

Net-Zero America - washington state report

Larson et al. 2020

February 2021

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	4.12	4.1	0	0	0	0
Sales of cooking units - Electric Resistance (%)	70.6	76.8	96	99.8	100	100	100
Sales of cooking units - Gas (%)	29.4	23.2	3.96	0.2	0	0	0
Sales of space heating units - Electric Heat Pump (%)	14	25.2	47.6	59.1	60.7	60.7	60.6
Sales of space heating units - Electric Resistance (%)	35.6	41	35.5	30.7	30	30.2	30.3
Sales of space heating units - Fossil (%)	8.89	13.2	9.93	8.85	8.62	8.41	8.39
Sales of space heating units - Gas (%)	41.5	20.6	6.9	1.33	0.7	0.659	0.662
Sales of water heating units - Electric Heat Pump (%)	0	6.87	37.5	47.6	48.6	48.6	48.6
Sales of water heating units - Electric Resistance (%)	45.5	59.1	48.2	46.1	46.1	46.1	46.1
Sales of water heating units - Gas Furnace (%)	47.5	28.5	9.06	0.967	0.047	0	0
Sales of water heating units - Other (%)	6.95	5.52	5.27	5.27	5.28	5.27	5.28

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	1,331	3,547	5,529	8,462	9,115	8,742
Public EV charging plugs - DC Fast (1000 units)	0.551	0	2.62	0	9.97	0	15.8
Public EV charging plugs - L2 (1000 units)	2.37	0	63.1	0	240	0	381
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 (%)	1.51	1.78	1.24	0.397	0.074	0.013	0
Vehicle sales - Light-duty - EV (%)	4.05	15.6	47.1	82.1	96.4	99.3	100
Vehicle sales - Light-duty - gasoline (%)	89.7	77.5	48.1	16.3	3.26	0.589	0
Vehicle sales - Light-duty - hybrid (%)	4.56	4.64	3.26	1.21	0.294	0.065	0
Vehicle sales - Light-duty - hydrogen FC (%)	0.11	0.337	0.2	0.062	0.012	0.002	0
Vehicle sales - Light-duty - other (%)	0.1	0.096	0.062	0.022	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)	160	162	160	153	146	145	146
Final energy use - Industry (PJ)	342	354	359	361	368	377	387
Final energy use - Residential (PJ)	246	227	199	170	144	128	117
Final energy use - Transportation (PJ)	656	650	592	519	454	412	391

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	22,776	24,705	0	0	0	0
Sales of cooking units - Electric Resistance (%)	27.5	41.7	78.2	85.4	85.8	85.8	85.8
Sales of cooking units - Gas (%)	72.5	58.3	21.8	14.6	14.2	14.2	14.2
Sales of space heating units - Electric Heat Pump (%)	2.72	15.7	39.9	56.5	59	59.1	59.1
Sales of space heating units - Electric Resistance (%)	18.3	17.1	34.2	39.6	40.2	40.2	40.2
Sales of space heating units - Fossil (%)	0	0	0	0	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 (%)	79	67.2	25.9	3.88	0.83	0.698	0.698
Sales of water heating units - Electric Heat Pump (%)	1.12	9.5	48.6	62.9	64.3	64.4	64.4
Sales of water heating units - Electric Resistance (%)	3.42	6.18	24.2	33.6	34.9	34.9	34.9
Sales of water heating units - Gas Furnace (%)	94.6	83.7	26.6	2.84	0.138	0	0
Sales of water heating units - Other (%)	0.885	0.628	0.63	0.632	0.632	0.63	0.631

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	3.77	3.88	6.5	6.9	5.9	6.14

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	0.003	0.249	0	0	0	0
Capital invested - Biomass w/ccu allam power plant (billion \$2018)	0	0	0	0	0	0.008	0.044
Capital invested - Biomass w/ccu power plant (billion \$2018)	0	0	0	0	0	0.02	0.172
Capital invested - Solar PV - Base (billion \$2018)	0	0	0	0	0	0	0
Capital invested - Solar PV - Constrained (billion \$2018)	0	0.2	0	0	0	0	0
Capital invested - Wind - Base (billion \$2018)	0	0	0.826	0.787	0.706	0.738	0.057
Capital invested - Wind - Constrained (billion \$2018)	0	0	2.11	3.35	11.6	9.51	1.16

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

Item	2020	2025	2030	2035	2040	2045	2050
Biomass power plant (GWh)	0	6.64	495	495	495	495	495
Biomass w/ccu allam power plant (GWh)	0	0	0	0	0	7.51	51.1
Biomass w/ccu power plant (GWh)	0	0	0	0	0	22.3	216
Solar - Base land use assumptions (GWh)	1,419	0	0	0	0	0	0
Solar - Constrained land use assumptions (GWh)	1,371	0	0	0	0	0	0
Wind - Base land use assumptions (GWh)	11,561	0	1,656	1,570	1,428	1,567	124
Wind - Constrained land use assumptions (GWh)	11,682	0	4,128	5,915	21,482	16,579	2,952

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

Item	2020	2025	2030	2035	2040	2045	2050
Biomass purchases (million \$2018/year)	0	49.2	148	149	149	200	644
Conversion capital investment - Cumulative 5-yr (million \$2018)	0	3.83	277	22.3	0	927	8,114
Number of facilities - Allam power w ccu (quantity)	0	0	0	0	0	1	2
Number of facilities - Beccs hydrogen (quantity)	0	0	0	0	0	1	8
Number of facilities - Diesel (quantity)	0	0	0	1	1	1	1
Number of facilities - Diesel ccu (quantity)	0	0	0	0	0	1	2
Number of facilities - Power (quantity)	0	1	1	1	1	1	1
Number of facilities - Power ccu (quantity)	0	0	0	0	0	1	2
Number of facilities - Pyrolysis (quantity)	0	0	0	1	1	1	1
Number of facilities - Pyrolysis ccu (quantity)	0	0	0	0	0	1	3
Number of facilities - Sng (quantity)	0	1	1	1	1	1	1
Number of facilities - Sng ccu (quantity)	0	0	0	0	0	1	1

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

Item	2020	2025	2030	2035	2040	2045	2050
Annual - All (MMT)	0	0	0	3.35	3.32	4.6	15
Annual - BECCS (MMT)	0	0	0	0	0	1.17	11.5
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	11.3	26.3
Cumulative - BECCS (MMT)	0	0	0	0	0	1.17	12.7
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 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	776	776	1,019	2,201
Cumulative investment - All (million \$2018)	0	0	0	1,802	1,801	1,948	2,738
Cumulative investment - Spur (million \$2018)	0	0	0	99.8	99.3	246	1,036
Cumulative investment - Trunk (million \$2018)	0	0	0	1,702	1,702	1,702	1,702
Spur (km)	0	0	0	101	101	344	1,526
Trunk (km)	0	0	0	675	675	675	675

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	-1,981
Carbon sink potential - Aggressive deployment - Permanent conservation cover (1000 tCO2e/y)	0	0	-147
Carbon sink potential - Aggressive deployment - Total (1000 tCO2e/y)	0	0	-2,129
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	-1,027
Carbon sink potential - Moderate deployment - Permanent conservation cover (1000 tCO2e/y)	0	0	-73.6
Carbon sink potential - Moderate deployment - Total (1000 tCO2e/y)	0	0	-1,101
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	2,798
Land impacted for carbon sink - Aggressive deployment - Permanent conservation cover (1000 hectares)	0	0	235
Land impacted for carbon sink - Aggressive deployment - Total (1000 hectares)	0	0	3,033
Land impacted for carbon sink - Moderate deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	0

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

Item	2020	2025	2050
Land impacted for carbon sink - Moderate deployment - Cropland measures (1000 hectares)	0	0	1,458
Land impacted for carbon sink - Moderate deployment - Permanent conservation cover (1000 hectares)	0	0	117
Land impacted for carbon sink - Moderate deployment - Total (1000 hectares)	0	0	1,575

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

Item	2020	2025	2050
Carbon sink potential - High - Accelerate regeneration (1000 tCO ₂ e/y)	0	0	2,170
Carbon sink potential - High - All (not counting overlap) (1000 tCO ₂ e/y)	0	0	71,521
Carbon sink potential - High - Avoid deforestation (1000 tCO ₂ e/y)	0	0	1,904
Carbon sink potential - High - Extend rotation length (1000 tCO ₂ e/y)	0	0	9,494
Carbon sink potential - High - Improve plantations (1000 tCO ₂ e/y)	0	0	4,080
Carbon sink potential - High - Increase retention of HWP (1000 tCO ₂ e/y)	0	0	29,790
Carbon sink potential - High - Increase trees outside forests (1000 tCO ₂ e/y)	0	0	1,078
Carbon sink potential - High - Reforest cropland (1000 tCO ₂ e/y)	0	0	14,981
Carbon sink potential - High - Reforest pasture (1000 tCO ₂ e/y)	0	0	2,477
Carbon sink potential - High - Restore productivity (1000 tCO ₂ e/y)	0	0	5,545
Carbon sink potential - Low - Accelerate regeneration (1000 tCO ₂ e/y)	0	0	1,087
Carbon sink potential - Low - All (not counting overlap) (1000 tCO ₂ e/y)	0	0	26,982
Carbon sink potential - Low - Avoid deforestation (1000 tCO ₂ e/y)	0	0	317
Carbon sink potential - Low - Extend rotation length (1000 tCO ₂ e/y)	0	0	3,647
Carbon sink potential - Low - Improve plantations (1000 tCO ₂ e/y)	0	0	2,076
Carbon sink potential - Low - Increase retention of HWP (1000 tCO ₂ e/y)	0	0	9,930
Carbon sink potential - Low - Increase trees outside forests (1000 tCO ₂ e/y)	0	0	377
Carbon sink potential - Low - Reforest cropland (1000 tCO ₂ e/y)	0	0	7,491
Carbon sink potential - Low - Reforest pasture (1000 tCO ₂ e/y)	0	0	188
Carbon sink potential - Low - Restore productivity (1000 tCO ₂ e/y)	0	0	1,869
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO ₂ e/y)	0	0	1,629
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO ₂ e/y)	0	0	49,216
Carbon sink potential - Mid - Avoid deforestation (1000 tCO ₂ e/y)	0	0	1,111
Carbon sink potential - Mid - Extend rotation length (1000 tCO ₂ e/y)	0	0	6,570
Carbon sink potential - Mid - Improve plantations (1000 tCO ₂ e/y)	0	0	3,042
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO ₂ e/y)	0	0	19,860

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

Item	2020	2025	2050
Carbon sink potential - Mid - Increase trees outside forests (1000 tCO2e/y)	0	0	728
Carbon sink potential - Mid - Reforest cropland (1000 tCO2e/y)	0	0	11,236
Carbon sink potential - Mid - Reforest pasture (1000 tCO2e/y)	0	0	1,332
Carbon sink potential - Mid - Restore productivity (1000 tCO2e/y)	0	0	3,707
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)	0	0	355
Land impacted for carbon sink potential - High - Avoid deforestation (over 30 years) (1000 hectares)	0	0	258
Land impacted for carbon sink potential - High - Extend rotation length (1000 hectares)	0	0	4,841
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)	0	0	1,503
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	102
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)	0	0	990
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)	0	0	70.4
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)	0	0	1,838
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)	0	0	9,959
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)	0	0	178
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)	0	0	242
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)	0	0	1,855
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)	0	0	752
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	53.9
Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares)	0	0	495
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)	0	0	12.2
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)	0	0	1,112
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)	0	0	4,699
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)	0	0	266
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)	0	0	250
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)	0	0	3,348
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)	0	0	1,131
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	78.2

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

Item	2020	2025	2050
Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares)	0	0	743
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)	0	0	88.2
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)	0	0	2,240
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)	0	0	8,144

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

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal (million 2019\$)	0	64	0.071	0.071	0.053	0.033	0
Monetary damages from air pollution - Natural Gas (million 2019\$)	0	59.3	35.2	31	30.1	25.2	20.1
Monetary damages from air pollution - Transportation (million 2019\$)	0	1,113	1,077	847	507	238	95
Premature deaths from air pollution - Coal (deaths)	0	7.18	0.008	0.008	0.006	0.004	0
Premature deaths from air pollution - Natural Gas (deaths)	0	6.69	3.97	3.51	3.4	2.84	2.28
Premature deaths from air pollution - Transportation (deaths)	0	125	121	95.3	57	26.7	10.7

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

Item	2020	2025	2030	2035	2040	2045	2050
By economic sector - Agriculture (jobs)	109	125	364	389	329	334	783
By economic sector - Construction (jobs)	11,841	8,570	8,392	10,289	10,284	9,831	13,352
By economic sector - Manufacturing (jobs)	4,798	4,850	7,540	9,472	8,742	7,531	8,676
By economic sector - Mining (jobs)	2,792	2,249	1,645	1,105	712	448	269
By economic sector - Other (jobs)	1,709	1,146	1,192	1,469	1,726	1,924	3,451
By economic sector - Pipeline (jobs)	421	418	361	502	229	169	210
By economic sector - Professional (jobs)	4,698	3,915	4,130	4,718	5,032	5,150	7,796
By economic sector - Trade (jobs)	3,859	3,140	2,993	3,186	3,344	3,411	5,119
By economic sector - Utilities (jobs)	4,096	4,450	5,095	7,657	7,723	6,900	7,084
By education level - All sectors - Associates degree or some college (jobs)	10,601	8,906	9,838	12,304	12,151	11,388	14,823
By education level - All sectors - Bachelors degree (jobs)	6,995	6,016	6,502	7,700	7,523	7,058	9,267
By education level - All sectors - Doctoral degree (jobs)	263	217	223	250	252	249	361
By education level - All sectors - High school diploma or less (jobs)	14,791	12,287	13,619	16,728	16,401	15,290	19,982
By education level - All sectors - Masters or professional degree (jobs)	1,672	1,437	1,531	1,805	1,794	1,711	2,305
By resource sector - Biomass (jobs)	450	537	1,003	1,107	989	1,216	3,342
By resource sector - CO2 (jobs)	0	0	0	1,741	53.5	90	814
By resource sector - Coal (jobs)	409	98.8	0	0	0	0	0
By resource sector - Grid (jobs)	4,122	5,671	7,561	11,493	14,009	12,552	11,879
By resource sector - Natural Gas (jobs)	2,967	2,549	2,064	2,014	1,796	1,380	1,366
By resource sector - Nuclear (jobs)	616	606	596	346	0.015	0.019	0.038
By resource sector - Oil (jobs)	6,733	6,006	4,868	3,624	2,612	1,888	1,284
By resource sector - Solar (jobs)	16,332	9,420	9,518	12,164	13,095	14,032	23,686
By resource sector - Wind (jobs)	2,694	3,976	6,104	6,298	5,567	4,538	4,367
Median wages - Annual - All (\$2019 per job)	66,752	68,136	68,415	69,492	70,588	71,567	71,977
On-Site or In-Plant Training - Total jobs - 1 to 4 years (jobs)	5,566	4,656	5,087	6,322	6,221	5,810	7,507
On-Site or In-Plant Training - Total jobs - 4 to 10 years (jobs)	2,354	1,923	2,005	2,514	2,489	2,347	3,065
On-Site or In-Plant Training - Total jobs - None (jobs)	5,690	4,750	5,226	6,339	6,219	5,850	7,782

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

Item	2020	2025	2030	2035	2040	2045	2050
On-Site or In-Plant Training - Total jobs - Over 10 years (jobs)	280	235	259	331	329	309	398
On-Site or In-Plant Training - Total jobs - Up to 1 year (jobs)	20,433	17,299	19,136	23,281	22,863	21,380	27,987
On-the-Job Training - All sectors - 1 to 4 years (jobs)	7,140	5,969	6,503	8,110	7,982	7,458	9,623
On-the-Job Training - All sectors - 4 to 10 years (jobs)	2,311	1,871	1,950	2,470	2,458	2,326	3,050
On-the-Job Training - All sectors - None (jobs)	1,976	1,632	1,753	2,087	2,054	1,945	2,628
On-the-Job Training - All sectors - Over 10 years (jobs)	369	300	331	401	386	358	469
On-the-Job Training - All sectors - Up to 1 year (jobs)	22,526	19,093	21,176	25,719	25,241	23,610	30,969
Related work experience - All sectors - 1 to 4 years (jobs)	12,271	10,375	11,351	13,836	13,598	12,729	16,616
Related work experience - All sectors - 4 to 10 years (jobs)	7,923	6,683	7,277	8,931	8,767	8,201	10,645
Related work experience - All sectors - None (jobs)	4,904	4,124	4,537	5,603	5,519	5,179	6,817
Related work experience - All sectors - Over 10 years (jobs)	2,086	1,784	1,983	2,424	2,366	2,195	2,807
Related work experience - All sectors - Up to 1 year (jobs)	7,137	5,897	6,565	7,993	7,871	7,393	9,853
Wage income - All (million \$2019)	2,291	1,967	2,170	2,696	2,691	2,555	3,365

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

Item	2020	2025	2030	2035	2040	2045	2050
Natural gas consumption - Annual (tcf)	235	238	201	161	121	76.3	52.9
Natural gas consumption - Cumulative (tcf)	0	0	0	0	0	0	4,854
Natural gas production - Annual (tcf)	0	0	0	0	0	0	0
Oil consumption - Annual (million bbls)	138	135	119	96.2	74.7	57.8	41.8
Oil consumption - Cumulative (million bbls)	0	0	0	0	0	0	2,955
Oil production - Annual (million bbls)	0	0	0	0	0	0	0

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	4.1	4.04	0	0	0	0
Sales of cooking units - Electric Resistance (%)	70.4	71.2	73.9	81.1	91	97.1	99.2
Sales of cooking units - Gas (%)	29.6	28.8	26.1	18.9	9.03	2.91	0.784
Sales of space heating units - Electric Heat Pump (%)	14	21.3	23.9	31.4	44.1	54.1	58.4
Sales of space heating units - Electric Resistance (%)	35.6	41.8	41.1	39.2	35.8	32.7	31
Sales of space heating units - Fossil (%)	8.89	13.8	13.5	12.4	10.6	9.24	8.81
Sales of space heating units - Gas (%)	41.5	23	21.5	17	9.58	4.03	1.76
Sales of water heating units - Electric Heat Pump (%)	0	1.23	4.71	14.8	30.9	42.3	46.7
Sales of water heating units - Electric Resistance (%)	45.5	61.3	60	56.4	51	47.6	46.5
Sales of water heating units - Gas Furnace (%)	47.5	31.9	29.8	23.3	12.8	4.87	1.59
Sales of water heating units - Other (%)	6.95	5.56	5.52	5.49	5.39	5.31	5.28

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	239	450	1,569	4,778	7,016
Public EV charging plugs - DC Fast (1000 units)	0.551	0	1.02	0	3.86	0	10.1
Public EV charging plugs - L2 (1000 units)	2.37	0	24.5	0	92.8	0	244
Vehicle sales - Heavy-duty - diesel (%)	97.4	96	91.3	79.8	58.2	32.1	13.7

Table 18: E- scenario - PILLAR 1: Efficiency/Electrification - Transportation (continued)

Item	2020	2025	2030	2035	2040	2045	2050
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 (%)	1.52	1.94	2.05	1.63	1.04	0.532	0.228
Vehicle sales - Light-duty - EV (%)	1.94	4.79	12.1	26.2	48.8	72.3	87.7
Vehicle sales - Light-duty - gasoline (%)	91.6	87.3	79.3	66.2	45.8	24.6	10.9
Vehicle sales - Light-duty - hybrid (%)	4.73	5.52	6.19	5.61	4.19	2.46	1.19
Vehicle sales - Light-duty - hydrogen FC (%)	0.113	0.379	0.324	0.246	0.174	0.096	0.045
Vehicle sales - Light-duty - other (%)	0.101	0.105	0.095	0.083	0.059	0.033	0.015
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)	160	163	165	166	164	162	160
Final energy use - Industry (PJ)	342	355	361	367	376	385	395
Final energy use - Residential (PJ)	246	227	207	188	169	150	133
Final energy use - Transportation (PJ)	657	654	611	573	544	510	470

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	22,723	24,348	0	0	0	0
Sales of cooking units - Electric Resistance (%)	27.5	31	36.1	49.7	68.6	80.2	84.3
Sales of cooking units - Gas (%)	72.5	69	63.9	50.3	31.4	19.8	15.7
Sales of space heating units - Electric Heat Pump (%)	2.72	11.9	14.6	22.8	37.2	49.8	55.8
Sales of space heating units - Electric Resistance (%)	18.3	13.9	15.8	21.6	30.6	36.8	39.3
Sales of space heating units - Fossil (%)	0	0	0	0	0	0	0
Sales of space heating units - Gas Furnace (%)	79	74.3	69.5	55.6	32.2	13.3	4.9
Sales of water heating units - Electric Heat Pump (%)	1.12	2.39	6.84	19.8	40.6	55.7	61.7
Sales of water heating units - Electric Resistance (%)	3.42	3.14	5.18	11.2	21.3	29.5	33.1
Sales of water heating units - Gas Furnace (%)	94.6	93.8	87.3	68.4	37.5	14.2	4.65
Sales of water heating units - Other (%)	0.885	0.628	0.63	0.632	0.632	0.63	0.631

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	2.95	2.96	4.08	4.22	5.76	6.07

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
Carbon sink potential - Aggressive deployment - Cropland measures (1000 tCO2e/y)	0	0	-1,981
Carbon sink potential - Aggressive deployment - Permanent conservation cover (1000 tCO2e/y)	0	0	-147
Carbon sink potential - Aggressive deployment - Total (1000 tCO2e/y)	0	0	-2,129

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

Item	2020	2025	2050
Carbon sink potential - Moderate deployment - Corn-ethanol to energy grasses (1000 tCO ₂ e/y)	0	0	0
Carbon sink potential - Moderate deployment - Cropland measures (1000 tCO ₂ e/y)	0	0	-1,027
Carbon sink potential - Moderate deployment - Permanent conservation cover (1000 tCO ₂ e/y)	0	0	-73.6
Carbon sink potential - Moderate deployment - Total (1000 tCO ₂ e/y)	0	0	-1,101
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	2,798
Land impacted for carbon sink - Aggressive deployment - Permanent conservation cover (1000 hectares)	0	0	235
Land impacted for carbon sink - Aggressive deployment - Total (1000 hectares)	0	0	3,033
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	1,458
Land impacted for carbon sink - Moderate deployment - Permanent conservation cover (1000 hectares)	0	0	117
Land impacted for carbon sink - Moderate deployment - Total (1000 hectares)	0	0	1,575

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

Item	2020	2025	2050
Carbon sink potential - High - Accelerate regeneration (1000 tCO ₂ e/y)	0	0	2,170
Carbon sink potential - High - All (not counting overlap) (1000 tCO ₂ e/y)	0	0	71,521
Carbon sink potential - High - Avoid deforestation (1000 tCO ₂ e/y)	0	0	1,904
Carbon sink potential - High - Extend rotation length (1000 tCO ₂ e/y)	0	0	9,494
Carbon sink potential - High - Improve plantations (1000 tCO ₂ e/y)	0	0	4,080
Carbon sink potential - High - Increase retention of HWP (1000 tCO ₂ e/y)	0	0	29,790
Carbon sink potential - High - Increase trees outside forests (1000 tCO ₂ e/y)	0	0	1,078
Carbon sink potential - High - Reforest cropland (1000 tCO ₂ e/y)	0	0	14,981
Carbon sink potential - High - Reforest pasture (1000 tCO ₂ e/y)	0	0	2,477
Carbon sink potential - High - Restore productivity (1000 tCO ₂ e/y)	0	0	5,545
Carbon sink potential - Low - Accelerate regeneration (1000 tCO ₂ e/y)	0	0	1,087
Carbon sink potential - Low - All (not counting overlap) (1000 tCO ₂ e/y)	0	0	26,982
Carbon sink potential - Low - Avoid deforestation (1000 tCO ₂ e/y)	0	0	317
Carbon sink potential - Low - Extend rotation length (1000 tCO ₂ e/y)	0	0	3,647
Carbon sink potential - Low - Improve plantations (1000 tCO ₂ e/y)	0	0	2,076

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

Item	2020	2025	2050
Carbon sink potential - Low - Increase retention of HWP (1000 tCO ₂ e/y)	0	0	9,930
Carbon sink potential - Low - Increase trees outside forests (1000 tCO ₂ e/y)	0	0	377
Carbon sink potential - Low - Reforest cropland (1000 tCO ₂ e/y)	0	0	7,491
Carbon sink potential - Low - Reforest pasture (1000 tCO ₂ e/y)	0	0	188
Carbon sink potential - Low - Restore productivity (1000 tCO ₂ e/y)	0	0	1,869
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO ₂ e/y)	0	0	1,629
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO ₂ e/y)	0	0	49,216
Carbon sink potential - Mid - Avoid deforestation (1000 tCO ₂ e/y)	0	0	1,111
Carbon sink potential - Mid - Extend rotation length (1000 tCO ₂ e/y)	0	0	6,570
Carbon sink potential - Mid - Improve plantations (1000 tCO ₂ e/y)	0	0	3,042
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO ₂ e/y)	0	0	19,860
Carbon sink potential - Mid - Increase trees outside forests (1000 tCO ₂ e/y)	0	0	728
Carbon sink potential - Mid - Reforest cropland (1000 tCO ₂ e/y)	0	0	11,236
Carbon sink potential - Mid - Reforest pasture (1000 tCO ₂ e/y)	0	0	1,332
Carbon sink potential - Mid - Restore productivity (1000 tCO ₂ e/y)	0	0	3,707
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)	0	0	355
Land impacted for carbon sink potential - High - Avoid deforestation (over 30 years) (1000 hectares)	0	0	258
Land impacted for carbon sink potential - High - Extend rotation length (1000 hectares)	0	0	4,841
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)	0	0	1,503
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	102
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)	0	0	990
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)	0	0	70.4
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)	0	0	1,838
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)	0	0	9,959
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)	0	0	178
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)	0	0	242
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)	0	0	1,855
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)	0	0	752
Land impacted for carbon sink potential - Low - Increase retention of HWP (1000 hectares)	0	0	0

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

Item	2020	2025	2050
Land impacted for carbon sink potential - Low - Increase trees outside forests (1000 hectares)	0	0	53.9
Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares)	0	0	495
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)	0	0	12.2
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)	0	0	1,112
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)	0	0	4,699
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)	0	0	266
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)	0	0	250
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)	0	0	3,348
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)	0	0	1,131
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	78.2
Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares)	0	0	743
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)	0	0	88.2
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)	0	0	2,240
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)	0	0	8,144

Table 24: E- scenario - IMPACTS - Health

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal (million 2019\$)	0	64	0.071	0.071	0.053	0.033	0
Monetary damages from air pollution - Natural Gas (million 2019\$)	0	62.4	33.3	23	17.6	14.2	14.6
Monetary damages from air pollution - Transportation (million 2019\$)	0	1,133	1,189	1,198	1,115	917	648
Premature deaths from air pollution - Coal (deaths)	0	7.18	0.008	0.008	0.006	0.004	0
Premature deaths from air pollution - Natural Gas (deaths)	0	7.04	3.76	2.59	1.98	1.6	1.65
Premature deaths from air pollution - Transportation (deaths)	0	127	134	135	125	103	72.9

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	4.12	4.1	0	0	0	0
Sales of cooking units - Electric Resistance (%)	70.6	76.8	96	99.8	100	100	100
Sales of cooking units - Gas (%)	29.4	23.2	3.96	0.2	0	0	0
Sales of space heating units - Electric Heat Pump (%)	14	25.2	47.6	59.1	60.7	60.7	60.6
Sales of space heating units - Electric Resistance (%)	35.6	41	35.5	30.7	30	30.2	30.3
Sales of space heating units - Fossil (%)	8.89	13.2	9.93	8.85	8.62	8.41	8.39
Sales of space heating units - Gas (%)	41.5	20.6	6.9	1.33	0.7	0.659	0.662
Sales of water heating units - Electric Heat Pump (%)	0	6.87	37.5	47.6	48.6	48.6	48.6

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

Item	2020	2025	2030	2035	2040	2045	2050
Sales of water heating units - Electric Resistance (%)	45.5	59.1	48.2	46.1	46.1	46.1	46.1
Sales of water heating units - Gas Furnace (%)	47.5	28.5	9.06	0.967	0.047	0	0
Sales of water heating units - Other (%)	6.95	5.52	5.27	5.27	5.28	5.27	5.28

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	1,331	3,547	5,529	8,462	9,115	8,742
Public EV charging plugs - DC Fast (1000 units)	0.551	0	2.62	0	9.97	0	15.8
Public EV charging plugs - L2 (1000 units)	2.37	0	63.1	0	240	0	381
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 (%)	1.51	1.78	1.24	0.397	0.074	0.013	0
Vehicle sales - Light-duty - EV (%)	4.05	15.6	47.1	82.1	96.4	99.3	100
Vehicle sales - Light-duty - gasoline (%)	89.7	77.5	48.1	16.3	3.26	0.589	0
Vehicle sales - Light-duty - hybrid (%)	4.56	4.64	3.26	1.21	0.294	0.065	0
Vehicle sales - Light-duty - hydrogen FC (%)	0.11	0.337	0.2	0.062	0.012	0.002	0
Vehicle sales - Light-duty - other (%)	0.1	0.096	0.062	0.022	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)	160	162	160	153	146	145	146
Final energy use - Industry (PJ)	342	354	359	361	368	377	387
Final energy use - Residential (PJ)	246	227	199	170	144	128	117
Final energy use - Transportation (PJ)	656	650	592	519	454	412	391

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	22,776	24,705	0	0	0	0
Sales of cooking units - Electric Resistance (%)	27.5	41.7	78.2	85.4	85.8	85.8	85.8
Sales of cooking units - Gas (%)	72.5	58.3	21.8	14.6	14.2	14.2	14.2
Sales of space heating units - Electric Heat Pump (%)	2.72	15.7	39.9	56.5	59	59.1	59.1
Sales of space heating units - Electric Resistance (%)	18.3	17.1	34.2	39.6	40.2	40.2	40.2
Sales of space heating units - Fossil (%)	0	0	0	0	0	0	0
Sales of space heating units - Gas Furnace (%)	79	67.2	25.9	3.88	0.83	0.698	0.698
Sales of water heating units - Electric Heat Pump (%)	1.12	9.5	48.6	62.9	64.3	64.4	64.4
Sales of water heating units - Electric Resistance (%)	3.42	6.18	24.2	33.6	34.9	34.9	34.9
Sales of water heating units - Gas Furnace (%)	94.6	83.7	26.6	2.84	0.138	0	0
Sales of water heating units - Other (%)	0.885	0.628	0.63	0.632	0.632	0.63	0.631

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	3.77	3.88	6.5	6.9	5.9	6.14

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

Item	2020	2025	2030	2035	2040	2045	2050
Capital invested - Solar PV - Base (billion \$2018)	0	0	0	0	0	0	6.65
Capital invested - Wind - Base (billion \$2018)	0	0	0.898	1.32	2.71	4.51	10.6

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

Item	2020	2025	2030	2035	2040	2045	2050
Solar - Base land use assumptions (GWh)	1,419	0	0	0	0	0	14,097
Solar - Constrained land use assumptions (GWh)	1,419	0	0	0	0	0	22,754
Wind - Base land use assumptions (GWh)	11,561	0	1,795	2,598	5,362	9,058	21,690
Wind - Constrained land use assumptions (GWh)	11,817	0	4,125	23,540	43,847	72,415	80,287

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	-1,981
Carbon sink potential - Aggressive deployment - Permanent conservation cover (1000 tCO2e/y)	0	0	-147
Carbon sink potential - Aggressive deployment - Total (1000 tCO2e/y)	0	0	-2,129
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	-1,027
Carbon sink potential - Moderate deployment - Permanent conservation cover (1000 tCO2e/y)	0	0	-73.6
Carbon sink potential - Moderate deployment - Total (1000 tCO2e/y)	0	0	-1,101
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	2,798
Land impacted for carbon sink - Aggressive deployment - Permanent conservation cover (1000 hectares)	0	0	235
Land impacted for carbon sink - Aggressive deployment - Total (1000 hectares)	0	0	3,033
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	1,458
Land impacted for carbon sink - Moderate deployment - Permanent conservation cover (1000 hectares)	0	0	117
Land impacted for carbon sink - Moderate deployment - Total (1000 hectares)	0	0	1,575

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

Item	2020	2025	2050
Carbon sink potential - High - Accelerate regeneration (1000 tCO ₂ e/y)	0	0	2,170
Carbon sink potential - High - All (not counting overlap) (1000 tCO ₂ e/y)	0	0	71,521
Carbon sink potential - High - Avoid deforestation (1000 tCO ₂ e/y)	0	0	1,904
Carbon sink potential - High - Extend rotation length (1000 tCO ₂ e/y)	0	0	9,494
Carbon sink potential - High - Improve plantations (1000 tCO ₂ e/y)	0	0	4,080
Carbon sink potential - High - Increase retention of HWP (1000 tCO ₂ e/y)	0	0	29,790
Carbon sink potential - High - Increase trees outside forests (1000 tCO ₂ e/y)	0	0	1,078
Carbon sink potential - High - Reforest cropland (1000 tCO ₂ e/y)	0	0	14,981
Carbon sink potential - High - Reforest pasture (1000 tCO ₂ e/y)	0	0	2,477
Carbon sink potential - High - Restore productivity (1000 tCO ₂ e/y)	0	0	5,545
Carbon sink potential - Low - Accelerate regeneration (1000 tCO ₂ e/y)	0	0	1,087
Carbon sink potential - Low - All (not counting overlap) (1000 tCO ₂ e/y)	0	0	26,982
Carbon sink potential - Low - Avoid deforestation (1000 tCO ₂ e/y)	0	0	317
Carbon sink potential - Low - Extend rotation length (1000 tCO ₂ e/y)	0	0	3,647
Carbon sink potential - Low - Improve plantations (1000 tCO ₂ e/y)	0	0	2,076
Carbon sink potential - Low - Increase retention of HWP (1000 tCO ₂ e/y)	0	0	9,930
Carbon sink potential - Low - Increase trees outside forests (1000 tCO ₂ e/y)	0	0	377
Carbon sink potential - Low - Reforest cropland (1000 tCO ₂ e/y)	0	0	7,491
Carbon sink potential - Low - Reforest pasture (1000 tCO ₂ e/y)	0	0	188
Carbon sink potential - Low - Restore productivity (1000 tCO ₂ e/y)	0	0	1,869
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO ₂ e/y)	0	0	1,629
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO ₂ e/y)	0	0	49,216
Carbon sink potential - Mid - Avoid deforestation (1000 tCO ₂ e/y)	0	0	1,111
Carbon sink potential - Mid - Extend rotation length (1000 tCO ₂ e/y)	0	0	6,570
Carbon sink potential - Mid - Improve plantations (1000 tCO ₂ e/y)	0	0	3,042
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO ₂ e/y)	0	0	19,860
Carbon sink potential - Mid - Increase trees outside forests (1000 tCO ₂ e/y)	0	0	728
Carbon sink potential - Mid - Reforest cropland (1000 tCO ₂ e/y)	0	0	11,236
Carbon sink potential - Mid - Reforest pasture (1000 tCO ₂ e/y)	0	0	1,332
Carbon sink potential - Mid - Restore productivity (1000 tCO ₂ e/y)	0	0	3,707
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)	0	0	355

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

Item	2020	2025	2050
Land impacted for carbon sink potential - High - Avoid deforestation (over 30 years) (1000 hectares)	0	0	258
Land impacted for carbon sink potential - High - Extend rotation length (1000 hectares)	0	0	4,841
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)	0	0	1,503
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	102
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)	0	0	990
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)	0	0	70.4
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)	0	0	1,838
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)	0	0	9,959
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)	0	0	178
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)	0	0	242
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)	0	0	1,855
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)	0	0	752
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	53.9
Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares)	0	0	495
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)	0	0	12.2
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)	0	0	1,112
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)	0	0	4,699
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)	0	0	266
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)	0	0	250
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)	0	0	3,348
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)	0	0	1,131
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	78.2
Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares)	0	0	743
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)	0	0	88.2
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)	0	0	2,240
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)	0	0	8,144

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

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal (million 2019\$)	0	64	0.071	0.071	0.053	0.033	0
Monetary damages from air pollution - Natural Gas (million 2019\$)	0	55.1	26.2	16.9	15.4	13	4.18
Monetary damages from air pollution - Transportation (million 2019\$)	0	1,113	1,077	847	507	238	95
Premature deaths from air pollution - Coal (deaths)	0	7.18	0.008	0.008	0.006	0.004	0
Premature deaths from air pollution - Natural Gas (deaths)	0	6.23	2.96	1.9	1.73	1.47	0.472
Premature deaths from air pollution - Transportation (deaths)	0	125	121	95.3	57	26.7	10.7

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	4.12	4.1	0	0	0	0
Sales of cooking units - Electric Resistance (%)	70.6	76.8	96	99.8	100	100	100
Sales of cooking units - Gas (%)	29.4	23.2	3.96	0.2	0	0	0
Sales of space heating units - Electric Heat Pump (%)	14	25.2	47.6	59.1	60.7	60.7	60.6
Sales of space heating units - Electric Resistance (%)	35.6	41	35.5	30.7	30	30.2	30.3
Sales of space heating units - Fossil (%)	8.89	13.2	9.93	8.85	8.62	8.41	8.39
Sales of space heating units - Gas (%)	41.5	20.6	6.9	1.33	0.7	0.659	0.662
Sales of water heating units - Electric Heat Pump (%)	0	6.87	37.5	47.6	48.6	48.6	48.6
Sales of water heating units - Electric Resistance (%)	45.5	59.1	48.2	46.1	46.1	46.1	46.1
Sales of water heating units - Gas Furnace (%)	47.5	28.5	9.06	0.967	0.047	0	0
Sales of water heating units - Other (%)	6.95	5.52	5.27	5.27	5.28	5.27	5.28

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	1,331	3,547	5,529	8,462	9,115	8,742
Public EV charging plugs - DC Fast (1000 units)	0.551	0	2.62	0	9.97	0	15.8
Public EV charging plugs - L2 (1000 units)	2.37	0	63.1	0	240	0	381
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 (%)	1.51	1.78	1.24	0.397	0.074	0.013	0
Vehicle sales - Light-duty - EV (%)	4.05	15.6	47.1	82.1	96.4	99.3	100
Vehicle sales - Light-duty - gasoline (%)	89.7	77.5	48.1	16.3	3.26	0.589	0
Vehicle sales - Light-duty - hybrid (%)	4.56	4.64	3.26	1.21	0.294	0.065	0
Vehicle sales - Light-duty - hydrogen FC (%)	0.11	0.337	0.2	0.062	0.012	0.002	0
Vehicle sales - Light-duty - other (%)	0.1	0.096	0.062	0.022	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 37: *E+RE- scenario - PILLAR 1: Efficiency/Electrification - Overview*

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Commercial (PJ)	160	162	160	153	146	145	146
Final energy use - Industry (PJ)	342	354	359	361	368	377	387
Final energy use - Residential (PJ)	246	227	199	170	144	128	117
Final energy use - Transportation (PJ)	656	650	592	519	454	412	391

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	22,776	24,705	0	0	0	0
Sales of cooking units - Electric Resistance (%)	27.5	41.7	78.2	85.4	85.8	85.8	85.8
Sales of cooking units - Gas (%)	72.5	58.3	21.8	14.6	14.2	14.2	14.2
Sales of space heating units - Electric Heat Pump (%)	2.72	15.7	39.9	56.5	59	59.1	59.1
Sales of space heating units - Electric Resistance (%)	18.3	17.1	34.2	39.6	40.2	40.2	40.2
Sales of space heating units - Fossil (%)	0	0	0	0	0	0	0
Sales of space heating units - Gas Furnace (%)	79	67.2	25.9	3.88	0.83	0.698	0.698
Sales of water heating units - Electric Heat Pump (%)	1.12	9.5	48.6	62.9	64.3	64.4	64.4
Sales of water heating units - Electric Resistance (%)	3.42	6.18	24.2	33.6	34.9	34.9	34.9
Sales of water heating units - Gas Furnace (%)	94.6	83.7	26.6	2.84	0.138	0	0
Sales of water heating units - Other (%)	0.885	0.628	0.63	0.632	0.632	0.63	0.631

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	3.77	3.88	6.5	6.9	5.9	6.14

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

Item	2020	2025	2030	2035	2040	2045	2050
Capital invested - Solar PV - Base (billion \$2018)	0	0	0	0	0	0.377	0
Capital invested - Solar PV - Constrained (billion \$2018)	0	0.437	0	0	1.54	0.688	0
Capital invested - Wind - Base (billion \$2018)	0	0.134	0.485	0.205	0.75	0.37	0
Capital invested - Wind - Constrained (billion \$2018)	0	0.094	1.29	0.695	3.43	5.19	0

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

Item	2020	2025	2030	2035	2040	2045
Solar - Base land use assumptions (GWh)	1,419	0	0	0	0	759
Solar - Constrained land use assumptions (GWh)	2,487	644	0	0	2,917	1,365
Wind - Base land use assumptions (GWh)	11,561	256	977	423	1,570	789
Wind - Constrained land use assumptions (GWh)	11,817	176	2,470	1,347	6,655	10,251

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 tCO ₂ e/y)	0	0	0
Carbon sink potential - Aggressive deployment - Cropland measures (1000 tCO ₂ e/y)	0	0	-1,981
Carbon sink potential - Aggressive deployment - Permanent conservation cover (1000 tCO ₂ e/y)	0	0	-147
Carbon sink potential - Aggressive deployment - Total (1000 tCO ₂ e/y)	0	0	-2,129
Carbon sink potential - Moderate deployment - Corn-ethanol to energy grasses (1000 tCO ₂ e/y)	0	0	0

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

Item	2020	2025	2050
Carbon sink potential - Moderate deployment - Cropland measures (1000 tCO ₂ e/y)	0	0	-1,027
Carbon sink potential - Moderate deployment - Permanent conservation cover (1000 tCO ₂ e/y)	0	0	-73.6
Carbon sink potential - Moderate deployment - Total (1000 tCO ₂ e/y)	0	0	-1,101
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	2,798
Land impacted for carbon sink - Aggressive deployment - Permanent conservation cover (1000 hectares)	0	0	235
Land impacted for carbon sink - Aggressive deployment - Total (1000 hectares)	0	0	3,033
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	1,458
Land impacted for carbon sink - Moderate deployment - Permanent conservation cover (1000 hectares)	0	0	117
Land impacted for carbon sink - Moderate deployment - Total (1000 hectares)	0	0	1,575

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

Item	2020	2025	2050
Carbon sink potential - High - Accelerate regeneration (1000 tCO ₂ e/y)	0	0	2,170
Carbon sink potential - High - All (not counting overlap) (1000 tCO ₂ e/y)	0	0	71,521
Carbon sink potential - High - Avoid deforestation (1000 tCO ₂ e/y)	0	0	1,904
Carbon sink potential - High - Extend rotation length (1000 tCO ₂ e/y)	0	0	9,494
Carbon sink potential - High - Improve plantations (1000 tCO ₂ e/y)	0	0	4,080
Carbon sink potential - High - Increase retention of HWP (1000 tCO ₂ e/y)	0	0	29,790
Carbon sink potential - High - Increase trees outside forests (1000 tCO ₂ e/y)	0	0	1,078
Carbon sink potential - High - Reforest cropland (1000 tCO ₂ e/y)	0	0	14,981
Carbon sink potential - High - Reforest pasture (1000 tCO ₂ e/y)	0	0	2,477
Carbon sink potential - High - Restore productivity (1000 tCO ₂ e/y)	0	0	5,545
Carbon sink potential - Low - Accelerate regeneration (1000 tCO ₂ e/y)	0	0	1,087
Carbon sink potential - Low - All (not counting overlap) (1000 tCO ₂ e/y)	0	0	26,982
Carbon sink potential - Low - Avoid deforestation (1000 tCO ₂ e/y)	0	0	317
Carbon sink potential - Low - Extend rotation length (1000 tCO ₂ e/y)	0	0	3,647
Carbon sink potential - Low - Improve plantations (1000 tCO ₂ e/y)	0	0	2,076
Carbon sink potential - Low - Increase retention of HWP (1000 tCO ₂ e/y)	0	0	9,930

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

Item	2020	2025	2050
Carbon sink potential - Low - Increase trees outside forests (1000 tCO ₂ e/y)	0	0	377
Carbon sink potential - Low - Reforest cropland (1000 tCO ₂ e/y)	0	0	7,491
Carbon sink potential - Low - Reforest pasture (1000 tCO ₂ e/y)	0	0	188
Carbon sink potential - Low - Restore productivity (1000 tCO ₂ e/y)	0	0	1,869
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO ₂ e/y)	0	0	1,629
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO ₂ e/y)	0	0	49,216
Carbon sink potential - Mid - Avoid deforestation (1000 tCO ₂ e/y)	0	0	1,111
Carbon sink potential - Mid - Extend rotation length (1000 tCO ₂ e/y)	0	0	6,570
Carbon sink potential - Mid - Improve plantations (1000 tCO ₂ e/y)	0	0	3,042
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO ₂ e/y)	0	0	19,860
Carbon sink potential - Mid - Increase trees outside forests (1000 tCO ₂ e/y)	0	0	728
Carbon sink potential - Mid - Reforest cropland (1000 tCO ₂ e/y)	0	0	11,236
Carbon sink potential - Mid - Reforest pasture (1000 tCO ₂ e/y)	0	0	1,332
Carbon sink potential - Mid - Restore productivity (1000 tCO ₂ e/y)	0	0	3,707
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)	0	0	355
Land impacted for carbon sink potential - High - Avoid deforestation (over 30 years) (1000 hectares)	0	0	258
Land impacted for carbon sink potential - High - Extend rotation length (1000 hectares)	0	0	4,841
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)	0	0	1,503
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	102
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)	0	0	990
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)	0	0	70.4
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)	0	0	1,838
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)	0	0	9,959
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)	0	0	178
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)	0	0	242
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)	0	0	1,855
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)	0	0	752
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	53.9

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

Item	2020	2025	2050
Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares)	0	0	495
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)	0	0	12.2
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)	0	0	1,112
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)	0	0	4,699
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)	0	0	266
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)	0	0	250
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)	0	0	3,348
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)	0	0	1,131
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	78.2
Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares)	0	0	743
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)	0	0	88.2
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)	0	0	2,240
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)	0	0	8,144

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

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal (million 2019\$)	0	64	0.071	0.071	0.053	0.033	0
Monetary damages from air pollution - Natural Gas (million 2019\$)	0	57.8	27.7	32.8	38.7	24.2	11.4
Monetary damages from air pollution - Transportation (million 2019\$)	0	1,113	1,077	847	507	238	95
Premature deaths from air pollution - Coal (deaths)	0	7.18	0.008	0.008	0.006	0.004	0
Premature deaths from air pollution - Natural Gas (deaths)	0	6.53	3.13	3.7	4.37	2.73	1.29
Premature deaths from air pollution - Transportation (deaths)	0	125	121	95.3	57	26.7	10.7

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	4.1	4.04	0	0	0	0
Sales of cooking units - Electric Resistance (%)	70.4	71.2	73.9	81.1	91	97.1	99.2
Sales of cooking units - Gas (%)	29.6	28.8	26.1	18.9	9.03	2.91	0.784
Sales of space heating units - Electric Heat Pump (%)	14	21.3	23.9	31.4	44.1	54.1	58.4
Sales of space heating units - Electric Resistance (%)	35.6	41.8	41.1	39.2	35.8	32.7	31
Sales of space heating units - Fossil (%)	8.89	13.8	13.5	12.4	10.6	9.24	8.81
Sales of space heating units - Gas (%)	41.5	23	21.5	17	9.58	4.03	1.76
Sales of water heating units - Electric Heat Pump (%)	0	1.23	4.71	14.8	30.9	42.3	46.7
Sales of water heating units - Electric Resistance (%)	45.5	61.3	60	56.4	51	47.6	46.5

Table 45: E-B+ scenario - PILLAR 1: Efficiency/Electrification - Residential (continued)

Item	2020	2025	2030	2035	2040	2045	2050
Sales of water heating units - Gas Furnace (%)	47.5	31.9	29.8	23.3	12.8	4.87	1.59
Sales of water heating units - Other (%)	6.95	5.56	5.52	5.49	5.39	5.31	5.28

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	239	450	1,569	4,778	7,016
Public EV charging plugs - DC Fast (1000 units)	0.551	0	1.02	0	3.86	0	10.1
Public EV charging plugs - L2 (1000 units)	2.37	0	24.5	0	92.8	0	244
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 (%)	1.52	1.94	2.05	1.63	1.04	0.532	0.228
Vehicle sales - Light-duty - EV (%)	1.94	4.79	12.1	26.2	48.8	72.3	87.7
Vehicle sales - Light-duty - gasoline (%)	91.6	87.3	79.3	66.2	45.8	24.6	10.9
Vehicle sales - Light-duty - hybrid (%)	4.73	5.52	6.19	5.61	4.19	2.46	1.19
Vehicle sales - Light-duty - hydrogen FC (%)	0.113	0.379	0.324	0.246	0.174	0.096	0.045
Vehicle sales - Light-duty - other (%)	0.101	0.105	0.095	0.083	0.059	0.033	0.015
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)	160	163	165	166	164	162	160
Final energy use - Industry (PJ)	342	355	361	367	376	385	395
Final energy use - Residential (PJ)	246	227	207	188	169	150	133
Final energy use - Transportation (PJ)	657	654	611	573	544	510	470

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	22,723	24,348	0	0	0	0
Sales of cooking units - Electric Resistance (%)	27.5	31	36.1	49.7	68.6	80.2	84.3
Sales of cooking units - Gas (%)	72.5	69	63.9	50.3	31.4	19.8	15.7
Sales of space heating units - Electric Heat Pump (%)	2.72	11.9	14.6	22.8	37.2	49.8	55.8
Sales of space heating units - Electric Resistance (%)	18.3	13.9	15.8	21.6	30.6	36.8	39.3
Sales of space heating units - Fossil (%)	0	0	0	0	0	0	0
Sales of space heating units - Gas Furnace (%)	79	74.3	69.5	55.6	32.2	13.3	4.9
Sales of water heating units - Electric Heat Pump (%)	1.12	2.39	6.84	19.8	40.6	55.7	61.7
Sales of water heating units - Electric Resistance (%)	3.42	3.14	5.18	11.2	21.3	29.5	33.1
Sales of water heating units - Gas Furnace (%)	94.6	93.8	87.3	68.4	37.5	14.2	4.65
Sales of water heating units - Other (%)	0.885	0.628	0.63	0.632	0.632	0.63	0.631

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	2.95	2.96	4.08	4.22	5.76	6.07

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	0.004	0.227	0	0	0	0
Capital invested - Biomass w/ccu allam power plant (billion \$2018)	0	0	0	0	0.008	0	0
Capital invested - Biomass w/ccu power plant (billion \$2018)	0	0	0	0	0.063	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	7.38	452	452	452	452	452
Biomass w/ccu allam power plant (GWh)	0	0	0	0	8.4	8.4	8.4
Biomass w/ccu power plant (GWh)	0	0	0	0	70.4	70.4	70.4

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

Item	2020	2025	2030	2035	2040	2045	2050
Biomass purchases (million \$2018/year)	0	63.7	192	194	290	684	729
Conversion capital investment - Cumulative 5-yr (million \$2018)	0	4.26	253	26.4	1,350	5,424	624
Number of facilities - Allam power w ccu (quantity)	0	0	0	0	1	1	1
Number of facilities - Beccs hydrogen (quantity)	0	0	0	0	1	6	7
Number of facilities - Diesel (quantity)	0	0	0	1	1	1	1
Number of facilities - Diesel ccu (quantity)	0	0	0	0	1	1	1
Number of facilities - Power (quantity)	0	1	1	1	1	1	1
Number of facilities - Power ccu (quantity)	0	0	0	0	1	1	1
Number of facilities - Pyrolysis (quantity)	0	0	0	1	1	1	1
Number of facilities - Pyrolysis ccu (quantity)	0	0	0	0	1	1	1
Number of facilities - Sng (quantity)	0	1	1	1	1	1	1
Number of facilities - Sng ccu (quantity)	0	0	0	0	0	0	0

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

Item	2020	2025	2030	2035	2040	2045	2050
Annual - All (MMT)	0	0	0	3.35	5.03	12.1	13
Annual - BECCS (MMT)	0	0	0	0	1.71	8.69	9.49
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	8.38	20.5	33.5
Cumulative - BECCS (MMT)	0	0	0	0	1.71	10.4	19.9
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	776	984	1,486	1,688
Cumulative investment - All (million \$2018)	0	0	0	1,800	1,935	2,313	2,443
Cumulative investment - Spur (million \$2018)	0	0	0	98.6	233	611	741
Cumulative investment - Trunk (million \$2018)	0	0	0	1,702	1,702	1,702	1,702
Spur (km)	0	0	0	101	309	811	1,013
Trunk (km)	0	0	0	675	675	675	675

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	-0.035
Carbon sink potential - Aggressive deployment - Cropland measures (1000 tCO2e/y)	0	0	-1,981
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	-147
Carbon sink potential - Aggressive deployment - Total (1000 tCO2e/y)	0	0	-2,129
Carbon sink potential - Moderate deployment - Corn-ethanol to energy grasses (1000 tCO2e/y)	0	0	-0.035
Carbon sink potential - Moderate deployment - Cropland measures (1000 tCO2e/y)	0	0	-1,027
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	-73.6
Carbon sink potential - Moderate deployment - Total (1000 tCO2e/y)	0	0	-1,101
Land impacted for carbon sink - Aggressive deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	0.062
Land impacted for carbon sink - Aggressive deployment - Cropland measures (1000 hectares)	0	0	6,909
Land impacted for carbon sink - Aggressive deployment - Cropland to woody energy crops (1000 hectares)	0	0	0.016
Land impacted for carbon sink - Aggressive deployment - Pasture to energy crops (1000 hectares)	0	0	2.81
Land impacted for carbon sink - Aggressive deployment - Permanent conservation cover (1000 hectares)	0	0	235
Land impacted for carbon sink - Aggressive deployment - Total (1000 hectares)	0	0	7,146
Land impacted for carbon sink - Moderate deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	0.062
Land impacted for carbon sink - Moderate deployment - Cropland measures (1000 hectares)	0	0	1,458
Land impacted for carbon sink - Moderate deployment - Cropland to woody energy crops (1000 hectares)	0	0	0.016
Land impacted for carbon sink - Moderate deployment - Pasture to energy crops (1000 hectares)	0	0	2.81
Land impacted for carbon sink - Moderate deployment - Permanent conservation cover (1000 hectares)	0	0	117
Land impacted for carbon sink - Moderate deployment - Total (1000 hectares)	0	0	1,578

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	2,170
Carbon sink potential - High - All (not counting overlap) (1000 tCO2e/y)	0	0	71,521
Carbon sink potential - High - Avoid deforestation (1000 tCO2e/y)	0	0	1,904
Carbon sink potential - High - Extend rotation length (1000 tCO2e/y)	0	0	9,494
Carbon sink potential - High - Improve plantations (1000 tCO2e/y)	0	0	4,080
Carbon sink potential - High - Increase retention of HWP (1000 tCO2e/y)	0	0	29,790
Carbon sink potential - High - Increase trees outside forests (1000 tCO2e/y)	0	0	1,078
Carbon sink potential - High - Reforest cropland (1000 tCO2e/y)	0	0	14,981
Carbon sink potential - High - Reforest pasture (1000 tCO2e/y)	0	0	2,477
Carbon sink potential - High - Restore productivity (1000 tCO2e/y)	0	0	5,545
Carbon sink potential - Low - Accelerate regeneration (1000 tCO2e/y)	0	0	1,087
Carbon sink potential - Low - All (not counting overlap) (1000 tCO2e/y)	0	0	26,982
Carbon sink potential - Low - Avoid deforestation (1000 tCO2e/y)	0	0	317
Carbon sink potential - Low - Extend rotation length (1000 tCO2e/y)	0	0	3,647
Carbon sink potential - Low - Improve plantations (1000 tCO2e/y)	0	0	2,076
Carbon sink potential - Low - Increase retention of HWP (1000 tCO2e/y)	0	0	9,930
Carbon sink potential - Low - Increase trees outside forests (1000 tCO2e/y)	0	0	377
Carbon sink potential - Low - Reforest cropland (1000 tCO2e/y)	0	0	7,491
Carbon sink potential - Low - Reforest pasture (1000 tCO2e/y)	0	0	188
Carbon sink potential - Low - Restore productivity (1000 tCO2e/y)	0	0	1,869
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO2e/y)	0	0	1,629
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO2e/y)	0	0	49,216
Carbon sink potential - Mid - Avoid deforestation (1000 tCO2e/y)	0	0	1,111
Carbon sink potential - Mid - Extend rotation length (1000 tCO2e/y)	0	0	6,570
Carbon sink potential - Mid - Improve plantations (1000 tCO2e/y)	0	0	3,042
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO2e/y)	0	0	19,860
Carbon sink potential - Mid - Increase trees outside forests (1000 tCO2e/y)	0	0	728
Carbon sink potential - Mid - Reforest cropland (1000 tCO2e/y)	0	0	11,236
Carbon sink potential - Mid - Reforest pasture (1000 tCO2e/y)	0	0	1,332
Carbon sink potential - Mid - Restore productivity (1000 tCO2e/y)	0	0	3,707
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)	0	0	355

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

Item	2020	2025	2050
Land impacted for carbon sink potential - High - Avoid deforestation (over 30 years) (1000 hectares)	0	0	258
Land impacted for carbon sink potential - High - Extend rotation length (1000 hectares)	0	0	4,841
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)	0	0	1,503
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	102
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)	0	0	990
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)	0	0	70.4
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)	0	0	1,838
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)	0	0	9,959
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)	0	0	178
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)	0	0	242
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)	0	0	1,855
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)	0	0	752
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	53.9
Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares)	0	0	495
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)	0	0	12.2
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)	0	0	1,112
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)	0	0	4,699
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)	0	0	266
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)	0	0	250
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)	0	0	3,348
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)	0	0	1,131
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	78.2
Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares)	0	0	743
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)	0	0	88.2
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)	0	0	2,240
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)	0	0	8,144

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	4.1	3.83	0	0	0	0
Sales of cooking units - Electric Resistance (%)	70.2	70.2	70.2	70.2	70.2	70.2	70.2
Sales of cooking units - Gas (%)	29.8	29.8	29.8	29.8	29.8	29.8	29.8
Sales of space heating units - Electric Heat Pump (%)	12.4	29.8	30.5	31.7	33.2	35.3	38.5
Sales of space heating units - Electric Resistance (%)	36.2	36.9	36.4	35.6	34.5	32.5	29.2
Sales of space heating units - Fossil (%)	9.05	12.7	11.5	10.8	10.6	10.5	10.6
Sales of space heating units - Gas (%)	42.3	20.7	21.6	21.9	21.7	21.7	21.7
Sales of water heating units - Electric Heat Pump (%)	0	0	0	0	0	0	0
Sales of water heating units - Electric Resistance (%)	45.5	61.7	61.7	61.6	61.6	61.6	61.6
Sales of water heating units - Gas Furnace (%)	47.5	32.7	32.8	32.8	32.8	32.8	32.8
Sales of water heating units - Other (%)	6.95	5.57	5.55	5.6	5.61	5.61	5.61

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 (%)	1.51	1.93	2.18	2.03	1.82	1.7	1.62
Vehicle sales - Light-duty - EV (%)	3.7	5.77	6.57	8.08	9.83	11.3	12.5
Vehicle sales - Light-duty - gasoline (%)	90	86.4	84.2	82.3	80.2	78.3	76.7
Vehicle sales - Light-duty - hybrid (%)	4.57	5.41	6.62	7.18	7.74	8.3	8.72
Vehicle sales - Light-duty - hydrogen FC (%)	0.111	0.375	0.343	0.304	0.301	0.301	0.312
Vehicle sales - Light-duty - other (%)	0.1	0.104	0.1	0.101	0.1	0.099	0.101
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)	160	165	169	173	178	188	201
Final energy use - Industry (PJ)	342	367	387	404	428	457	490
Final energy use - Residential (PJ)	246	227	210	196	186	179	172
Final energy use - Transportation (PJ)	656	659	625	605	608	624	642

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	22,575	23,159	0	0	0	0
Sales of cooking units - Electric Resistance (%)	27.5	29	29	29	29	28.9	28.9
Sales of cooking units - Gas (%)	72.5	71	71	71	71	71.1	71.1
Sales of space heating units - Electric Heat Pump (%)	2.72	21.4	53.8	64.1	65.2	65.3	65.3
Sales of space heating units - Electric Resistance (%)	18.3	16.1	25.2	30.3	33.5	33.9	34
Sales of space heating units - Fossil (%)	0	0	0	0	0	0	0
Sales of space heating units - Gas Furnace (%)	79	62.5	21	5.54	1.3	0.744	0.697
Sales of water heating units - Electric Heat Pump (%)	1.12	0.821	0.82	0.824	0.831	0.834	0.834

Table 61: REF scenario - PILLAR 1: Efficiency/Electrification - Commercial (continued)

Item	2020	2025	2030	2035	2040	2045	2050
Sales of water heating units - Electric Resistance (%)	3.42	2.42	2.42	2.44	2.44	2.44	2.44
Sales of water heating units - Gas Furnace (%)	94.6	96.1	96.1	96.1	96.1	96.1	96.1
Sales of water heating units - Other (%)	0.885	0.628	0.63	0.632	0.632	0.63	0.631

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	3.38	3.44	3.99	4.11	3.95	4.04

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

Item	2020	2025	2030	2050
Business-as-usual carbon sink - Natural uptake (Mt CO2e/y)	-27.2	0	-5.37	-4.47
Business-as-usual carbon sink - Retained in Hardwood Products (Mt CO2e/y)	-8.11	0	-13.6	-14.3
Business-as-usual carbon sink - Total (Mt CO2e/y)	-35.3	0	-19	-18.8
Carbon sink potential - High - Accelerate regeneration (1000 tCO2e/y)	0	0	0	2,170
Carbon sink potential - High - All (not counting overlap) (1000 tCO2e/y)	0	0	0	71,521
Carbon sink potential - High - Avoid deforestation (1000 tCO2e/y)	0	0	0	1,904
Carbon sink potential - High - Extend rotation length (1000 tCO2e/y)	0	0	0	9,494
Carbon sink potential - High - Improve plantations (1000 tCO2e/y)	0	0	0	4,080
Carbon sink potential - High - Increase retention of HWP (1000 tCO2e/y)	0	0	0	29,790
Carbon sink potential - High - Increase trees outside forests (1000 tCO2e/y)	0	0	0	1,078
Carbon sink potential - High - Reforest cropland (1000 tCO2e/y)	0	0	0	14,981
Carbon sink potential - High - Reforest pasture (1000 tCO2e/y)	0	0	0	2,477
Carbon sink potential - High - Restore productivity (1000 tCO2e/y)	0	0	0	5,545
Carbon sink potential - Low - Accelerate regeneration (1000 tCO2e/y)	0	0	0	1,087
Carbon sink potential - Low - All (not counting overlap) (1000 tCO2e/y)	0	0	0	26,982
Carbon sink potential - Low - Avoid deforestation (1000 tCO2e/y)	0	0	0	317
Carbon sink potential - Low - Extend rotation length (1000 tCO2e/y)	0	0	0	3,647
Carbon sink potential - Low - Improve plantations (1000 tCO2e/y)	0	0	0	2,076
Carbon sink potential - Low - Increase retention of HWP (1000 tCO2e/y)	0	0	0	9,930
Carbon sink potential - Low - Increase trees outside forests (1000 tCO2e/y)	0	0	0	377
Carbon sink potential - Low - Reforest cropland (1000 tCO2e/y)	0	0	0	7,491
Carbon sink potential - Low - Reforest pasture (1000 tCO2e/y)	0	0	0	188
Carbon sink potential - Low - Restore productivity (1000 tCO2e/y)	0	0	0	1,869
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO2e/y)	0	0	0	1,629
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO2e/y)	0	0	0	49,216

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

Item	2020	2025	2030	2050
Carbon sink potential - Mid - Avoid deforestation (1000 tCO2e/y)	0	0	0	1,111
Carbon sink potential - Mid - Extend rotation length (1000 tCO2e/y)	0	0	0	6,570
Carbon sink potential - Mid - Improve plantations (1000 tCO2e/y)	0	0	0	3,042
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO2e/y)	0	0	0	19,860
Carbon sink potential - Mid - Increase trees outside forests (1000 tCO2e/y)	0	0	0	728
Carbon sink potential - Mid - Reforest cropland (1000 tCO2e/y)	0	0	0	11,236
Carbon sink potential - Mid - Reforest pasture (1000 tCO2e/y)	0	0	0	1,332
Carbon sink potential - Mid - Restore productivity (1000 tCO2e/y)	0	0	0	3,707
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)	0	0	0	355
Land impacted for carbon sink potential - High - Avoid deforestation (over 30 years) (1000 hectares)	0	0	0	258
Land impacted for carbon sink potential - High - Extend rotation length (1000 hectares)	0	0	0	4,841
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)	0	0	0	1,503
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	102
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)	0	0	0	990
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)	0	0	0	70.4
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)	0	0	0	1,838
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)	0	0	0	9,959
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)	0	0	0	178
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)	0	0	0	242
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)	0	0	0	1,855
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)	0	0	0	752
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	53.9
Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares)	0	0	0	495
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)	0	0	0	12.2
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)	0	0	0	1,112
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)	0	0	0	4,699
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)	0	0	0	266
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)	0	0	0	250

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

Item	2020	2025	2030	2050
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)	0	0	0	3,348
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)	0	0	0	1,131
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	78.2
Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares)	0	0	0	743
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)	0	0	0	88.2
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)	0	0	0	2,240
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)	0	0	0	8,144

Table 64: *REF scenario - IMPACTS - Health*

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal (million 2019\$)	0	273	196	36	28.3	25.9	24.3
Monetary damages from air pollution - Natural Gas (million 2019\$)	0	72.7	72	75.4	61	55.4	57.5
Monetary damages from air pollution - Transportation (million 2019\$)	0	1,130	1,203	1,275	1,353	1,434	1,517
Premature deaths from air pollution - Coal (deaths)	0	30.6	22	4.05	3.18	2.91	2.73
Premature deaths from air pollution - Natural Gas (deaths)	0	8.21	8.13	8.52	6.89	6.26	6.49
Premature deaths from air pollution - Transportation (deaths)	0	127	135	143	152	161	171