Net-Zero America - virginia state report

Larson et al. 2020

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

Notes

- These data are a subset of 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.)
- Some results are not model outputs, but rather they are limits that apply across all scenarios (e.g., maximum carbon storage potential in agricultural soils).

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

Item	2020	2025	2030	2035	2040	2045	2050
Residential HVAC investment in 2020s vs. REF - Cumulative 5-yr (billion $2018)	0	6.43	6.21	0	0	0	0
Sales of cooking units - Electric Resistance (%)	70.5	76.8	96	99.8	100	100	100
Sales of cooking units - Gas (%)	29.5	23.2	3.97	0.2	0	0	0
Sales of space heating units - Electric Heat Pump (%)	25.4	42.2	78.8	86.9	87.3	87.3	87.3
Sales of space heating units - Electric Resistance (%)	18.4	18.4	7.74	5.33	5.23	5.33	5.34
Sales of space heating units - Fossil (%)	12.1	15.8	6.87	4.89	4.78	4.71	4.71
Sales of space heating units - Gas (%)	44.1	23.6	6.62	2.84	2.69	2.7	2.7
Sales of water heating units - Electric Heat Pump (%)	0	8.78	46.5	54.9	55.3	55.3	55.3
Sales of water heating units - Electric Resistance (%)	50.1	62.2	46.3	42.7	42.5	42.5	42.5
Sales of water heating units - Gas Furnace (%)	45.5	26.1	4.92	0.208	0	0	0
Sales of water heating units - Other (%)	4.39	2.95	2.33	2.2	2.21	2.22	2.23

Table 2: *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	1,456	3,742	6,046	9,166	9,967	9,508
Public EV charging plugs - DC Fast (1000 units)	0.39	0	2.58	0	11.2	0	18
Public EV charging plugs - L2 (1000 units)	1.37	0	61.9	0	268	0	433
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 (%)	1.42	1.7	1.21	0.385	0.072	0.013	0
Vehicle sales - Light-duty - EV (%)	4.33	16.5	48.4	82.6	96.4	99.3	100
Vehicle sales - Light-duty - gasoline (%)	89.2	76.6	46.8	15.8	3.19	0.587	0
Vehicle sales - Light-duty - hybrid (%)	4.83	4.83	3.35	1.23	0.302	0.067	0
Vehicle sales - Light-duty - hydrogen FC (%)	0.11	0.333	0.193	0.059	0.012	0.002	0
Vehicle sales - Light-duty - other (%)	0.096	0.092	0.059	0.021	0.004	0.001	0
Vehicle sales - Medium-duty - diesel (%)	64.7	59.7	42.3	14.4	2.59	0.384	0
Vehicle sales - Medium-duty - EV (%)	0.784	5.07	25.3	60.8	76.5	79.5	80
Vehicle sales - Medium-duty - gasoline (%)	33.7	33.3	25.5	9.32	1.77	0.277	0
Vehicle sales - Medium-duty - hybrid (%)	0.363	0.402	0.341	0.14	0.03	0.005	0
Vehicle sales - Medium-duty - hydrogen FC (%)	0.196	1.27	6.33	15.2	19.1	19.9	20
Vehicle sales - Medium-duty - other (%)	0.253	0.255	0.205	0.083	0.019	0.004	0

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

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Commercial (PJ)	246	247	237	223	212	208	211
Final energy use - Industry (PJ)	381	402	412	418	428	431	439
Final energy use - Residential (PJ)	313	296	274	246	223	210	204
Final energy use - Transportation (PJ)	709	660	582	488	403	349	324

Table 4: *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)	0	31,138	34,700	0	0	0	0
Sales of cooking units - Electric Resistance (%)	32	46	79.9	86.5	86.9	86.9	86.9
Sales of cooking units - Gas (%)	68	54	20.1	13.5	13.1	13.1	13.1
Sales of space heating units - Electric Heat Pump (%)	4.92	28.4	70.7	83.8	85.1	85.1	85.1
Sales of space heating units - Electric Resistance (%)	4.71	8.37	10.5	12.6	13	13	13
Sales of space heating units - Fossil (%)	7.87	4.09	0.778	0.033	0	0	0

Table 4: *E+ scenario - PILLAR 1: Efficiency/Electrification - Commercial (continued)*

Item	2020	2025	2030	2035	2040	2045	2050
Sales of space heating units - Gas Furnace (%)	82.5	59.2	18.1	3.58	1.92	1.89	1.88
Sales of water heating units - Electric Heat Pump (%)	0.167	10.5	54.6	64.4	64.8	64.8	64.8
Sales of water heating units - Electric Resistance (%)	4.19	10.8	28.4	32.3	32.5	32.5	32.5
Sales of water heating units - Gas Furnace (%)	91.5	74.5	14.1	0.593	0	0	0
Sales of water heating units - Other (%)	4.17	4.15	3.01	2.72	2.72	2.72	2.72

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

Item	2020	2025	2030	2035	2040	2045	2050
Electricity distribution capital invested - Cumulative 5-yr (billion $2018)	0	4.76	4.85	8.11	8.58	8.03	8.37

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	0.005	0.924	0	0	0	0
Capital invested - Biomass w/ccu allam power plant (billion $2018)	0	0	0	0	0	0	0
Capital invested - Biomass w/ccu power plant (billion $2018)	0	0	0	0	0	0	0
Capital invested - Offshore Wind - Base (billion $2018)	0	0.157	0.192	0.399	3.46	0	0
Capital invested - Offshore Wind - Constrained (billion $2018)	0	0.226	0.192	0.285	3.52	0	0
Capital invested - Solar PV - Base (billion $2018)	0	21.3	10.4	15.4	11.5	10.4	7.01
Capital invested - Solar PV - Constrained (billion $2018)	0	25	11.8	20	11	12.1	8.72
Capital invested - Wind - Base (billion $2018)	0	0	7.75	5.4	10.5	1.63	1.3
Capital invested - Wind - Constrained (billion $2018)	0	0	20.7	9.24	0.089	0	1.8

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

Item	2020	2025	2030	2035	2040	2045	2050
Biomass power plant (GWh)	0	8.72	1,823	1,823	1,823	1,823	1,823
Biomass w/ccu allam power plant (GWh)	0	0	0	0	0	0	0
Biomass w/ccu power plant (GWh)	0	0	0	0	0	0	0
OffshoreWind - Base land use assumptions (GWh)	0	250	362	883	9,146	0	0
OffshoreWind - Constrained land use assumptions (GWh)	0	250	362	883	9,146	0	0
Solar - Base land use assumptions (GWh)	5,353	30,275	16,362	26,394	20,732	19,927	14,286
Solar - Constrained land use assumptions (GWh)	5,284	28,753	17,435	31,243	13,750	15,993	9,883
Wind - Base land use assumptions (GWh)	269	0	20,052	13,676	25,063	3,826	3,223
Wind - Constrained land use assumptions (GWh)	269	0	48,110	20,678	163	0	2,172

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

Item	2020	2025	2030	2035	2040	2045	2050
Biomass purchases (million $2018/year)	0	135	422	423	423	423	520
Conversion capital investment - Cumulative 5-yr (million $2018)	0	5.03	1,031	30.1	0.478	0	2,067
Number of facilities - Allam power w ccu (quantity)	0	0	0	0	0	0	0
Number of facilities - Beccs hydrogen (quantity)	0	0	0	0	0	0	2
Number of facilities - Diesel (quantity)	0	0	0	1	1	1	1
Number of facilities - Diesel ccu (quantity)	0	0	0	0	0	0	0
Number of facilities - Power (quantity)	0	1	1	1	1	1	1
Number of facilities - Power ccu (quantity)	0	0	0	0	0	0	0
Number of facilities - Pyrolysis (quantity)	0	0	0	1	1	1	1
Number of facilities - Pyrolysis ccu (quantity)	0	0	0	0	0	0	0

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

Item	2020	2025	2030	2035	2040	2045	2050
Number of facilities - Sng (quantity)	0	1	1	1	1	1	1
Number of facilities - Sng ccu (quantity)	0	0	0	0	0	0	0

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

Item	2020	2025	2030	2035	2040	2045	2050
Annual - All (MMT)	0	0	0	3.88	3.76	3.76	6.49
Annual - BECCS (MMT)	0	0	0	0	0	0	2.66
Annual - Cement and lime (MMT)	0	0	0	3.35	3.32	3.42	3.53
Annual - NGCC (MMT)	0	0	0	0.53	0.45	0.34	0.3
Cumulative - All (MMT)	0	0	0	3.88	7.64	11.4	17.9
Cumulative - BECCS (MMT)	0	0	0	0	0	0	2.66
Cumulative - Cement and lime (MMT)	0	0	0	3.35	6.67	10.1	13.6
Cumulative - NGCC (MMT)	0	0	0	0.53	0.98	1.32	1.62

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

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

Table 11: *E+ scenario - PILLAR 4: CCUS - CO2 pipelines*

Item	2020	2025	2030	2035	2040	2045	2050
All (km)	0	0	0	507	507	507	805
Cumulative investment - All (million $2018)	0	0	0	2,259	2,258	2,260	2,500
Cumulative investment - Spur (million $2018)	0	0	0	155	154	157	396
Cumulative investment - Trunk (million $2018)	0	0	0	2,104	2,104	2,104	2,104
Spur (km)	0	0	0	154	154	154	452
Trunk (km)	0	0	0	353	353	353	353

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

Item	2020	2025	2050
Carbon sink potential - Aggressive deployment - Corn-ethanol to energy grasses (1000 tCO2e/y)	0	0	0
Carbon sink potential - Aggressive deployment - Cropland measures (1000 tCO2e/y)	0	0	-1,871
Carbon sink potential - Aggressive deployment - Permanent conservation cover (1000 tCO2e/y)	0	0	-67.3
Carbon sink potential - Aggressive deployment - Total (1000 tCO2e/y)	0	0	-1,938
Carbon sink potential - Moderate deployment - Corn-ethanol to energy grasses (1000 tCO2e/y)	0	0	0
Carbon sink potential - Moderate deployment - Cropland measures (1000 tCO2e/y)	0	0	-986
Carbon sink potential - Moderate deployment - Permanent conservation cover (1000 tCO2e/y)	0	0	-33.7
Carbon sink potential - Moderate deployment - Total (1000 tCO2e/y)	0	0	-1,020
Land impacted for carbon sink - Aggressive deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	0
Land impacted for carbon sink - Aggressive deployment - Cropland measures (1000 hectares)	0	0	1,127
Land impacted for carbon sink - Aggressive deployment - Permanent conservation cover (1000 hectares)	0	0	122

Table 12: *E+ scenario - PILLAR 6: Land sinks - Agriculture (continued)*

Item	2020	2025	2050
Land impacted for carbon sink - Aggressive deployment - Total (1000 hectares)	0	0	1,249
Land impacted for carbon sink - Moderate deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	0
Land impacted for carbon sink - Moderate deployment - Cropland measures (1000 hectares)	0	0	594
Land impacted for carbon sink - Moderate deployment - Permanent conservation cover (1000 hectares)	0	0	61.2
Land impacted for carbon sink - Moderate deployment - Total (1000 hectares)	0	0	655

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

Item	2020	2025	2050
Carbon sink potential - High - Accelerate regeneration (1000 tCO2e/y)	0	0	254
Carbon sink potential - High - All (not counting overlap) (1000 tCO2e/y)	0	0	34,151
Carbon sink potential - High - Avoid deforestation (1000 tCO2e/y)	0	0	2,149
Carbon sink potential - High - Extend rotation length (1000 tCO2e/y)	0	0	9,384
Carbon sink potential - High - Improve plantations (1000 tCO2e/y)	0	0	2,265
Carbon sink potential - High - Increase retention of HWP (1000 tCO2e/y)	0	0	9,560
Carbon sink potential - High - Increase trees outside forests (1000 tCO2e/y)	0	0	702
Carbon sink potential - High - Reforest cropland (1000 tCO2e/y)	0	0	300
Carbon sink potential - High - Reforest pasture (1000 tCO2e/y)	0	0	6,186
Carbon sink potential - High - Restore productivity (1000 tCO2e/y)	0	0	3,351
Carbon sink potential - Low - Accelerate regeneration (1000 tCO2e/y)	0	0	127
Carbon sink potential - Low - All (not counting overlap) (1000 tCO2e/y)	0	0	10,423
Carbon sink potential - Low - Avoid deforestation (1000 tCO2e/y)	0	0	358
Carbon sink potential - Low - Extend rotation length (1000 tCO2e/y)	0	0	3,605
Carbon sink potential - Low - Improve plantations (1000 tCO2e/y)	0	0	1,153
Carbon sink potential - Low - Increase retention of HWP (1000 tCO2e/y)	0	0	3,187
Carbon sink potential - Low - Increase trees outside forests (1000 tCO2e/y)	0	0	246
Carbon sink potential - Low - Reforest cropland (1000 tCO2e/y)	0	0	150
Carbon sink potential - Low - Reforest pasture (1000 tCO2e/y)	0	0	469
Carbon sink potential - Low - Restore productivity (1000 tCO2e/y)	0	0	1,130
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO2e/y)	0	0	190
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO2e/y)	0	0	22,267
Carbon sink potential - Mid - Avoid deforestation (1000 tCO2e/y)	0	0	1,254

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

Item	2020	2025	2050
Carbon sink potential - Mid - Extend rotation length (1000 tCO2e/y)	0	0	6,494
Carbon sink potential - Mid - Improve plantations (1000 tCO2e/y)	0	0	1,689
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO2e/y)	0	0	6,373
Carbon sink potential - Mid - Increase trees outside forests (1000 tCO2e/y)	0	0	474
Carbon sink potential - Mid - Reforest cropland (1000 tCO2e/y)	0	0	225
Carbon sink potential - Mid - Reforest pasture (1000 tCO2e/y)	0	0	3,327
Carbon sink potential - Mid - Restore productivity (1000 tCO2e/y)	0	0	2,240
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)	0	0	41.5
Land impacted for carbon sink potential - High - Avoid deforestation (over 30 years) (1000 hectares)	0	0	291
Land impacted for carbon sink potential - High - Extend rotation length (1000 hectares)	0	0	4,785
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)	0	0	835
Land impacted for carbon sink potential - High - Increase retention of HWP (1000 hectares)	0	0	0
Land impacted for carbon sink potential - High - Increase trees outside forests (1000 hectares)	0	0	66.7
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)	0	0	19.8
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)	0	0	176
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)	0	0	1,111
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)	0	0	7,325
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)	0	0	20.8
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)	0	0	273
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)	0	0	1,833
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)	0	0	417
Land impacted for carbon sink potential - Low - Increase retention of HWP (1000 hectares)	0	0	0
Land impacted for carbon sink potential - Low - Increase trees outside forests (1000 hectares)	0	0	35.1
Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares)	0	0	9.91
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)	0	0	30.5
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)	0	0	672
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)	0	0	3,292
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)	0	0	31.1
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)	0	0	282
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)	0	0	3,309

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

Item	2020	2025	2050
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)	0	0	628
Land impacted for carbon sink potential - Mid - Increase retention of HWP (1000 hectares)	0	0	0
Land impacted for carbon sink potential - Mid - Increase trees outside forests (1000 hectares)	0	0	50.9
Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares)	0	0	14.9
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)	0	0	220
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)	0	0	1,354
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)	0	0	5,890

Table 14: *E+ scenario - IMPACTS - Health*

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal (million 2019$)	0	850	0.777	0.765	0.682	0.487	0.043
Monetary damages from air pollution - Natural Gas (million 2019$)	0	219	159	96	80.9	39.7	15.8
Monetary damages from air pollution - Transportation (million 2019$)	0	939	876	665	385	173	65.5
Premature deaths from air pollution - Coal (deaths)	0	95.4	0.087	0.086	0.077	0.055	0.005
Premature deaths from air pollution - Natural Gas (deaths)	0	24.7	17.9	10.8	9.14	4.48	1.78
Premature deaths from air pollution - Transportation (deaths)	0	106	98.5	74.8	43.3	19.5	7.37

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

Item	2020	2025	2030	2035	2040	2045	2050
By economic sector - Agriculture (jobs)	377	419	1,112	1,315	1,087	840	809
By economic sector - Construction (jobs)	6,941	22,203	21,077	28,476	31,550	29,524	28,852
By economic sector - Manufacturing (jobs)	6,930	12,648	22,817	23,376	19,372	21,199	17,256
By economic sector - Mining (jobs)	5,348	3,933	2,711	1,871	1,247	811	532
By economic sector - Other (jobs)	585	3,445	3,067	4,478	5,132	5,356	5,678
By economic sector - Pipeline (jobs)	648	638	540	692	330	223	190
By economic sector - Professional (jobs)	4,060	9,189	10,304	13,589	16,508	16,062	16,258
By economic sector - Trade (jobs)	3,599	6,477	6,358	8,232	9,877	9,878	10,210
By economic sector - Utilities (jobs)	8,393	13,578	16,421	22,067	26,170	24,088	23,677
By education level - All sectors - Associates degree or some college (jobs)	11,267	22,955	26,700	33,265	35,774	34,758	33,328
By education level - All sectors - Bachelors degree (jobs)	7,803	14,202	16,704	20,276	21,823	21,269	20,425
By education level - All sectors - Doctoral degree (jobs)	250	493	540	680	777	753	747
By education level - All sectors - High school diploma or less (jobs)	15,724	31,486	36,552	45,030	47,515	45,977	43,866
By education level - All sectors - Masters or professional degree (jobs)	1,838	3,393	3,912	4,847	5,383	5,222	5,097
By resource sector - Biomass (jobs)	1,387	1,600	3,016	3,684	3,237	3,069	3,471
By resource sector - CO2 (jobs)	0	0	0	2,189	128	159	444
By resource sector - Coal (jobs)	3,520	2,025	1,063	849	742	670	594
By resource sector - Grid (jobs)	8,161	19,398	26,618	37,207	48,133	44,956	45,446
By resource sector - Natural Gas (jobs)	8,138	8,140	6,617	5,566	5,298	3,940	2,360
By resource sector - Nuclear (jobs)	1,518	989	973	564	0	0	0
By resource sector - Oil (jobs)	6,693	5,733	4,544	3,230	2,161	1,402	860
By resource sector - Solar (jobs)	7,416	34,531	36,719	43,800	37,807	37,496	34,505
By resource sector - Wind (jobs)	50	114	4,858	7,006	13,766	16,288	15,782
Median wages - Annual - All ($2019 per job)	61,780	60,633	61,397	62,227	63,665	64,451	65,651

Table 15: *E+ scenario - IMPACTS - Jobs (continued)*

Item	2020	2025	2030	2035	2040	2045	2050
On-Site or In-Plant Training - Total jobs - 1 to 4 years (jobs)	5,889	11,897	13,673	17,039	18,325	17,712	16,982
On-Site or In-Plant Training - Total jobs - 4 to 10 years (jobs)	2,303	4,923	5,298	6,850	7,603	7,231	7,039
On-Site or In-Plant Training - Total jobs - None (jobs)	5,890	11,817	13,818	16,985	18,082	17,614	16,859
On-Site or In-Plant Training - Total jobs - Over 10 years (jobs)	289	616	710	903	987	951	917
On-Site or In-Plant Training - Total jobs - Up to 1 year (jobs)	22,511	43,277	50,909	62,321	66,275	64,471	61,665
On-the-Job Training - All sectors - 1 to 4 years (jobs)	7,529	15,287	17,510	21,893	23,625	22,808	21,885
On-the-Job Training - All sectors - 4 to 10 years (jobs)	2,206	4,873	5,200	6,791	7,578	7,199	7,027
On-the-Job Training - All sectors - None (jobs)	1,993	3,982	4,522	5,567	5,951	5,802	5,593
On-the-Job Training - All sectors - Over 10 years (jobs)	351	749	877	1,057	1,082	1,060	993
On-the-Job Training - All sectors - Up to 1 year (jobs)	24,803	47,639	56,299	68,789	73,036	71,110	67,966
Related work experience - All sectors - 1 to 4 years (jobs)	13,436	25,881	30,055	37,052	39,750	38,538	36,974
Related work experience - All sectors - 4 to 10 years (jobs)	8,479	16,682	19,316	23,912	25,749	24,946	23,921
Related work experience - All sectors - None (jobs)	5,231	10,462	12,126	15,079	16,158	15,650	15,043
Related work experience - All sectors - Over 10 years (jobs)	2,315	4,437	5,307	6,440	6,815	6,652	6,316
Related work experience - All sectors - Up to 1 year (jobs)	7,420	15,068	17,604	21,614	22,799	22,194	21,208
Wage income - All (million $2019)	2,279	4,398	5,183	6,478	7,085	6,960	6,793

Table 16: *E+ scenario - IMPACTS - Fossil fuel industries*

Item	2020	2025	2030	2035	2040	2045	2050
Natural gas consumption - Annual (tcf)	484	491	414	332	250	157	109
Natural gas consumption - Cumulative (tcf)	0	0	0	0	0	0	9,993
Natural gas production - Annual (tcf)	123	136	129	112	94.7	75.1	58.4
Oil consumption - Annual (million bbls)	137	129	111	85.7	61.8	42.9	28
Oil consumption - Cumulative (million bbls)	0	0	0	0	0	0	2,649
Oil production - Annual (million bbls)	0.006	0.006	0.006	0.006	0.005	0.004	0.003

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

Item	2020	2025	2030	2035	2040	2045	2050
Residential HVAC investment in 2020s vs. REF - Cumulative 5-yr (billion $2018)	0	6.4	6.15	0	0	0	0
Sales of cooking units - Electric Resistance (%)	70.4	71.2	73.9	81	91	97.1	99.2
Sales of cooking units - Gas (%)	29.6	28.8	26.1	19	9.05	2.92	0.786
Sales of space heating units - Electric Heat Pump (%)	25.4	35.1	39.3	51.3	69.7	81.7	85.8
Sales of space heating units - Electric Resistance (%)	18.4	20.5	19.2	15.6	10.3	6.88	5.68
Sales of space heating units - Fossil (%)	12.1	17.5	16.6	13.7	9.14	6.15	5.13
Sales of space heating units - Gas (%)	44.1	26.9	24.9	19.4	10.9	5.32	3.37
Sales of water heating units - Electric Heat Pump (%)	0	1.51	5.8	18.2	37.1	49.5	53.8
Sales of water heating units - Electric Resistance (%)	50.1	65.3	63.5	58.2	50.1	44.9	43.1
Sales of water heating units - Gas Furnace (%)	45.5	30.1	27.7	20.8	10.2	3.27	0.852
Sales of water heating units - Other (%)	4.39	3.08	3.01	2.82	2.52	2.32	2.25

Table 18: *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	0	237	495	1,674	5,255	7,661
Public EV charging plugs - DC Fast (1000 units)	0.39	0	0.815	0	4.16	0	11.6
Public EV charging plugs - L2 (1000 units)	1.37	0	19.6	0	99.8	0	277
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 (%)	1.44	1.87	2.03	1.61	1.02	0.522	0.224
Vehicle sales - Light-duty - EV (%)	2.03	5	12.5	26.9	49.5	72.8	87.9
Vehicle sales - Light-duty - gasoline (%)	91.3	86.9	78.6	65.3	44.9	24.1	10.7
Vehicle sales - Light-duty - hybrid (%)	5.01	5.8	6.46	5.82	4.3	2.51	1.2
Vehicle sales - Light-duty - hydrogen FC (%)	0.112	0.377	0.319	0.241	0.169	0.093	0.043
Vehicle sales - Light-duty - other (%)	0.098	0.101	0.091	0.079	0.057	0.031	0.014
Vehicle sales - Medium-duty - diesel (%)	64.8	62.2	57.7	49.4	35.6	19.6	8.37
Vehicle sales - Medium-duty - EV (%)	0.664	1.94	5.49	14.3	31.4	52.6	68
Vehicle sales - Medium-duty - gasoline (%)	33.8	34.7	34.7	31.9	24.4	14.2	6.33
Vehicle sales - Medium-duty - hybrid (%)	0.363	0.418	0.464	0.478	0.414	0.275	0.141
Vehicle sales - Medium-duty - hydrogen FC (%)	0.166	0.485	1.37	3.58	7.86	13.2	17
Vehicle sales - Medium-duty - other (%)	0.253	0.266	0.279	0.286	0.258	0.184	0.102

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

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Commercial (PJ)	246	247	244	240	233	227	224
Final energy use - Industry (PJ)	381	403	413	422	433	437	443
Final energy use - Residential (PJ)	313	297	288	278	263	239	221
Final energy use - Transportation (PJ)	710	666	609	562	524	480	428

Table 20: *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)	0	31,112	34,614	0	0	0	0
Sales of cooking units - Electric Resistance (%)	32	36.2	40.9	53.4	71	81.7	85.5
Sales of cooking units - Gas (%)	68	63.8	59.1	46.6	29	18.3	14.5
Sales of space heating units - Electric Heat Pump (%)	4.92	20.4	25.2	39.1	61.2	76.9	82.9
Sales of space heating units - Electric Resistance (%)	4.71	8.04	8.28	9.07	10.5	11.9	12.7
Sales of space heating units - Fossil (%)	7.87	4.72	4.38	3.33	1.64	0.517	0.135
Sales of space heating units - Gas Furnace (%)	82.5	66.9	62.2	48.4	26.6	10.7	4.34
Sales of water heating units - Electric Heat Pump (%)	0.167	2.04	7.05	21.5	43.6	58.1	63.1
Sales of water heating units - Electric Resistance (%)	4.19	7.46	9.4	15.2	24	29.7	31.8
Sales of water heating units - Gas Furnace (%)	91.5	86.1	79.2	59.5	29.1	9.3	2.42
Sales of water heating units - Other (%)	4.17	4.38	4.34	3.87	3.3	2.91	2.76

Table 21: *E- scenario - PILLAR 1: Efficiency/Electrification - Electricity demand*

Item	2020	2025	2030	2035	2040	2045	2050
Electricity distribution capital invested - Cumulative 5-yr (billion $2018)	0	4.07	4.08	5.45	5.62	6.97	7.29

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

Item	2020	2025	2050
Carbon sink potential - Aggressive deployment - Corn-ethanol to energy grasses (1000 tCO2e/y)	0	0	0

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

Item	2020	2025	2050
Carbon sink potential - Aggressive deployment - Cropland measures (1000 tCO2e/y)	0	0	-1,871
Carbon sink potential - Aggressive deployment - Permanent conservation cover (1000 tCO2e/y)	0	0	-67.3
Carbon sink potential - Aggressive deployment - Total (1000 tCO2e/y)	0	0	-1,938
Carbon sink potential - Moderate deployment - Corn-ethanol to energy grasses (1000 tCO2e/y)	0	0	0
Carbon sink potential - Moderate deployment - Cropland measures (1000 tCO2e/y)	0	0	-986
Carbon sink potential - Moderate deployment - Permanent conservation cover (1000 tCO2e/y)	0	0	-33.7
Carbon sink potential - Moderate deployment - Total (1000 tCO2e/y)	0	0	-1,020
Land impacted for carbon sink - Aggressive deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	0
Land impacted for carbon sink - Aggressive deployment - Cropland measures (1000 hectares)	0	0	1,127
Land impacted for carbon sink - Aggressive deployment - Permanent conservation cover (1000 hectares)	0	0	122
Land impacted for carbon sink - Aggressive deployment - Total (1000 hectares)	0	0	1,249
Land impacted for carbon sink - Moderate deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	0
Land impacted for carbon sink - Moderate deployment - Cropland measures (1000 hectares)	0	0	594
Land impacted for carbon sink - Moderate deployment - Permanent conservation cover (1000 hectares)	0	0	61.2
Land impacted for carbon sink - Moderate deployment - Total (1000 hectares)	0	0	655

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

Item	2020	2025	2050
Carbon sink potential - High - Accelerate regeneration (1000 tCO2e/y)	0	0	254
Carbon sink potential - High - All (not counting overlap) (1000 tCO2e/y)	0	0	34,151
Carbon sink potential - High - Avoid deforestation (1000 tCO2e/y)	0	0	2,149
Carbon sink potential - High - Extend rotation length (1000 tCO2e/y)	0	0	9,384
Carbon sink potential - High - Improve plantations (1000 tCO2e/y)	0	0	2,265
Carbon sink potential - High - Increase retention of HWP (1000 tCO2e/y)	0	0	9,560
Carbon sink potential - High - Increase trees outside forests (1000 tCO2e/y)	0	0	702
Carbon sink potential - High - Reforest cropland (1000 tCO2e/y)	0	0	300
Carbon sink potential - High - Reforest pasture (1000 tCO2e/y)	0	0	6,186
Carbon sink potential - High - Restore productivity (1000 tCO2e/y)	0	0	3,351
Carbon sink potential - Low - Accelerate regeneration (1000 tCO2e/y)	0	0	127
Carbon sink potential - Low - All (not counting overlap) (1000 tCO2e/y)	0	0	10,423

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

Item	2020	2025	2050
Carbon sink potential - Low - Avoid deforestation (1000 tCO2e/y)	0	0	358
Carbon sink potential - Low - Extend rotation length (1000 tCO2e/y)	0	0	3,605
Carbon sink potential - Low - Improve plantations (1000 tCO2e/y)	0	0	1,153
Carbon sink potential - Low - Increase retention of HWP (1000 tCO2e/y)	0	0	3,187
Carbon sink potential - Low - Increase trees outside forests (1000 tCO2e/y)	0	0	246
Carbon sink potential - Low - Reforest cropland (1000 tCO2e/y)	0	0	150
Carbon sink potential - Low - Reforest pasture (1000 tCO2e/y)	0	0	469
Carbon sink potential - Low - Restore productivity (1000 tCO2e/y)	0	0	1,130
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO2e/y)	0	0	190
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO2e/y)	0	0	22,267
Carbon sink potential - Mid - Avoid deforestation (1000 tCO2e/y)	0	0	1,254
Carbon sink potential - Mid - Extend rotation length (1000 tCO2e/y)	0	0	6,494
Carbon sink potential - Mid - Improve plantations (1000 tCO2e/y)	0	0	1,689
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO2e/y)	0	0	6,373
Carbon sink potential - Mid - Increase trees outside forests (1000 tCO2e/y)	0	0	474
Carbon sink potential - Mid - Reforest cropland (1000 tCO2e/y)	0	0	225
Carbon sink potential - Mid - Reforest pasture (1000 tCO2e/y)	0	0	3,327
Carbon sink potential - Mid - Restore productivity (1000 tCO2e/y)	0	0	2,240
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)	0	0	41.5
Land impacted for carbon sink potential - High - Avoid deforestation (over 30 years) (1000 hectares)	0	0	291
Land impacted for carbon sink potential - High - Extend rotation length (1000 hectares)	0	0	4,785
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)	0	0	835
Land impacted for carbon sink potential - High - Increase retention of HWP (1000 hectares)	0	0	0
Land impacted for carbon sink potential - High - Increase trees outside forests (1000 hectares)	0	0	66.7
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)	0	0	19.8
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)	0	0	176
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)	0	0	1,111
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)	0	0	7,325
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)	0	0	20.8
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)	0	0	273

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

Item	2020	2025	2050
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)	0	0	1,833
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)	0	0	417
Land impacted for carbon sink potential - Low - Increase retention of HWP (1000 hectares)	0	0	0
Land impacted for carbon sink potential - Low - Increase trees outside forests (1000 hectares)	0	0	35.1
Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares)	0	0	9.91
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)	0	0	30.5
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)	0	0	672
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)	0	0	3,292
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)	0	0	31.1
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)	0	0	282
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)	0	0	3,309
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)	0	0	628
Land impacted for carbon sink potential - Mid - Increase retention of HWP (1000 hectares)	0	0	0
Land impacted for carbon sink potential - Mid - Increase trees outside forests (1000 hectares)	0	0	50.9
Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares)	0	0	14.9
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)	0	0	220
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)	0	0	1,354
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)	0	0	5,890

Table 24: *E- scenario - IMPACTS - Health*

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal (million 2019$)	0	850	0.777	0.765	0.682	0.487	0.043
Monetary damages from air pollution - Natural Gas (million 2019$)	0	187	126	51.6	22.9	7.67	4.53
Monetary damages from air pollution - Transportation (million 2019$)	0	957	969	943	850	676	462
Premature deaths from air pollution - Coal (deaths)	0	95.4	0.087	0.086	0.077	0.055	0.005
Premature deaths from air pollution - Natural Gas (deaths)	0	21.1	14.3	5.82	2.59	0.866	0.512
Premature deaths from air pollution - Transportation (deaths)	0	108	109	106	95.6	76	51.9

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

Item	2020	2025	2030	2035	2040	2045	2050
Residential HVAC investment in 2020s vs. REF - Cumulative 5-yr (billion $2018)	0	6.43	6.21	0	0	0	0
Sales of cooking units - Electric Resistance (%)	70.5	76.8	96	99.8	100	100	100
Sales of cooking units - Gas (%)	29.5	23.2	3.97	0.2	0	0	0
Sales of space heating units - Electric Heat Pump (%)	25.4	42.2	78.8	86.9	87.3	87.3	87.3

Table 25: *E+RE+ scenario - PILLAR 1: Efficiency/Electrification - Residential (continued)*

Item	2020	2025	2030	2035	2040	2045	2050
Sales of space heating units - Electric Resistance (%)	18.4	18.4	7.74	5.33	5.23	5.33	5.34
Sales of space heating units - Fossil (%)	12.1	15.8	6.87	4.89	4.78	4.71	4.71
Sales of space heating units - Gas (%)	44.1	23.6	6.62	2.84	2.69	2.7	2.7
Sales of water heating units - Electric Heat Pump (%)	0	8.78	46.5	54.9	55.3	55.3	55.3
Sales of water heating units - Electric Resistance (%)	50.1	62.2	46.3	42.7	42.5	42.5	42.5
Sales of water heating units - Gas Furnace (%)	45.5	26.1	4.92	0.208	0	0	0
Sales of water heating units - Other (%)	4.39	2.95	2.33	2.2	2.21	2.22	2.23

Table 26: *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)	0	1,456	3,742	6,046	9,166	9,967	9,508
Public EV charging plugs - DC Fast (1000 units)	0.39	0	2.58	0	11.2	0	18
Public EV charging plugs - L2 (1000 units)	1.37	0	61.9	0	268	0	433
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 (%)	1.42	1.7	1.21	0.385	0.072	0.013	0
Vehicle sales - Light-duty - EV (%)	4.33	16.5	48.4	82.6	96.4	99.3	100
Vehicle sales - Light-duty - gasoline (%)	89.2	76.6	46.8	15.8	3.19	0.587	0
Vehicle sales - Light-duty - hybrid (%)	4.83	4.83	3.35	1.23	0.302	0.067	0
Vehicle sales - Light-duty - hydrogen FC (%)	0.11	0.333	0.193	0.059	0.012	0.002	0
Vehicle sales - Light-duty - other (%)	0.096	0.092	0.059	0.021	0.004	0.001	0
Vehicle sales - Medium-duty - diesel (%)	64.7	59.7	42.3	14.4	2.59	0.384	0
Vehicle sales - Medium-duty - EV (%)	0.784	5.07	25.3	60.8	76.5	79.5	80
Vehicle sales - Medium-duty - gasoline (%)	33.7	33.3	25.5	9.32	1.77	0.277	0
Vehicle sales - Medium-duty - hybrid (%)	0.363	0.402	0.341	0.14	0.03	0.005	0
Vehicle sales - Medium-duty - hydrogen FC (%)	0.196	1.27	6.33	15.2	19.1	19.9	20
Vehicle sales - Medium-duty - other (%)	0.253	0.255	0.205	0.083	0.019	0.004	0

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

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Commercial (PJ)	246	247	237	223	212	208	211
Final energy use - Industry (PJ)	381	402	412	418	428	431	439
Final energy use - Residential (PJ)	313	296	274	246	223	210	204
Final energy use - Transportation (PJ)	709	660	582	488	403	349	324

Table 28: *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)	0	31,138	34,700	0	0	0	0
Sales of cooking units - Electric Resistance (%)	32	46	79.9	86.5	86.9	86.9	86.9
Sales of cooking units - Gas (%)	68	54	20.1	13.5	13.1	13.1	13.1
Sales of space heating units - Electric Heat Pump (%)	4.92	28.4	70.7	83.8	85.1	85.1	85.1
Sales of space heating units - Electric Resistance (%)	4.71	8.37	10.5	12.6	13	13	13
Sales of space heating units - Fossil (%)	7.87	4.09	0.778	0.033	0	0	0
Sales of space heating units - Gas Furnace (%)	82.5	59.2	18.1	3.58	1.92	1.89	1.88
Sales of water heating units - Electric Heat Pump (%)	0.167	10.5	54.6	64.4	64.8	64.8	64.8
Sales of water heating units - Electric Resistance (%)	4.19	10.8	28.4	32.3	32.5	32.5	32.5
Sales of water heating units - Gas Furnace (%)	91.5	74.5	14.1	0.593	0	0	0

Table 28: *E+RE+ scenario - PILLAR 1: Efficiency/Electrification - Commercial (continued)*

Item	2020	2025	2030	2035	2040	2045	2050
Sales of water heating units - Other (%)	4.17	4.15	3.01	2.72	2.72	2.72	2.72

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

Item	2020	2025	2030	2035	2040	2045	2050
Electricity distribution capital invested - Cumulative 5-yr (billion $2018)	0	4.76	4.85	8.11	8.58	8.03	8.37

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	0.157	0.251	4.43	9.84	11.8	0
Capital invested - Solar PV - Base (billion $2018)	0	21.3	15.1	26.2	10.3	10.1	106
Capital invested - Wind - Base (billion $2018)	0	0	10.7	7.72	14.1	1.18	0

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	250	471	9,919	25,419	37,477	0
OffshoreWind - Constrained land use assumptions (GWh)	0	359	362	9,919	0	0	62,896
Solar - Base land use assumptions (GWh)	6,021	30,212	23,787	44,891	18,622	19,488	217,400
Solar - Constrained land use assumptions (GWh)	10,039	26,520	20,752	28,091	17,808	16,772	263,440
Wind - Base land use assumptions (GWh)	269	0	27,231	18,704	31,472	2,501	0
Wind - Constrained land use assumptions (GWh)	269	0	61,962	6,989	0	0	33,675

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

Item	2020	2025	2050
Carbon sink potential - Aggressive deployment - Corn-ethanol to energy grasses (1000 tCO2e/y)	0	0	0
Carbon sink potential - Aggressive deployment - Cropland measures (1000 tCO2e/y)	0	0	-1,871
Carbon sink potential - Aggressive deployment - Permanent conservation cover (1000 tCO2e/y)	0	0	-67.3
Carbon sink potential - Aggressive deployment - Total (1000 tCO2e/y)	0	0	-1,938
Carbon sink potential - Moderate deployment - Corn-ethanol to energy grasses (1000 tCO2e/y)	0	0	0
Carbon sink potential - Moderate deployment - Cropland measures (1000 tCO2e/y)	0	0	-986
Carbon sink potential - Moderate deployment - Permanent conservation cover (1000 tCO2e/y)	0	0	-33.7
Carbon sink potential - Moderate deployment - Total (1000 tCO2e/y)	0	0	-1,020
Land impacted for carbon sink - Aggressive deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	0
Land impacted for carbon sink - Aggressive deployment - Cropland measures (1000 hectares)	0	0	1,127
Land impacted for carbon sink - Aggressive deployment - Permanent conservation cover (1000 hectares)	0	0	122
Land impacted for carbon sink - Aggressive deployment - Total (1000 hectares)	0	0	1,249
Land impacted for carbon sink - Moderate deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	0
Land impacted for carbon sink - Moderate deployment - Cropland measures (1000 hectares)	0	0	594

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

Item	2020	2025	2050
Land impacted for carbon sink - Moderate deployment - Permanent conservation cover (1000 hectares)	0	0	61.2
Land impacted for carbon sink - Moderate deployment - Total (1000 hectares)	0	0	655

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

Item	2020	2025	2050
Carbon sink potential - High - Accelerate regeneration (1000 tCO2e/y)	0	0	254
Carbon sink potential - High - All (not counting overlap) (1000 tCO2e/y)	0	0	34,151
Carbon sink potential - High - Avoid deforestation (1000 tCO2e/y)	0	0	2,149
Carbon sink potential - High - Extend rotation length (1000 tCO2e/y)	0	0	9,384
Carbon sink potential - High - Improve plantations (1000 tCO2e/y)	0	0	2,265
Carbon sink potential - High - Increase retention of HWP (1000 tCO2e/y)	0	0	9,560
Carbon sink potential - High - Increase trees outside forests (1000 tCO2e/y)	0	0	702
Carbon sink potential - High - Reforest cropland (1000 tCO2e/y)	0	0	300
Carbon sink potential - High - Reforest pasture (1000 tCO2e/y)	0	0	6,186
Carbon sink potential - High - Restore productivity (1000 tCO2e/y)	0	0	3,351
Carbon sink potential - Low - Accelerate regeneration (1000 tCO2e/y)	0	0	127
Carbon sink potential - Low - All (not counting overlap) (1000 tCO2e/y)	0	0	10,423
Carbon sink potential - Low - Avoid deforestation (1000 tCO2e/y)	0	0	358
Carbon sink potential - Low - Extend rotation length (1000 tCO2e/y)	0	0	3,605
Carbon sink potential - Low - Improve plantations (1000 tCO2e/y)	0	0	1,153
Carbon sink potential - Low - Increase retention of HWP (1000 tCO2e/y)	0	0	3,187
Carbon sink potential - Low - Increase trees outside forests (1000 tCO2e/y)	0	0	246
Carbon sink potential - Low - Reforest cropland (1000 tCO2e/y)	0	0	150
Carbon sink potential - Low - Reforest pasture (1000 tCO2e/y)	0	0	469
Carbon sink potential - Low - Restore productivity (1000 tCO2e/y)	0	0	1,130
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO2e/y)	0	0	190
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO2e/y)	0	0	22,267
Carbon sink potential - Mid - Avoid deforestation (1000 tCO2e/y)	0	0	1,254
Carbon sink potential - Mid - Extend rotation length (1000 tCO2e/y)	0	0	6,494
Carbon sink potential - Mid - Improve plantations (1000 tCO2e/y)	0	0	1,689
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO2e/y)	0	0	6,373
Carbon sink potential - Mid - Increase trees outside forests (1000 tCO2e/y)	0	0	474

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

Item	2020	2025	2050
Carbon sink potential - Mid - Reforest cropland (1000 tCO2e/y)	0	0	225
Carbon sink potential - Mid - Reforest pasture (1000 tCO2e/y)	0	0	3,327
Carbon sink potential - Mid - Restore productivity (1000 tCO2e/y)	0	0	2,240
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)	0	0	41.5
Land impacted for carbon sink potential - High - Avoid deforestation (over 30 years) (1000 hectares)	0	0	291
Land impacted for carbon sink potential - High - Extend rotation length (1000 hectares)	0	0	4,785
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)	0	0	835
Land impacted for carbon sink potential - High - Increase retention of HWP (1000 hectares)	0	0	0
Land impacted for carbon sink potential - High - Increase trees outside forests (1000 hectares)	0	0	66.7
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)	0	0	19.8
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)	0	0	176
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)	0	0	1,111
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)	0	0	7,325
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)	0	0	20.8
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)	0	0	273
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)	0	0	1,833
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)	0	0	417
Land impacted for carbon sink potential - Low - Increase retention of HWP (1000 hectares)	0	0	0
Land impacted for carbon sink potential - Low - Increase trees outside forests (1000 hectares)	0	0	35.1
Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares)	0	0	9.91
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)	0	0	30.5
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)	0	0	672
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)	0	0	3,292
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)	0	0	31.1
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)	0	0	282
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)	0	0	3,309
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)	0	0	628
Land impacted for carbon sink potential - Mid - Increase retention of HWP (1000 hectares)	0	0	0
Land impacted for carbon sink potential - Mid - Increase trees outside forests (1000 hectares)	0	0	50.9
Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares)	0	0	14.9

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

Item	2020	2025	2050
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)	0	0	220
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)	0	0	1,354
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)	0	0	5,890

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

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal (million 2019$)	0	850	0.777	0.765	0.682	0.487	0.043
Monetary damages from air pollution - Natural Gas (million 2019$)	0	169	128	75.9	48.4	14.7	3.66
Monetary damages from air pollution - Transportation (million 2019$)	0	939	876	665	385	173	65.5
Premature deaths from air pollution - Coal (deaths)	0	95.4	0.087	0.086	0.077	0.055	0.005
Premature deaths from air pollution - Natural Gas (deaths)	0	19.1	14.5	8.57	5.47	1.66	0.413
Premature deaths from air pollution - Transportation (deaths)	0	106	98.5	74.8	43.3	19.5	7.37

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

Item	2020	2025	2030	2035	2040	2045	2050
Residential HVAC investment in 2020s vs. REF - Cumulative 5-yr (billion $2018)	0	6.43	6.21	0	0	0	0
Sales of cooking units - Electric Resistance (%)	70.5	76.8	96	99.8	100	100	100
Sales of cooking units - Gas (%)	29.5	23.2	3.97	0.2	0	0	0
Sales of space heating units - Electric Heat Pump (%)	25.4	42.2	78.8	86.9	87.3	87.3	87.3
Sales of space heating units - Electric Resistance (%)	18.4	18.4	7.74	5.33	5.23	5.33	5.34
Sales of space heating units - Fossil (%)	12.1	15.8	6.87	4.89	4.78	4.71	4.71
Sales of space heating units - Gas (%)	44.1	23.6	6.62	2.84	2.69	2.7	2.7
Sales of water heating units - Electric Heat Pump (%)	0	8.78	46.5	54.9	55.3	55.3	55.3
Sales of water heating units - Electric Resistance (%)	50.1	62.2	46.3	42.7	42.5	42.5	42.5
Sales of water heating units - Gas Furnace (%)	45.5	26.1	4.92	0.208	0	0	0
Sales of water heating units - Other (%)	4.39	2.95	2.33	2.2	2.21	2.22	2.23

Table 36: *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)	0	1,456	3,742	6,046	9,166	9,967	9,508
Public EV charging plugs - DC Fast (1000 units)	0.39	0	2.58	0	11.2	0	18
Public EV charging plugs - L2 (1000 units)	1.37	0	61.9	0	268	0	433
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 (%)	1.42	1.7	1.21	0.385	0.072	0.013	0
Vehicle sales - Light-duty - EV (%)	4.33	16.5	48.4	82.6	96.4	99.3	100
Vehicle sales - Light-duty - gasoline (%)	89.2	76.6	46.8	15.8	3.19	0.587	0
Vehicle sales - Light-duty - hybrid (%)	4.83	4.83	3.35	1.23	0.302	0.067	0
Vehicle sales - Light-duty - hydrogen FC (%)	0.11	0.333	0.193	0.059	0.012	0.002	0
Vehicle sales - Light-duty - other (%)	0.096	0.092	0.059	0.021	0.004	0.001	0
Vehicle sales - Medium-duty - diesel (%)	64.7	59.7	42.3	14.4	2.59	0.384	0

Table 36: *E+RE- scenario - PILLAR 1: Efficiency/Electrification - Transportation (continued)*

Item	2020	2025	2030	2035	2040	2045	2050
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 37: *E+RE- scenario - PILLAR 1: Efficiency/Electrification - Overview*

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Commercial (PJ)	246	247	237	223	212	208	211
Final energy use - Industry (PJ)	381	402	412	418	428	431	439
Final energy use - Residential (PJ)	313	296	274	246	223	210	204
Final energy use - Transportation (PJ)	709	660	582	488	403	349	324

Table 38: *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)	0	31,138	34,700	0	0	0	0
Sales of cooking units - Electric Resistance (%)	32	46	79.9	86.5	86.9	86.9	86.9
Sales of cooking units - Gas (%)	68	54	20.1	13.5	13.1	13.1	13.1
Sales of space heating units - Electric Heat Pump (%)	4.92	28.4	70.7	83.8	85.1	85.1	85.1
Sales of space heating units - Electric Resistance (%)	4.71	8.37	10.5	12.6	13	13	13
Sales of space heating units - Fossil (%)	7.87	4.09	0.778	0.033	0	0	0
Sales of space heating units - Gas Furnace (%)	82.5	59.2	18.1	3.58	1.92	1.89	1.88
Sales of water heating units - Electric Heat Pump (%)	0.167	10.5	54.6	64.4	64.8	64.8	64.8
Sales of water heating units - Electric Resistance (%)	4.19	10.8	28.4	32.3	32.5	32.5	32.5
Sales of water heating units - Gas Furnace (%)	91.5	74.5	14.1	0.593	0	0	0
Sales of water heating units - Other (%)	4.17	4.15	3.01	2.72	2.72	2.72	2.72

Table 39: *E+RE- scenario - PILLAR 1: Efficiency/Electrification - Electricity demand*

Item	2020	2025	2030	2035	2040	2045	2050
Electricity distribution capital invested - Cumulative 5-yr (billion $2018)	0	4.76	4.85	8.11	8.58	8.03	8.37

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	0.157	0.192	0	0	0.088	0
Capital invested - Offshore Wind - Constrained (billion $2018)	0	0	0	0	0	0	0
Capital invested - Solar PV - Base (billion $2018)	0	9.13	8.28	3.3	7.12	6.22	0.463
Capital invested - Solar PV - Constrained (billion $2018)	0	5.29	4.41	2.11	5.62	7.88	0.463
Capital invested - Wind - Base (billion $2018)	0	0.803	2.45	0	0.453	0.085	0.118
Capital invested - Wind - Constrained (billion $2018)	0	1.14	9.89	0	0.816	0.294	0.29

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	250	362	0	0	269	0
OffshoreWind - Constrained land use assumptions (GWh)	0	359	0	362	0	267	0
Solar - Base land use assumptions (GWh)	5,869	13,021	13,112	5,646	12,945	11,994	948
Solar - Constrained land use assumptions (GWh)	6,759	7,485	6,977	3,630	10,268	15,164	935

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

Item	2020	2025	2030	2035	2040	2045	2050
Wind - Base land use assumptions (GWh)	269	2,026	6,490	0	1,292	247	366
Wind - Constrained land use assumptions (GWh)	269	2,862	24,736	0	2,149	783	821

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

Item	2020	2025	2050
Carbon sink potential - Aggressive deployment - Corn-ethanol to energy grasses (1000 tCO2e/y)	0	0	0
Carbon sink potential - Aggressive deployment - Cropland measures (1000 tCO2e/y)	0	0	-1,871
Carbon sink potential - Aggressive deployment - Permanent conservation cover (1000 tCO2e/y)	0	0	-67.3
Carbon sink potential - Aggressive deployment - Total (1000 tCO2e/y)	0	0	-1,938
Carbon sink potential - Moderate deployment - Corn-ethanol to energy grasses (1000 tCO2e/y)	0	0	0
Carbon sink potential - Moderate deployment - Cropland measures (1000 tCO2e/y)	0	0	-986
Carbon sink potential - Moderate deployment - Permanent conservation cover (1000 tCO2e/y)	0	0	-33.7
Carbon sink potential - Moderate deployment - Total (1000 tCO2e/y)	0	0	-1,020
Land impacted for carbon sink - Aggressive deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	0
Land impacted for carbon sink - Aggressive deployment - Cropland measures (1000 hectares)	0	0	1,127
Land impacted for carbon sink - Aggressive deployment - Permanent conservation cover (1000 hectares)	0	0	122
Land impacted for carbon sink - Aggressive deployment - Total (1000 hectares)	0	0	1,249
Land impacted for carbon sink - Moderate deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	0
Land impacted for carbon sink - Moderate deployment - Cropland measures (1000 hectares)	0	0	594
Land impacted for carbon sink - Moderate deployment - Permanent conservation cover (1000 hectares)	0	0	61.2
Land impacted for carbon sink - Moderate deployment - Total (1000 hectares)	0	0	655

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

Item	2020	2025	2050
Carbon sink potential - High - Accelerate regeneration (1000 tCO2e/y)	0	0	254
Carbon sink potential - High - All (not counting overlap) (1000 tCO2e/y)	0	0	34,151
Carbon sink potential - High - Avoid deforestation (1000 tCO2e/y)	0	0	2,149
Carbon sink potential - High - Extend rotation length (1000 tCO2e/y)	0	0	9,384
Carbon sink potential - High - Improve plantations (1000 tCO2e/y)	0	0	2,265
Carbon sink potential - High - Increase retention of HWP (1000 tCO2e/y)	0	0	9,560
Carbon sink potential - High - Increase trees outside forests (1000 tCO2e/y)	0	0	702
Carbon sink potential - High - Reforest cropland (1000 tCO2e/y)	0	0	300

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

Item	2020	2025	2050
Carbon sink potential - High - Reforest pasture (1000 tCO2e/y)	0	0	6,186
Carbon sink potential - High - Restore productivity (1000 tCO2e/y)	0	0	3,351
Carbon sink potential - Low - Accelerate regeneration (1000 tCO2e/y)	0	0	127
Carbon sink potential - Low - All (not counting overlap) (1000 tCO2e/y)	0	0	10,423
Carbon sink potential - Low - Avoid deforestation (1000 tCO2e/y)	0	0	358
Carbon sink potential - Low - Extend rotation length (1000 tCO2e/y)	0	0	3,605
Carbon sink potential - Low - Improve plantations (1000 tCO2e/y)	0	0	1,153
Carbon sink potential - Low - Increase retention of HWP (1000 tCO2e/y)	0	0	3,187
Carbon sink potential - Low - Increase trees outside forests (1000 tCO2e/y)	0	0	246
Carbon sink potential - Low - Reforest cropland (1000 tCO2e/y)	0	0	150
Carbon sink potential - Low - Reforest pasture (1000 tCO2e/y)	0	0	469
Carbon sink potential - Low - Restore productivity (1000 tCO2e/y)	0	0	1,130
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO2e/y)	0	0	190
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO2e/y)	0	0	22,267
Carbon sink potential - Mid - Avoid deforestation (1000 tCO2e/y)	0	0	1,254
Carbon sink potential - Mid - Extend rotation length (1000 tCO2e/y)	0	0	6,494
Carbon sink potential - Mid - Improve plantations (1000 tCO2e/y)	0	0	1,689
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO2e/y)	0	0	6,373
Carbon sink potential - Mid - Increase trees outside forests (1000 tCO2e/y)	0	0	474
Carbon sink potential - Mid - Reforest cropland (1000 tCO2e/y)	0	0	225
Carbon sink potential - Mid - Reforest pasture (1000 tCO2e/y)	0	0	3,327
Carbon sink potential - Mid - Restore productivity (1000 tCO2e/y)	0	0	2,240
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)	0	0	41.5
Land impacted for carbon sink potential - High - Avoid deforestation (over 30 years) (1000 hectares)	0	0	291
Land impacted for carbon sink potential - High - Extend rotation length (1000 hectares)	0	0	4,785
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)	0	0	835
Land impacted for carbon sink potential - High - Increase retention of HWP (1000 hectares)	0	0	0
Land impacted for carbon sink potential - High - Increase trees outside forests (1000 hectares)	0	0	66.7
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)	0	0	19.8
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)	0	0	176
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)	0	0	1,111

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

Item	2020	2025	2050
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)	0	0	7,325
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)	0	0	20.8
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)	0	0	273
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)	0	0	1,833
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)	0	0	417
Land impacted for carbon sink potential - Low - Increase retention of HWP (1000 hectares)	0	0	0
Land impacted for carbon sink potential - Low - Increase trees outside forests (1000 hectares)	0	0	35.1
Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares)	0	0	9.91
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)	0	0	30.5
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)	0	0	672
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)	0	0	3,292
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)	0	0	31.1
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)	0	0	282
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)	0	0	3,309
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)	0	0	628
Land impacted for carbon sink potential - Mid - Increase retention of HWP (1000 hectares)	0	0	0
Land impacted for carbon sink potential - Mid - Increase trees outside forests (1000 hectares)	0	0	50.9
Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares)	0	0	14.9
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)	0	0	220
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)	0	0	1,354
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)	0	0	5,890

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

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal (million 2019$)	0	850	0.777	0.765	0.682	0.487	0.043
Monetary damages from air pollution - Natural Gas (million 2019$)	0	213	161	173	132	42.3	13.8
Monetary damages from air pollution - Transportation (million 2019$)	0	939	876	665	385	173	65.5
Premature deaths from air pollution - Coal (deaths)	0	95.4	0.087	0.086	0.077	0.055	0.005
Premature deaths from air pollution - Natural Gas (deaths)	0	24.1	18.2	19.5	14.9	4.78	1.56
Premature deaths from air pollution - Transportation (deaths)	0	106	98.5	74.8	43.3	19.5	7.37

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

Item	2020	2025	2030	2035	2040	2045	2050
Residential HVAC investment in 2020s vs. REF - Cumulative 5-yr (billion $2018)	0	6.4	6.15	0	0	0	0
Sales of cooking units - Electric Resistance (%)	70.4	71.2	73.9	81	91	97.1	99.2
Sales of cooking units - Gas (%)	29.6	28.8	26.1	19	9.05	2.92	0.786
Sales of space heating units - Electric Heat Pump (%)	25.4	35.1	39.3	51.3	69.7	81.7	85.8
Sales of space heating units - Electric Resistance (%)	18.4	20.5	19.2	15.6	10.3	6.88	5.68
Sales of space heating units - Fossil (%)	12.1	17.5	16.6	13.7	9.14	6.15	5.13
Sales of space heating units - Gas (%)	44.1	26.9	24.9	19.4	10.9	5.32	3.37
Sales of water heating units - Electric Heat Pump (%)	0	1.51	5.8	18.2	37.1	49.5	53.8
Sales of water heating units - Electric Resistance (%)	50.1	65.3	63.5	58.2	50.1	44.9	43.1
Sales of water heating units - Gas Furnace (%)	45.5	30.1	27.7	20.8	10.2	3.27	0.852
Sales of water heating units - Other (%)	4.39	3.08	3.01	2.82	2.52	2.32	2.25

Table 46: *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	0	237	495	1,674	5,255	7,661
Public EV charging plugs - DC Fast (1000 units)	0.39	0	0.815	0	4.16	0	11.6
Public EV charging plugs - L2 (1000 units)	1.37	0	19.6	0	99.8	0	277
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 (%)	1.44	1.87	2.03	1.61	1.02	0.522	0.224
Vehicle sales - Light-duty - EV (%)	2.03	5	12.5	26.9	49.5	72.8	87.9
Vehicle sales - Light-duty - gasoline (%)	91.3	86.9	78.6	65.3	44.9	24.1	10.7
Vehicle sales - Light-duty - hybrid (%)	5.01	5.8	6.46	5.82	4.3	2.51	1.2
Vehicle sales - Light-duty - hydrogen FC (%)	0.112	0.377	0.319	0.241	0.169	0.093	0.043
Vehicle sales - Light-duty - other (%)	0.098	0.101	0.091	0.079	0.057	0.031	0.014
Vehicle sales - Medium-duty - diesel (%)	64.8	62.2	57.7	49.4	35.6	19.6	8.37
Vehicle sales - Medium-duty - EV (%)	0.664	1.94	5.49	14.3	31.4	52.6	68
Vehicle sales - Medium-duty - gasoline (%)	33.8	34.7	34.7	31.9	24.4	14.2	6.33
Vehicle sales - Medium-duty - hybrid (%)	0.363	0.418	0.464	0.478	0.414	0.275	0.141
Vehicle sales - Medium-duty - hydrogen FC (%)	0.166	0.485	1.37	3.58	7.86	13.2	17
Vehicle sales - Medium-duty - other (%)	0.253	0.266	0.279	0.286	0.258	0.184	0.102

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

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Commercial (PJ)	246	247	244	240	233	227	224
Final energy use - Industry (PJ)	381	403	413	422	433	437	443
Final energy use - Residential (PJ)	313	297	288	278	263	239	221
Final energy use - Transportation (PJ)	710	666	609	562	524	480	428

Table 48: *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)	0	31,112	34,614	0	0	0	0
Sales of cooking units - Electric Resistance (%)	32	36.2	40.9	53.4	71	81.7	85.5
Sales of cooking units - Gas (%)	68	63.8	59.1	46.6	29	18.3	14.5
Sales of space heating units - Electric Heat Pump (%)	4.92	20.4	25.2	39.1	61.2	76.9	82.9
Sales of space heating units - Electric Resistance (%)	4.71	8.04	8.28	9.07	10.5	11.9	12.7
Sales of space heating units - Fossil (%)	7.87	4.72	4.38	3.33	1.64	0.517	0.135

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

Item	2020	2025	2030	2035	2040	2045	2050
Sales of space heating units - Gas Furnace (%)	82.5	66.9	62.2	48.4	26.6	10.7	4.34
Sales of water heating units - Electric Heat Pump (%)	0.167	2.04	7.05	21.5	43.6	58.1	63.1
Sales of water heating units - Electric Resistance (%)	4.19	7.46	9.4	15.2	24	29.7	31.8
Sales of water heating units - Gas Furnace (%)	91.5	86.1	79.2	59.5	29.1	9.3	2.42
Sales of water heating units - Other (%)	4.17	4.38	4.34	3.87	3.3	2.91	2.76

Table 49: *E-B+ scenario - PILLAR 1: Efficiency/Electrification - Electricity demand*

Item	2020	2025	2030	2035	2040	2045	2050
Electricity distribution capital invested - Cumulative 5-yr (billion $2018)	0	4.07	4.08	5.45	5.62	6.97	7.29

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

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

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

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

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

Item	2020	2025	2030	2035	2040	2045	2050
Biomass purchases (million $2018/year)	0	0	512	515	515	515	900
Conversion capital investment - Cumulative 5-yr (million $2018)	0	0	1,031	30.8	0.343	0	4,523
Number of facilities - Allam power w ccu (quantity)	0	0	0	0	0	0	0
Number of facilities - Beccs hydrogen (quantity)	0	0	0	0	0	0	0
Number of facilities - Diesel (quantity)	0	0	0	0	0	0	0
Number of facilities - Diesel ccu (quantity)	0	0	0	0	0	0	0
Number of facilities - Power (quantity)	0	0	0	0	0	0	0
Number of facilities - Power ccu (quantity)	0	0	0	0	0	0	0
Number of facilities - Pyrolysis (quantity)	0	0	0	0	0	0	5
Number of facilities - Pyrolysis ccu (quantity)	0	0	0	0	0	0	0
Number of facilities - Sng (quantity)	0	0	0	0	0	0	0
Number of facilities - Sng ccu (quantity)	0	0	0	0	0	0	0

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

Item	2020	2025	2030	2035	2040	2045	2050
Annual - All (MMT)	0	0	0	3.35	3.32	3.42	3.53
Annual - BECCS (MMT)	0	0	0	0	0	0	0
Annual - Cement and lime (MMT)	0	0	0	3.35	3.32	3.42	3.53
Annual - NGCC (MMT)	0	0	0	0	0	0	0
Cumulative - All (MMT)	0	0	0	3.35	6.67	10.1	13.6
Cumulative - BECCS (MMT)	0	0	0	0	0	0	0
Cumulative - Cement and lime (MMT)	0	0	0	3.35	6.67	10.1	13.6
Cumulative - NGCC (MMT)	0	0	0	0	0	0	0

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

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

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

Item	2020	2025	2030	2035	2040	2045	2050
All (km)	0	0	0	506	506	506	543
Cumulative investment - All (million $2018)	0	0	0	2,258	2,257	2,260	2,292
Cumulative investment - Spur (million $2018)	0	0	0	155	154	157	188
Cumulative investment - Trunk (million $2018)	0	0	0	2,104	2,104	2,104	2,104
Spur (km)	0	0	0	153	153	153	190
Trunk (km)	0	0	0	353	353	353	353

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

Item	2020	2025	2050
Carbon sink potential - Aggressive deployment - Corn-ethanol to energy grasses (1000 tCO2e/y)	0	0	-204
Carbon sink potential - Aggressive deployment - Cropland measures (1000 tCO2e/y)	0	0	-1,727
Carbon sink potential - Aggressive deployment - Cropland to woody energy crops (1000 tCO2e/y)	0	0	0
Carbon sink potential - Aggressive deployment - Pasture to energy crops (1000 tCO2e/y)	0	0	0
Carbon sink potential - Aggressive deployment - Permanent conservation cover (1000 tCO2e/y)	0	0	-60.7
Carbon sink potential - Aggressive deployment - Total (1000 tCO2e/y)	0	0	-1,993
Carbon sink potential - Moderate deployment - Corn-ethanol to energy grasses (1000 tCO2e/y)	0	0	-204
Carbon sink potential - Moderate deployment - Cropland measures (1000 tCO2e/y)	0	0	-911
Carbon sink potential - Moderate deployment - Cropland to woody energy crops (1000 tCO2e/y)	0	0	0
Carbon sink potential - Moderate deployment - Pasture to energy crops (1000 tCO2e/y)	0	0	0
Carbon sink potential - Moderate deployment - Permanent conservation cover (1000 tCO2e/y)	0	0	-30.4
Carbon sink potential - Moderate deployment - Total (1000 tCO2e/y)	0	0	-1,145
Land impacted for carbon sink - Aggressive deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	117
Land impacted for carbon sink - Aggressive deployment - Cropland measures (1000 hectares)	0	0	2,514
Land impacted for carbon sink - Aggressive deployment - Cropland to woody energy crops (1000 hectares)	0	0	23.6
Land impacted for carbon sink - Aggressive deployment - Pasture to energy crops (1000 hectares)	0	0	297
Land impacted for carbon sink - Aggressive deployment - Permanent conservation cover (1000 hectares)	0	0	110
Land impacted for carbon sink - Aggressive deployment - Total (1000 hectares)	0	0	3,063
Land impacted for carbon sink - Moderate deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	117

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

Item	2020	2025	2050
Land impacted for carbon sink - Moderate deployment - Cropland measures (1000 hectares)	0	0	537
Land impacted for carbon sink - Moderate deployment - Cropland to woody energy crops (1000 hectares)	0	0	23.6
Land impacted for carbon sink - Moderate deployment - Pasture to energy crops (1000 hectares)	0	0	297
Land impacted for carbon sink - Moderate deployment - Permanent conservation cover (1000 hectares)	0	0	55.2
Land impacted for carbon sink - Moderate deployment - Total (1000 hectares)	0	0	1,030

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

Item	2020	2025	2050
Carbon sink potential - High - Accelerate regeneration (1000 tCO2e/y)	0	0	254
Carbon sink potential - High - All (not counting overlap) (1000 tCO2e/y)	0	0	34,151
Carbon sink potential - High - Avoid deforestation (1000 tCO2e/y)	0	0	2,149
Carbon sink potential - High - Extend rotation length (1000 tCO2e/y)	0	0	9,384
Carbon sink potential - High - Improve plantations (1000 tCO2e/y)	0	0	2,265
Carbon sink potential - High - Increase retention of HWP (1000 tCO2e/y)	0	0	9,560
Carbon sink potential - High - Increase trees outside forests (1000 tCO2e/y)	0	0	702
Carbon sink potential - High - Reforest cropland (1000 tCO2e/y)	0	0	300
Carbon sink potential - High - Reforest pasture (1000 tCO2e/y)	0	0	6,186
Carbon sink potential - High - Restore productivity (1000 tCO2e/y)	0	0	3,351
Carbon sink potential - Low - Accelerate regeneration (1000 tCO2e/y)	0	0	127
Carbon sink potential - Low - All (not counting overlap) (1000 tCO2e/y)	0	0	10,423
Carbon sink potential - Low - Avoid deforestation (1000 tCO2e/y)	0	0	358
Carbon sink potential - Low - Extend rotation length (1000 tCO2e/y)	0	0	3,605
Carbon sink potential - Low - Improve plantations (1000 tCO2e/y)	0	0	1,153
Carbon sink potential - Low - Increase retention of HWP (1000 tCO2e/y)	0	0	3,187
Carbon sink potential - Low - Increase trees outside forests (1000 tCO2e/y)	0	0	246
Carbon sink potential - Low - Reforest cropland (1000 tCO2e/y)	0	0	150
Carbon sink potential - Low - Reforest pasture (1000 tCO2e/y)	0	0	469
Carbon sink potential - Low - Restore productivity (1000 tCO2e/y)	0	0	1,130
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO2e/y)	0	0	190
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO2e/y)	0	0	22,267
Carbon sink potential - Mid - Avoid deforestation (1000 tCO2e/y)	0	0	1,254

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

Item	2020	2025	2050
Carbon sink potential - Mid - Extend rotation length (1000 tCO2e/y)	0	0	6,494
Carbon sink potential - Mid - Improve plantations (1000 tCO2e/y)	0	0	1,689
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO2e/y)	0	0	6,373
Carbon sink potential - Mid - Increase trees outside forests (1000 tCO2e/y)	0	0	474
Carbon sink potential - Mid - Reforest cropland (1000 tCO2e/y)	0	0	225
Carbon sink potential - Mid - Reforest pasture (1000 tCO2e/y)	0	0	3,327
Carbon sink potential - Mid - Restore productivity (1000 tCO2e/y)	0	0	2,240
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)	0	0	41.5
Land impacted for carbon sink potential - High - Avoid deforestation (over 30 years) (1000 hectares)	0	0	291
Land impacted for carbon sink potential - High - Extend rotation length (1000 hectares)	0	0	4,785
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)	0	0	835
Land impacted for carbon sink potential - High - Increase retention of HWP (1000 hectares)	0	0	0
Land impacted for carbon sink potential - High - Increase trees outside forests (1000 hectares)	0	0	66.7
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)	0	0	19.8
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)	0	0	176
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)	0	0	1,111
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)	0	0	7,325
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)	0	0	20.8
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)	0	0	273
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)	0	0	1,833
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)	0	0	417
Land impacted for carbon sink potential - Low - Increase retention of HWP (1000 hectares)	0	0	0
Land impacted for carbon sink potential - Low - Increase trees outside forests (1000 hectares)	0	0	35.1
Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares)	0	0	9.91
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)	0	0	30.5
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)	0	0	672
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)	0	0	3,292
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)	0	0	31.1
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)	0	0	282
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)	0	0	3,309

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

Item	2020	2025	2050
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)	0	0	628
Land impacted for carbon sink potential - Mid - Increase retention of HWP (1000 hectares)	0	0	0
Land impacted for carbon sink potential - Mid - Increase trees outside forests (1000 hectares)	0	0	50.9
Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares)	0	0	14.9
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)	0	0	220
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)	0	0	1,354
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)	0	0	5,890

Table 58: *REF scenario - PILLAR 1: Efficiency/Electrification - Residential*

Item	2020	2025	2030	2035	2040	2045	2050
Residential HVAC investment in 2020s vs. REF - Cumulative 5-yr (billion $2018)	0	6.34	5.72	0	0	0	0
Sales of cooking units - Electric Resistance (%)	70.1	70.1	70.1	70.1	70.1	70.1	70.1
Sales of cooking units - Gas (%)	29.9	29.9	29.9	29.9	29.9	29.9	29.9
Sales of space heating units - Electric Heat Pump (%)	23.5	46.8	47.7	48.9	49.9	51	52.7
Sales of space heating units - Electric Resistance (%)	18.9	17	16.7	16.1	15.6	14.6	12.7
Sales of space heating units - Fossil (%)	12.4	13.6	8.94	6.9	6.71	6.67	6.75
Sales of space heating units - Gas (%)	45.2	22.7	26.7	28	27.8	27.7	27.8
Sales of water heating units - Electric Heat Pump (%)	0	0	0	0	0	0	0
Sales of water heating units - Electric Resistance (%)	50.1	65.9	65.9	65.8	65.8	65.7	65.7
Sales of water heating units - Gas Furnace (%)	45.5	31	31	31	31.1	31.1	31.2
Sales of water heating units - Other (%)	4.39	3.1	3.11	3.12	3.13	3.14	3.15

Table 59: *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 (%)	1.43	1.86	2.16	2.02	1.81	1.69	1.6
Vehicle sales - Light-duty - EV (%)	3.97	6.13	6.94	8.56	10.4	11.9	13.1
Vehicle sales - Light-duty - gasoline (%)	89.5	85.9	83.5	81.6	79.4	77.5	76
Vehicle sales - Light-duty - hybrid (%)	4.85	5.67	6.91	7.47	8	8.52	8.89
Vehicle sales - Light-duty - hydrogen FC (%)	0.11	0.372	0.339	0.299	0.295	0.295	0.305
Vehicle sales - Light-duty - other (%)	0.096	0.1	0.097	0.097	0.096	0.095	0.097
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 60: *REF scenario - PILLAR 1: Efficiency/Electrification - Overview*

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Commercial (PJ)	246	251	253	255	257	265	279
Final energy use - Industry (PJ)	381	412	434	451	473	490	511
Final energy use - Residential (PJ)	313	298	294	293	296	303	311

Table 60: *REF scenario - PILLAR 1: Efficiency/Electrification - Overview (continued)*

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Transportation (PJ)	709	670	623	596	599	617	640

Table 61: *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)	0	30,680	31,883	0	0	0	0
Sales of cooking units - Electric Resistance (%)	32	34.3	34.3	34.3	34.4	34.3	34.3
Sales of cooking units - Gas (%)	68	65.7	65.7	65.7	65.6	65.7	65.7
Sales of space heating units - Electric Heat Pump (%)	4.92	24.3	48.6	68.6	71.8	72.2	72.2
Sales of space heating units - Electric Resistance (%)	4.71	8.77	12.8	20	25.1	25.8	25.9
Sales of space heating units - Fossil (%)	7.87	4.59	3.39	1.45	0.212	0.017	0
Sales of space heating units - Gas Furnace (%)	82.5	62.3	35.2	9.95	2.88	1.94	1.88
Sales of water heating units - Electric Heat Pump (%)	0.167	0.273	0.269	0.271	0.272	0.27	0.272
Sales of water heating units - Electric Resistance (%)	4.19	6.76	6.69	6.7	6.72	6.7	6.71
Sales of water heating units - Gas Furnace (%)	91.5	88.5	88.5	88.6	88.5	88.5	88.6
Sales of water heating units - Other (%)	4.17	4.42	4.53	4.44	4.48	4.5	4.46

Table 62: *REF scenario - PILLAR 1: Efficiency/Electrification - Electricity demand*

Item	2020	2025	2030	2035	2040	2045	2050
Electricity distribution capital invested - Cumulative 5-yr (billion $2018)	0	4.39	4.43	6.57	6.87	7.03	7.31

Table 63: *REF scenario - PILLAR 6: Land sinks - Forests*

Item	2020	2025	2030	2050
Business-as-usual carbon sink - Natural uptake (Mt CO2e/y)	-41.9	0	-12.3	-10
Business-as-usual carbon sink - Retained in Hardwood Products (Mt CO2e/y)	-2.6	0	-4.34	-4.57
Business-as-usual carbon sink - Total (Mt CO2e/y)	-44.5	0	-16.7	-14.6
Carbon sink potential - High - Accelerate regeneration (1000 tCO2e/y)	0	0	0	254
Carbon sink potential - High - All (not counting overlap) (1000 tCO2e/y)	0	0	0	34,151
Carbon sink potential - High - Avoid deforestation (1000 tCO2e/y)	0	0	0	2,149
Carbon sink potential - High - Extend rotation length (1000 tCO2e/y)	0	0	0	9,384
Carbon sink potential - High - Improve plantations (1000 tCO2e/y)	0	0	0	2,265
Carbon sink potential - High - Increase retention of HWP (1000 tCO2e/y)	0	0	0	9,560
Carbon sink potential - High - Increase trees outside forests (1000 tCO2e/y)	0	0	0	702
Carbon sink potential - High - Reforest cropland (1000 tCO2e/y)	0	0	0	300
Carbon sink potential - High - Reforest pasture (1000 tCO2e/y)	0	0	0	6,186
Carbon sink potential - High - Restore productivity (1000 tCO2e/y)	0	0	0	3,351
Carbon sink potential - Low - Accelerate regeneration (1000 tCO2e/y)	0	0	0	127
Carbon sink potential - Low - All (not counting overlap) (1000 tCO2e/y)	0	0	0	10,423
Carbon sink potential - Low - Avoid deforestation (1000 tCO2e/y)	0	0	0	358

Table 63: *REF scenario - PILLAR 6: Land sinks - Forests (continued)*

Item	2020	2025	2030	2050
Carbon sink potential - Low - Extend rotation length (1000 tCO2e/y)	0	0	0	3,605
Carbon sink potential - Low - Improve plantations (1000 tCO2e/y)	0	0	0	1,153
Carbon sink potential - Low - Increase retention of HWP (1000 tCO2e/y)	0	0	0	3,187
Carbon sink potential - Low - Increase trees outside forests (1000 tCO2e/y)	0	0	0	246
Carbon sink potential - Low - Reforest cropland (1000 tCO2e/y)	0	0	0	150
Carbon sink potential - Low - Reforest pasture (1000 tCO2e/y)	0	0	0	469
Carbon sink potential - Low - Restore productivity (1000 tCO2e/y)	0	0	0	1,130
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO2e/y)	0	0	0	190
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO2e/y)	0	0	0	22,267
Carbon sink potential - Mid - Avoid deforestation (1000 tCO2e/y)	0	0	0	1,254
Carbon sink potential - Mid - Extend rotation length (1000 tCO2e/y)	0	0	0	6,494
Carbon sink potential - Mid - Improve plantations (1000 tCO2e/y)	0	0	0	1,689
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO2e/y)	0	0	0	6,373
Carbon sink potential - Mid - Increase trees outside forests (1000 tCO2e/y)	0	0	0	474
Carbon sink potential - Mid - Reforest cropland (1000 tCO2e/y)	0	0	0	225
Carbon sink potential - Mid - Reforest pasture (1000 tCO2e/y)	0	0	0	3,327
Carbon sink potential - Mid - Restore productivity (1000 tCO2e/y)	0	0	0	2,240
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)	0	0	0	41.5
Land impacted for carbon sink potential - High - Avoid deforestation (over 30 years) (1000 hectares)	0	0	0	291
Land impacted for carbon sink potential - High - Extend rotation length (1000 hectares)	0	0	0	4,785
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)	0	0	0	835
Land impacted for carbon sink potential - High - Increase retention of HWP (1000 hectares)	0	0	0	0
Land impacted for carbon sink potential - High - Increase trees outside forests (1000 hectares)	0	0	0	66.7
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)	0	0	0	19.8
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)	0	0	0	176
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)	0	0	0	1,111
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)	0	0	0	7,325
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)	0	0	0	20.8
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)	0	0	0	273
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)	0	0	0	1,833

Table 63: *REF scenario - PILLAR 6: Land sinks - Forests (continued)*

Item	2020	2025	2030	2050
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)	0	0	0	417
Land impacted for carbon sink potential - Low - Increase retention of HWP (1000 hectares)	0	0	0	0
Land impacted for carbon sink potential - Low - Increase trees outside forests (1000 hectares)	0	0	0	35.1
Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares)	0	0	0	9.91
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)	0	0	0	30.5
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)	0	0	0	672
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)	0	0	0	3,292
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)	0	0	0	31.1
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)	0	0	0	282
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)	0	0	0	3,309
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)	0	0	0	628
Land impacted for carbon sink potential - Mid - Increase retention of HWP (1000 hectares)	0	0	0	0
Land impacted for carbon sink potential - Mid - Increase trees outside forests (1000 hectares)	0	0	0	50.9
Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares)	0	0	0	14.9
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)	0	0	0	220
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)	0	0	0	1,354
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)	0	0	0	5,890

Table 64: *REF scenario - IMPACTS - Health*

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal (million 2019$)	0	2,378	1,491	1,359	1,305	1,275	1,176
Monetary damages from air pollution - Natural Gas (million 2019$)	0	156	167	189	210	197	196
Monetary damages from air pollution - Transportation (million 2019$)	0	954	979	1,004	1,032	1,058	1,084
Premature deaths from air pollution - Coal (deaths)	0	267	167	153	146	143	132
Premature deaths from air pollution - Natural Gas (deaths)	0	17.6	18.8	21.4	23.7	22.2	22.2
Premature deaths from air pollution - Transportation (deaths)	0	107	110	113	116	119	122