36.4
Sales of water heating units - Other (%)	0.018	0.021	0.021	0.021	0.021	0.021	0.02

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	168	352	1,190	3,738	5,448
Public EV charging plugs - DC Fast (1000 units)	0.168		0.604		3.11		8.65
Public EV charging plugs - L2 (1000 units)	0.739		14.5		74.8		208
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 (%)	1.6	2.01	2.06	1.64	1.06	0.542	0.232
Vehicle sales - Light-duty - EV (%)	1.84	4.58	11.6	25.5	48	71.8	87.5
Vehicle sales - Light-duty - gasoline (%)	91.9	87.7	79.9	67.1	46.6	25.1	11.1
Vehicle sales - Light-duty - hybrid (%)	4.45	5.26	5.92	5.41	4.07	2.42	1.17
Vehicle sales - Light-duty - hydrogen FC (%)	0.113	0.381	0.328	0.252	0.179	0.1	0.046
Vehicle sales - Light-duty - other (%)	0.105	0.108	0.098	0.086	0.062	0.034	0.016
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)							-2,423
Carbon sink potential - Aggressive deployment - Cropland measures (1000 tCO2e/y)							-13,821
Carbon sink potential - Aggressive deployment - Permanent conservation cover (1000 tCO2e/y)							-414
Carbon sink potential - Aggressive deployment - Total (1000 tCO2e/y)							-16,658
Carbon sink potential - Moderate deployment - Corn-ethanol to energy grasses (1000 tCO2e/y)							-2,423
Carbon sink potential - Moderate deployment - Cropland measures (1000 tCO2e/y)							-7,283
Carbon sink potential - Moderate deployment - Permanent conservation cover (1000 tCO2e/y)							-207
Carbon sink potential - Moderate deployment - Total (1000 tCO2e/y)							-9,914
Land impacted for carbon sink - Aggressive deployment - Corn-ethanol to energy grasses (1000 hectares)							1,097
Land impacted for carbon sink - Aggressive deployment - Cropland measures (1000 hectares)							6,974
Land impacted for carbon sink - Aggressive deployment - Permanent conservation cover (1000 hectares)							753

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)							8,824
Land impacted for carbon sink - Moderate deployment - Corn-ethanol to energy grasses (1000 hectares)							1,097
Land impacted for carbon sink - Moderate deployment - Cropland measures (1000 hectares)							3,675
Land impacted for carbon sink - Moderate deployment - Permanent conservation cover (1000 hectares)							376
Land impacted for carbon sink - Moderate deployment - Total (1000 hectares)							5,149

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)							-479
Carbon sink potential - High - All (not counting overlap) (1000 tCO <sub>2</sub> e/y)							-40,029
Carbon sink potential - High - Avoid deforestation (1000 tCO <sub>2</sub> e/y)							-1,871
Carbon sink potential - High - Extend rotation length (1000 tCO <sub>2</sub> e/y)							-8,507
Carbon sink potential - High - Improve plantations (1000 tCO <sub>2</sub> e/y)							-793
Carbon sink potential - High - Increase retention of HWP (1000 tCO <sub>2</sub> e/y)							-4,667
Carbon sink potential - High - Increase trees outside forests (1000 tCO <sub>2</sub> e/y)							-3,012
Carbon sink potential - High - Reforest cropland (1000 tCO <sub>2</sub> e/y)							-8,069
Carbon sink potential - High - Reforest pasture (1000 tCO <sub>2</sub> e/y)							-8,313
Carbon sink potential - High - Restore productivity (1000 tCO <sub>2</sub> e/y)							-4,318
Carbon sink potential - Low - Accelerate regeneration (1000 tCO <sub>2</sub> e/y)							-240
Carbon sink potential - Low - All (not counting overlap) (1000 tCO <sub>2</sub> e/y)							-12,952
Carbon sink potential - Low - Avoid deforestation (1000 tCO <sub>2</sub> e/y)							-312
Carbon sink potential - Low - Extend rotation length (1000 tCO <sub>2</sub> e/y)							-3,267
Carbon sink potential - Low - Improve plantations (1000 tCO <sub>2</sub> e/y)							-404
Carbon sink potential - Low - Increase retention of HWP (1000 tCO <sub>2</sub> e/y)							-1,556
Carbon sink potential - Low - Increase trees outside forests (1000 tCO <sub>2</sub> e/y)							-1,054
Carbon sink potential - Low - Reforest cropland (1000 tCO <sub>2</sub> e/y)							-4,034
Carbon sink potential - Low - Reforest pasture (1000 tCO <sub>2</sub> e/y)							-630
Carbon sink potential - Low - Restore productivity (1000 tCO <sub>2</sub> e/y)							-1,455
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO <sub>2</sub> e/y)							-359

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)							-26,484
Carbon sink potential - Mid - Avoid deforestation (1000 tCO <sub>2</sub> e/y)							-1,091
Carbon sink potential - Mid - Extend rotation length (1000 tCO <sub>2</sub> e/y)							-5,887
Carbon sink potential - Mid - Improve plantations (1000 tCO <sub>2</sub> e/y)							-591
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO <sub>2</sub> e/y)							-3,112
Carbon sink potential - Mid - Increase trees outside forests (1000 tCO <sub>2</sub> e/y)							-2,033
Carbon sink potential - Mid - Reforest cropland (1000 tCO <sub>2</sub> e/y)							-6,052
Carbon sink potential - Mid - Reforest pasture (1000 tCO <sub>2</sub> e/y)							-4,472
Carbon sink potential - Mid - Restore productivity (1000 tCO <sub>2</sub> e/y)							-2,887
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)							78.3
Land impacted for carbon sink potential - High - Avoid deforestation (over 30 years) (1000 hectares)							253
Land impacted for carbon sink potential - High - Extend rotation length (1000 hectares)							4,338
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)							292
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)							286
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)							533
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)							236
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)							1,431
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)							7,449
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)							39.1
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)							238
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)							1,662
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)							146
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)							151
Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares)							267
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)							40.9
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)							866
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)							3,409
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)							58.7
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)							246
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)							3,000
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)							220
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)							218
Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares)							400
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)							296
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)							1,744
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)							6,183

Table 24: E- scenario - IMPACTS - Health

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal (million 2019\$)		289	0.208	0.199	0.163	0.109	0.003
Monetary damages from air pollution - Natural Gas (million 2019\$)		103	55.2	21.4	10.1	4.7	4.5
Monetary damages from air pollution - Transportation (million 2019\$)		1,543	1,586	1,574	1,446	1,174	823
Premature deaths from air pollution - Coal (deaths)		32.6	0.024	0.023	0.018	0.012	0
Premature deaths from air pollution - Natural Gas (deaths)		11.6	6.23	2.42	1.14	0.531	0.508
Premature deaths from air pollution - Transportation (deaths)		174	178	177	163	132	92.6



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)		15,866	17,271				
Sales of cooking units - Electric Resistance (%)	44.8	57.1	84	89.3	89.6	89.6	89.6
Sales of cooking units - Gas (%)	55.2	42.9	16	10.7	10.4	10.4	10.4
Sales of space heating units - Electric Heat Pump (%)	1.8	6.82	26.5	71.8	85.3	86.8	86.9
Sales of space heating units - Electric Resistance (%)	3.09	5.73	8.18	11.9	12.6	12.6	12.6
Sales of space heating units - Fossil (%)	4.77	2.09	0.407	0.017	0	0	0
Sales of space heating units - Gas Furnace (%)	90.3	85.4	64.9	16.3	2.07	0.546	0.457
Sales of water heating units - Electric Heat Pump (%)	0.491	1.66	12.6	38.5	46.3	47.1	47.2
Sales of water heating units - Electric Resistance (%)	4.33	7.76	18.5	43.6	51.2	52.1	52.2
Sales of water heating units - Gas Furnace (%)	94.1	89.6	68.2	17.2	1.81	0.101	0
Sales of water heating units - Other (%)	1.03	0.934	0.727	0.678	0.674	0.676	0.676

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)		3.87	3.99	7.91	8.48	7.13	7.47

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

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Commercial (PJ)	221	216	207	194	179	168	160
Final energy use - Industry (PJ)	391	405	406	401	400	399	401
Final energy use - Residential (PJ)	296	280	265	236	202	173	153
Final energy use - Transportation (PJ)	552	519	460	389	325	285	269

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)		4.14	4.85				
Sales of cooking units - Electric Resistance (%)	58.9	67.6	94.5	99.7	100	100	100
Sales of cooking units - Gas (%)	41.1	32.4	5.54	0.279	0	0	0
Sales of space heating units - Electric Heat Pump (%)	3.41	7.97	30.9	76.7	90.3	91.9	91.7
Sales of space heating units - Electric Resistance (%)	9.83	13.9	11.3	5.52	3.76	3.59	3.79
Sales of space heating units - Fossil (%)	8.97	15.5	11.4	5.34	3.47	3.15	3.18
Sales of space heating units - Gas (%)	77.8	62.6	46.3	12.4	2.5	1.41	1.31
Sales of water heating units - Electric Heat Pump (%)	0	0.704	9.95	31.7	37.9	38.6	38.6
Sales of water heating units - Electric Resistance (%)	20.7	35.3	41.3	56	60.8	61.3	61.3
Sales of water heating units - Gas Furnace (%)	79.2	64	48.7	12.3	1.29	0.072	0
Sales of water heating units - Other (%)	0.018	0.021	0.021	0.021	0.02	0.02	0.02

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)		1,035	2,659	4,300	6,517	7,089	6,761
Public EV charging plugs - DC Fast (1000 units)	0.168		1.92		8.36		13.5
Public EV charging plugs - L2 (1000 units)	0.739		46.2		201		325
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 (%)	1.59	1.85	1.27	0.408	0.075	0.013	0
Vehicle sales - Light-duty - EV (%)	3.78	14.8	45.8	81.6	96.3	99.3	100
Vehicle sales - Light-duty - gasoline (%)	90.1	78.5	49.5	16.8	3.32	0.591	0
Vehicle sales - Light-duty - hybrid (%)	4.29	4.45	3.17	1.18	0.287	0.062	0
Vehicle sales - Light-duty - hydrogen FC (%)	0.111	0.342	0.206	0.064	0.013	0.002	0
Vehicle sales - Light-duty - other (%)	0.103	0.1	0.065	0.023	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)		0	0	0	0.529	0	2.4
Capital invested - Wind - Base (billion \$2018)		12.8	8.51	17.6	27.5	39.7	39.1
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)	312	312	312	312	908	908	3,946
Installed renewables - Solar - Constrained land use assumptions (MW)	624	624	624	624	2,739	3,301	19,929
Installed renewables - Wind - Base land use assumptions (MW)	4,989	13,656	20,048	34,266	57,528	92,970	129,876
Installed renewables - Wind - Constrained land use assumptions (MW)	9,978	12,734	17,257	28,938	41,331	54,542	133,637

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)	558	558	558	558	1,453	1,453	6,011
Solar - Constrained land use assumptions (GWh)	1,116	1,116	1,116	1,116	4,287	5,128	30,084
Wind - Base land use assumptions (GWh)	20,531	51,648	74,029	122,673	200,761	317,866	435,531
Wind - Constrained land use assumptions (GWh)	41,063	50,665	65,777	104,100	143,207	183,267	455,176

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)							-2,423
Carbon sink potential - Aggressive deployment - Cropland measures (1000 tCO <sub>2</sub> e/y)							-13,821
Carbon sink potential - Aggressive deployment - Permanent conservation cover (1000 tCO <sub>2</sub> e/y)							-414
Carbon sink potential - Aggressive deployment - Total (1000 tCO <sub>2</sub> e/y)							-16,658
Carbon sink potential - Moderate deployment - Corn-ethanol to energy grasses (1000 tCO <sub>2</sub> e/y)							-2,423
Carbon sink potential - Moderate deployment - Cropland measures (1000 tCO <sub>2</sub> e/y)							-7,283
Carbon sink potential - Moderate deployment - Permanent conservation cover (1000 tCO <sub>2</sub> e/y)							-207
Carbon sink potential - Moderate deployment - Total (1000 tCO <sub>2</sub> e/y)							-9,914
Land impacted for carbon sink - Aggressive deployment - Corn-ethanol to energy grasses (1000 hectares)							1,097
Land impacted for carbon sink - Aggressive deployment - Cropland measures (1000 hectares)							6,974
Land impacted for carbon sink - Aggressive deployment - Permanent conservation cover (1000 hectares)							753
Land impacted for carbon sink - Aggressive deployment - Total (1000 hectares)							8,824
Land impacted for carbon sink - Moderate deployment - Corn-ethanol to energy grasses (1000 hectares)							1,097
Land impacted for carbon sink - Moderate deployment - Cropland measures (1000 hectares)							3,675
Land impacted for carbon sink - Moderate deployment - Permanent conservation cover (1000 hectares)							376
Land impacted for carbon sink - Moderate deployment - Total (1000 hectares)							5,149

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)							-479
Carbon sink potential - High - All (not counting overlap) (1000 tCO <sub>2</sub> e/y)							-40,029
Carbon sink potential - High - Avoid deforestation (1000 tCO <sub>2</sub> e/y)							-1,871
Carbon sink potential - High - Extend rotation length (1000 tCO <sub>2</sub> e/y)							-8,507
Carbon sink potential - High - Improve plantations (1000 tCO <sub>2</sub> e/y)							-793
Carbon sink potential - High - Increase retention of HWP (1000 tCO <sub>2</sub> e/y)							-4,667

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)							-3,012
Carbon sink potential - High - Reforest cropland (1000 tCO <sub>2</sub> e/y)							-8,069
Carbon sink potential - High - Reforest pasture (1000 tCO <sub>2</sub> e/y)							-8,313
Carbon sink potential - High - Restore productivity (1000 tCO <sub>2</sub> e/y)							-4,318
Carbon sink potential - Low - Accelerate regeneration (1000 tCO <sub>2</sub> e/y)							-240
Carbon sink potential - Low - All (not counting overlap) (1000 tCO <sub>2</sub> e/y)							-12,952
Carbon sink potential - Low - Avoid deforestation (1000 tCO <sub>2</sub> e/y)							-312
Carbon sink potential - Low - Extend rotation length (1000 tCO <sub>2</sub> e/y)							-3,267
Carbon sink potential - Low - Improve plantations (1000 tCO <sub>2</sub> e/y)							-404
Carbon sink potential - Low - Increase retention of HWP (1000 tCO <sub>2</sub> e/y)							-1,556
Carbon sink potential - Low - Increase trees outside forests (1000 tCO <sub>2</sub> e/y)							-1,054
Carbon sink potential - Low - Reforest cropland (1000 tCO <sub>2</sub> e/y)							-4,034
Carbon sink potential - Low - Reforest pasture (1000 tCO <sub>2</sub> e/y)							-630
Carbon sink potential - Low - Restore productivity (1000 tCO <sub>2</sub> e/y)							-1,455
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO <sub>2</sub> e/y)							-359
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO <sub>2</sub> e/y)							-26,484
Carbon sink potential - Mid - Avoid deforestation (1000 tCO <sub>2</sub> e/y)							-1,091
Carbon sink potential - Mid - Extend rotation length (1000 tCO <sub>2</sub> e/y)							-5,887
Carbon sink potential - Mid - Improve plantations (1000 tCO <sub>2</sub> e/y)							-591
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO <sub>2</sub> e/y)							-3,112
Carbon sink potential - Mid - Increase trees outside forests (1000 tCO <sub>2</sub> e/y)							-2,033
Carbon sink potential - Mid - Reforest cropland (1000 tCO <sub>2</sub> e/y)							-6,052
Carbon sink potential - Mid - Reforest pasture (1000 tCO <sub>2</sub> e/y)							-4,472
Carbon sink potential - Mid - Restore productivity (1000 tCO <sub>2</sub> e/y)							-2,887
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)							78.3
Land impacted for carbon sink potential - High - Avoid deforestation (over 30 years) (1000 hectares)							253
Land impacted for carbon sink potential - High - Extend rotation length (1000 hectares)							4,338
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)							292

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)							286
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)							533
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)							236
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)							1,431
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)							7,449
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)							39.1
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)							238
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)							1,662
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)							146
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)							151
Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares)							267
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)							40.9
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)							866
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)							3,409
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)							58.7
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)							246
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)							3,000
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)							220
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)							218

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)							400
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)							296
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)							1,744
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)							6,183

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

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal (million 2019\$)		289	0.208	0.199	0.163	0.109	0.003
Monetary damages from air pollution - Natural Gas (million 2019\$)		96.3	57.6	18.4	10.9	5.55	4.32
Monetary damages from air pollution - Transportation (million 2019\$)		1,518	1,442	1,116	659	315	138
Premature deaths from air pollution - Coal (deaths)		32.6	0.024	0.023	0.018	0.012	0
Premature deaths from air pollution - Natural Gas (deaths)		10.9	6.5	2.07	1.23	0.626	0.488
Premature deaths from air pollution - Transportation (deaths)		171	162	126	74.2	35.4	15.6

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)		15,866	17,271				
Sales of cooking units - Electric Resistance (%)	44.8	57.1	84	89.3	89.6	89.6	89.6
Sales of cooking units - Gas (%)	55.2	42.9	16	10.7	10.4	10.4	10.4
Sales of space heating units - Electric Heat Pump (%)	1.8	6.82	26.5	71.8	85.3	86.8	86.9
Sales of space heating units - Electric Resistance (%)	3.09	5.73	8.18	11.9	12.6	12.6	12.6
Sales of space heating units - Fossil (%)	4.77	2.09	0.407	0.017	0	0	0
Sales of space heating units - Gas Furnace (%)	90.3	85.4	64.9	16.3	2.07	0.546	0.457
Sales of water heating units - Electric Heat Pump (%)	0.491	1.66	12.6	38.5	46.3	47.1	47.2
Sales of water heating units - Electric Resistance (%)	4.33	7.76	18.5	43.6	51.2	52.1	52.2
Sales of water heating units - Gas Furnace (%)	94.1	89.6	68.2	17.2	1.81	0.101	0
Sales of water heating units - Other (%)	1.03	0.934	0.727	0.678	0.674	0.676	0.676

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)		3.87	3.99	7.91	8.48	7.13	7.47

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

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Commercial (PJ)	221	216	207	194	179	168	160

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

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Industry (PJ)	391	405	406	401	400	399	401
Final energy use - Residential (PJ)	296	280	265	236	202	173	153
Final energy use - Transportation (PJ)	552	519	460	389	325	285	269

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)		4.14	4.85				
Sales of cooking units - Electric Resistance (%)	58.9	67.6	94.5	99.7	100	100	100
Sales of cooking units - Gas (%)	41.1	32.4	5.54	0.279	0	0	0
Sales of space heating units - Electric Heat Pump (%)	3.41	7.97	30.9	76.7	90.3	91.9	91.7
Sales of space heating units - Electric Resistance (%)	9.83	13.9	11.3	5.52	3.76	3.59	3.79
Sales of space heating units - Fossil (%)	8.97	15.5	11.4	5.34	3.47	3.15	3.18
Sales of space heating units - Gas (%)	77.8	62.6	46.3	12.4	2.5	1.41	1.31
Sales of water heating units - Electric Heat Pump (%)	0	0.704	9.95	31.7	37.9	38.6	38.6
Sales of water heating units - Electric Resistance (%)	20.7	35.3	41.3	56	60.8	61.3	61.3
Sales of water heating units - Gas Furnace (%)	79.2	64	48.7	12.3	1.29	0.072	0
Sales of water heating units - Other (%)	0.018	0.021	0.021	0.021	0.02	0.02	0.02

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)		1,035	2,659	4,300	6,517	7,089	6,761
Public EV charging plugs - DC Fast (1000 units)	0.168		1.92		8.36		13.5
Public EV charging plugs - L2 (1000 units)	0.739		46.2		201		325
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 (%)	1.59	1.85	1.27	0.408	0.075	0.013	0
Vehicle sales - Light-duty - EV (%)	3.78	14.8	45.8	81.6	96.3	99.3	100
Vehicle sales - Light-duty - gasoline (%)	90.1	78.5	49.5	16.8	3.32	0.591	0
Vehicle sales - Light-duty - hybrid (%)	4.29	4.45	3.17	1.18	0.287	0.062	0
Vehicle sales - Light-duty - hydrogen FC (%)	0.111	0.342	0.206	0.064	0.013	0.002	0
Vehicle sales - Light-duty - other (%)	0.103	0.1	0.065	0.023	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	0	0	0
Capital invested - Solar PV - Constrained (billion \$2018)		0	0	0	0	0	0
Capital invested - Wind - Base (billion \$2018)		4.96	8.01	5.14	7.11	10.2	0.152
Capital invested - Wind - Constrained (billion \$2018)		0.597	1.29	2.44	3.11	3.72	0.108
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)	312	312	312	312	312	312	312
Installed renewables - Solar - Constrained land use assumptions (MW)	312	312	312	312	312	312	312
Installed renewables - Wind - Base land use assumptions (MW)	4,989	8,359	14,377	18,520	24,535	33,667	33,810
Installed renewables - Wind - Constrained land use assumptions (MW)	4,989	5,395	6,367	8,337	10,965	14,287	14,389

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)	558	558	558	558	558	558	558
Solar - Constrained land use assumptions (GWh)	558	558	558	558	558	558	558
Wind - Base land use assumptions (GWh)	20,531	32,719	54,161	68,730	89,499	120,671	121,150
Wind - Constrained land use assumptions (GWh)	20,531	21,967	25,332	31,915	40,586	51,465	51,789

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)							-2,423
Carbon sink potential - Aggressive deployment - Cropland measures (1000 tCO2e/y)							-13,821
Carbon sink potential - Aggressive deployment - Permanent conservation cover (1000 tCO2e/y)							-414
Carbon sink potential - Aggressive deployment - Total (1000 tCO2e/y)							-16,658
Carbon sink potential - Moderate deployment - Corn-ethanol to energy grasses (1000 tCO2e/y)							-2,423
Carbon sink potential - Moderate deployment - Cropland measures (1000 tCO2e/y)							-7,283
Carbon sink potential - Moderate deployment - Permanent conservation cover (1000 tCO2e/y)							-207
Carbon sink potential - Moderate deployment - Total (1000 tCO2e/y)							-9,914



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)							1,097
Land impacted for carbon sink - Aggressive deployment - Cropland measures (1000 hectares)							6,974
Land impacted for carbon sink - Aggressive deployment - Permanent conservation cover (1000 hectares)							753
Land impacted for carbon sink - Aggressive deployment - Total (1000 hectares)							8,824
Land impacted for carbon sink - Moderate deployment - Corn-ethanol to energy grasses (1000 hectares)							1,097
Land impacted for carbon sink - Moderate deployment - Cropland measures (1000 hectares)							3,675
Land impacted for carbon sink - Moderate deployment - Permanent conservation cover (1000 hectares)							376
Land impacted for carbon sink - Moderate deployment - Total (1000 hectares)							5,149

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)							-479
Carbon sink potential - High - All (not counting overlap) (1000 tCO <sub>2</sub> e/y)							-40,029
Carbon sink potential - High - Avoid deforestation (1000 tCO <sub>2</sub> e/y)							-1,871
Carbon sink potential - High - Extend rotation length (1000 tCO <sub>2</sub> e/y)							-8,507
Carbon sink potential - High - Improve plantations (1000 tCO <sub>2</sub> e/y)							-793
Carbon sink potential - High - Increase retention of HWP (1000 tCO <sub>2</sub> e/y)							-4,667
Carbon sink potential - High - Increase trees outside forests (1000 tCO <sub>2</sub> e/y)							-3,012
Carbon sink potential - High - Reforest cropland (1000 tCO <sub>2</sub> e/y)							-8,069
Carbon sink potential - High - Reforest pasture (1000 tCO <sub>2</sub> e/y)							-8,313
Carbon sink potential - High - Restore productivity (1000 tCO <sub>2</sub> e/y)							-4,318
Carbon sink potential - Low - Accelerate regeneration (1000 tCO <sub>2</sub> e/y)							-240
Carbon sink potential - Low - All (not counting overlap) (1000 tCO <sub>2</sub> e/y)							-12,952
Carbon sink potential - Low - Avoid deforestation (1000 tCO <sub>2</sub> e/y)							-312
Carbon sink potential - Low - Extend rotation length (1000 tCO <sub>2</sub> e/y)							-3,267
Carbon sink potential - Low - Improve plantations (1000 tCO <sub>2</sub> e/y)							-404
Carbon sink potential - Low - Increase retention of HWP (1000 tCO <sub>2</sub> e/y)							-1,556
Carbon sink potential - Low - Increase trees outside forests (1000 tCO <sub>2</sub> e/y)							-1,054

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)							-4,034
Carbon sink potential - Low - Reforest pasture (1000 tCO <sub>2</sub> e/y)							-630
Carbon sink potential - Low - Restore productivity (1000 tCO <sub>2</sub> e/y)							-1,455
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO <sub>2</sub> e/y)							-359
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO <sub>2</sub> e/y)							-26,484
Carbon sink potential - Mid - Avoid deforestation (1000 tCO <sub>2</sub> e/y)							-1,091
Carbon sink potential - Mid - Extend rotation length (1000 tCO <sub>2</sub> e/y)							-5,887
Carbon sink potential - Mid - Improve plantations (1000 tCO <sub>2</sub> e/y)							-591
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO <sub>2</sub> e/y)							-3,112
Carbon sink potential - Mid - Increase trees outside forests (1000 tCO <sub>2</sub> e/y)							-2,033
Carbon sink potential - Mid - Reforest cropland (1000 tCO <sub>2</sub> e/y)							-6,052
Carbon sink potential - Mid - Reforest pasture (1000 tCO <sub>2</sub> e/y)							-4,472
Carbon sink potential - Mid - Restore productivity (1000 tCO <sub>2</sub> e/y)							-2,887
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)							78.3
Land impacted for carbon sink potential - High - Avoid deforestation (over 30 years) (1000 hectares)							253
Land impacted for carbon sink potential - High - Extend rotation length (1000 hectares)							4,338
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)							292
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)							286
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)							533
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)							236
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)							1,431
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)							7,449
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)							39.1
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)							238

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)							1,662
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)							146
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)							151
Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares)							267
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)							40.9
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)							866
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)							3,409
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)							58.7
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)							246
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)							3,000
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)							220
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)							218
Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares)							400
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)							296
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)							1,744
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)							6,183

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

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal (million 2019\$)		289	0.208	0.199	0.163	0.109	0.003
Monetary damages from air pollution - Natural Gas (million 2019\$)		109	68.4	85.1	57.8	28.1	10.9
Monetary damages from air pollution - Transportation (million 2019\$)		1,518	1,442	1,116	659	315	138
Premature deaths from air pollution - Coal (deaths)		32.6	0.024	0.023	0.018	0.012	0

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

Item	2020	2025	2030	2035	2040	2045	2050
Premature deaths from air pollution - Natural Gas (deaths)		12.3	7.72	9.61	6.53	3.17	1.23
Premature deaths from air pollution - Transportation (deaths)		171	162	126	74.2	35.4	15.6

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)		15,866	17,291				
Sales of cooking units - Electric Resistance (%)	44.8	49.3	53.1	63	76.9	85.5	88.5
Sales of cooking units - Gas (%)	55.2	50.7	46.9	37	23.1	14.5	11.5
Sales of space heating units - Electric Heat Pump (%)	1.8	5.6	6.81	10.6	19.8	32.1	40.2
Sales of space heating units - Electric Resistance (%)	3.09	5.44	5.57	6.02	6.98	8.07	8.69
Sales of space heating units - Fossil (%)	4.77	2.45	2.43	2.18	1.78	1.47	1.36
Sales of space heating units - Gas Furnace (%)	90.3	86.5	85.2	81.2	71.4	58.3	49.7
Sales of water heating units - Electric Heat Pump (%)	0.491	1.03	1.71	3.92	9.33	16.6	21.3
Sales of water heating units - Electric Resistance (%)	4.33	7.15	7.85	9.96	15.2	22.3	26.9
Sales of water heating units - Gas Furnace (%)	94.1	90.8	89.5	85.2	74.6	60.3	50.9
Sales of water heating units - Other (%)	1.03	0.978	0.967	0.931	0.876	0.845	0.834

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)		3.06	3.08	4.07	4.2	6.25	6.61

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

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Commercial (PJ)	221	216	210	204	198	192	187
Final energy use - Industry (PJ)	391	406	408	408	409	409	410
Final energy use - Residential (PJ)	296	280	269	259	249	237	223
Final energy use - Transportation (PJ)	552	523	479	445	418	387	350

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)		4.12	4.74				
Sales of cooking units - Electric Resistance (%)	58.7	59.8	63.6	73.5	87.4	95.9	98.9
Sales of cooking units - Gas (%)	41.3	40.2	36.4	26.5	12.6	4.07	1.1
Sales of space heating units - Electric Heat Pump (%)	3.41	6.07	7.47	11.9	22.3	35.6	44
Sales of space heating units - Electric Resistance (%)	9.83	14.1	13.8	13.3	12.1	10.4	9.55
Sales of space heating units - Fossil (%)	8.97	16.1	15.9	15.1	13.3	11.3	10.2
Sales of space heating units - Gas (%)	77.8	63.8	62.8	59.6	52.3	42.7	36.3
Sales of water heating units - Electric Heat Pump (%)	0	0.188	0.757	2.61	7.15	13.2	17.1
Sales of water heating units - Electric Resistance (%)	20.7	35	35.3	36.5	39.6	43.7	46.5

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 (%)	79.2	64.8	63.9	60.9	53.3	43.1	36.4
Sales of water heating units - Other (%)	0.018	0.021	0.021	0.021	0.021	0.021	0.02

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	168	352	1,190	3,738	5,448
Public EV charging plugs - DC Fast (1000 units)	0.168		0.604		3.11		8.65
Public EV charging plugs - L2 (1000 units)	0.739		14.5		74.8		208
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 (%)	1.6	2.01	2.06	1.64	1.06	0.542	0.232
Vehicle sales - Light-duty - EV (%)	1.84	4.58	11.6	25.5	48	71.8	87.5
Vehicle sales - Light-duty - gasoline (%)	91.9	87.7	79.9	67.1	46.6	25.1	11.1
Vehicle sales - Light-duty - hybrid (%)	4.45	5.26	5.92	5.41	4.07	2.42	1.17
Vehicle sales - Light-duty - hydrogen FC (%)	0.113	0.381	0.328	0.252	0.179	0.1	0.046
Vehicle sales - Light-duty - other (%)	0.105	0.108	0.098	0.086	0.062	0.034	0.016
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	0.046	0.387	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	88.1	849	849	849	849	849
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

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

Item	2020	2025	2030	2035	2040	2045	2050
Biomass purchases (million \$2018/year)		31.8	191	951	2,401	3,337	8,444
Conversion capital investment - Cumulative 5-yr (million \$2018)		50.2	432	8,095	15,433	9,966	67,223
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	9	30	42	42
Number of facilities - Diesel (quantity)	0	0	0	1	1	1	1
Number of facilities - Diesel ccu (quantity)	0	0	0	0	0	0	0
Number of facilities - Power (quantity)	0	1	1	1	1	1	1
Number of facilities - Power ccu (quantity)	0	0	0	0	0	0	0
Number of facilities - Pyrolysis (quantity)	0	0	0	1	1	1	47
Number of facilities - Pyrolysis ccu (quantity)	0	0	0	0	0	0	18
Number of facilities - Sng (quantity)	0	1	1	1	1	1	1
Number of facilities - Sng ccu (quantity)	0	0	0	0	0	0	0

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

Item	2020	2025	2030	2035	2040	2045	2050
Annual - All (MMT)		0	0	10.4	30.2	43	55.1
Annual - BECCS (MMT)		0	0	10.4	30.2	43	55.1
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	10.4	40.6	83.6	139
Cumulative - BECCS (MMT)		0	0	10.4	40.6	83.6	139
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	0	385	1,087	1,282	1,789
Cumulative investment - All (million \$2018)		0	0	715	1,223	1,916	2,313
Cumulative investment - Spur (million \$2018)		0	0	250	759	1,452	1,848
Cumulative investment - Trunk (million \$2018)		0	0	464	464	464	464
Spur (km)		0	0	297	999	1,194	1,701
Trunk (km)		0	0	88.1	88.1	88.1	88.1

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)							-2,914
Carbon sink potential - Aggressive deployment - Cropland measures (1000 tCO2e/y)							-12,952
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)							-386
Carbon sink potential - Aggressive deployment - Total (1000 tCO2e/y)							-16,252
Carbon sink potential - Moderate deployment - Corn-ethanol to energy grasses (1000 tCO2e/y)							-2,914
Carbon sink potential - Moderate deployment - Cropland measures (1000 tCO2e/y)							-6,825
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)							-193
Carbon sink potential - Moderate deployment - Total (1000 tCO2e/y)							-9,932
Land impacted for carbon sink - Aggressive deployment - Corn-ethanol to energy grasses (1000 hectares)							1,589
Land impacted for carbon sink - Aggressive deployment - Cropland measures (1000 hectares)							16,087
Land impacted for carbon sink - Aggressive deployment - Cropland to woody energy crops (1000 hectares)							29.2
Land impacted for carbon sink - Aggressive deployment - Pasture to energy crops (1000 hectares)							137
Land impacted for carbon sink - Aggressive deployment - Permanent conservation cover (1000 hectares)							702
Land impacted for carbon sink - Aggressive deployment - Total (1000 hectares)							18,543
Land impacted for carbon sink - Moderate deployment - Corn-ethanol to energy grasses (1000 hectares)							1,589
Land impacted for carbon sink - Moderate deployment - Cropland measures (1000 hectares)							3,433
Land impacted for carbon sink - Moderate deployment - Cropland to woody energy crops (1000 hectares)							29.2
Land impacted for carbon sink - Moderate deployment - Pasture to energy crops (1000 hectares)							137
Land impacted for carbon sink - Moderate deployment - Permanent conservation cover (1000 hectares)							351
Land impacted for carbon sink - Moderate deployment - Total (1000 hectares)							5,538

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)							-479
Carbon sink potential - High - All (not counting overlap) (1000 tCO <sub>2</sub> e/y)							-40,029
Carbon sink potential - High - Avoid deforestation (1000 tCO <sub>2</sub> e/y)							-1,871
Carbon sink potential - High - Extend rotation length (1000 tCO <sub>2</sub> e/y)							-8,507
Carbon sink potential - High - Improve plantations (1000 tCO <sub>2</sub> e/y)							-793
Carbon sink potential - High - Increase retention of HWP (1000 tCO <sub>2</sub> e/y)							-4,667
Carbon sink potential - High - Increase trees outside forests (1000 tCO <sub>2</sub> e/y)							-3,012
Carbon sink potential - High - Reforest cropland (1000 tCO <sub>2</sub> e/y)							-8,069
Carbon sink potential - High - Reforest pasture (1000 tCO <sub>2</sub> e/y)							-8,313
Carbon sink potential - High - Restore productivity (1000 tCO <sub>2</sub> e/y)							-4,318
Carbon sink potential - Low - Accelerate regeneration (1000 tCO <sub>2</sub> e/y)							-240
Carbon sink potential - Low - All (not counting overlap) (1000 tCO <sub>2</sub> e/y)							-12,952
Carbon sink potential - Low - Avoid deforestation (1000 tCO <sub>2</sub> e/y)							-312
Carbon sink potential - Low - Extend rotation length (1000 tCO <sub>2</sub> e/y)							-3,267
Carbon sink potential - Low - Improve plantations (1000 tCO <sub>2</sub> e/y)							-404
Carbon sink potential - Low - Increase retention of HWP (1000 tCO <sub>2</sub> e/y)							-1,556
Carbon sink potential - Low - Increase trees outside forests (1000 tCO <sub>2</sub> e/y)							-1,054
Carbon sink potential - Low - Reforest cropland (1000 tCO <sub>2</sub> e/y)							-4,034
Carbon sink potential - Low - Reforest pasture (1000 tCO <sub>2</sub> e/y)							-630
Carbon sink potential - Low - Restore productivity (1000 tCO <sub>2</sub> e/y)							-1,455
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO <sub>2</sub> e/y)							-359
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO <sub>2</sub> e/y)							-26,484
Carbon sink potential - Mid - Avoid deforestation (1000 tCO <sub>2</sub> e/y)							-1,091
Carbon sink potential - Mid - Extend rotation length (1000 tCO <sub>2</sub> e/y)							-5,887
Carbon sink potential - Mid - Improve plantations (1000 tCO <sub>2</sub> e/y)							-591
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO <sub>2</sub> e/y)							-3,112
Carbon sink potential - Mid - Increase trees outside forests (1000 tCO <sub>2</sub> e/y)							-2,033
Carbon sink potential - Mid - Reforest cropland (1000 tCO <sub>2</sub> e/y)							-6,052
Carbon sink potential - Mid - Reforest pasture (1000 tCO <sub>2</sub> e/y)							-4,472
Carbon sink potential - Mid - Restore productivity (1000 tCO <sub>2</sub> e/y)							-2,887



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)							78.3
Land impacted for carbon sink potential - High - Avoid deforestation (over 30 years) (1000 hectares)							253
Land impacted for carbon sink potential - High - Extend rotation length (1000 hectares)							4,338
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)							292
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)							286
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)							533
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)							236
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)							1,431
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)							7,449
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)							39.1
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)							238
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)							1,662
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)							146
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)							151
Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares)							267
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)							40.9
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)							866
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)							3,409
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)							58.7

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)							246
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)							3,000
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)							220
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)							218
Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares)							400
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)							296
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)							1,744
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)							6,183

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

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal (million 2019\$)		289	0.208	0.199	0.163	0.109	0.003
Monetary damages from air pollution - Natural Gas (million 2019\$)		101	50.1	26.8	17.7	8.07	4.46
Monetary damages from air pollution - Transportation (million 2019\$)		1,543	1,586	1,574	1,446	1,174	823
Premature deaths from air pollution - Coal (deaths)		32.6	0.024	0.023	0.018	0.012	0
Premature deaths from air pollution - Natural Gas (deaths)		11.4	5.66	3.02	1.99	0.911	0.503
Premature deaths from air pollution - Transportation (deaths)		174	178	177	163	132	92.6

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)		15,688	16,188				
Sales of cooking units - Electric Resistance (%)	44.8	47.8	47.9	47.8	47.9	47.9	48
Sales of cooking units - Gas (%)	55.2	52.2	52.1	52.2	52.1	52.1	52
Sales of space heating units - Electric Heat Pump (%)	1.8	12.1	41.6	67.7	72.9	73.7	73.7
Sales of space heating units - Electric Resistance (%)	3.09	6.45	11.5	19.7	24.9	25.8	25.8
Sales of space heating units - Fossil (%)	4.77	2.37	1.87	0.846	0.129	0.011	0
Sales of space heating units - Gas Furnace (%)	90.3	79.1	45.1	11.8	1.99	0.575	0.459
Sales of water heating units - Electric Heat Pump (%)	0.491	0.81	0.809	0.808	0.806	0.803	0.802
Sales of water heating units - Electric Resistance (%)	4.33	6.94	6.97	6.94	6.93	6.95	6.95

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 (%)	94.1	91.3	91.2	91.3	91.3	91.3	91.3
Sales of water heating units - Other (%)	1.03	0.982	0.983	0.981	0.978	0.982	0.983

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)		3.78	3.89	5.19	5.44	4.77	4.91

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

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Commercial (PJ)	221	221	221	218	216	217	223
Final energy use - Industry (PJ)	391	416	428	441	457	472	491
Final energy use - Residential (PJ)	296	281	273	268	265	264	263
Final energy use - Transportation (PJ)	552	526	489	468	472	488	508

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)		4.02	4.15				
Sales of cooking units - Electric Resistance (%)	58.3	58.3	58.3	58.3	58.3	58.3	58.3
Sales of cooking units - Gas (%)	41.7	41.7	41.7	41.7	41.7	41.7	41.7
Sales of space heating units - Electric Heat Pump (%)	2.72	9.25	9.56	10	10.4	10.8	11.4
Sales of space heating units - Electric Resistance (%)	9.92	13.6	13.4	13.3	13.2	12.7	12.4
Sales of space heating units - Fossil (%)	9.2	15	14.2	13.5	13.2	13	13.1
Sales of space heating units - Gas (%)	78.2	62.1	62.9	63.2	63.2	63.4	63.2
Sales of water heating units - Electric Heat Pump (%)	0	0	0	0	0	0	0
Sales of water heating units - Electric Resistance (%)	20.7	34.9	34.8	34.8	34.8	34.8	34.7
Sales of water heating units - Gas Furnace (%)	79.2	65.1	65.2	65.2	65.2	65.2	65.2
Sales of water heating units - Other (%)	0.018	0.021	0.021	0.021	0.021	0.021	0.021

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 (%)	1.59	2	2.19	2.04	1.84	1.71	1.63
Vehicle sales - Light-duty - EV (%)	3.43	5.43	6.19	7.61	9.28	10.8	11.9
Vehicle sales - Light-duty - gasoline (%)	90.5	86.9	84.8	83	81	79	77.5
Vehicle sales - Light-duty - hybrid (%)	4.31	5.16	6.32	6.89	7.47	8.07	8.55
Vehicle sales - Light-duty - hydrogen FC (%)	0.111	0.378	0.348	0.31	0.307	0.308	0.319
Vehicle sales - Light-duty - other (%)	0.104	0.108	0.104	0.105	0.104	0.103	0.106
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)							-479
Carbon sink potential - High - All (not counting overlap) (1000 tCO2e/y)							-40,029
Carbon sink potential - High - Avoid deforestation (1000 tCO2e/y)							-1,871
Carbon sink potential - High - Extend rotation length (1000 tCO2e/y)							-8,507
Carbon sink potential - High - Improve plantations (1000 tCO2e/y)							-793
Carbon sink potential - High - Increase retention of HWP (1000 tCO2e/y)							-4,667
Carbon sink potential - High - Increase trees outside forests (1000 tCO2e/y)							-3,012
Carbon sink potential - High - Reforest cropland (1000 tCO2e/y)							-8,069
Carbon sink potential - High - Reforest pasture (1000 tCO2e/y)							-8,313
Carbon sink potential - High - Restore productivity (1000 tCO2e/y)							-4,318
Carbon sink potential - Low - Accelerate regeneration (1000 tCO2e/y)							-240
Carbon sink potential - Low - All (not counting overlap) (1000 tCO2e/y)							-12,952
Carbon sink potential - Low - Avoid deforestation (1000 tCO2e/y)							-312
Carbon sink potential - Low - Extend rotation length (1000 tCO2e/y)							-3,267
Carbon sink potential - Low - Improve plantations (1000 tCO2e/y)							-404
Carbon sink potential - Low - Increase retention of HWP (1000 tCO2e/y)							-1,556
Carbon sink potential - Low - Increase trees outside forests (1000 tCO2e/y)							-1,054
Carbon sink potential - Low - Reforest cropland (1000 tCO2e/y)							-4,034
Carbon sink potential - Low - Reforest pasture (1000 tCO2e/y)							-630
Carbon sink potential - Low - Restore productivity (1000 tCO2e/y)							-1,455
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO2e/y)							-359
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO2e/y)							-26,484
Carbon sink potential - Mid - Avoid deforestation (1000 tCO2e/y)							-1,091
Carbon sink potential - Mid - Extend rotation length (1000 tCO2e/y)							-5,887
Carbon sink potential - Mid - Improve plantations (1000 tCO2e/y)							-591
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO2e/y)							-3,112

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)							-2,033
Carbon sink potential - Mid - Reforest cropland (1000 tCO <sub>2</sub> e/y)							-6,052
Carbon sink potential - Mid - Reforest pasture (1000 tCO <sub>2</sub> e/y)							-4,472
Carbon sink potential - Mid - Restore productivity (1000 tCO <sub>2</sub> e/y)							-2,887
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)							78.3
Land impacted for carbon sink potential - High - Avoid deforestation (over 30 years) (1000 hectares)							253
Land impacted for carbon sink potential - High - Extend rotation length (1000 hectares)							4,338
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)							292
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)							286
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)							533
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)							236
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)							1,431
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)							7,449
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)							39.1
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)							238
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)							1,662
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)							146
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)							151
Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares)							267
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)							40.9
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)							866

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)							3,409
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)							58.7
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)							246
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)							3,000
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)							220
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)							218
Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares)							400
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)							296
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)							1,744
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)							6,183

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)	-33.3		-15.2				-13.5
Business-as-usual carbon sink - Retained in Hardwood Products (Mt CO <sub>2</sub> e/y)	-1.27		-2.28				-2.37
Business-as-usual carbon sink - Total (Mt CO <sub>2</sub> e/y)	-34.5		-17.4				-15.9

Table 66: REF scenario - IMPACTS - Health

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal (million 2019\$)		793	443	267	215	190	184
Monetary damages from air pollution - Natural Gas (million 2019\$)		140	154	179	112	88.5	77.9
Monetary damages from air pollution - Transportation (million 2019\$)		1,543	1,609	1,680	1,760	1,841	1,924
Premature deaths from air pollution - Coal (deaths)		89.5	50	30.2	24.2	21.4	20.8
Premature deaths from air pollution - Natural Gas (deaths)		15.8	17.4	20.2	12.7	9.99	8.79
Premature deaths from air pollution - Transportation (deaths)		174	181	189	198	207	216