



# Net-Zero America - texas 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)		92,591	107,907				
Sales of cooking units - Electric Resistance (%)	30.1	44.4	79.2	86.1	86.5	86.4	86.5
Sales of cooking units - Gas (%)	69.9	55.6	20.8	13.9	13.5	13.6	13.5
Sales of space heating units - Electric Heat Pump (%)	6.39	26.3	76.9	91.1	92.2	92.2	92.2
Sales of space heating units - Electric Resistance (%)	5.23	4.51	4.79	6.09	6.39	6.41	6.42
Sales of space heating units - Fossil (%)	0	0	0	0	0	0	0
Sales of space heating units - Gas Furnace (%)	88.4	69.2	18.3	2.84	1.39	1.35	1.34
Sales of water heating units - Electric Heat Pump (%)	0.154	10.7	56.3	66.5	66.9	66.9	66.9
Sales of water heating units - Electric Resistance (%)	4.33	8.13	26.9	31.1	31.3	31.3	31.3
Sales of water heating units - Gas Furnace (%)	93.4	79.3	15	0.631	0	0	0
Sales of water heating units - Other (%)	2.08	1.83	1.82	1.82	1.83	1.83	1.83

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)		22.7	23.6	38.5	41	31.3	32.4

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

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Commercial (PJ)	700	703	680	646	618	611	621
Final energy use - Industry (PJ)	3,891	4,374	4,672	4,814	4,969	5,063	5,241
Final energy use - Residential (PJ)	833	805	759	696	642	616	611
Final energy use - Transportation (PJ)	2,702	2,603	2,334	2,008	1,714	1,533	1,453

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)		22.2	28.7				
Sales of cooking units - Electric Resistance (%)	63.8	71.5	95.1	99.8	100	100	100
Sales of cooking units - Gas (%)	36.2	28.5	4.87	0.245	0	0	0
Sales of space heating units - Electric Heat Pump (%)	14.3	29.1	74.6	84.7	85.2	85	85
Sales of space heating units - Electric Resistance (%)	43.4	42.6	17.9	12.3	12.1	12.4	12.4
Sales of space heating units - Fossil (%)	3.05	4.67	2.39	1.88	1.84	1.81	1.8
Sales of space heating units - Gas (%)	39.3	23.7	5.17	1.03	0.847	0.825	0.821
Sales of water heating units - Electric Heat Pump (%)	0	11.9	63.1	74.6	75.1	75.1	75.1
Sales of water heating units - Electric Resistance (%)	53.8	58.4	30.1	23.6	23.3	23.4	23.4
Sales of water heating units - Gas Furnace (%)	44.2	28	5.25	0.218	0	0	0
Sales of water heating units - Other (%)	2.01	1.61	1.59	1.56	1.56	1.57	1.57

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)		4,242	10,921	17,620	26,721	29,049	27,715
Public EV charging plugs - DC Fast (1000 units)	0.675		7.03		30.3		48.9
Public EV charging plugs - L2 (1000 units)	3.14		169		728		1,176
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 (%)	1.67	1.92	1.31	0.419	0.077	0.013	0
Vehicle sales - Light-duty - EV (%)	3.51	13.9	44.6	81	96.2	99.3	100
Vehicle sales - Light-duty - gasoline (%)	90.6	79.4	50.8	17.3	3.39	0.593	0
Vehicle sales - Light-duty - hybrid (%)	4.03	4.25	3.08	1.16	0.279	0.06	0
Vehicle sales - Light-duty - hydrogen FC (%)	0.111	0.347	0.213	0.067	0.013	0.002	0
Vehicle sales - Light-duty - other (%)	0.107	0.103	0.069	0.024	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	0.002	0.136	0	0.009	0	0
Capital invested - Biomass w/ccu allam power plant (billion \$2018)	0	0	0	0.027	0.002	0.015	0.031
Capital invested - Biomass w/ccu power plant (billion \$2018)	0	0	6.41	0	0	0.016	0.258
Capital invested - Offshore Wind - Base (billion \$2018)		0.216	0.126	0.189	0	0.05	10.9
Capital invested - Solar PV - Base (billion \$2018)		22.9	24.1	28.4	28.6	26.9	31.8
Capital invested - Solar PV - Constrained (billion \$2018)		51.1	28.6	29.6	27.3	30.1	37.5
Capital invested - Wind - Base (billion \$2018)		16.8	30.2	28.5	42.1	28.2	20.3
Capital invested - Wind - Constrained (billion \$2018)		29	40.5	35.5	44	29.7	19.1
Installed renewables - OffshoreWind - Base land use assumptions (MW)	0	76.2	129	221	221	255	8,930
Installed renewables - OffshoreWind - Constrained land use assumptions (MW)	0	76.2	129	221	221	255	8,930
Installed renewables - Rooftop PV (MW)	609	1,096	1,822	2,940	4,591	6,804	9,761
Installed renewables - Solar - Base land use assumptions (MW)	8,490	28,490	52,086	82,212	114,417	146,567	186,789
Installed renewables - Solar - Constrained land use assumptions (MW)	8,389	40,880	68,700	98,233	123,619	161,194	207,240
Installed renewables - Wind - Base land use assumptions (MW)	37,952	49,364	72,059	95,027	130,660	155,833	174,995
Installed renewables - Wind - Constrained land use assumptions (MW)	37,952	50,913	82,251	108,688	145,229	171,245	189,110

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

Item	2020	2025	2030	2035	2040	2045	2050
Biomass power plant (GWh)	0	4.22	271	271	290	290	290
Biomass w/ccu allam power plant (GWh)	0	0	0	26.8	28.5	43.7	74.8
Biomass w/ccu power plant (GWh)	0	0	7,189	7,189	7,189	7,207	7,496
OffshoreWind - Base land use assumptions (GWh)	0	301	508	871	871	1,004	33,643
OffshoreWind - Constrained land use assumptions (GWh)	0	301	508	871	871	1,004	33,643
Solar - Base land use assumptions (GWh)	18,855	60,468	108,964	168,900	231,062	292,119	369,496
Solar - Constrained land use assumptions (GWh)	18,650	84,307	136,045	191,587	239,205	309,500	393,736
Wind - Base land use assumptions (GWh)	149,083	192,289	274,698	356,368	482,279	570,294	634,757
Wind - Constrained land use assumptions (GWh)	149,083	195,933	296,153	383,373	504,669	590,257	648,515

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

Item	2020	2025	2030	2035	2040	2045	2050
Biomass purchases (million \$2018/year)		0.873	298	662	997	1,394	1,420
Conversion capital investment - Cumulative 5-yr (million \$2018)		2.44	6,027	6,686	6,128	7,284	551
Number of facilities - Allam power w ccu (quantity)	0	0	0	1	3	5	5
Number of facilities - Beccs hydrogen (quantity)	0	0	0	6	13	25	25
Number of facilities - Diesel (quantity)	0	0	0	1	1	1	1
Number of facilities - Diesel ccu (quantity)	0	0	0	1	3	5	5
Number of facilities - Power (quantity)	0	1	1	1	1	1	1
Number of facilities - Power ccu (quantity)	0	0	5	6	6	7	8
Number of facilities - Pyrolysis (quantity)	0	0	0	1	1	1	1
Number of facilities - Pyrolysis ccu (quantity)	0	0	0	1	3	5	5
Number of facilities - Sng (quantity)	0	1	1	1	1	1	1
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	10.6	27.5	42.6	56.2	64.6
Annual - BECCS (MMT)		0	7.12	15.6	23.2	32.6	33.2
Annual - Cement and lime (MMT)		0	3.24	3.35	6.64	6.84	14.1
Annual - NGCC (MMT)		0	0.22	8.53	12.8	16.8	17.3
Cumulative - All (MMT)		0	10.6	38.1	80.7	137	202
Cumulative - BECCS (MMT)		0	7.12	22.8	46	78.6	112
Cumulative - Cement and lime (MMT)		0	3.24	6.59	13.2	20.1	34.2
Cumulative - NGCC (MMT)		0	0.22	8.75	21.5	38.3	55.6

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

Item	2020	2025	2030	2035	2040	2045	2050
All (km)		708	2,025	3,726	5,225	7,057	7,808
Cumulative investment - All (million \$2018)		3,706	9,870	10,931	12,050	13,213	13,770
Cumulative investment - Spur (million \$2018)		0	430	1,491	2,610	3,772	4,329
Cumulative investment - Trunk (million \$2018)		3,706	9,440	9,440	9,440	9,440	9,440
Spur (km)		0	496	2,197	3,696	5,528	6,279
Trunk (km)		708	1,529	1,529	1,529	1,529	1,529

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

Item	2020	2025	2030	2035	2040	2045	2050
CO2 storage (MMT)		0	28.5	93.4	169	270	363
Injection wells (wells)		0	24	97	174	290	362
Resource characterization, appraisal, permitting costs (million \$2020)		157	2,677	4,202	4,202	4,202	4,202
Wells and facilities construction costs (million \$2020)		0	751	2,927	5,217	8,723	10,830

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)							-322
Carbon sink potential - Aggressive deployment - Cropland measures (1000 tCO2e/y)							-13,586
Carbon sink potential - Aggressive deployment - Permanent conservation cover (1000 tCO2e/y)							-615
Carbon sink potential - Aggressive deployment - Total (1000 tCO2e/y)							-14,523
Carbon sink potential - Moderate deployment - Corn-ethanol to energy grasses (1000 tCO2e/y)							-322
Carbon sink potential - Moderate deployment - Cropland measures (1000 tCO2e/y)							-7,102
Carbon sink potential - Moderate deployment - Permanent conservation cover (1000 tCO2e/y)							-307
Carbon sink potential - Moderate deployment - Total (1000 tCO2e/y)							-7,732
Land impacted for carbon sink - Aggressive deployment - Corn-ethanol to energy grasses (1000 hectares)							208
Land impacted for carbon sink - Aggressive deployment - Cropland measures (1000 hectares)							10,684
Land impacted for carbon sink - Aggressive deployment - Permanent conservation cover (1000 hectares)							999
Land impacted for carbon sink - Aggressive deployment - Total (1000 hectares)							11,891
Land impacted for carbon sink - Moderate deployment - Corn-ethanol to energy grasses (1000 hectares)							208
Land impacted for carbon sink - Moderate deployment - Cropland measures (1000 hectares)							5,592
Land impacted for carbon sink - Moderate deployment - Permanent conservation cover (1000 hectares)							499
Land impacted for carbon sink - Moderate deployment - Total (1000 hectares)							6,299

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)							-8,931
Carbon sink potential - High - All (not counting overlap) (1000 tCO <sub>2</sub> e/y)							-148,038
Carbon sink potential - High - Avoid deforestation (1000 tCO <sub>2</sub> e/y)							-6,717
Carbon sink potential - High - Extend rotation length (1000 tCO <sub>2</sub> e/y)							-15,037
Carbon sink potential - High - Improve plantations (1000 tCO <sub>2</sub> e/y)							-2,622
Carbon sink potential - High - Increase retention of HWP (1000 tCO <sub>2</sub> e/y)							-13,128
Carbon sink potential - High - Increase trees outside forests (1000 tCO <sub>2</sub> e/y)							-4,082
Carbon sink potential - High - Reforest cropland (1000 tCO <sub>2</sub> e/y)							-38,605
Carbon sink potential - High - Reforest pasture (1000 tCO <sub>2</sub> e/y)							-39,514
Carbon sink potential - High - Restore productivity (1000 tCO <sub>2</sub> e/y)							-19,401
Carbon sink potential - Low - Accelerate regeneration (1000 tCO <sub>2</sub> e/y)							-4,475
Carbon sink potential - Low - All (not counting overlap) (1000 tCO <sub>2</sub> e/y)							-47,345
Carbon sink potential - Low - Avoid deforestation (1000 tCO <sub>2</sub> e/y)							-1,120
Carbon sink potential - Low - Extend rotation length (1000 tCO <sub>2</sub> e/y)							-5,776
Carbon sink potential - Low - Improve plantations (1000 tCO <sub>2</sub> e/y)							-1,334
Carbon sink potential - Low - Increase retention of HWP (1000 tCO <sub>2</sub> e/y)							-4,376
Carbon sink potential - Low - Increase trees outside forests (1000 tCO <sub>2</sub> e/y)							-1,429
Carbon sink potential - Low - Reforest cropland (1000 tCO <sub>2</sub> e/y)							-19,303
Carbon sink potential - Low - Reforest pasture (1000 tCO <sub>2</sub> e/y)							-2,993
Carbon sink potential - Low - Restore productivity (1000 tCO <sub>2</sub> e/y)							-6,540
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO <sub>2</sub> e/y)							-6,703
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO <sub>2</sub> e/y)							-97,668
Carbon sink potential - Mid - Avoid deforestation (1000 tCO <sub>2</sub> e/y)							-3,918
Carbon sink potential - Mid - Extend rotation length (1000 tCO <sub>2</sub> e/y)							-10,406
Carbon sink potential - Mid - Improve plantations (1000 tCO <sub>2</sub> e/y)							-1,955
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO <sub>2</sub> e/y)							-8,752
Carbon sink potential - Mid - Increase trees outside forests (1000 tCO <sub>2</sub> e/y)							-2,756
Carbon sink potential - Mid - Reforest cropland (1000 tCO <sub>2</sub> e/y)							-28,954
Carbon sink potential - Mid - Reforest pasture (1000 tCO <sub>2</sub> e/y)							-21,254
Carbon sink potential - Mid - Restore productivity (1000 tCO <sub>2</sub> e/y)							-12,970



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)							1,461
Land impacted for carbon sink potential - High - Avoid deforestation (over 30 years) (1000 hectares)							909
Land impacted for carbon sink potential - High - Extend rotation length (1000 hectares)							7,668
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)							966
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)							388
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)							2,552
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)							1,123
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)							6,431
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)							21,498
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)							731
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)							854
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)							2,938
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)							483
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)							204
Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares)							1,276
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)							195
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)							3,891
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)							10,571
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)							1,096

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)							882
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)							5,303
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)							727
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)							296
Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares)							1,914
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)							1,407
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)							7,837
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)							19,461

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

Item	2020	2025	2030	2035	2040	2045	2050
Natural gas consumption - Annual (tcf)		3,431	2,892	2,320	1,746	1,099	762
Natural gas consumption - Cumulative (tcf)							69,865
Natural gas production - Annual (tcf)		8,345	7,888	6,870	5,809	4,607	3,578
Oil consumption - Annual (million bbls)		953	866	729	597	492	401
Oil consumption - Cumulative (million bbls)							22,296
Oil production - Annual (million bbls)		2,881	2,891	2,887	2,287	1,859	1,237

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

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal (million 2019\$)		982	0.882	0.837	0.634	0.41	0.005
Monetary damages from air pollution - Natural Gas (million 2019\$)		695	395	227	217	100	67.3
Monetary damages from air pollution - Transportation (million 2019\$)		4,679	4,521	3,556	2,127	1,004	411
Premature deaths from air pollution - Coal (deaths)		111	0.1	0.095	0.072	0.046	0.001
Premature deaths from air pollution - Natural Gas (deaths)		78.4	44.6	25.6	24.5	11.3	7.6
Premature deaths from air pollution - Transportation (deaths)		526	508	400	239	113	46.3

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

Item	2020	2025	2030	2035	2040	2045	2050
By economic sector - Agriculture (jobs)		805	1,170	2,053	2,137	2,072	1,701
By economic sector - Construction (jobs)		107,942	117,928	130,598	138,595	135,804	145,957
By economic sector - Manufacturing (jobs)		163,272	180,479	212,582	194,247	156,863	174,857
By economic sector - Mining (jobs)		181,192	144,017	111,632	73,299	47,779	26,498

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

Item	2020	2025	2030	2035	2040	2045	2050
By economic sector - Other (jobs)		7,622	9,713	12,617	15,740	17,519	22,655
By economic sector - Pipeline (jobs)		12,107	11,629	10,239	8,242	6,545	4,759
By economic sector - Professional (jobs)		75,788	78,333	84,285	86,860	85,368	89,186
By economic sector - Trade (jobs)		83,703	79,607	77,534	70,472	64,162	62,495
By economic sector - Utilities (jobs)		72,051	75,760	87,133	100,671	101,761	114,477
By education level - All sectors - Associates degree or some college (jobs)		204,885	205,870	218,044	210,831	190,858	202,337
By education level - All sectors - Bachelors degree (jobs)		169,699	163,481	165,004	151,219	132,957	133,928
By education level - All sectors - Doctoral degree (jobs)		5,661	5,417	5,379	5,017	4,571	4,534
By education level - All sectors - High school diploma or less (jobs)		284,454	285,799	302,112	287,887	257,915	269,991
By education level - All sectors - Masters or professional degree (jobs)		39,783	38,069	38,136	35,310	31,571	31,794
By resource sector - Biomass (jobs)		2,156	2,906	5,447	6,199	7,587	7,372
By resource sector - CO2 (jobs)		3,800	7,363	3,775	4,355	6,081	7,013
By resource sector - Coal (jobs)		3,731	443	64.5	54.3	47.5	41.4
By resource sector - Grid (jobs)		82,876	100,180	136,224	165,283	173,846	206,972
By resource sector - Natural Gas (jobs)		164,883	131,138	100,627	78,324	52,576	31,906
By resource sector - Nuclear (jobs)		2,594	2,000	700	0.008	0.018	0.032
By resource sector - Oil (jobs)		307,881	278,453	250,309	183,956	139,185	88,861
By resource sector - Solar (jobs)		66,025	81,149	110,182	122,306	119,492	162,552
By resource sector - Wind (jobs)		70,537	95,001	121,345	129,787	119,058	137,867
Median wages - Annual - All (\$2019 per job)		63,652	63,502	63,087	62,901	63,276	62,820
On-Site or In-Plant Training - Total jobs - 1 to 4 years (jobs)		109,769	109,481	114,761	109,942	99,109	103,725
On-Site or In-Plant Training - Total jobs - 4 to 10 years (jobs)		41,363	41,216	42,797	41,938	38,793	40,284
On-Site or In-Plant Training - Total jobs - None (jobs)		114,378	113,240	118,086	111,827	100,043	104,590
On-Site or In-Plant Training - Total jobs - Over 10 years (jobs)		5,054	5,180	5,575	5,524	5,090	5,419
On-Site or In-Plant Training - Total jobs - Up to 1 year (jobs)		433,917	429,518	447,455	421,034	374,838	388,566
On-the-Job Training - All sectors - 1 to 4 years (jobs)		139,437	139,013	145,665	140,053	126,600	132,758
On-the-Job Training - All sectors - 4 to 10 years (jobs)		37,383	37,627	39,515	39,476	36,995	38,968
On-the-Job Training - All sectors - None (jobs)		39,972	39,016	40,005	37,395	33,349	34,469
On-the-Job Training - All sectors - Over 10 years (jobs)		7,063	7,083	7,466	7,016	6,170	6,493
On-the-Job Training - All sectors - Up to 1 year (jobs)		480,628	475,896	496,024	466,324	414,758	429,896
Related work experience - All sectors - 1 to 4 years (jobs)		261,265	257,699	266,945	251,418	224,522	231,544
Related work experience - All sectors - 4 to 10 years (jobs)		165,133	163,134	169,255	160,387	143,725	148,979
Related work experience - All sectors - None (jobs)		97,291	97,030	101,785	97,282	87,653	91,620
Related work experience - All sectors - Over 10 years (jobs)		47,094	46,377	48,088	44,945	39,659	41,088
Related work experience - All sectors - Up to 1 year (jobs)		133,699	134,395	142,601	136,233	122,313	129,351
Wage income - All (million \$2019)		44,843	44,367	45,972	43,422	39,100	40,371

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)		92,535	107,526				
Sales of cooking units - Electric Resistance (%)	30.1	34.2	39	52	70.1	81.2	85
Sales of cooking units - Gas (%)	69.9	65.8	61	48	29.9	18.8	15
Sales of space heating units - Electric Heat Pump (%)	6.39	16.7	22.6	39.2	65.2	83.1	89.8
Sales of space heating units - Electric Resistance (%)	5.23	4.51	4.54	4.7	5.13	5.79	6.22
Sales of space heating units - Fossil (%)	0	0	0	0	0	0	0
Sales of space heating units - Gas Furnace (%)	88.4	78.8	72.9	56.1	29.7	11.1	4.01
Sales of water heating units - Electric Heat Pump (%)	0.154	1.96	7.14	22.1	44.9	59.9	65.1
Sales of water heating units - Electric Resistance (%)	4.33	4.5	6.61	12.8	22.2	28.4	30.5
Sales of water heating units - Gas Furnace (%)	93.4	91.7	84.4	63.3	31	9.9	2.58
Sales of water heating units - Other (%)	2.08	1.83	1.82	1.82	1.83	1.83	1.83

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)		19.1	19.6	24.1	25.1	33.9	35.8

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

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Commercial (PJ)	700	704	700	693	678	663	655
Final energy use - Industry (PJ)	3,891	4,375	4,678	4,836	5,002	5,094	5,266
Final energy use - Residential (PJ)	833	808	795	778	738	694	660
Final energy use - Transportation (PJ)	2,704	2,621	2,420	2,258	2,136	1,994	1,823

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)		21.9	27.1				
Sales of cooking units - Electric Resistance (%)	63.7	64.6	68	76.7	88.9	96.4	99
Sales of cooking units - Gas (%)	36.3	35.4	32	23.3	11.1	3.58	0.964
Sales of space heating units - Electric Heat Pump (%)	14.3	20.3	25.5	40.5	63.3	78.1	83.3
Sales of space heating units - Electric Resistance (%)	43.4	47.3	44.3	36.1	23.8	16	13.2
Sales of space heating units - Fossil (%)	3.05	5.12	4.92	4.14	2.95	2.18	1.92
Sales of space heating units - Gas (%)	39.3	27.2	25.2	19.3	9.88	3.69	1.58
Sales of water heating units - Electric Heat Pump (%)	0	2.05	7.87	24.6	50.4	67.2	73
Sales of water heating units - Electric Resistance (%)	53.8	63.9	60.9	51.6	37.2	27.8	24.5
Sales of water heating units - Gas Furnace (%)	44.2	32.4	29.6	22.2	10.9	3.45	0.893
Sales of water heating units - Other (%)	2.01	1.61	1.6	1.59	1.6	1.58	1.57

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	695	1,441	4,884	15,313	22,329
Public EV charging plugs - DC Fast (1000 units)	0.675		2.24		11.3		31.3
Public EV charging plugs - L2 (1000 units)	3.14		54		272		753
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 (%)	1.68	2.07	2.08	1.66	1.07	0.553	0.236
Vehicle sales - Light-duty - EV (%)	1.75	4.37	11.2	24.8	47.2	71.3	87.3
Vehicle sales - Light-duty - gasoline (%)	92.2	88.1	80.6	68	47.5	25.7	11.3
Vehicle sales - Light-duty - hybrid (%)	4.17	5	5.65	5.2	3.96	2.37	1.16
Vehicle sales - Light-duty - hydrogen FC (%)	0.113	0.384	0.333	0.257	0.184	0.103	0.048
Vehicle sales - Light-duty - other (%)	0.108	0.112	0.102	0.09	0.065	0.036	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)							-322
Carbon sink potential - Aggressive deployment - Cropland measures (1000 tCO2e/y)							-13,586
Carbon sink potential - Aggressive deployment - Permanent conservation cover (1000 tCO2e/y)							-615
Carbon sink potential - Aggressive deployment - Total (1000 tCO2e/y)							-14,523
Carbon sink potential - Moderate deployment - Corn-ethanol to energy grasses (1000 tCO2e/y)							-322
Carbon sink potential - Moderate deployment - Cropland measures (1000 tCO2e/y)							-7,102
Carbon sink potential - Moderate deployment - Permanent conservation cover (1000 tCO2e/y)							-307
Carbon sink potential - Moderate deployment - Total (1000 tCO2e/y)							-7,732
Land impacted for carbon sink - Aggressive deployment - Corn-ethanol to energy grasses (1000 hectares)							208
Land impacted for carbon sink - Aggressive deployment - Cropland measures (1000 hectares)							10,684
Land impacted for carbon sink - Aggressive deployment - Permanent conservation cover (1000 hectares)							999

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)							11,891
Land impacted for carbon sink - Moderate deployment - Corn-ethanol to energy grasses (1000 hectares)							208
Land impacted for carbon sink - Moderate deployment - Cropland measures (1000 hectares)							5,592
Land impacted for carbon sink - Moderate deployment - Permanent conservation cover (1000 hectares)							499
Land impacted for carbon sink - Moderate deployment - Total (1000 hectares)							6,299

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)							-8,931
Carbon sink potential - High - All (not counting overlap) (1000 tCO <sub>2</sub> e/y)							-148,038
Carbon sink potential - High - Avoid deforestation (1000 tCO <sub>2</sub> e/y)							-6,717
Carbon sink potential - High - Extend rotation length (1000 tCO <sub>2</sub> e/y)							-15,037
Carbon sink potential - High - Improve plantations (1000 tCO <sub>2</sub> e/y)							-2,622
Carbon sink potential - High - Increase retention of HWP (1000 tCO <sub>2</sub> e/y)							-13,128
Carbon sink potential - High - Increase trees outside forests (1000 tCO <sub>2</sub> e/y)							-4,082
Carbon sink potential - High - Reforest cropland (1000 tCO <sub>2</sub> e/y)							-38,605
Carbon sink potential - High - Reforest pasture (1000 tCO <sub>2</sub> e/y)							-39,514
Carbon sink potential - High - Restore productivity (1000 tCO <sub>2</sub> e/y)							-19,401
Carbon sink potential - Low - Accelerate regeneration (1000 tCO <sub>2</sub> e/y)							-4,475
Carbon sink potential - Low - All (not counting overlap) (1000 tCO <sub>2</sub> e/y)							-47,345
Carbon sink potential - Low - Avoid deforestation (1000 tCO <sub>2</sub> e/y)							-1,120
Carbon sink potential - Low - Extend rotation length (1000 tCO <sub>2</sub> e/y)							-5,776
Carbon sink potential - Low - Improve plantations (1000 tCO <sub>2</sub> e/y)							-1,334
Carbon sink potential - Low - Increase retention of HWP (1000 tCO <sub>2</sub> e/y)							-4,376
Carbon sink potential - Low - Increase trees outside forests (1000 tCO <sub>2</sub> e/y)							-1,429
Carbon sink potential - Low - Reforest cropland (1000 tCO <sub>2</sub> e/y)							-19,303
Carbon sink potential - Low - Reforest pasture (1000 tCO <sub>2</sub> e/y)							-2,993
Carbon sink potential - Low - Restore productivity (1000 tCO <sub>2</sub> e/y)							-6,540
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO <sub>2</sub> e/y)							-6,703

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)							-97,668
Carbon sink potential - Mid - Avoid deforestation (1000 tCO <sub>2</sub> e/y)							-3,918
Carbon sink potential - Mid - Extend rotation length (1000 tCO <sub>2</sub> e/y)							-10,406
Carbon sink potential - Mid - Improve plantations (1000 tCO <sub>2</sub> e/y)							-1,955
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO <sub>2</sub> e/y)							-8,752
Carbon sink potential - Mid - Increase trees outside forests (1000 tCO <sub>2</sub> e/y)							-2,756
Carbon sink potential - Mid - Reforest cropland (1000 tCO <sub>2</sub> e/y)							-28,954
Carbon sink potential - Mid - Reforest pasture (1000 tCO <sub>2</sub> e/y)							-21,254
Carbon sink potential - Mid - Restore productivity (1000 tCO <sub>2</sub> e/y)							-12,970
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)							1,461
Land impacted for carbon sink potential - High - Avoid deforestation (over 30 years) (1000 hectares)							909
Land impacted for carbon sink potential - High - Extend rotation length (1000 hectares)							7,668
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)							966
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)							388
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)							2,552
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)							1,123
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)							6,431
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)							21,498
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)							731
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)							854
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)							2,938
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)							483
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)							204
Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares)							1,276
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)							195
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)							3,891
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)							10,571
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)							1,096
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)							882
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)							5,303
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)							727
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)							296
Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares)							1,914
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)							1,407
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)							7,837
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)							19,461

Table 24: E- scenario - IMPACTS - Health

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal (million 2019\$)		982	0.882	0.837	0.634	0.41	0.005
Monetary damages from air pollution - Natural Gas (million 2019\$)		704	318	160	92.6	41.2	29.2
Monetary damages from air pollution - Transportation (million 2019\$)		4,756	4,973	5,004	4,655	3,823	2,700
Premature deaths from air pollution - Coal (deaths)		111	0.1	0.095	0.072	0.046	0.001
Premature deaths from air pollution - Natural Gas (deaths)		79.5	35.9	18.1	10.5	4.65	3.29
Premature deaths from air pollution - Transportation (deaths)		535	559	563	524	430	304



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)		92,591	107,907				
Sales of cooking units - Electric Resistance (%)	30.1	44.4	79.2	86.1	86.5	86.4	86.5
Sales of cooking units - Gas (%)	69.9	55.6	20.8	13.9	13.5	13.6	13.5
Sales of space heating units - Electric Heat Pump (%)	6.39	26.3	76.9	91.1	92.2	92.2	92.2
Sales of space heating units - Electric Resistance (%)	5.23	4.51	4.79	6.09	6.39	6.41	6.42
Sales of space heating units - Fossil (%)	0	0	0	0	0	0	0
Sales of space heating units - Gas Furnace (%)	88.4	69.2	18.3	2.84	1.39	1.35	1.34
Sales of water heating units - Electric Heat Pump (%)	0.154	10.7	56.3	66.5	66.9	66.9	66.9
Sales of water heating units - Electric Resistance (%)	4.33	8.13	26.9	31.1	31.3	31.3	31.3
Sales of water heating units - Gas Furnace (%)	93.4	79.3	15	0.631	0	0	0
Sales of water heating units - Other (%)	2.08	1.83	1.82	1.82	1.83	1.83	1.83

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)		22.7	23.6	38.5	41	31.3	32.4

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

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Commercial (PJ)	700	703	680	646	618	611	621
Final energy use - Industry (PJ)	3,891	4,374	4,672	4,814	4,969	5,063	5,241
Final energy use - Residential (PJ)	833	805	759	696	642	616	611
Final energy use - Transportation (PJ)	2,702	2,603	2,334	2,008	1,714	1,533	1,453

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)		22.2	28.7				
Sales of cooking units - Electric Resistance (%)	63.8	71.5	95.1	99.8	100	100	100
Sales of cooking units - Gas (%)	36.2	28.5	4.87	0.245	0	0	0
Sales of space heating units - Electric Heat Pump (%)	14.3	29.1	74.6	84.7	85.2	85	85
Sales of space heating units - Electric Resistance (%)	43.4	42.6	17.9	12.3	12.1	12.4	12.4
Sales of space heating units - Fossil (%)	3.05	4.67	2.39	1.88	1.84	1.81	1.8
Sales of space heating units - Gas (%)	39.3	23.7	5.17	1.03	0.847	0.825	0.821
Sales of water heating units - Electric Heat Pump (%)	0	11.9	63.1	74.6	75.1	75.1	75.1
Sales of water heating units - Electric Resistance (%)	53.8	58.4	30.1	23.6	23.3	23.4	23.4
Sales of water heating units - Gas Furnace (%)	44.2	28	5.25	0.218	0	0	0
Sales of water heating units - Other (%)	2.01	1.61	1.59	1.56	1.56	1.57	1.57

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)		4,242	10,921	17,620	26,721	29,049	27,715
Public EV charging plugs - DC Fast (1000 units)	0.675		7.03		30.3		48.9
Public EV charging plugs - L2 (1000 units)	3.14		169		728		1,176
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 (%)	1.67	1.92	1.31	0.419	0.077	0.013	0
Vehicle sales - Light-duty - EV (%)	3.51	13.9	44.6	81	96.2	99.3	100
Vehicle sales - Light-duty - gasoline (%)	90.6	79.4	50.8	17.3	3.39	0.593	0
Vehicle sales - Light-duty - hybrid (%)	4.03	4.25	3.08	1.16	0.279	0.06	0
Vehicle sales - Light-duty - hydrogen FC (%)	0.111	0.347	0.213	0.067	0.013	0.002	0
Vehicle sales - Light-duty - other (%)	0.107	0.103	0.069	0.024	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 - Offshore Wind - Base (billion \$2018)		0.216	0.126	0.189	0.189	0.118	17.7
Capital invested - Solar PV - Base (billion \$2018)		30.6	23.9	42.6	49.1	80.1	76.1
Capital invested - Wind - Base (billion \$2018)		25.2	32.7	52.6	81.2	76.8	87.8
Installed renewables - OffshoreWind - Base land use assumptions (MW)	0	76.2	129	221	330	410	14,559
Installed renewables - OffshoreWind - Constrained land use assumptions (MW)	0	0	0	0	0	0	17,860
Installed renewables - Solar - Base land use assumptions (MW)	8,490	35,230	58,557	103,778	159,069	254,690	350,889
Installed renewables - Solar - Constrained land use assumptions (MW)	16,980	75,863	144,584	247,520	343,057	487,179	689,533
Installed renewables - Wind - Base land use assumptions (MW)	37,952	55,095	79,638	122,001	190,708	259,192	342,094
Installed renewables - Wind - Constrained land use assumptions (MW)	75,904	115,299	180,736	275,191	418,573	579,801	824,308

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	301	508	871	1,297	1,609	52,389
OffshoreWind - Constrained land use assumptions (GWh)	0	0	0	0	0	0	67,286
Solar - Base land use assumptions (GWh)	18,855	74,393	122,020	211,416	317,645	502,868	686,864
Solar - Constrained land use assumptions (GWh)	37,709	150,779	278,185	465,913	642,528	910,260	1,282,937
Wind - Base land use assumptions (GWh)	149,083	213,500	301,669	452,469	689,464	919,753	1,194,501

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

Item	2020	2025	2030	2035	2040	2045	2050
Wind - Constrained land use assumptions (GWh)	298,167	438,291	647,119	960,456	1,428,028	1,930,548	2,650,418

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)							-322
Carbon sink potential - Aggressive deployment - Cropland measures (1000 tCO <sub>2</sub> e/y)							-13,586
Carbon sink potential - Aggressive deployment - Permanent conservation cover (1000 tCO <sub>2</sub> e/y)							-615
Carbon sink potential - Aggressive deployment - Total (1000 tCO <sub>2</sub> e/y)							-14,523
Carbon sink potential - Moderate deployment - Corn-ethanol to energy grasses (1000 tCO <sub>2</sub> e/y)							-322
Carbon sink potential - Moderate deployment - Cropland measures (1000 tCO <sub>2</sub> e/y)							-7,102
Carbon sink potential - Moderate deployment - Permanent conservation cover (1000 tCO <sub>2</sub> e/y)							-307
Carbon sink potential - Moderate deployment - Total (1000 tCO <sub>2</sub> e/y)							-7,732
Land impacted for carbon sink - Aggressive deployment - Corn-ethanol to energy grasses (1000 hectares)							208
Land impacted for carbon sink - Aggressive deployment - Cropland measures (1000 hectares)							10,684
Land impacted for carbon sink - Aggressive deployment - Permanent conservation cover (1000 hectares)							999
Land impacted for carbon sink - Aggressive deployment - Total (1000 hectares)							11,891
Land impacted for carbon sink - Moderate deployment - Corn-ethanol to energy grasses (1000 hectares)							208
Land impacted for carbon sink - Moderate deployment - Cropland measures (1000 hectares)							5,592
Land impacted for carbon sink - Moderate deployment - Permanent conservation cover (1000 hectares)							499
Land impacted for carbon sink - Moderate deployment - Total (1000 hectares)							6,299

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)							-8,931
Carbon sink potential - High - All (not counting overlap) (1000 tCO <sub>2</sub> e/y)							-148,038
Carbon sink potential - High - Avoid deforestation (1000 tCO <sub>2</sub> e/y)							-6,717

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

Item	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - High - Extend rotation length (1000 tCO2e/y)							-15,037
Carbon sink potential - High - Improve plantations (1000 tCO2e/y)							-2,622
Carbon sink potential - High - Increase retention of HWP (1000 tCO2e/y)							-13,128
Carbon sink potential - High - Increase trees outside forests (1000 tCO2e/y)							-4,082
Carbon sink potential - High - Reforest cropland (1000 tCO2e/y)							-38,605
Carbon sink potential - High - Reforest pasture (1000 tCO2e/y)							-39,514
Carbon sink potential - High - Restore productivity (1000 tCO2e/y)							-19,401
Carbon sink potential - Low - Accelerate regeneration (1000 tCO2e/y)							-4,475
Carbon sink potential - Low - All (not counting overlap) (1000 tCO2e/y)							-47,345
Carbon sink potential - Low - Avoid deforestation (1000 tCO2e/y)							-1,120
Carbon sink potential - Low - Extend rotation length (1000 tCO2e/y)							-5,776
Carbon sink potential - Low - Improve plantations (1000 tCO2e/y)							-1,334
Carbon sink potential - Low - Increase retention of HWP (1000 tCO2e/y)							-4,376
Carbon sink potential - Low - Increase trees outside forests (1000 tCO2e/y)							-1,429
Carbon sink potential - Low - Reforest cropland (1000 tCO2e/y)							-19,303
Carbon sink potential - Low - Reforest pasture (1000 tCO2e/y)							-2,993
Carbon sink potential - Low - Restore productivity (1000 tCO2e/y)							-6,540
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO2e/y)							-6,703
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO2e/y)							-97,668
Carbon sink potential - Mid - Avoid deforestation (1000 tCO2e/y)							-3,918
Carbon sink potential - Mid - Extend rotation length (1000 tCO2e/y)							-10,406
Carbon sink potential - Mid - Improve plantations (1000 tCO2e/y)							-1,955
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO2e/y)							-8,752
Carbon sink potential - Mid - Increase trees outside forests (1000 tCO2e/y)							-2,756
Carbon sink potential - Mid - Reforest cropland (1000 tCO2e/y)							-28,954
Carbon sink potential - Mid - Reforest pasture (1000 tCO2e/y)							-21,254
Carbon sink potential - Mid - Restore productivity (1000 tCO2e/y)							-12,970
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)							1,461
Land impacted for carbon sink potential - High - Avoid deforestation (over 30 years) (1000 hectares)							909

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 - Extend rotation length (1000 hectares)							7,668
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)							966
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)							388
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)							2,552
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)							1,123
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)							6,431
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)							21,498
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)							731
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)							854
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)							2,938
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)							483
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)							204
Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares)							1,276
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)							195
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)							3,891
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)							10,571
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)							1,096
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)							882
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)							5,303
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)							727

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 - Increase retention of HWP (1000 hectares)							0
Land impacted for carbon sink potential - Mid - Increase trees outside forests (1000 hectares)							296
Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares)							1,914
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)							1,407
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)							7,837
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)							19,461

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

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal (million 2019\$)		982	0.882	0.837	0.634	0.41	0.005
Monetary damages from air pollution - Natural Gas (million 2019\$)		613	355	150	121	53.5	28.9
Monetary damages from air pollution - Transportation (million 2019\$)		4,679	4,521	3,556	2,127	1,004	411
Premature deaths from air pollution - Coal (deaths)		111	0.1	0.095	0.072	0.046	0.001
Premature deaths from air pollution - Natural Gas (deaths)		69.2	40.1	16.9	13.6	6.04	3.26
Premature deaths from air pollution - Transportation (deaths)		526	508	400	239	113	46.3

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)		92,591	107,907				
Sales of cooking units - Electric Resistance (%)	30.1	44.4	79.2	86.1	86.5	86.4	86.5
Sales of cooking units - Gas (%)	69.9	55.6	20.8	13.9	13.5	13.6	13.5
Sales of space heating units - Electric Heat Pump (%)	6.39	26.3	76.9	91.1	92.2	92.2	92.2
Sales of space heating units - Electric Resistance (%)	5.23	4.51	4.79	6.09	6.39	6.41	6.42
Sales of space heating units - Fossil (%)	0	0	0	0	0	0	0
Sales of space heating units - Gas Furnace (%)	88.4	69.2	18.3	2.84	1.39	1.35	1.34
Sales of water heating units - Electric Heat Pump (%)	0.154	10.7	56.3	66.5	66.9	66.9	66.9
Sales of water heating units - Electric Resistance (%)	4.33	8.13	26.9	31.1	31.3	31.3	31.3
Sales of water heating units - Gas Furnace (%)	93.4	79.3	15	0.631	0	0	0
Sales of water heating units - Other (%)	2.08	1.83	1.82	1.82	1.83	1.83	1.83

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)		22.7	23.6	38.5	41	31.3	32.4

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

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Commercial (PJ)	700	703	680	646	618	611	621
Final energy use - Industry (PJ)	3,891	4,374	4,672	4,814	4,969	5,063	5,241
Final energy use - Residential (PJ)	833	805	759	696	642	616	611
Final energy use - Transportation (PJ)	2,702	2,603	2,334	2,008	1,714	1,533	1,453

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)		22.2	28.7				
Sales of cooking units - Electric Resistance (%)	63.8	71.5	95.1	99.8	100	100	100
Sales of cooking units - Gas (%)	36.2	28.5	4.87	0.245	0	0	0
Sales of space heating units - Electric Heat Pump (%)	14.3	29.1	74.6	84.7	85.2	85	85
Sales of space heating units - Electric Resistance (%)	43.4	42.6	17.9	12.3	12.1	12.4	12.4
Sales of space heating units - Fossil (%)	3.05	4.67	2.39	1.88	1.84	1.81	1.8
Sales of space heating units - Gas (%)	39.3	23.7	5.17	1.03	0.847	0.825	0.821
Sales of water heating units - Electric Heat Pump (%)	0	11.9	63.1	74.6	75.1	75.1	75.1
Sales of water heating units - Electric Resistance (%)	53.8	58.4	30.1	23.6	23.3	23.4	23.4
Sales of water heating units - Gas Furnace (%)	44.2	28	5.25	0.218	0	0	0
Sales of water heating units - Other (%)	2.01	1.61	1.59	1.56	1.56	1.57	1.57

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)		4,242	10,921	17,620	26,721	29,049	27,715
Public EV charging plugs - DC Fast (1000 units)	0.675		7.03		30.3		48.9
Public EV charging plugs - L2 (1000 units)	3.14		169		728		1,176
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 (%)	1.67	1.92	1.31	0.419	0.077	0.013	0
Vehicle sales - Light-duty - EV (%)	3.51	13.9	44.6	81	96.2	99.3	100
Vehicle sales - Light-duty - gasoline (%)	90.6	79.4	50.8	17.3	3.39	0.593	0
Vehicle sales - Light-duty - hybrid (%)	4.03	4.25	3.08	1.16	0.279	0.06	0
Vehicle sales - Light-duty - hydrogen FC (%)	0.111	0.347	0.213	0.067	0.013	0.002	0
Vehicle sales - Light-duty - other (%)	0.107	0.103	0.069	0.024	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

Table 39: *E+RE- scenario - PILLAR 1: Efficiency/Electrification - Transportation (continued)*

Item	2020	2025	2030	2035	2040	2045	2050
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 - Offshore Wind - Base (billion \$2018)		0.216	0	0.107	0	0	0
Capital invested - Solar PV - Base (billion \$2018)		25.2	19.9	3.81	7.97	14.7	23.2
Capital invested - Solar PV - Constrained (billion \$2018)		36.4	32.8	7.97	7.44	14.1	19.2
Capital invested - Wind - Base (billion \$2018)		7.11	9.23	4.77	17.5	10.8	8.55
Capital invested - Wind - Constrained (billion \$2018)		7.22	11.1	14.8	20.9	11.9	7.61
Installed renewables - OffshoreWind - Base land use assumptions (MW)	0	76.2	76.2	129	129	129	129
Installed renewables - OffshoreWind - Constrained land use assumptions (MW)	0	0	0	0	0	0	0
Installed renewables - Solar - Base land use assumptions (MW)	8,490	30,520	50,022	54,071	63,049	80,561	109,822
Installed renewables - Solar - Constrained land use assumptions (MW)	8,490	40,324	72,380	80,847	89,233	106,015	130,248
Installed renewables - Wind - Base land use assumptions (MW)	37,952	42,785	49,721	53,569	68,374	77,997	86,070
Installed renewables - Wind - Constrained land use assumptions (MW)	37,952	42,860	51,183	63,086	80,764	91,347	98,532

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	301	301	508	508	508	508
OffshoreWind - Constrained land use assumptions (GWh)	0	0	0	0	0	0	0
Solar - Base land use assumptions (GWh)	18,855	64,740	104,775	112,953	130,682	165,164	222,995
Solar - Constrained land use assumptions (GWh)	18,855	81,042	140,947	157,020	173,102	204,785	249,159
Wind - Base land use assumptions (GWh)	149,083	167,638	193,628	207,268	260,631	294,820	322,744
Wind - Constrained land use assumptions (GWh)	149,083	167,831	197,061	227,982	286,208	322,408	346,549

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)							-322
Carbon sink potential - Aggressive deployment - Cropland measures (1000 tCO2e/y)							-13,586
Carbon sink potential - Aggressive deployment - Permanent conservation cover (1000 tCO2e/y)							-615
Carbon sink potential - Aggressive deployment - Total (1000 tCO2e/y)							-14,523
Carbon sink potential - Moderate deployment - Corn-ethanol to energy grasses (1000 tCO2e/y)							-322



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

Item	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - Moderate deployment - Cropland measures (1000 tCO <sub>2</sub> e/y)							-7,102
Carbon sink potential - Moderate deployment - Permanent conservation cover (1000 tCO <sub>2</sub> e/y)							-307
Carbon sink potential - Moderate deployment - Total (1000 tCO <sub>2</sub> e/y)							-7,732
Land impacted for carbon sink - Aggressive deployment - Corn-ethanol to energy grasses (1000 hectares)							208
Land impacted for carbon sink - Aggressive deployment - Cropland measures (1000 hectares)							10,684
Land impacted for carbon sink - Aggressive deployment - Permanent conservation cover (1000 hectares)							999
Land impacted for carbon sink - Aggressive deployment - Total (1000 hectares)							11,891
Land impacted for carbon sink - Moderate deployment - Corn-ethanol to energy grasses (1000 hectares)							208
Land impacted for carbon sink - Moderate deployment - Cropland measures (1000 hectares)							5,592
Land impacted for carbon sink - Moderate deployment - Permanent conservation cover (1000 hectares)							499
Land impacted for carbon sink - Moderate deployment - Total (1000 hectares)							6,299

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)							-8,931
Carbon sink potential - High - All (not counting overlap) (1000 tCO <sub>2</sub> e/y)							-148,038
Carbon sink potential - High - Avoid deforestation (1000 tCO <sub>2</sub> e/y)							-6,717
Carbon sink potential - High - Extend rotation length (1000 tCO <sub>2</sub> e/y)							-15,037
Carbon sink potential - High - Improve plantations (1000 tCO <sub>2</sub> e/y)							-2,622
Carbon sink potential - High - Increase retention of HWP (1000 tCO <sub>2</sub> e/y)							-13,128
Carbon sink potential - High - Increase trees outside forests (1000 tCO <sub>2</sub> e/y)							-4,082
Carbon sink potential - High - Reforest cropland (1000 tCO <sub>2</sub> e/y)							-38,605
Carbon sink potential - High - Reforest pasture (1000 tCO <sub>2</sub> e/y)							-39,514
Carbon sink potential - High - Restore productivity (1000 tCO <sub>2</sub> e/y)							-19,401
Carbon sink potential - Low - Accelerate regeneration (1000 tCO <sub>2</sub> e/y)							-4,475
Carbon sink potential - Low - All (not counting overlap) (1000 tCO <sub>2</sub> e/y)							-47,345
Carbon sink potential - Low - Avoid deforestation (1000 tCO <sub>2</sub> e/y)							-1,120

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

Item	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - Low - Extend rotation length (1000 tCO2e/y)							-5,776
Carbon sink potential - Low - Improve plantations (1000 tCO2e/y)							-1,334
Carbon sink potential - Low - Increase retention of HWP (1000 tCO2e/y)							-4,376
Carbon sink potential - Low - Increase trees outside forests (1000 tCO2e/y)							-1,429
Carbon sink potential - Low - Reforest cropland (1000 tCO2e/y)							-19,303
Carbon sink potential - Low - Reforest pasture (1000 tCO2e/y)							-2,993
Carbon sink potential - Low - Restore productivity (1000 tCO2e/y)							-6,540
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO2e/y)							-6,703
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO2e/y)							-97,668
Carbon sink potential - Mid - Avoid deforestation (1000 tCO2e/y)							-3,918
Carbon sink potential - Mid - Extend rotation length (1000 tCO2e/y)							-10,406
Carbon sink potential - Mid - Improve plantations (1000 tCO2e/y)							-1,955
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO2e/y)							-8,752
Carbon sink potential - Mid - Increase trees outside forests (1000 tCO2e/y)							-2,756
Carbon sink potential - Mid - Reforest cropland (1000 tCO2e/y)							-28,954
Carbon sink potential - Mid - Reforest pasture (1000 tCO2e/y)							-21,254
Carbon sink potential - Mid - Restore productivity (1000 tCO2e/y)							-12,970
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)							1,461
Land impacted for carbon sink potential - High - Avoid deforestation (over 30 years) (1000 hectares)							909
Land impacted for carbon sink potential - High - Extend rotation length (1000 hectares)							7,668
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)							966
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)							388
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)							2,552
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)							1,123
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)							6,431

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 - High - Total impacted (over 30 years) (1000 hectares)							21,498
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)							731
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)							854
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)							2,938
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)							483
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)							204
Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares)							1,276
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)							195
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)							3,891
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)							10,571
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)							1,096
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)							882
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)							5,303
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)							727
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)							296
Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares)							1,914
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)							1,407
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)							7,837
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)							19,461

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

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal (million 2019\$)		982	0.882	0.837	0.634	0.41	0.005
Monetary damages from air pollution - Natural Gas (million 2019\$)		674	506	376	318	145	80.3
Monetary damages from air pollution - Transportation (million 2019\$)		4,679	4,521	3,556	2,127	1,004	411
Premature deaths from air pollution - Coal (deaths)		111	0.1	0.095	0.072	0.046	0.001
Premature deaths from air pollution - Natural Gas (deaths)		76	57.1	42.4	35.9	16.3	9.06
Premature deaths from air pollution - Transportation (deaths)		526	508	400	239	113	46.3

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)		92,535	107,526				
Sales of cooking units - Electric Resistance (%)	30.1	34.2	39	52	70.1	81.2	85
Sales of cooking units - Gas (%)	69.9	65.8	61	48	29.9	18.8	15
Sales of space heating units - Electric Heat Pump (%)	6.39	16.7	22.6	39.2	65.2	83.1	89.8
Sales of space heating units - Electric Resistance (%)	5.23	4.51	4.54	4.7	5.13	5.79	6.22
Sales of space heating units - Fossil (%)	0	0	0	0	0	0	0
Sales of space heating units - Gas Furnace (%)	88.4	78.8	72.9	56.1	29.7	11.1	4.01
Sales of water heating units - Electric Heat Pump (%)	0.154	1.96	7.14	22.1	44.9	59.9	65.1
Sales of water heating units - Electric Resistance (%)	4.33	4.5	6.61	12.8	22.2	28.4	30.5
Sales of water heating units - Gas Furnace (%)	93.4	91.7	84.4	63.3	31	9.9	2.58
Sales of water heating units - Other (%)	2.08	1.83	1.82	1.82	1.83	1.83	1.83

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)		19.1	19.6	24.1	25.1	33.9	35.8

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

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Commercial (PJ)	700	704	700	693	678	663	655
Final energy use - Industry (PJ)	3,891	4,375	4,678	4,836	5,002	5,094	5,266
Final energy use - Residential (PJ)	833	808	795	778	738	694	660
Final energy use - Transportation (PJ)	2,704	2,621	2,420	2,258	2,136	1,994	1,823

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)		21.9	27.1				
Sales of cooking units - Electric Resistance (%)	63.7	64.6	68	76.7	88.9	96.4	99
Sales of cooking units - Gas (%)	36.3	35.4	32	23.3	11.1	3.58	0.964
Sales of space heating units - Electric Heat Pump (%)	14.3	20.3	25.5	40.5	63.3	78.1	83.3

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

Item	2020	2025	2030	2035	2040	2045	2050
Sales of space heating units - Electric Resistance (%)	43.4	47.3	44.3	36.1	23.8	16	13.2
Sales of space heating units - Fossil (%)	3.05	5.12	4.92	4.14	2.95	2.18	1.92
Sales of space heating units - Gas (%)	39.3	27.2	25.2	19.3	9.88	3.69	1.58
Sales of water heating units - Electric Heat Pump (%)	0	2.05	7.87	24.6	50.4	67.2	73
Sales of water heating units - Electric Resistance (%)	53.8	63.9	60.9	51.6	37.2	27.8	24.5
Sales of water heating units - Gas Furnace (%)	44.2	32.4	29.6	22.2	10.9	3.45	0.893
Sales of water heating units - Other (%)	2.01	1.61	1.6	1.59	1.6	1.58	1.57

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	695	1,441	4,884	15,313	22,329
Public EV charging plugs - DC Fast (1000 units)	0.675		2.24		11.3		31.3
Public EV charging plugs - L2 (1000 units)	3.14		54		272		753
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 (%)	1.68	2.07	2.08	1.66	1.07	0.553	0.236
Vehicle sales - Light-duty - EV (%)	1.75	4.37	11.2	24.8	47.2	71.3	87.3
Vehicle sales - Light-duty - gasoline (%)	92.2	88.1	80.6	68	47.5	25.7	11.3
Vehicle sales - Light-duty - hybrid (%)	4.17	5	5.65	5.2	3.96	2.37	1.16
Vehicle sales - Light-duty - hydrogen FC (%)	0.113	0.384	0.333	0.257	0.184	0.103	0.048
Vehicle sales - Light-duty - other (%)	0.108	0.112	0.102	0.09	0.065	0.036	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	0.003	0.009	0	0.014	0	0
Capital invested - Biomass w/ccu allam power plant (billion \$2018)	0	0	0	0.038	0.015	0.013	0.05
Capital invested - Biomass w/ccu power plant (billion \$2018)	0	0	15.1	11.6	27.2	1	9.41

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

Item	2020	2025	2030	2035	2040	2045	2050
Biomass power plant (GWh)	0	5	22.5	22.5	51.8	51.8	51.8
Biomass w/ccu allam power plant (GWh)	0	0	0	38.2	53.4	66.8	116
Biomass w/ccu power plant (GWh)	0	0	16,905	29,918	60,456	61,582	72,147

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

Item	2020	2025	2030	2035	2040	2045	2050
Biomass purchases (million \$2018/year)		3.03	1,085	5,343	7,752	9,088	10,150
Conversion capital investment - Cumulative 5-yr (million \$2018)		2.92	13,826	48,977	30,237	15,040	13,128
Number of facilities - Allam power w ccu (quantity)	0	0	0	1	3	4	5
Number of facilities - Beccs hydrogen (quantity)	0	0	0	44	50	65	70
Number of facilities - Diesel (quantity)	0	0	0	1	2	2	2
Number of facilities - Diesel ccu (quantity)	0	0	0	1	3	4	4
Number of facilities - Power (quantity)	0	1	1	1	2	2	2
Number of facilities - Power ccu (quantity)	0	0	14	24	48	49	58
Number of facilities - Pyrolysis (quantity)	0	0	0	1	2	2	2
Number of facilities - Pyrolysis ccu (quantity)	0	0	0	0	1	2	3
Number of facilities - Sng (quantity)	0	1	1	1	1	1	1
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	20	82.3	123	145	171
Annual - BECCS (MMT)		0	16.7	78.8	116	135	151
Annual - Cement and lime (MMT)		0	3.24	3.35	6.64	6.84	14.1
Annual - NGCC (MMT)		0	0.01	0.15	0.12	2.93	6.25
Cumulative - All (MMT)		0	20	102	225	370	541
Cumulative - BECCS (MMT)		0	16.7	95.6	211	346	497
Cumulative - Cement and lime (MMT)		0	3.24	6.59	13.2	20.1	34.2
Cumulative - NGCC (MMT)		0	0.01	0.16	0.28	3.21	9.46

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

Item	2020	2025	2030	2035	2040	2045	2050
All (km)		708	2,386	5,232	7,401	9,393	10,975
Cumulative investment - All (million \$2018)		3,706	10,471	16,421	20,544	22,345	24,019
Cumulative investment - Spur (million \$2018)		0	773	3,345	5,344	7,146	8,819
Cumulative investment - Trunk (million \$2018)		3,706	9,698	13,077	15,200	15,200	15,200
Spur (km)		0	857	3,162	5,051	7,043	8,625
Trunk (km)		708	1,529	2,070	2,350	2,350	2,350

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

Item	2020	2025	2030	2035	2040	2045	2050
CO2 storage (MMT)		0	39.7	179	356	492	519
Injection wells (wells)		0	38	148	264	442	549
Resource characterization, appraisal, permitting costs (million \$2020)		157	4,112	6,534	6,534	6,534	6,534
Wells and facilities construction costs (million \$2020)		0	1,143	4,456	7,942	13,279	16,486

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)							-1,972

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

Item	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - Aggressive deployment - Cropland measures (1000 tCO <sub>2</sub> e/y)							-12,539
Carbon sink potential - Aggressive deployment - Cropland to woody energy crops (1000 tCO <sub>2</sub> e/y)							0
Carbon sink potential - Aggressive deployment - Pasture to energy crops (1000 tCO <sub>2</sub> e/y)							0
Carbon sink potential - Aggressive deployment - Permanent conservation cover (1000 tCO <sub>2</sub> e/y)							-543
Carbon sink potential - Aggressive deployment - Total (1000 tCO <sub>2</sub> e/y)							-15,055
Carbon sink potential - Moderate deployment - Corn-ethanol to energy grasses (1000 tCO <sub>2</sub> e/y)							-1,972
Carbon sink potential - Moderate deployment - Cropland measures (1000 tCO <sub>2</sub> e/y)							-6,549
Carbon sink potential - Moderate deployment - Cropland to woody energy crops (1000 tCO <sub>2</sub> e/y)							0
Carbon sink potential - Moderate deployment - Pasture to energy crops (1000 tCO <sub>2</sub> e/y)							0
Carbon sink potential - Moderate deployment - Permanent conservation cover (1000 tCO <sub>2</sub> e/y)							-271
Carbon sink potential - Moderate deployment - Total (1000 tCO <sub>2</sub> e/y)							-8,793
Land impacted for carbon sink - Aggressive deployment - Corn-ethanol to energy grasses (1000 hectares)							1,265
Land impacted for carbon sink - Aggressive deployment - Cropland measures (1000 hectares)							23,841
Land impacted for carbon sink - Aggressive deployment - Cropland to woody energy crops (1000 hectares)							203
Land impacted for carbon sink - Aggressive deployment - Pasture to energy crops (1000 hectares)							5,475
Land impacted for carbon sink - Aggressive deployment - Permanent conservation cover (1000 hectares)							885
Land impacted for carbon sink - Aggressive deployment - Total (1000 hectares)							31,668
Land impacted for carbon sink - Moderate deployment - Corn-ethanol to energy grasses (1000 hectares)							1,265
Land impacted for carbon sink - Moderate deployment - Cropland measures (1000 hectares)							5,049
Land impacted for carbon sink - Moderate deployment - Cropland to woody energy crops (1000 hectares)							203
Land impacted for carbon sink - Moderate deployment - Pasture to energy crops (1000 hectares)							5,475

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

Item	2020	2025	2030	2035	2040	2045	2050
Land impacted for carbon sink - Moderate deployment - Permanent conservation cover (1000 hectares)							442
Land impacted for carbon sink - Moderate deployment - Total (1000 hectares)							12,434

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)							-8,931
Carbon sink potential - High - All (not counting overlap) (1000 tCO <sub>2</sub> e/y)							-148,038
Carbon sink potential - High - Avoid deforestation (1000 tCO <sub>2</sub> e/y)							-6,717
Carbon sink potential - High - Extend rotation length (1000 tCO <sub>2</sub> e/y)							-15,037
Carbon sink potential - High - Improve plantations (1000 tCO <sub>2</sub> e/y)							-2,622
Carbon sink potential - High - Increase retention of HWP (1000 tCO <sub>2</sub> e/y)							-13,128
Carbon sink potential - High - Increase trees outside forests (1000 tCO <sub>2</sub> e/y)							-4,082
Carbon sink potential - High - Reforest cropland (1000 tCO <sub>2</sub> e/y)							-38,605
Carbon sink potential - High - Reforest pasture (1000 tCO <sub>2</sub> e/y)							-39,514
Carbon sink potential - High - Restore productivity (1000 tCO <sub>2</sub> e/y)							-19,401
Carbon sink potential - Low - Accelerate regeneration (1000 tCO <sub>2</sub> e/y)							-4,475
Carbon sink potential - Low - All (not counting overlap) (1000 tCO <sub>2</sub> e/y)							-47,345
Carbon sink potential - Low - Avoid deforestation (1000 tCO <sub>2</sub> e/y)							-1,120
Carbon sink potential - Low - Extend rotation length (1000 tCO <sub>2</sub> e/y)							-5,776
Carbon sink potential - Low - Improve plantations (1000 tCO <sub>2</sub> e/y)							-1,334
Carbon sink potential - Low - Increase retention of HWP (1000 tCO <sub>2</sub> e/y)							-4,376
Carbon sink potential - Low - Increase trees outside forests (1000 tCO <sub>2</sub> e/y)							-1,429
Carbon sink potential - Low - Reforest cropland (1000 tCO <sub>2</sub> e/y)							-19,303
Carbon sink potential - Low - Reforest pasture (1000 tCO <sub>2</sub> e/y)							-2,993
Carbon sink potential - Low - Restore productivity (1000 tCO <sub>2</sub> e/y)							-6,540
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO <sub>2</sub> e/y)							-6,703
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO <sub>2</sub> e/y)							-97,668
Carbon sink potential - Mid - Avoid deforestation (1000 tCO <sub>2</sub> e/y)							-3,918
Carbon sink potential - Mid - Extend rotation length (1000 tCO <sub>2</sub> e/y)							-10,406
Carbon sink potential - Mid - Improve plantations (1000 tCO <sub>2</sub> e/y)							-1,955
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO <sub>2</sub> e/y)							-8,752



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

Item	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - Mid - Increase trees outside forests (1000 tCO2e/y)							-2,756
Carbon sink potential - Mid - Reforest cropland (1000 tCO2e/y)							-28,954
Carbon sink potential - Mid - Reforest pasture (1000 tCO2e/y)							-21,254
Carbon sink potential - Mid - Restore productivity (1000 tCO2e/y)							-12,970
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)							1,461
Land impacted for carbon sink potential - High - Avoid deforestation (over 30 years) (1000 hectares)							909
Land impacted for carbon sink potential - High - Extend rotation length (1000 hectares)							7,668
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)							966
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)							388
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)							2,552
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)							1,123
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)							6,431
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)							21,498
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)							731
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)							854
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)							2,938
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)							483
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)							204
Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares)							1,276
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)							195
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)							3,891

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 - Low - Total impacted (over 30 years) (1000 hectares)							10,571
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)							1,096
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)							882
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)							5,303
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)							727
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)							296
Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares)							1,914
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)							1,407
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)							7,837
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)							19,461

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

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal (million 2019\$)		982	0.882	0.837	0.634	0.41	0.005
Monetary damages from air pollution - Natural Gas (million 2019\$)		645	328	206	180	86.9	56.8
Monetary damages from air pollution - Transportation (million 2019\$)		4,756	4,973	5,004	4,655	3,823	2,700
Premature deaths from air pollution - Coal (deaths)		111	0.1	0.095	0.072	0.046	0.001
Premature deaths from air pollution - Natural Gas (deaths)		72.8	37.1	23.3	20.3	9.81	6.41
Premature deaths from air pollution - Transportation (deaths)		535	559	563	524	430	304

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)		90,575	95,067				
Sales of cooking units - Electric Resistance (%)	30.1	32.3	32.2	32.3	32.3	32.2	32.3
Sales of cooking units - Gas (%)	69.9	67.7	67.8	67.7	67.7	67.8	67.7
Sales of space heating units - Electric Heat Pump (%)	6.39	29	70.5	79	79.5	79.5	79.5
Sales of space heating units - Electric Resistance (%)	5.23	6.36	12.1	15.9	18.7	19.1	19.1
Sales of space heating units - Fossil (%)	0	0	0	0	0	0	0

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

Item	2020	2025	2030	2035	2040	2045	2050
Sales of space heating units - Gas Furnace (%)	88.4	64.7	17.4	5.08	1.83	1.39	1.34
Sales of water heating units - Electric Heat Pump (%)	0.154	0.132	0.129	0.132	0.131	0.13	0.129
Sales of water heating units - Electric Resistance (%)	4.33	3.75	3.72	3.73	3.75	3.74	3.75
Sales of water heating units - Gas Furnace (%)	93.4	94.3	94.3	94.3	94.3	94.3	94.3
Sales of water heating units - Other (%)	2.08	1.83	1.82	1.82	1.83	1.83	1.83

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)		24.3	25.5	38.5	41	32.8	34.1

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

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Commercial (PJ)	699	714	723	730	744	773	820
Final energy use - Industry (PJ)	3,891	4,400	4,708	4,872	5,055	5,192	5,374
Final energy use - Residential (PJ)	833	811	817	837	865	900	933
Final energy use - Transportation (PJ)	2,703	2,633	2,461	2,363	2,377	2,448	2,536

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)		21.4	22.1				
Sales of cooking units - Electric Resistance (%)	63.4	63.4	63.4	63.4	63.4	63.4	63.4
Sales of cooking units - Gas (%)	36.6	36.6	36.6	36.6	36.6	36.6	36.6
Sales of space heating units - Electric Heat Pump (%)	11.8	38.1	39.3	41.3	43.1	45.6	49.3
Sales of space heating units - Electric Resistance (%)	44.8	37.5	36.8	35.9	34.6	32.3	28.5
Sales of space heating units - Fossil (%)	3.12	3.34	3.39	3.37	3.32	3.31	3.33
Sales of space heating units - Gas (%)	40.4	21.1	20.5	19.5	19	18.8	18.9
Sales of water heating units - Electric Heat Pump (%)	0	0	0	0	0	0	0
Sales of water heating units - Electric Resistance (%)	53.8	65.1	65.3	65.3	65.2	65.2	65.2
Sales of water heating units - Gas Furnace (%)	44.2	33.3	33.1	33.1	33.2	33.2	33.2
Sales of water heating units - Other (%)	2.01	1.61	1.6	1.6	1.61	1.61	1.61

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 (%)	1.68	2.07	2.21	2.05	1.85	1.73	1.64
Vehicle sales - Light-duty - EV (%)	3.16	5.08	5.81	7.12	8.7	10.2	11.3
Vehicle sales - Light-duty - gasoline (%)	90.9	87.5	85.5	83.8	81.8	79.9	78.2
Vehicle sales - Light-duty - hybrid (%)	4.04	4.91	6.03	6.6	7.2	7.84	8.37

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

Item	2020	2025	2030	2035	2040	2045	2050
Vehicle sales - Light-duty - hydrogen FC (%)	0.111	0.381	0.353	0.315	0.314	0.315	0.326
Vehicle sales - Light-duty - other (%)	0.108	0.111	0.108	0.109	0.108	0.107	0.11
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)							-8,931
Carbon sink potential - High - All (not counting overlap) (1000 tCO <sub>2</sub> e/y)							-148,038
Carbon sink potential - High - Avoid deforestation (1000 tCO <sub>2</sub> e/y)							-6,717
Carbon sink potential - High - Extend rotation length (1000 tCO <sub>2</sub> e/y)							-15,037
Carbon sink potential - High - Improve plantations (1000 tCO <sub>2</sub> e/y)							-2,622
Carbon sink potential - High - Increase retention of HWP (1000 tCO <sub>2</sub> e/y)							-13,128
Carbon sink potential - High - Increase trees outside forests (1000 tCO <sub>2</sub> e/y)							-4,082
Carbon sink potential - High - Reforest cropland (1000 tCO <sub>2</sub> e/y)							-38,605
Carbon sink potential - High - Reforest pasture (1000 tCO <sub>2</sub> e/y)							-39,514
Carbon sink potential - High - Restore productivity (1000 tCO <sub>2</sub> e/y)							-19,401
Carbon sink potential - Low - Accelerate regeneration (1000 tCO <sub>2</sub> e/y)							-4,475
Carbon sink potential - Low - All (not counting overlap) (1000 tCO <sub>2</sub> e/y)							-47,345
Carbon sink potential - Low - Avoid deforestation (1000 tCO <sub>2</sub> e/y)							-1,120
Carbon sink potential - Low - Extend rotation length (1000 tCO <sub>2</sub> e/y)							-5,776
Carbon sink potential - Low - Improve plantations (1000 tCO <sub>2</sub> e/y)							-1,334
Carbon sink potential - Low - Increase retention of HWP (1000 tCO <sub>2</sub> e/y)							-4,376
Carbon sink potential - Low - Increase trees outside forests (1000 tCO <sub>2</sub> e/y)							-1,429
Carbon sink potential - Low - Reforest cropland (1000 tCO <sub>2</sub> e/y)							-19,303
Carbon sink potential - Low - Reforest pasture (1000 tCO <sub>2</sub> e/y)							-2,993
Carbon sink potential - Low - Restore productivity (1000 tCO <sub>2</sub> e/y)							-6,540
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO <sub>2</sub> e/y)							-6,703
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO <sub>2</sub> e/y)							-97,668
Carbon sink potential - Mid - Avoid deforestation (1000 tCO <sub>2</sub> e/y)							-3,918

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

Item	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - Mid - Extend rotation length (1000 tCO2e/y)							-10,406
Carbon sink potential - Mid - Improve plantations (1000 tCO2e/y)							-1,955
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO2e/y)							-8,752
Carbon sink potential - Mid - Increase trees outside forests (1000 tCO2e/y)							-2,756
Carbon sink potential - Mid - Reforest cropland (1000 tCO2e/y)							-28,954
Carbon sink potential - Mid - Reforest pasture (1000 tCO2e/y)							-21,254
Carbon sink potential - Mid - Restore productivity (1000 tCO2e/y)							-12,970
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)							1,461
Land impacted for carbon sink potential - High - Avoid deforestation (over 30 years) (1000 hectares)							909
Land impacted for carbon sink potential - High - Extend rotation length (1000 hectares)							7,668
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)							966
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)							388
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)							2,552
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)							1,123
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)							6,431
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)							21,498
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)							731
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)							854
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)							2,938
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)							483
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)							204

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 - Reforest cropland (1000 hectares)							1,276
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)							195
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)							3,891
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)							10,571
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)							1,096
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)							882
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)							5,303
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)							727
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)							296
Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares)							1,914
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)							1,407
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)							7,837
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)							19,461

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)	-14.2		-31.5				-25.5
Business-as-usual carbon sink - Retained in Hardwood Products (Mt CO2e/y)	-3.57		-5.96				-6.27
Business-as-usual carbon sink - Total (Mt CO2e/y)	-17.8		-37.5				-31.8

Table 66: REF scenario - IMPACTS - Health

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal (million 2019\$)		5,197	1,938	1,112	874	785	698
Monetary damages from air pollution - Natural Gas (million 2019\$)		824	962	1,064	870	732	813
Monetary damages from air pollution - Transportation (million 2019\$)		4,751	5,037	5,328	5,647	5,969	6,300
Premature deaths from air pollution - Coal (deaths)		587	219	126	98.7	88.7	78.8
Premature deaths from air pollution - Natural Gas (deaths)		93	109	120	98.2	82.6	91.8

Table 66: *REF scenario - IMPACTS - Health (continued)*

Item	2020	2025	2030	2035	2040	2045	2050
Premature deaths from air pollution - Transportation (deaths)		534	566	599	635	671	709