



# Net-Zero America - north dakota state report

2021-03-15

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)		2,165	2,361				
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 (%)	6.09	4.46	15.5	53	81.8	86.3	86.7
Sales of space heating units - Electric Resistance (%)	9.99	5.81	8.04	12	12.9	12.9	12.9
Sales of space heating units - Fossil (%)	9.8	2.42	0.475	0.02	0	0	0
Sales of space heating units - Gas Furnace (%)	74.1	87.3	76	35	5.3	0.843	0.483
Sales of water heating units - Electric Heat Pump (%)	1.62	1.17	6.88	27.5	44	46.5	46.7
Sales of water heating units - Electric Resistance (%)	13.6	7.49	13.1	33.4	49.8	52.4	52.6
Sales of water heating units - Gas Furnace (%)	82.1	90.4	79.3	38.4	5.51	0.416	0
Sales of water heating units - Other (%)	2.67	0.964	0.742	0.696	0.692	0.695	0.695

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)		0.777	0.801	1.5	1.61	1.57	1.66

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

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Commercial (PJ)	25.2	24.8	24	22.9	21.6	20.3	19.5
Final energy use - Industry (PJ)	124	130	131	130	129	129	130
Final energy use - Residential (PJ)	38.3	36.3	34.5	31.9	28.4	25	22.3
Final energy use - Transportation (PJ)	104	97.6	88.2	76.6	66	59.6	57.2

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)		0.514	0.598				
Sales of cooking units - Electric Resistance (%)	80.2	84.4	97.3	99.9	100	100	100
Sales of cooking units - Gas (%)	19.8	15.6	2.66	0.134	0	0	0
Sales of space heating units - Electric Heat Pump (%)	8.4	12.9	25.9	58.5	84	88	87.9
Sales of space heating units - Electric Resistance (%)	28.4	34.1	30.9	19.4	10.1	8.76	8.9
Sales of space heating units - Fossil (%)	13.7	18.3	14.3	8.01	3.29	2.43	2.5
Sales of space heating units - Gas (%)	49.5	34.6	28.9	14.1	2.65	0.854	0.684
Sales of water heating units - Electric Heat Pump (%)	0	0.203	3.49	14.3	21.9	23	23.1
Sales of water heating units - Electric Resistance (%)	52.4	66.9	67.7	71.6	76.1	76.8	76.8
Sales of water heating units - Gas Furnace (%)	47.6	32.8	28.8	14	2.01	0.152	0
Sales of water heating units - Other (%)	0.036	0.035	0.035	0.035	0.035	0.035	0.035

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)		173	442	719	1,088	1,186	1,130
Public EV charging plugs - DC Fast (1000 units)	0.024		0.353		1.57		2.54
Public EV charging plugs - L2 (1000 units)	0.043		8.49		37.8		61.2
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 (%)	1.96	2.17	1.42	0.461	0.082	0.013	0
Vehicle sales - Light-duty - EV (%)	2.56	11.1	39.9	79.2	96	99.3	100
Vehicle sales - Light-duty - gasoline (%)	92.2	82.7	55.6	19.2	3.64	0.601	0
Vehicle sales - Light-duty - hybrid (%)	3.1	3.59	2.75	1.07	0.251	0.052	0
Vehicle sales - Light-duty - hydrogen FC (%)	0.113	0.363	0.237	0.075	0.015	0.002	0
Vehicle sales - Light-duty - other (%)	0.12	0.116	0.081	0.029	0.005	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	0.024	0	0.007	0
Capital invested - Biomass w/ccu power plant (billion \$2018)	0	0	0.081	0	0	0.013	0
Capital invested - Wind - Base (billion \$2018)		0	0	0.287	0.603	3.22	9.02
Capital invested - Wind - Constrained (billion \$2018)		0.092	1.88	4.94	9.39	26.8	72.8
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)	0.496	0.883	1.13	1.5	2	2.58	3.26
Installed renewables - Solar - Base land use assumptions (MW)	0	0	0	0	0	0	0
Installed renewables - Solar - Constrained land use assumptions (MW)	0	0	0	0	0	0	0
Installed renewables - Wind - Base land use assumptions (MW)	4,732	4,732	4,732	4,963	5,473	8,346	16,863
Installed renewables - Wind - Constrained land use assumptions (MW)	4,732	4,732	5,564	9,404	16,174	39,067	104,561

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	23.9	23.9	30.8	30.8
Biomass w/ccu power plant (GWh)	0	0	90.7	90.7	90.7	105	105

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

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)	0	0	0	0	0	0	0
Solar - Constrained land use assumptions (GWh)	0	0	0	0	0	0	0
Wind - Base land use assumptions (GWh)	19,216	19,216	19,216	20,024	21,802	32,070	62,105
Wind - Constrained land use assumptions (GWh)	19,216	19,216	22,168	35,712	58,941	137,238	352,916

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

Item	2020	2025	2030	2035	2040	2045	2050
Biomass purchases (million \$2018/year)		0	4.97	410	529	609	1,023
Conversion capital investment - Cumulative 5-yr (million \$2018)		0	74.4	5,477	1,614	1,086	5,582
Number of facilities - Allam power w ccu (quantity)	0	0	0	1	1	2	2
Number of facilities - Beccs hydrogen (quantity)	0	0	0	7	10	13	17
Number of facilities - Diesel (quantity)	0	0	0	0	0	0	0
Number of facilities - Diesel ccu (quantity)	0	0	0	1	2	3	3
Number of facilities - Power (quantity)	0	0	0	0	0	0	0
Number of facilities - Power ccu (quantity)	0	0	1	1	1	2	2
Number of facilities - Pyrolysis (quantity)	0	0	0	0	0	0	0
Number of facilities - Pyrolysis ccu (quantity)	0	0	0	1	2	3	3
Number of facilities - Sng (quantity)	0	0	0	0	0	0	0
Number of facilities - Sng ccu (quantity)	0	0	1	1	1	2	2

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

Item	2020	2025	2030	2035	2040	2045	2050
Annual - All (MMT)		0	0.09	7.12	9.17	10.5	17.7
Annual - BECCS (MMT)		0	0.09	7.08	9.15	10.5	17.7
Annual - Cement and lime (MMT)		0	0	0	0	0	0
Annual - NGCC (MMT)		0	0	0.03	0.03	0.02	0.01
Cumulative - All (MMT)		0	0.09	7.21	16.4	26.9	44.6
Cumulative - BECCS (MMT)		0	0.09	7.17	16.3	26.8	44.5
Cumulative - Cement and lime (MMT)		0	0	0	0	0	0
Cumulative - NGCC (MMT)		0	0	0.03	0.06	0.08	0.09

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

Item	2020	2025	2030	2035	2040	2045	2050
All (km)		0	554	2,251	2,490	3,079	4,487
Cumulative investment - All (million \$2018)		0	416	2,905	3,053	3,385	4,468
Cumulative investment - Spur (million \$2018)		0	217	1,178	1,327	1,659	2,742
Cumulative investment - Trunk (million \$2018)		0	199	1,726	1,726	1,726	1,726
Spur (km)		0	416	1,805	2,044	2,633	4,042
Trunk (km)		0	138	446	446	446	446

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

Item	2020	2025	2030	2035	2040	2045	2050
CO2 storage (MMT)		0	2.19	6.17	11.7	18.9	25.2
Injection wells (wells)		0	4	15	26	44	54
Resource characterization, appraisal, permitting costs (million \$2020)		135	406	542	542	542	542
Wells and facilities construction costs (million \$2020)		0	113	439	783	1,309	1,625

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)							-551
Carbon sink potential - Aggressive deployment - Cropland measures (1000 tCO2e/y)							-10,108
Carbon sink potential - Aggressive deployment - Permanent conservation cover (1000 tCO2e/y)							-660
Carbon sink potential - Aggressive deployment - Total (1000 tCO2e/y)							-11,319
Carbon sink potential - Moderate deployment - Corn-ethanol to energy grasses (1000 tCO2e/y)							-551
Carbon sink potential - Moderate deployment - Cropland measures (1000 tCO2e/y)							-5,330
Carbon sink potential - Moderate deployment - Permanent conservation cover (1000 tCO2e/y)							-330
Carbon sink potential - Moderate deployment - Total (1000 tCO2e/y)							-6,211
Land impacted for carbon sink - Aggressive deployment - Corn-ethanol to energy grasses (1000 hectares)							300
Land impacted for carbon sink - Aggressive deployment - Cropland measures (1000 hectares)							9,928
Land impacted for carbon sink - Aggressive deployment - Permanent conservation cover (1000 hectares)							1,092
Land impacted for carbon sink - Aggressive deployment - Total (1000 hectares)							11,320
Land impacted for carbon sink - Moderate deployment - Corn-ethanol to energy grasses (1000 hectares)							300
Land impacted for carbon sink - Moderate deployment - Cropland measures (1000 hectares)							5,237
Land impacted for carbon sink - Moderate deployment - Permanent conservation cover (1000 hectares)							546
Land impacted for carbon sink - Moderate deployment - Total (1000 hectares)							6,083

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)							-38.5
Carbon sink potential - High - All (not counting overlap) (1000 tCO <sub>2</sub> e/y)							-23,528
Carbon sink potential - High - Avoid deforestation (1000 tCO <sub>2</sub> e/y)							-821
Carbon sink potential - High - Extend rotation length (1000 tCO <sub>2</sub> e/y)							-414
Carbon sink potential - High - Improve plantations (1000 tCO <sub>2</sub> e/y)							-20.6
Carbon sink potential - High - Increase retention of HWP (1000 tCO <sub>2</sub> e/y)							-41.5
Carbon sink potential - High - Increase trees outside forests (1000 tCO <sub>2</sub> e/y)							-3,342
Carbon sink potential - High - Reforest cropland (1000 tCO <sub>2</sub> e/y)							-13,386
Carbon sink potential - High - Reforest pasture (1000 tCO <sub>2</sub> e/y)							-5,274
Carbon sink potential - High - Restore productivity (1000 tCO <sub>2</sub> e/y)							-191
Carbon sink potential - Low - Accelerate regeneration (1000 tCO <sub>2</sub> e/y)							-19.3
Carbon sink potential - Low - All (not counting overlap) (1000 tCO <sub>2</sub> e/y)							-8,666
Carbon sink potential - Low - Avoid deforestation (1000 tCO <sub>2</sub> e/y)							-137
Carbon sink potential - Low - Extend rotation length (1000 tCO <sub>2</sub> e/y)							-159
Carbon sink potential - Low - Improve plantations (1000 tCO <sub>2</sub> e/y)							-10.5
Carbon sink potential - Low - Increase retention of HWP (1000 tCO <sub>2</sub> e/y)							-13.8
Carbon sink potential - Low - Increase trees outside forests (1000 tCO <sub>2</sub> e/y)							-1,170
Carbon sink potential - Low - Reforest cropland (1000 tCO <sub>2</sub> e/y)							-6,693
Carbon sink potential - Low - Reforest pasture (1000 tCO <sub>2</sub> e/y)							-400
Carbon sink potential - Low - Restore productivity (1000 tCO <sub>2</sub> e/y)							-64.3
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO <sub>2</sub> e/y)							-28.9
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO <sub>2</sub> e/y)							-16,097
Carbon sink potential - Mid - Avoid deforestation (1000 tCO <sub>2</sub> e/y)							-479
Carbon sink potential - Mid - Extend rotation length (1000 tCO <sub>2</sub> e/y)							-286
Carbon sink potential - Mid - Improve plantations (1000 tCO <sub>2</sub> e/y)							-15.4
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO <sub>2</sub> e/y)							-27.6
Carbon sink potential - Mid - Increase trees outside forests (1000 tCO <sub>2</sub> e/y)							-2,256
Carbon sink potential - Mid - Reforest cropland (1000 tCO <sub>2</sub> e/y)							-10,039
Carbon sink potential - Mid - Reforest pasture (1000 tCO <sub>2</sub> e/y)							-2,837
Carbon sink potential - Mid - Restore productivity (1000 tCO <sub>2</sub> e/y)							-127



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)							6.3
Land impacted for carbon sink potential - High - Avoid deforestation (over 30 years) (1000 hectares)							111
Land impacted for carbon sink potential - High - Extend rotation length (1000 hectares)							211
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)							7.59
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)							317
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)							885
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)							150
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)							63.2
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)							1,752
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)							3.15
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)							104
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)							80.8
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)							3.79
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)							167
Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares)							443
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)							26
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)							38.2
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)							866
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)							4.72

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)							108
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)							146
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)							5.71
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)							242
Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares)							664
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)							188
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)							77
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)							1,435

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

Item	2020	2025	2030	2035	2040	2045	2050
Natural gas consumption - Annual (tcf)		98.1	82.7	66.3	49.9	31.4	21.8
Natural gas consumption - Cumulative (tcf)							1,997
Natural gas production - Annual (tcf)		690	653	568	481	381	296
Oil consumption - Annual (million bbls)		46	42.8	37.1	31.1	26.4	21.8
Oil consumption - Cumulative (million bbls)							1,120
Oil production - Annual (million bbls)		598	600	599	475	386	257

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

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal (million 2019\$)		24.9	0.018	0.017	0.013	0.008	0
Monetary damages from air pollution - Natural Gas (million 2019\$)		6.03	3.33	2	1.7	1.07	0.466
Monetary damages from air pollution - Transportation (million 2019\$)		24.3	22.3	16.7	9.47	4.22	1.6
Premature deaths from air pollution - Coal (deaths)		2.82	0.002	0.002	0.001	0.001	0
Premature deaths from air pollution - Natural Gas (deaths)		0.681	0.376	0.225	0.192	0.121	0.053
Premature deaths from air pollution - Transportation (deaths)		2.73	2.51	1.88	1.06	0.474	0.179

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

Item	2020	2025	2030	2035	2040	2045	2050
By economic sector - Agriculture (jobs)		819	825	1,384	1,095	696	883
By economic sector - Construction (jobs)		8,513	7,968	9,267	7,706	8,666	11,179
By economic sector - Manufacturing (jobs)		10,549	11,439	13,536	12,081	9,891	11,265
By economic sector - Mining (jobs)		11,230	8,984	7,222	4,831	3,348	2,008

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

Item	2020	2025	2030	2035	2040	2045	2050
By economic sector - Other (jobs)		267	230	262	270	396	686
By economic sector - Pipeline (jobs)		1,477	1,486	1,775	1,313	1,210	1,181
By economic sector - Professional (jobs)		4,758	4,147	4,634	4,202	4,756	6,844
By economic sector - Trade (jobs)		8,804	7,514	6,824	5,155	4,501	4,598
By economic sector - Utilities (jobs)		3,426	2,545	4,160	3,639	5,794	9,514
By education level - All sectors - Associates degree or some college (jobs)		13,835	12,551	13,935	11,576	11,698	14,875
By education level - All sectors - Bachelors degree (jobs)		11,621	10,352	10,762	8,735	8,341	9,983
By education level - All sectors - Doctoral degree (jobs)		366	320	328	272	273	344
By education level - All sectors - High school diploma or less (jobs)		21,431	19,639	21,671	17,778	17,039	20,585
By education level - All sectors - Masters or professional degree (jobs)		2,590	2,276	2,366	1,932	1,907	2,371
By resource sector - Biomass (jobs)		1,923	1,882	3,450	3,008	2,575	3,902
By resource sector - CO2 (jobs)		72	432	3,217	1,824	3,002	5,307
By resource sector - Coal (jobs)		1,398	306	18.4	13.6	10.5	8.79
By resource sector - Grid (jobs)		3,938	2,787	4,099	4,717	8,046	13,277
By resource sector - Natural Gas (jobs)		6,390	5,139	3,906	2,818	2,150	1,561
By resource sector - Nuclear (jobs)		0	0	0	0	0	0
By resource sector - Oil (jobs)		28,669	26,333	24,126	17,859	13,626	8,672
By resource sector - Solar (jobs)		2,034	2,406	3,519	3,643	3,208	4,484
By resource sector - Wind (jobs)		5,420	5,854	6,728	6,411	6,640	10,946
Median wages - Annual - All (\$2019 per job)		60,555	60,862	61,280	61,936	63,658	64,907
On-Site or In-Plant Training - Total jobs - 1 to 4 years (jobs)		7,418	6,719	7,403	6,108	6,136	7,689
On-Site or In-Plant Training - Total jobs - 4 to 10 years (jobs)		2,761	2,462	2,735	2,239	2,387	3,082
On-Site or In-Plant Training - Total jobs - None (jobs)		8,039	7,274	7,902	6,507	6,318	7,801
On-Site or In-Plant Training - Total jobs - Over 10 years (jobs)		339	311	356	297	311	408
On-Site or In-Plant Training - Total jobs - Up to 1 year (jobs)		31,286	28,372	30,667	25,141	24,105	29,178
On-the-Job Training - All sectors - 1 to 4 years (jobs)		9,249	8,361	9,249	7,644	7,771	9,842
On-the-Job Training - All sectors - 4 to 10 years (jobs)		2,470	2,197	2,489	2,051	2,247	2,972
On-the-Job Training - All sectors - None (jobs)		2,964	2,658	2,793	2,262	2,152	2,575
On-the-Job Training - All sectors - Over 10 years (jobs)		483	451	494	408	389	472
On-the-Job Training - All sectors - Up to 1 year (jobs)		34,677	31,471	34,038	27,928	26,698	32,297
Related work experience - All sectors - 1 to 4 years (jobs)		18,227	16,425	17,727	14,543	14,190	17,296
Related work experience - All sectors - 4 to 10 years (jobs)		11,239	10,123	10,964	9,012	8,946	11,109
Related work experience - All sectors - None (jobs)		7,088	6,441	7,073	5,797	5,666	6,961
Related work experience - All sectors - Over 10 years (jobs)		3,122	2,839	3,060	2,525	2,451	3,007
Related work experience - All sectors - Up to 1 year (jobs)		10,168	9,310	10,238	8,416	8,004	9,785
Wage income - All (million \$2019)		3,018	2,747	3,007	2,496	2,499	3,126

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)		2,165	2,363				
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 (%)	6.09	3.87	4.9	7.61	14.7	26.5	37
Sales of space heating units - Electric Resistance (%)	9.99	5.53	5.63	6.05	7.05	8.18	8.82
Sales of space heating units - Fossil (%)	9.8	2.84	2.83	2.55	2.12	1.71	1.57
Sales of space heating units - Gas Furnace (%)	74.1	87.8	86.6	83.8	76.1	63.6	52.6
Sales of water heating units - Electric Heat Pump (%)	1.62	0.913	1.44	2.92	6.86	13.4	19.4
Sales of water heating units - Electric Resistance (%)	13.6	7.24	7.77	9.19	13.1	19.6	25.5
Sales of water heating units - Gas Furnace (%)	82.1	90.8	89.8	86.9	79.2	66.1	54.3
Sales of water heating units - Other (%)	2.67	1.01	0.99	0.955	0.899	0.868	0.856

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)		0.635	0.643	0.813	0.84	1.28	1.36

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

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Commercial (PJ)	25.2	24.8	24.2	23.7	23.1	22.6	22.2
Final energy use - Industry (PJ)	124	130	132	133	133	134	134
Final energy use - Residential (PJ)	38.3	36.3	34.8	33.5	32.4	31.2	29.7
Final energy use - Transportation (PJ)	104	98.2	91.1	85.7	81.6	76.8	71

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)		0.511	0.578				
Sales of cooking units - Electric Resistance (%)	80.2	80.7	82.5	87.3	93.9	98	99.5
Sales of cooking units - Gas (%)	19.8	19.3	17.5	12.7	6.06	1.96	0.527
Sales of space heating units - Electric Heat Pump (%)	8.4	11.6	12.7	15.6	22.9	33.8	43
Sales of space heating units - Electric Resistance (%)	28.4	34.3	33.8	33	30.5	26.9	23.9
Sales of space heating units - Fossil (%)	13.7	19	18.9	18	16.1	13.6	12
Sales of space heating units - Gas (%)	49.5	35.1	34.6	33.4	30.5	25.7	21.2
Sales of water heating units - Electric Heat Pump (%)	0	0.054	0.328	1.13	3.24	6.62	9.51
Sales of water heating units - Electric Resistance (%)	52.4	66.9	67	67.1	67.8	69.2	70.5
Sales of water heating units - Gas Furnace (%)	47.6	33	32.6	31.8	29	24.2	19.9
Sales of water heating units - Other (%)	0.036	0.035	0.035	0.035	0.035	0.035	0.035

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	27.7	58.9	198	626	911
Public EV charging plugs - DC Fast (1000 units)	0.024		0.106		0.58		1.63
Public EV charging plugs - L2 (1000 units)	0.043		2.55		14		39.2
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 (%)	1.96	2.3	2.13	1.72	1.14	0.593	0.252
Vehicle sales - Light-duty - EV (%)	1.41	3.65	9.65	22.3	44.4	69.4	86.5
Vehicle sales - Light-duty - gasoline (%)	93.2	89.4	83.1	71.2	50.7	27.7	12.1
Vehicle sales - Light-duty - hybrid (%)	3.19	4.09	4.66	4.44	3.53	2.2	1.11
Vehicle sales - Light-duty - hydrogen FC (%)	0.114	0.392	0.35	0.276	0.203	0.115	0.053
Vehicle sales - Light-duty - other (%)	0.121	0.124	0.116	0.102	0.075	0.042	0.019
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)							-551
Carbon sink potential - Aggressive deployment - Cropland measures (1000 tCO2e/y)							-10,108
Carbon sink potential - Aggressive deployment - Permanent conservation cover (1000 tCO2e/y)							-660
Carbon sink potential - Aggressive deployment - Total (1000 tCO2e/y)							-11,319
Carbon sink potential - Moderate deployment - Corn-ethanol to energy grasses (1000 tCO2e/y)							-551
Carbon sink potential - Moderate deployment - Cropland measures (1000 tCO2e/y)							-5,330
Carbon sink potential - Moderate deployment - Permanent conservation cover (1000 tCO2e/y)							-330
Carbon sink potential - Moderate deployment - Total (1000 tCO2e/y)							-6,211
Land impacted for carbon sink - Aggressive deployment - Corn-ethanol to energy grasses (1000 hectares)							300
Land impacted for carbon sink - Aggressive deployment - Cropland measures (1000 hectares)							9,928
Land impacted for carbon sink - Aggressive deployment - Permanent conservation cover (1000 hectares)							1,092

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)							11,320
Land impacted for carbon sink - Moderate deployment - Corn-ethanol to energy grasses (1000 hectares)							300
Land impacted for carbon sink - Moderate deployment - Cropland measures (1000 hectares)							5,237
Land impacted for carbon sink - Moderate deployment - Permanent conservation cover (1000 hectares)							546
Land impacted for carbon sink - Moderate deployment - Total (1000 hectares)							6,083

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)							-38.5
Carbon sink potential - High - All (not counting overlap) (1000 tCO <sub>2</sub> e/y)							-23,528
Carbon sink potential - High - Avoid deforestation (1000 tCO <sub>2</sub> e/y)							-821
Carbon sink potential - High - Extend rotation length (1000 tCO <sub>2</sub> e/y)							-414
Carbon sink potential - High - Improve plantations (1000 tCO <sub>2</sub> e/y)							-20.6
Carbon sink potential - High - Increase retention of HWP (1000 tCO <sub>2</sub> e/y)							-41.5
Carbon sink potential - High - Increase trees outside forests (1000 tCO <sub>2</sub> e/y)							-3,342
Carbon sink potential - High - Reforest cropland (1000 tCO <sub>2</sub> e/y)							-13,386
Carbon sink potential - High - Reforest pasture (1000 tCO <sub>2</sub> e/y)							-5,274
Carbon sink potential - High - Restore productivity (1000 tCO <sub>2</sub> e/y)							-191
Carbon sink potential - Low - Accelerate regeneration (1000 tCO <sub>2</sub> e/y)							-19.3
Carbon sink potential - Low - All (not counting overlap) (1000 tCO <sub>2</sub> e/y)							-8,666
Carbon sink potential - Low - Avoid deforestation (1000 tCO <sub>2</sub> e/y)							-137
Carbon sink potential - Low - Extend rotation length (1000 tCO <sub>2</sub> e/y)							-159
Carbon sink potential - Low - Improve plantations (1000 tCO <sub>2</sub> e/y)							-10.5
Carbon sink potential - Low - Increase retention of HWP (1000 tCO <sub>2</sub> e/y)							-13.8
Carbon sink potential - Low - Increase trees outside forests (1000 tCO <sub>2</sub> e/y)							-1,170
Carbon sink potential - Low - Reforest cropland (1000 tCO <sub>2</sub> e/y)							-6,693
Carbon sink potential - Low - Reforest pasture (1000 tCO <sub>2</sub> e/y)							-400
Carbon sink potential - Low - Restore productivity (1000 tCO <sub>2</sub> e/y)							-64.3
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO <sub>2</sub> e/y)							-28.9

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)							-16,097
Carbon sink potential - Mid - Avoid deforestation (1000 tCO <sub>2</sub> e/y)							-479
Carbon sink potential - Mid - Extend rotation length (1000 tCO <sub>2</sub> e/y)							-286
Carbon sink potential - Mid - Improve plantations (1000 tCO <sub>2</sub> e/y)							-15.4
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO <sub>2</sub> e/y)							-27.6
Carbon sink potential - Mid - Increase trees outside forests (1000 tCO <sub>2</sub> e/y)							-2,256
Carbon sink potential - Mid - Reforest cropland (1000 tCO <sub>2</sub> e/y)							-10,039
Carbon sink potential - Mid - Reforest pasture (1000 tCO <sub>2</sub> e/y)							-2,837
Carbon sink potential - Mid - Restore productivity (1000 tCO <sub>2</sub> e/y)							-127
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)							6.3
Land impacted for carbon sink potential - High - Avoid deforestation (over 30 years) (1000 hectares)							111
Land impacted for carbon sink potential - High - Extend rotation length (1000 hectares)							211
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)							7.59
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)							317
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)							885
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)							150
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)							63.2
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)							1,752
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)							3.15
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)							104
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)							80.8
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)							3.79
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)							167
Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares)							443
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)							26
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)							38.2
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)							866
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)							4.72
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)							108
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)							146
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)							5.71
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)							242
Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares)							664
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)							188
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)							77
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)							1,435

Table 24: E- scenario - IMPACTS - Health

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal (million 2019\$)		24.9	0.018	0.017	0.013	0.008	0
Monetary damages from air pollution - Natural Gas (million 2019\$)		6.06	2.98	1.58	0.901	0.439	0.301
Monetary damages from air pollution - Transportation (million 2019\$)		24.6	24.4	23.4	20.8	16.4	11.1
Premature deaths from air pollution - Coal (deaths)		2.82	0.002	0.002	0.001	0.001	0
Premature deaths from air pollution - Natural Gas (deaths)		0.684	0.337	0.178	0.102	0.05	0.034
Premature deaths from air pollution - Transportation (deaths)		2.77	2.75	2.63	2.34	1.84	1.25



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)		2,165	2,361				
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 (%)	6.09	4.46	15.5	53	81.8	86.3	86.7
Sales of space heating units - Electric Resistance (%)	9.99	5.81	8.04	12	12.9	12.9	12.9
Sales of space heating units - Fossil (%)	9.8	2.42	0.475	0.02	0	0	0
Sales of space heating units - Gas Furnace (%)	74.1	87.3	76	35	5.3	0.843	0.483
Sales of water heating units - Electric Heat Pump (%)	1.62	1.17	6.88	27.5	44	46.5	46.7
Sales of water heating units - Electric Resistance (%)	13.6	7.49	13.1	33.4	49.8	52.4	52.6
Sales of water heating units - Gas Furnace (%)	82.1	90.4	79.3	38.4	5.51	0.416	0
Sales of water heating units - Other (%)	2.67	0.964	0.742	0.696	0.692	0.695	0.695

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)		0.777	0.801	1.5	1.61	1.57	1.66

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

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Commercial (PJ)	25.2	24.8	24	22.9	21.6	20.3	19.5
Final energy use - Industry (PJ)	124	130	131	130	129	129	130
Final energy use - Residential (PJ)	38.3	36.3	34.5	31.9	28.4	25	22.3
Final energy use - Transportation (PJ)	104	97.6	88.2	76.6	66	59.6	57.2

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)		0.514	0.598				
Sales of cooking units - Electric Resistance (%)	80.2	84.4	97.3	99.9	100	100	100
Sales of cooking units - Gas (%)	19.8	15.6	2.66	0.134	0	0	0
Sales of space heating units - Electric Heat Pump (%)	8.4	12.9	25.9	58.5	84	88	87.9
Sales of space heating units - Electric Resistance (%)	28.4	34.1	30.9	19.4	10.1	8.76	8.9
Sales of space heating units - Fossil (%)	13.7	18.3	14.3	8.01	3.29	2.43	2.5
Sales of space heating units - Gas (%)	49.5	34.6	28.9	14.1	2.65	0.854	0.684
Sales of water heating units - Electric Heat Pump (%)	0	0.203	3.49	14.3	21.9	23	23.1
Sales of water heating units - Electric Resistance (%)	52.4	66.9	67.7	71.6	76.1	76.8	76.8
Sales of water heating units - Gas Furnace (%)	47.6	32.8	28.8	14	2.01	0.152	0
Sales of water heating units - Other (%)	0.036	0.035	0.035	0.035	0.035	0.035	0.035

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)		173	442	719	1,088	1,186	1,130
Public EV charging plugs - DC Fast (1000 units)	0.024		0.353		1.57		2.54
Public EV charging plugs - L2 (1000 units)	0.043		8.49		37.8		61.2
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 (%)	1.96	2.17	1.42	0.461	0.082	0.013	0
Vehicle sales - Light-duty - EV (%)	2.56	11.1	39.9	79.2	96	99.3	100
Vehicle sales - Light-duty - gasoline (%)	92.2	82.7	55.6	19.2	3.64	0.601	0
Vehicle sales - Light-duty - hybrid (%)	3.1	3.59	2.75	1.07	0.251	0.052	0
Vehicle sales - Light-duty - hydrogen FC (%)	0.113	0.363	0.237	0.075	0.015	0.002	0
Vehicle sales - Light-duty - other (%)	0.12	0.116	0.081	0.029	0.005	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 - Wind - Base (billion \$2018)		0	0	0.709	3.37	14.5	34.2
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 - Solar - Base land use assumptions (MW)	0	0	0	0	0	0	0
Installed renewables - Solar - Constrained land use assumptions (MW)	0	0	0	0	0	0	0
Installed renewables - Wind - Base land use assumptions (MW)	4,732	4,732	4,732	5,303	8,154	21,114	53,385
Installed renewables - Wind - Constrained land use assumptions (MW)	9,463	9,463	12,337	22,217	73,658	278,472	365,562

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)	0	0	0	0	0	0	0
Solar - Constrained land use assumptions (GWh)	0	0	0	0	0	0	0
Wind - Base land use assumptions (GWh)	19,216	19,216	19,216	21,195	31,306	76,704	185,837
Wind - Constrained land use assumptions (GWh)	38,431	38,431	48,634	83,200	259,155	921,913	1,175,106

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)							-551
Carbon sink potential - Aggressive deployment - Cropland measures (1000 tCO <sub>2</sub> e/y)							-10,108
Carbon sink potential - Aggressive deployment - Permanent conservation cover (1000 tCO <sub>2</sub> e/y)							-660
Carbon sink potential - Aggressive deployment - Total (1000 tCO <sub>2</sub> e/y)							-11,319
Carbon sink potential - Moderate deployment - Corn-ethanol to energy grasses (1000 tCO <sub>2</sub> e/y)							-551
Carbon sink potential - Moderate deployment - Cropland measures (1000 tCO <sub>2</sub> e/y)							-5,330
Carbon sink potential - Moderate deployment - Permanent conservation cover (1000 tCO <sub>2</sub> e/y)							-330
Carbon sink potential - Moderate deployment - Total (1000 tCO <sub>2</sub> e/y)							-6,211
Land impacted for carbon sink - Aggressive deployment - Corn-ethanol to energy grasses (1000 hectares)							300
Land impacted for carbon sink - Aggressive deployment - Cropland measures (1000 hectares)							9,928
Land impacted for carbon sink - Aggressive deployment - Permanent conservation cover (1000 hectares)							1,092
Land impacted for carbon sink - Aggressive deployment - Total (1000 hectares)							11,320
Land impacted for carbon sink - Moderate deployment - Corn-ethanol to energy grasses (1000 hectares)							300
Land impacted for carbon sink - Moderate deployment - Cropland measures (1000 hectares)							5,237
Land impacted for carbon sink - Moderate deployment - Permanent conservation cover (1000 hectares)							546
Land impacted for carbon sink - Moderate deployment - Total (1000 hectares)							6,083

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)							-38.5
Carbon sink potential - High - All (not counting overlap) (1000 tCO <sub>2</sub> e/y)							-23,528
Carbon sink potential - High - Avoid deforestation (1000 tCO <sub>2</sub> e/y)							-821
Carbon sink potential - High - Extend rotation length (1000 tCO <sub>2</sub> e/y)							-414
Carbon sink potential - High - Improve plantations (1000 tCO <sub>2</sub> e/y)							-20.6
Carbon sink potential - High - Increase retention of HWP (1000 tCO <sub>2</sub> e/y)							-41.5

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)							-3,342
Carbon sink potential - High - Reforest cropland (1000 tCO <sub>2</sub> e/y)							-13,386
Carbon sink potential - High - Reforest pasture (1000 tCO <sub>2</sub> e/y)							-5,274
Carbon sink potential - High - Restore productivity (1000 tCO <sub>2</sub> e/y)							-191
Carbon sink potential - Low - Accelerate regeneration (1000 tCO <sub>2</sub> e/y)							-19.3
Carbon sink potential - Low - All (not counting overlap) (1000 tCO <sub>2</sub> e/y)							-8,666
Carbon sink potential - Low - Avoid deforestation (1000 tCO <sub>2</sub> e/y)							-137
Carbon sink potential - Low - Extend rotation length (1000 tCO <sub>2</sub> e/y)							-159
Carbon sink potential - Low - Improve plantations (1000 tCO <sub>2</sub> e/y)							-10.5
Carbon sink potential - Low - Increase retention of HWP (1000 tCO <sub>2</sub> e/y)							-13.8
Carbon sink potential - Low - Increase trees outside forests (1000 tCO <sub>2</sub> e/y)							-1,170
Carbon sink potential - Low - Reforest cropland (1000 tCO <sub>2</sub> e/y)							-6,693
Carbon sink potential - Low - Reforest pasture (1000 tCO <sub>2</sub> e/y)							-400
Carbon sink potential - Low - Restore productivity (1000 tCO <sub>2</sub> e/y)							-64.3
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO <sub>2</sub> e/y)							-28.9
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO <sub>2</sub> e/y)							-16,097
Carbon sink potential - Mid - Avoid deforestation (1000 tCO <sub>2</sub> e/y)							-479
Carbon sink potential - Mid - Extend rotation length (1000 tCO <sub>2</sub> e/y)							-286
Carbon sink potential - Mid - Improve plantations (1000 tCO <sub>2</sub> e/y)							-15.4
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO <sub>2</sub> e/y)							-27.6
Carbon sink potential - Mid - Increase trees outside forests (1000 tCO <sub>2</sub> e/y)							-2,256
Carbon sink potential - Mid - Reforest cropland (1000 tCO <sub>2</sub> e/y)							-10,039
Carbon sink potential - Mid - Reforest pasture (1000 tCO <sub>2</sub> e/y)							-2,837
Carbon sink potential - Mid - Restore productivity (1000 tCO <sub>2</sub> e/y)							-127
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)							6.3
Land impacted for carbon sink potential - High - Avoid deforestation (over 30 years) (1000 hectares)							111
Land impacted for carbon sink potential - High - Extend rotation length (1000 hectares)							211
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)							7.59

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)							317
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)							885
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)							150
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)							63.2
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)							1,752
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)							3.15
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)							104
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)							80.8
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)							3.79
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)							167
Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares)							443
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)							26
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)							38.2
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)							866
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)							4.72
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)							108
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)							146
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)							5.71
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)							242

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)							664
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)							188
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)							77
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)							1,435

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

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal (million 2019\$)		24.9	0.018	0.017	0.013	0.008	0
Monetary damages from air pollution - Natural Gas (million 2019\$)		5.52	2.94	1.21	0.905	0.477	0.265
Monetary damages from air pollution - Transportation (million 2019\$)		24.3	22.3	16.7	9.47	4.22	1.6
Premature deaths from air pollution - Coal (deaths)		2.82	0.002	0.002	0.001	0.001	0
Premature deaths from air pollution - Natural Gas (deaths)		0.623	0.332	0.136	0.102	0.054	0.03
Premature deaths from air pollution - Transportation (deaths)		2.73	2.51	1.88	1.06	0.474	0.179

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)		2,165	2,361				
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 (%)	6.09	4.46	15.5	53	81.8	86.3	86.7
Sales of space heating units - Electric Resistance (%)	9.99	5.81	8.04	12	12.9	12.9	12.9
Sales of space heating units - Fossil (%)	9.8	2.42	0.475	0.02	0	0	0
Sales of space heating units - Gas Furnace (%)	74.1	87.3	76	35	5.3	0.843	0.483
Sales of water heating units - Electric Heat Pump (%)	1.62	1.17	6.88	27.5	44	46.5	46.7
Sales of water heating units - Electric Resistance (%)	13.6	7.49	13.1	33.4	49.8	52.4	52.6
Sales of water heating units - Gas Furnace (%)	82.1	90.4	79.3	38.4	5.51	0.416	0
Sales of water heating units - Other (%)	2.67	0.964	0.742	0.696	0.692	0.695	0.695

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)		0.777	0.801	1.5	1.61	1.57	1.66

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

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Commercial (PJ)	25.2	24.8	24	22.9	21.6	20.3	19.5

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

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Industry (PJ)	124	130	131	130	129	129	130
Final energy use - Residential (PJ)	38.3	36.3	34.5	31.9	28.4	25	22.3
Final energy use - Transportation (PJ)	104	97.6	88.2	76.6	66	59.6	57.2

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)		0.514	0.598				
Sales of cooking units - Electric Resistance (%)	80.2	84.4	97.3	99.9	100	100	100
Sales of cooking units - Gas (%)	19.8	15.6	2.66	0.134	0	0	0
Sales of space heating units - Electric Heat Pump (%)	8.4	12.9	25.9	58.5	84	88	87.9
Sales of space heating units - Electric Resistance (%)	28.4	34.1	30.9	19.4	10.1	8.76	8.9
Sales of space heating units - Fossil (%)	13.7	18.3	14.3	8.01	3.29	2.43	2.5
Sales of space heating units - Gas (%)	49.5	34.6	28.9	14.1	2.65	0.854	0.684
Sales of water heating units - Electric Heat Pump (%)	0	0.203	3.49	14.3	21.9	23	23.1
Sales of water heating units - Electric Resistance (%)	52.4	66.9	67.7	71.6	76.1	76.8	76.8
Sales of water heating units - Gas Furnace (%)	47.6	32.8	28.8	14	2.01	0.152	0
Sales of water heating units - Other (%)	0.036	0.035	0.035	0.035	0.035	0.035	0.035

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)		173	442	719	1,088	1,186	1,130
Public EV charging plugs - DC Fast (1000 units)	0.024		0.353		1.57		2.54
Public EV charging plugs - L2 (1000 units)	0.043		8.49		37.8		61.2
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 (%)	1.96	2.17	1.42	0.461	0.082	0.013	0
Vehicle sales - Light-duty - EV (%)	2.56	11.1	39.9	79.2	96	99.3	100
Vehicle sales - Light-duty - gasoline (%)	92.2	82.7	55.6	19.2	3.64	0.601	0
Vehicle sales - Light-duty - hybrid (%)	3.1	3.59	2.75	1.07	0.251	0.052	0
Vehicle sales - Light-duty - hydrogen FC (%)	0.113	0.363	0.237	0.075	0.015	0.002	0
Vehicle sales - Light-duty - other (%)	0.12	0.116	0.081	0.029	0.005	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 - Wind - Base (billion \$2018)		0	0	0	0.232	0.325	0
Capital invested - Wind - Constrained (billion \$2018)		0	0.248	1.04	2.61	3.33	0.033
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)	0	0	0	0	0	0	0
Installed renewables - Solar - Constrained land use assumptions (MW)	0	0	0	0	0	0	0
Installed renewables - Wind - Base land use assumptions (MW)	4,732	4,732	4,732	4,732	4,928	5,218	5,218
Installed renewables - Wind - Constrained land use assumptions (MW)	4,732	4,732	4,917	5,753	7,961	10,934	10,965

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)	0	0	0	0	0	0	0
Solar - Constrained land use assumptions (GWh)	0	0	0	0	0	0	0
Wind - Base land use assumptions (GWh)	19,216	19,216	19,216	19,216	19,895	20,908	20,908
Wind - Constrained land use assumptions (GWh)	19,216	19,216	19,875	22,824	30,646	41,008	41,114

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)							-551
Carbon sink potential - Aggressive deployment - Cropland measures (1000 tCO2e/y)							-10,108
Carbon sink potential - Aggressive deployment - Permanent conservation cover (1000 tCO2e/y)							-660
Carbon sink potential - Aggressive deployment - Total (1000 tCO2e/y)							-11,319
Carbon sink potential - Moderate deployment - Corn-ethanol to energy grasses (1000 tCO2e/y)							-551
Carbon sink potential - Moderate deployment - Cropland measures (1000 tCO2e/y)							-5,330
Carbon sink potential - Moderate deployment - Permanent conservation cover (1000 tCO2e/y)							-330
Carbon sink potential - Moderate deployment - Total (1000 tCO2e/y)							-6,211
Land impacted for carbon sink - Aggressive deployment - Corn-ethanol to energy grasses (1000 hectares)							300



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 - Cropland measures (1000 hectares)							9,928
Land impacted for carbon sink - Aggressive deployment - Permanent conservation cover (1000 hectares)							1,092
Land impacted for carbon sink - Aggressive deployment - Total (1000 hectares)							11,320
Land impacted for carbon sink - Moderate deployment - Corn-ethanol to energy grasses (1000 hectares)							300
Land impacted for carbon sink - Moderate deployment - Cropland measures (1000 hectares)							5,237
Land impacted for carbon sink - Moderate deployment - Permanent conservation cover (1000 hectares)							546
Land impacted for carbon sink - Moderate deployment - Total (1000 hectares)							6,083

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)							-38.5
Carbon sink potential - High - All (not counting overlap) (1000 tCO <sub>2</sub> e/y)							-23,528
Carbon sink potential - High - Avoid deforestation (1000 tCO <sub>2</sub> e/y)							-821
Carbon sink potential - High - Extend rotation length (1000 tCO <sub>2</sub> e/y)							-414
Carbon sink potential - High - Improve plantations (1000 tCO <sub>2</sub> e/y)							-20.6
Carbon sink potential - High - Increase retention of HWP (1000 tCO <sub>2</sub> e/y)							-41.5
Carbon sink potential - High - Increase trees outside forests (1000 tCO <sub>2</sub> e/y)							-3,342
Carbon sink potential - High - Reforest cropland (1000 tCO <sub>2</sub> e/y)							-13,386
Carbon sink potential - High - Reforest pasture (1000 tCO <sub>2</sub> e/y)							-5,274
Carbon sink potential - High - Restore productivity (1000 tCO <sub>2</sub> e/y)							-191
Carbon sink potential - Low - Accelerate regeneration (1000 tCO <sub>2</sub> e/y)							-19.3
Carbon sink potential - Low - All (not counting overlap) (1000 tCO <sub>2</sub> e/y)							-8,666
Carbon sink potential - Low - Avoid deforestation (1000 tCO <sub>2</sub> e/y)							-137
Carbon sink potential - Low - Extend rotation length (1000 tCO <sub>2</sub> e/y)							-159
Carbon sink potential - Low - Improve plantations (1000 tCO <sub>2</sub> e/y)							-10.5
Carbon sink potential - Low - Increase retention of HWP (1000 tCO <sub>2</sub> e/y)							-13.8
Carbon sink potential - Low - Increase trees outside forests (1000 tCO <sub>2</sub> e/y)							-1,170
Carbon sink potential - Low - Reforest cropland (1000 tCO <sub>2</sub> e/y)							-6,693

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

Item	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - Low - Reforest pasture (1000 tCO <sub>2</sub> e/y)							-400
Carbon sink potential - Low - Restore productivity (1000 tCO <sub>2</sub> e/y)							-64.3
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO <sub>2</sub> e/y)							-28.9
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO <sub>2</sub> e/y)							-16,097
Carbon sink potential - Mid - Avoid deforestation (1000 tCO <sub>2</sub> e/y)							-479
Carbon sink potential - Mid - Extend rotation length (1000 tCO <sub>2</sub> e/y)							-286
Carbon sink potential - Mid - Improve plantations (1000 tCO <sub>2</sub> e/y)							-15.4
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO <sub>2</sub> e/y)							-27.6
Carbon sink potential - Mid - Increase trees outside forests (1000 tCO <sub>2</sub> e/y)							-2,256
Carbon sink potential - Mid - Reforest cropland (1000 tCO <sub>2</sub> e/y)							-10,039
Carbon sink potential - Mid - Reforest pasture (1000 tCO <sub>2</sub> e/y)							-2,837
Carbon sink potential - Mid - Restore productivity (1000 tCO <sub>2</sub> e/y)							-127
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)							6.3
Land impacted for carbon sink potential - High - Avoid deforestation (over 30 years) (1000 hectares)							111
Land impacted for carbon sink potential - High - Extend rotation length (1000 hectares)							211
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)							7.59
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)							317
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)							885
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)							150
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)							63.2
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)							1,752
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)							3.15
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)							104
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)							80.8

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 - Improve plantations (1000 hectares)							3.79
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)							167
Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares)							443
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)							26
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)							38.2
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)							866
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)							4.72
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)							108
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)							146
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)							5.71
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)							242
Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares)							664
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)							188
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)							77
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)							1,435

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

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal (million 2019\$)		24.9	0.018	0.017	0.013	0.008	0
Monetary damages from air pollution - Natural Gas (million 2019\$)		6.1	3.38	3.33	3.08	1.42	0.482
Monetary damages from air pollution - Transportation (million 2019\$)		24.3	22.3	16.7	9.47	4.22	1.6
Premature deaths from air pollution - Coal (deaths)		2.82	0.002	0.002	0.001	0.001	0
Premature deaths from air pollution - Natural Gas (deaths)		0.689	0.381	0.376	0.348	0.16	0.054
Premature deaths from air pollution - Transportation (deaths)		2.73	2.51	1.88	1.06	0.474	0.179

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)		2,165	2,363				
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 (%)	6.09	3.87	4.9	7.61	14.7	26.5	37
Sales of space heating units - Electric Resistance (%)	9.99	5.53	5.63	6.05	7.05	8.18	8.82
Sales of space heating units - Fossil (%)	9.8	2.84	2.83	2.55	2.12	1.71	1.57
Sales of space heating units - Gas Furnace (%)	74.1	87.8	86.6	83.8	76.1	63.6	52.6
Sales of water heating units - Electric Heat Pump (%)	1.62	0.913	1.44	2.92	6.86	13.4	19.4
Sales of water heating units - Electric Resistance (%)	13.6	7.24	7.77	9.19	13.1	19.6	25.5
Sales of water heating units - Gas Furnace (%)	82.1	90.8	89.8	86.9	79.2	66.1	54.3
Sales of water heating units - Other (%)	2.67	1.01	0.99	0.955	0.899	0.868	0.856

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)		0.635	0.643	0.813	0.84	1.28	1.36

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

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Commercial (PJ)	25.2	24.8	24.2	23.7	23.1	22.6	22.2
Final energy use - Industry (PJ)	124	130	132	133	133	134	134
Final energy use - Residential (PJ)	38.3	36.3	34.8	33.5	32.4	31.2	29.7
Final energy use - Transportation (PJ)	104	98.2	91.1	85.7	81.6	76.8	71

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)		0.511	0.578				
Sales of cooking units - Electric Resistance (%)	80.2	80.7	82.5	87.3	93.9	98	99.5
Sales of cooking units - Gas (%)	19.8	19.3	17.5	12.7	6.06	1.96	0.527
Sales of space heating units - Electric Heat Pump (%)	8.4	11.6	12.7	15.6	22.9	33.8	43
Sales of space heating units - Electric Resistance (%)	28.4	34.3	33.8	33	30.5	26.9	23.9
Sales of space heating units - Fossil (%)	13.7	19	18.9	18	16.1	13.6	12
Sales of space heating units - Gas (%)	49.5	35.1	34.6	33.4	30.5	25.7	21.2
Sales of water heating units - Electric Heat Pump (%)	0	0.054	0.328	1.13	3.24	6.62	9.51
Sales of water heating units - Electric Resistance (%)	52.4	66.9	67	67.1	67.8	69.2	70.5
Sales of water heating units - Gas Furnace (%)	47.6	33	32.6	31.8	29	24.2	19.9
Sales of water heating units - Other (%)	0.036	0.035	0.035	0.035	0.035	0.035	0.035

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	27.7	58.9	198	626	911
Public EV charging plugs - DC Fast (1000 units)	0.024		0.106		0.58		1.63
Public EV charging plugs - L2 (1000 units)	0.043		2.55		14		39.2
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 (%)	1.96	2.3	2.13	1.72	1.14	0.593	0.252
Vehicle sales - Light-duty - EV (%)	1.41	3.65	9.65	22.3	44.4	69.4	86.5
Vehicle sales - Light-duty - gasoline (%)	93.2	89.4	83.1	71.2	50.7	27.7	12.1
Vehicle sales - Light-duty - hybrid (%)	3.19	4.09	4.66	4.44	3.53	2.2	1.11
Vehicle sales - Light-duty - hydrogen FC (%)	0.114	0.392	0.35	0.276	0.203	0.115	0.053
Vehicle sales - Light-duty - other (%)	0.121	0.124	0.116	0.102	0.075	0.042	0.019
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	0.025	0	0	0
Capital invested - Biomass w/ccu power plant (billion \$2018)	0	0	0.093	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	25.4	25.4	25.4	25.4
Biomass w/ccu power plant (GWh)	0	0	104	104	104	104	104

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

Item	2020	2025	2030	2035	2040	2045	2050
Biomass purchases (million \$2018/year)		0	7.15	1,263	1,720	2,728	2,728
Conversion capital investment - Cumulative 5-yr (million \$2018)		0	85.5	14,002	5,075	11,208	0
Number of facilities - Allam power w ccu (quantity)	0	0	0	1	1	1	1
Number of facilities - Beccs hydrogen (quantity)	0	0	0	15	19	32	32
Number of facilities - Diesel (quantity)	0	0	0	0	0	0	0
Number of facilities - Diesel ccu (quantity)	0	0	0	1	1	1	1
Number of facilities - Power (quantity)	0	0	0	0	0	0	0
Number of facilities - Power ccu (quantity)	0	0	1	1	1	1	1
Number of facilities - Pyrolysis (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 - Pyrolysis ccu (quantity)	0	0	0	1	1	1	1
Number of facilities - Sng (quantity)	0	0	0	0	0	0	0
Number of facilities - Sng ccu (quantity)	0	0	1	1	1	1	1

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

Item	2020	2025	2030	2035	2040	2045	2050
Annual - All (MMT)		0	0.11	18.1	24.6	39	39
Annual - BECCS (MMT)		0	0.11	18	24.6	39	39
Annual - Cement and lime (MMT)		0	0	0	0	0	0
Annual - NGCC (MMT)		0	0	0.02	0.02	0.01	0.01
Cumulative - All (MMT)		0	0.11	18.2	42.8	81.8	121
Cumulative - BECCS (MMT)		0	0.11	18.1	42.7	81.7	121
Cumulative - Cement and lime (MMT)		0	0	0	0	0	0
Cumulative - NGCC (MMT)		0	0	0.02	0.04	0.05	0.06

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

Item	2020	2025	2030	2035	2040	2045	2050
All (km)		0	455	2,328	2,992	3,878	3,913
Cumulative investment - All (million \$2018)		0	366	3,445	3,929	5,013	5,032
Cumulative investment - Spur (million \$2018)		0	166	1,623	2,107	3,191	3,210
Cumulative investment - Trunk (million \$2018)		0	199	1,822	1,822	1,822	1,822
Spur (km)		0	317	1,882	2,546	3,432	3,467
Trunk (km)		0	138	446	446	446	446

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

Item	2020	2025	2030	2035	2040	2045	2050
CO2 storage (MMT)		0	4.62	20.3	40.4	56.1	58.5
Injection wells (wells)		0	10	38	68	113	141
Resource characterization, appraisal, permitting costs (million \$2020)		135	623	975	975	975	975
Wells and facilities construction costs (million \$2020)		0	293	1,142	2,035	3,403	4,225

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)							-1,265
Carbon sink potential - Aggressive deployment - Cropland measures (1000 tCO2e/y)							-9,446
Carbon sink potential - Aggressive deployment - Cropland to woody energy crops (1000 tCO2e/y)							0
Carbon sink potential - Aggressive deployment - Pasture to energy crops (1000 tCO2e/y)							0
Carbon sink potential - Aggressive deployment - Permanent conservation cover (1000 tCO2e/y)							-619
Carbon sink potential - Aggressive deployment - Total (1000 tCO2e/y)							-11,329

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

Item	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - Moderate deployment - Corn-ethanol to energy grasses (1000 tCO2e/y)							-1,265
Carbon sink potential - Moderate deployment - Cropland measures (1000 tCO2e/y)							-4,981
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)							-309
Carbon sink potential - Moderate deployment - Total (1000 tCO2e/y)							-6,555
Land impacted for carbon sink - Aggressive deployment - Corn-ethanol to energy grasses (1000 hectares)							925
Land impacted for carbon sink - Aggressive deployment - Cropland measures (1000 hectares)							22,983
Land impacted for carbon sink - Aggressive deployment - Cropland to woody energy crops (1000 hectares)							63.5
Land impacted for carbon sink - Aggressive deployment - Pasture to energy crops (1000 hectares)							0
Land impacted for carbon sink - Aggressive deployment - Permanent conservation cover (1000 hectares)							1,024
Land impacted for carbon sink - Aggressive deployment - Total (1000 hectares)							24,995
Land impacted for carbon sink - Moderate deployment - Corn-ethanol to energy grasses (1000 hectares)							925
Land impacted for carbon sink - Moderate deployment - Cropland measures (1000 hectares)							4,910
Land impacted for carbon sink - Moderate deployment - Cropland to woody energy crops (1000 hectares)							63.5
Land impacted for carbon sink - Moderate deployment - Pasture to energy crops (1000 hectares)							0
Land impacted for carbon sink - Moderate deployment - Permanent conservation cover (1000 hectares)							512
Land impacted for carbon sink - Moderate deployment - Total (1000 hectares)							6,411

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 tCO2e/y)							-38.5
Carbon sink potential - High - All (not counting overlap) (1000 tCO2e/y)							-23,528
Carbon sink potential - High - Avoid deforestation (1000 tCO2e/y)							-821

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

Item	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - High - Extend rotation length (1000 tCO <sub>2</sub> e/y)							-414
Carbon sink potential - High - Improve plantations (1000 tCO <sub>2</sub> e/y)							-20.6
Carbon sink potential - High - Increase retention of HWP (1000 tCO <sub>2</sub> e/y)							-41.5
Carbon sink potential - High - Increase trees outside forests (1000 tCO <sub>2</sub> e/y)							-3,342
Carbon sink potential - High - Reforest cropland (1000 tCO <sub>2</sub> e/y)							-13,386
Carbon sink potential - High - Reforest pasture (1000 tCO <sub>2</sub> e/y)							-5,274
Carbon sink potential - High - Restore productivity (1000 tCO <sub>2</sub> e/y)							-191
Carbon sink potential - Low - Accelerate regeneration (1000 tCO <sub>2</sub> e/y)							-19.3
Carbon sink potential - Low - All (not counting overlap) (1000 tCO <sub>2</sub> e/y)							-8,666
Carbon sink potential - Low - Avoid deforestation (1000 tCO <sub>2</sub> e/y)							-137
Carbon sink potential - Low - Extend rotation length (1000 tCO <sub>2</sub> e/y)							-159
Carbon sink potential - Low - Improve plantations (1000 tCO <sub>2</sub> e/y)							-10.5
Carbon sink potential - Low - Increase retention of HWP (1000 tCO <sub>2</sub> e/y)							-13.8
Carbon sink potential - Low - Increase trees outside forests (1000 tCO <sub>2</sub> e/y)							-1,170
Carbon sink potential - Low - Reforest cropland (1000 tCO <sub>2</sub> e/y)							-6,693
Carbon sink potential - Low - Reforest pasture (1000 tCO <sub>2</sub> e/y)							-400
Carbon sink potential - Low - Restore productivity (1000 tCO <sub>2</sub> e/y)							-64.3
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO <sub>2</sub> e/y)							-28.9
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO <sub>2</sub> e/y)							-16,097
Carbon sink potential - Mid - Avoid deforestation (1000 tCO <sub>2</sub> e/y)							-479
Carbon sink potential - Mid - Extend rotation length (1000 tCO <sub>2</sub> e/y)							-286
Carbon sink potential - Mid - Improve plantations (1000 tCO <sub>2</sub> e/y)							-15.4
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO <sub>2</sub> e/y)							-27.6
Carbon sink potential - Mid - Increase trees outside forests (1000 tCO <sub>2</sub> e/y)							-2,256
Carbon sink potential - Mid - Reforest cropland (1000 tCO <sub>2</sub> e/y)							-10,039
Carbon sink potential - Mid - Reforest pasture (1000 tCO <sub>2</sub> e/y)							-2,837
Carbon sink potential - Mid - Restore productivity (1000 tCO <sub>2</sub> e/y)							-127
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)							6.3
Land impacted for carbon sink potential - High - Avoid deforestation (over 30 years) (1000 hectares)							111



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 - Extend rotation length (1000 hectares)							211
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)							7.59
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)							317
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)							885
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)							150
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)							63.2
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)							1,752
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)							3.15
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)							104
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)							80.8
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)							3.79
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)							167
Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares)							443
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)							26
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)							38.2
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)							866
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)							4.72
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)							108
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)							146
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)							5.71

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 - Increase retention of HWP (1000 hectares)							0
Land impacted for carbon sink potential - Mid - Increase trees outside forests (1000 hectares)							242
Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares)							664
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)							188
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)							77
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)							1,435

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

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal (million 2019\$)		24.9	0.018	0.017	0.013	0.008	0
Monetary damages from air pollution - Natural Gas (million 2019\$)		5.8	2.74	1.77	1.3	0.704	0.304
Monetary damages from air pollution - Transportation (million 2019\$)		24.6	24.4	23.4	20.8	16.4	11.1
Premature deaths from air pollution - Coal (deaths)		2.82	0.002	0.002	0.001	0.001	0
Premature deaths from air pollution - Natural Gas (deaths)		0.654	0.309	0.2	0.147	0.079	0.034
Premature deaths from air pollution - Transportation (deaths)		2.77	2.75	2.63	2.34	1.84	1.25

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)		2,141	2,215				
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 (%)	6.09	9.24	32.5	59.3	67.6	69.1	69.4
Sales of space heating units - Electric Resistance (%)	9.99	6.97	13.8	23.6	29.3	30.1	30.1
Sales of space heating units - Fossil (%)	9.8	2.76	2.28	1.06	0.17	0.016	0
Sales of space heating units - Gas Furnace (%)	74.1	81	51.4	16	2.93	0.762	0.485
Sales of water heating units - Electric Heat Pump (%)	1.62	0.827	0.827	0.829	0.828	0.824	0.82
Sales of water heating units - Electric Resistance (%)	13.6	7.16	7.17	7.13	7.14	7.14	7.13
Sales of water heating units - Gas Furnace (%)	82.1	91	91	91	91	91	91
Sales of water heating units - Other (%)	2.67	1.01	1.01	1.01	1	1.01	1.01

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)		0.725	0.744	0.892	0.926	0.943	0.974

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

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Commercial (PJ)	25.2	25.4	25.5	25.4	25.2	25.4	26
Final energy use - Industry (PJ)	124	133	138	143	148	154	160
Final energy use - Residential (PJ)	38.3	36.6	35.5	34.8	34.5	34.4	34.4
Final energy use - Transportation (PJ)	104	98.2	91.8	88.1	88.4	90.8	94

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)		0.501	0.505				
Sales of cooking units - Electric Resistance (%)	80	80	80	80	80	80	80
Sales of cooking units - Gas (%)	20	20	20	20	20	20	20
Sales of space heating units - Electric Heat Pump (%)	8.16	12.8	12.9	13.2	13.6	14.2	14.8
Sales of space heating units - Electric Resistance (%)	28.5	33.8	33.6	33.4	32.8	32.4	31.9
Sales of space heating units - Fossil (%)	13.8	18.3	17.1	16.2	15.9	15.6	15.8
Sales of space heating units - Gas (%)	49.6	35.1	36.3	37.2	37.7	37.8	37.6
Sales of water heating units - Electric Heat Pump (%)	0	0	0	0	0	0	0
Sales of water heating units - Electric Resistance (%)	52.4	66.9	66.9	66.7	66.7	66.6	66.5
Sales of water heating units - Gas Furnace (%)	47.6	33.1	33.1	33.3	33.3	33.4	33.4
Sales of water heating units - Other (%)	0.036	0.035	0.035	0.035	0.035	0.035	0.035

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 (%)	1.96	2.31	2.26	2.09	1.9	1.78	1.69
Vehicle sales - Light-duty - EV (%)	2.22	3.88	4.45	5.36	6.61	7.88	8.97
Vehicle sales - Light-duty - gasoline (%)	92.5	89.3	87.8	86.5	84.8	82.9	81.2
Vehicle sales - Light-duty - hybrid (%)	3.11	4.04	4.96	5.55	6.2	6.95	7.69
Vehicle sales - Light-duty - hydrogen FC (%)	0.113	0.391	0.37	0.335	0.337	0.341	0.353
Vehicle sales - Light-duty - other (%)	0.12	0.124	0.122	0.123	0.124	0.123	0.127
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
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 tCO <sub>2</sub> e/y)							-38.5
Carbon sink potential - High - All (not counting overlap) (1000 tCO <sub>2</sub> e/y)							-23,528
Carbon sink potential - High - Avoid deforestation (1000 tCO <sub>2</sub> e/y)							-821
Carbon sink potential - High - Extend rotation length (1000 tCO <sub>2</sub> e/y)							-414
Carbon sink potential - High - Improve plantations (1000 tCO <sub>2</sub> e/y)							-20.6
Carbon sink potential - High - Increase retention of HWP (1000 tCO <sub>2</sub> e/y)							-41.5
Carbon sink potential - High - Increase trees outside forests (1000 tCO <sub>2</sub> e/y)							-3,342
Carbon sink potential - High - Reforest cropland (1000 tCO <sub>2</sub> e/y)							-13,386
Carbon sink potential - High - Reforest pasture (1000 tCO <sub>2</sub> e/y)							-5,274
Carbon sink potential - High - Restore productivity (1000 tCO <sub>2</sub> e/y)							-191
Carbon sink potential - Low - Accelerate regeneration (1000 tCO <sub>2</sub> e/y)							-19.3
Carbon sink potential - Low - All (not counting overlap) (1000 tCO <sub>2</sub> e/y)							-8,666
Carbon sink potential - Low - Avoid deforestation (1000 tCO <sub>2</sub> e/y)							-137
Carbon sink potential - Low - Extend rotation length (1000 tCO <sub>2</sub> e/y)							-159
Carbon sink potential - Low - Improve plantations (1000 tCO <sub>2</sub> e/y)							-10.5
Carbon sink potential - Low - Increase retention of HWP (1000 tCO <sub>2</sub> e/y)							-13.8
Carbon sink potential - Low - Increase trees outside forests (1000 tCO <sub>2</sub> e/y)							-1,170
Carbon sink potential - Low - Reforest cropland (1000 tCO <sub>2</sub> e/y)							-6,693
Carbon sink potential - Low - Reforest pasture (1000 tCO <sub>2</sub> e/y)							-400
Carbon sink potential - Low - Restore productivity (1000 tCO <sub>2</sub> e/y)							-64.3
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO <sub>2</sub> e/y)							-28.9
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO <sub>2</sub> e/y)							-16,097
Carbon sink potential - Mid - Avoid deforestation (1000 tCO <sub>2</sub> e/y)							-479
Carbon sink potential - Mid - Extend rotation length (1000 tCO <sub>2</sub> e/y)							-286
Carbon sink potential - Mid - Improve plantations (1000 tCO <sub>2</sub> e/y)							-15.4
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO <sub>2</sub> e/y)							-27.6
Carbon sink potential - Mid - Increase trees outside forests (1000 tCO <sub>2</sub> e/y)							-2,256
Carbon sink potential - Mid - Reforest cropland (1000 tCO <sub>2</sub> e/y)							-10,039
Carbon sink potential - Mid - Reforest pasture (1000 tCO <sub>2</sub> e/y)							-2,837
Carbon sink potential - Mid - Restore productivity (1000 tCO <sub>2</sub> e/y)							-127

Table 64: REF 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)							6.3
Land impacted for carbon sink potential - High - Avoid deforestation (over 30 years) (1000 hectares)							111
Land impacted for carbon sink potential - High - Extend rotation length (1000 hectares)							211
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)							7.59
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)							317
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)							885
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)							150
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)							63.2
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)							1,752
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)							3.15
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)							104
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)							80.8
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)							3.79
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)							167
Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares)							443
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)							26
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)							38.2
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)							866
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)							4.72

Table 64: REF 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)							108
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)							146
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)							5.71
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)							242
Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares)							664
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)							188
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)							77
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)							1,435

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 CO2e/y)	-1.19		0.158				0.045
Business-as-usual carbon sink - Retained in Hardwood Products (Mt CO2e/y)	-0.011		-0.023				-0.025
Business-as-usual carbon sink - Total (Mt CO2e/y)	-1.2		0.135				0.021

Table 66: REF scenario - IMPACTS - Health

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal (million 2019\$)		77.4	35.6	21.7	17.1	14.9	14.2
Monetary damages from air pollution - Natural Gas (million 2019\$)		6.77	6.14	6.34	4.48	3.82	3.17
Monetary damages from air pollution - Transportation (million 2019\$)		24.6	24.8	25	25.3	25.7	26.1
Premature deaths from air pollution - Coal (deaths)		8.74	4.02	2.45	1.93	1.68	1.61
Premature deaths from air pollution - Natural Gas (deaths)		0.764	0.693	0.716	0.506	0.431	0.358
Premature deaths from air pollution - Transportation (deaths)		2.77	2.79	2.81	2.85	2.89	2.93