

Net-Zero America - oregon 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	2.54	2.66	0	0	0	0
Sales of cooking units - Electric Resistance (%)	65.6	73	95.4	99.8	100	100	100
Sales of cooking units - Gas (%)	34.4	27	4.63	0.233	0	0	0
Sales of space heating units - Electric Heat Pump (%)	12.4	24.5	48.3	57.6	58.8	58.8	58.7
Sales of space heating units - Electric Resistance (%)	31	37.4	34.1	31.4	31	31.2	31.3
Sales of space heating units - Fossil (%)	8.35	13.5	10.5	9.63	9.42	9.21	9.21
Sales of space heating units - Gas (%)	48.3	24.7	7.17	1.4	0.846	0.812	0.816
Sales of water heating units - Electric Heat Pump (%)	0	7.68	41.4	51	51.8	51.8	51.8
Sales of water heating units - Electric Resistance (%)	40.2	54.8	44.8	43.1	43.1	43.1	43.1
Sales of water heating units - Gas Furnace (%)	53.4	32.3	8.69	0.78	0.033	0	0
Sales of water heating units - Other (%)	6.41	5.3	5.09	5.09	5.1	5.11	5.12

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	737	1,953	3,062	4,679	5,048	4,837
Public EV charging plugs - DC Fast (1000 units)	0.347	0	1.51	0	5.84	0	9.31
Public EV charging plugs - L2 (1000 units)	1.3	0	36.3	0	141	0	224
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 (%)	1.62	1.88	1.29	0.412	0.076	0.013	0
Vehicle sales - Light-duty - EV (%)	3.67	14.4	45.3	81.3	96.3	99.3	100
Vehicle sales - Light-duty - gasoline (%)	90.3	78.9	50	17	3.35	0.592	0
Vehicle sales - Light-duty - hybrid (%)	4.18	4.37	3.13	1.17	0.284	0.062	0
Vehicle sales - Light-duty - hydrogen FC (%)	0.111	0.344	0.209	0.065	0.013	0.002	0
Vehicle sales - Light-duty - other (%)	0.105	0.101	0.067	0.023	0.005	0.001	0
Vehicle sales - Medium-duty - diesel (%)	64.7	59.7	42.3	14.4	2.59	0.384	0
Vehicle sales - Medium-duty - EV (%)	0.784	5.07	25.3	60.8	76.5	79.5	80
Vehicle sales - Medium-duty - gasoline (%)	33.7	33.3	25.5	9.32	1.77	0.277	0
Vehicle sales - Medium-duty - hybrid (%)	0.363	0.402	0.341	0.14	0.03	0.005	0
Vehicle sales - Medium-duty - hydrogen FC (%)	0.196	1.27	6.33	15.2	19.1	19.9	20
Vehicle sales - Medium-duty - other (%)	0.253	0.255	0.205	0.083	0.019	0.004	0

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

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Commercial (PJ)	93.8	95	93.3	89	85.5	84.8	85.9
Final energy use - Industry (PJ)	209	215	214	219	226	230	236
Final energy use - Residential (PJ)	151	140	123	104	88.4	78.3	72.2
Final energy use - Transportation (PJ)	334	313	278	236	197	173	163

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	13,358	14,518	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 (%)	2.5	16.7	41.2	54.8	56.6	56.7	56.7
Sales of space heating units - Electric Resistance (%)	16.7	17.5	36.3	42	42.6	42.6	42.6
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 (%)	80.8	65.8	22.5	3.25	0.79	0.695	0.695
Sales of water heating units - Electric Heat Pump (%)	1	10.3	52.2	64.9	66	66	66
Sales of water heating units - Electric Resistance (%)	3.08	6.46	25	32.5	33.3	33.3	33.3
Sales of water heating units - Gas Furnace (%)	95.1	82.6	22.2	1.99	0.085	0	0
Sales of water heating units - Other (%)	0.791	0.625	0.628	0.63	0.63	0.629	0.629

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	2.38	2.48	3.93	4.2	3.62	3.78

Table 6: *E+ scenario - PILLAR 2: Clean Electricity - Generating capacity*

Item	2020	2025	2030	2035	2040	2045	2050
Capital invested - Biomass power plant (billion \$2018)	0	0	0	0	0	0	0
Capital invested - Biomass w/ccu allam power plant (billion \$2018)	0	0	0	0	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	0.417	0	0	0.179	0	12.3
Capital invested - Offshore Wind - Constrained (billion \$2018)	0	0.46	0	0	0	0.231	14.1
Capital invested - Solar PV - Base (billion \$2018)	0	0	0	0	0	0	0
Capital invested - Solar PV - Constrained (billion \$2018)	0	1.68	0	0	0	0	0
Capital invested - Wind - Base (billion \$2018)	0	0	2.51	1.27	1.2	0.855	0.175
Capital invested - Wind - Constrained (billion \$2018)	0	0	2.32	2.86	7.4	6.28	0.499

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

Item	2020	2025	2030	2035	2040	2045	2050
Biomass power plant (GWh)	0	0	0	0	0	0	0
Biomass w/ccu allam power plant (GWh)	0	0	0	0	0	0	0
Biomass w/ccu power plant (GWh)	0	0	0	0	0	0	0
OffshoreWind - Base land use assumptions (GWh)	0	522	0	0	422	0	38,382
OffshoreWind - Constrained land use assumptions (GWh)	0	522	0	0	422	0	38,382
Solar - Base land use assumptions (GWh)	2,011	0	0	0	0	0	0
Solar - Constrained land use assumptions (GWh)	1,737	0	0	0	0	0	0
Wind - Base land use assumptions (GWh)	14,129	0	5,290	2,744	2,613	1,899	381
Wind - Constrained land use assumptions (GWh)	14,129	0	4,759	4,933	13,384	11,933	882

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

Item	2020	2025	2030	2035	2040	2045	2050
Biomass purchases (million \$2018/year)	0	0	0	0	0	124	398
Conversion capital investment - Cumulative 5-yr (million \$2018)	0	0	0	0	0	2,271	5,019
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	4	11
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	0
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	0	0	0	0	0	0
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	0	0	2.92	9.37
Annual - BECCS (MMT)	0	0	0	0	0	2.92	9.37
Annual - Cement and lime (MMT)	0	0	0	0	0	0	0
Annual - NGCC (MMT)	0	0	0	0	0	0	0
Cumulative - All (MMT)	0	0	0	0	0	2.92	12.3
Cumulative - BECCS (MMT)	0	0	0	0	0	2.92	12.3
Cumulative - Cement and lime (MMT)	0	0	0	0	0	0	0
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	497	497	871	1,423
Cumulative investment - All (million \$2018)	0	0	0	1,561	1,561	1,794	2,143
Cumulative investment - Spur (million \$2018)	0	0	0	0	0	234	583
Cumulative investment - Trunk (million \$2018)	0	0	0	1,561	1,561	1,561	1,561
Spur (km)	0	0	0	0	0	373	926
Trunk (km)	0	0	0	497	497	497	497

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	-1,084
Carbon sink potential - Aggressive deployment - Permanent conservation cover (1000 tCO2e/y)	0	0	-74.1
Carbon sink potential - Aggressive deployment - Total (1000 tCO2e/y)	0	0	-1,158
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	-558
Carbon sink potential - Moderate deployment - Permanent conservation cover (1000 tCO2e/y)	0	0	-37
Carbon sink potential - Moderate deployment - Total (1000 tCO2e/y)	0	0	-595
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	1,788
Land impacted for carbon sink - Aggressive deployment - Permanent conservation cover (1000 hectares)	0	0	126

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	1,914
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	926
Land impacted for carbon sink - Moderate deployment - Permanent conservation cover (1000 hectares)	0	0	62.8
Land impacted for carbon sink - Moderate deployment - Total (1000 hectares)	0	0	988

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	3,070
Carbon sink potential - High - All (not counting overlap) (1000 tCO ₂ e/y)	0	0	60,233
Carbon sink potential - High - Avoid deforestation (1000 tCO ₂ e/y)	0	0	1,267
Carbon sink potential - High - Extend rotation length (1000 tCO ₂ e/y)	0	0	11,025
Carbon sink potential - High - Improve plantations (1000 tCO ₂ e/y)	0	0	5,746
Carbon sink potential - High - Increase retention of HWP (1000 tCO ₂ e/y)	0	0	20,097
Carbon sink potential - High - Increase trees outside forests (1000 tCO ₂ e/y)	0	0	660
Carbon sink potential - High - Reforest cropland (1000 tCO ₂ e/y)	0	0	6,564
Carbon sink potential - High - Reforest pasture (1000 tCO ₂ e/y)	0	0	3,779
Carbon sink potential - High - Restore productivity (1000 tCO ₂ e/y)	0	0	8,025
Carbon sink potential - Low - Accelerate regeneration (1000 tCO ₂ e/y)	0	0	1,538
Carbon sink potential - Low - All (not counting overlap) (1000 tCO ₂ e/y)	0	0	22,111
Carbon sink potential - Low - Avoid deforestation (1000 tCO ₂ e/y)	0	0	211
Carbon sink potential - Low - Extend rotation length (1000 tCO ₂ e/y)	0	0	4,235
Carbon sink potential - Low - Improve plantations (1000 tCO ₂ e/y)	0	0	2,923
Carbon sink potential - Low - Increase retention of HWP (1000 tCO ₂ e/y)	0	0	6,699
Carbon sink potential - Low - Increase trees outside forests (1000 tCO ₂ e/y)	0	0	231
Carbon sink potential - Low - Reforest cropland (1000 tCO ₂ e/y)	0	0	3,282
Carbon sink potential - Low - Reforest pasture (1000 tCO ₂ e/y)	0	0	286
Carbon sink potential - Low - Restore productivity (1000 tCO ₂ e/y)	0	0	2,705
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO ₂ e/y)	0	0	2,304
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO ₂ e/y)	0	0	41,121
Carbon sink potential - Mid - Avoid deforestation (1000 tCO ₂ e/y)	0	0	739

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

Item	2020	2025	2050
Carbon sink potential - Mid - Extend rotation length (1000 tCO ₂ e/y)	0	0	7,630
Carbon sink potential - Mid - Improve plantations (1000 tCO ₂ e/y)	0	0	4,284
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO ₂ e/y)	0	0	13,398
Carbon sink potential - Mid - Increase trees outside forests (1000 tCO ₂ e/y)	0	0	446
Carbon sink potential - Mid - Reforest cropland (1000 tCO ₂ e/y)	0	0	4,923
Carbon sink potential - Mid - Reforest pasture (1000 tCO ₂ e/y)	0	0	2,033
Carbon sink potential - Mid - Restore productivity (1000 tCO ₂ e/y)	0	0	5,365
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)	0	0	502
Land impacted for carbon sink potential - High - Avoid deforestation (over 30 years) (1000 hectares)	0	0	172
Land impacted for carbon sink potential - High - Extend rotation length (1000 hectares)	0	0	5,622
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)	0	0	2,117
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	62.7
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)	0	0	434
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)	0	0	107
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)	0	0	2,660
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)	0	0	11,677
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)	0	0	251
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)	0	0	161
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)	0	0	2,154
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)	0	0	1,058
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	33
Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares)	0	0	217
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)	0	0	18.6
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)	0	0	1,609
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)	0	0	5,503
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)	0	0	377
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)	0	0	166
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)	0	0	3,888

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	1,593
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	47.9
Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares)	0	0	325
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)	0	0	135
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)	0	0	3,241
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)	0	0	9,773

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

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal (million 2019\$)	0	36.7	0.043	0.043	0.027	0.016	0
Monetary damages from air pollution - Natural Gas (million 2019\$)	0	38.6	22.4	18.6	17.2	13.9	10.5
Monetary damages from air pollution - Transportation (million 2019\$)	0	414	387	294	170	77.9	31.3
Premature deaths from air pollution - Coal (deaths)	0	4.12	0.005	0.005	0.003	0.002	0
Premature deaths from air pollution - Natural Gas (deaths)	0	4.36	2.52	2.1	1.94	1.57	1.18
Premature deaths from air pollution - Transportation (deaths)	0	46.6	43.5	33.1	19.1	8.76	3.52

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

Item	2020	2025	2030	2035	2040	2045	2050
By economic sector - Agriculture (jobs)	168	183	298	156	105	229	501
By economic sector - Construction (jobs)	14,601	9,860	9,552	11,033	10,875	11,128	23,154
By economic sector - Manufacturing (jobs)	2,619	2,689	4,018	4,949	4,552	4,061	5,967
By economic sector - Mining (jobs)	1,443	1,109	788	503	297	160	80.2
By economic sector - Other (jobs)	2,323	1,508	1,565	1,882	2,198	2,513	5,237
By economic sector - Pipeline (jobs)	265	259	218	358	124	109	129
By economic sector - Professional (jobs)	5,379	4,290	4,527	4,973	5,413	5,976	13,282
By economic sector - Trade (jobs)	3,718	2,854	2,896	3,218	3,532	3,890	8,534
By economic sector - Utilities (jobs)	3,618	4,145	4,455	6,315	6,083	6,269	15,629
By education level - All sectors - Associates degree or some college (jobs)	10,775	8,494	8,962	10,765	10,703	11,062	23,425
By education level - All sectors - Bachelors degree (jobs)	6,520	5,307	5,592	6,496	6,510	6,766	14,373
By education level - All sectors - Doctoral degree (jobs)	271	212	219	242	253	272	589
By education level - All sectors - High school diploma or less (jobs)	14,956	11,566	12,160	14,290	14,083	14,514	30,392
By education level - All sectors - Masters or professional degree (jobs)	1,612	1,319	1,383	1,596	1,630	1,721	3,734
By resource sector - Biomass (jobs)	574	647	788	400	290	840	2,149
By resource sector - CO2 (jobs)	0	0	0	1,544	0	250	659
By resource sector - Coal (jobs)	271	86.9	0	0	0	0	0
By resource sector - Grid (jobs)	4,190	6,144	7,093	9,281	10,434	10,900	29,558
By resource sector - Natural Gas (jobs)	2,637	2,131	1,792	1,840	1,654	1,259	1,035
By resource sector - Nuclear (jobs)	0	0	0	0	0	0	0
By resource sector - Oil (jobs)	3,085	2,619	2,054	1,431	922	562	300
By resource sector - Solar (jobs)	20,557	11,450	11,083	13,181	14,424	15,631	27,983
By resource sector - Wind (jobs)	2,819	3,820	5,507	5,711	5,457	4,893	10,829
Median wages - Annual - All (\$2019 per job)	60,761	62,291	62,798	63,770	64,648	65,678	67,496

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)	5,649	4,427	4,632	5,533	5,475	5,642	11,956
On-Site or In-Plant Training - Total jobs - 4 to 10 years (jobs)	2,538	1,945	1,979	2,369	2,341	2,426	5,225
On-Site or In-Plant Training - Total jobs - None (jobs)	5,681	4,437	4,681	5,482	5,470	5,677	11,904
On-Site or In-Plant Training - Total jobs - Over 10 years (jobs)	294	233	245	297	294	304	652
On-Site or In-Plant Training - Total jobs - Up to 1 year (jobs)	19,972	15,855	16,780	19,707	19,600	20,288	42,777
On-the-Job Training - All sectors - 1 to 4 years (jobs)	7,288	5,712	5,968	7,149	7,070	7,285	15,467
On-the-Job Training - All sectors - 4 to 10 years (jobs)	2,548	1,939	1,970	2,369	2,346	2,436	5,258
On-the-Job Training - All sectors - None (jobs)	1,970	1,517	1,579	1,833	1,841	1,918	4,026
On-the-Job Training - All sectors - Over 10 years (jobs)	373	279	292	343	335	339	681
On-the-Job Training - All sectors - Up to 1 year (jobs)	21,955	17,451	18,508	21,696	21,588	22,358	47,081
Related work experience - All sectors - 1 to 4 years (jobs)	12,069	9,580	10,079	11,879	11,825	12,253	25,966
Related work experience - All sectors - 4 to 10 years (jobs)	7,872	6,236	6,539	7,757	7,696	7,947	16,851
Related work experience - All sectors - None (jobs)	4,934	3,889	4,093	4,854	4,818	5,004	10,602
Related work experience - All sectors - Over 10 years (jobs)	1,997	1,604	1,705	2,022	2,000	2,049	4,301
Related work experience - All sectors - Up to 1 year (jobs)	7,262	5,587	5,901	6,877	6,840	7,084	14,793
Wage income - All (million \$2019)	2,074	1,676	1,778	2,130	2,145	2,256	4,895

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

Item	2020	2025	2030	2035	2040	2045	2050
Natural gas consumption - Annual (tcf)	195	198	167	134	101	63.4	44
Natural gas consumption - Cumulative (tcf)	0	0	0	0	0	0	4,030
Natural gas production - Annual (tcf)	0.55	0.609	0.576	0.502	0.424	0.336	0.261
Oil consumption - Annual (million bbls)	63.3	58.9	50.4	38	26.4	17.2	9.78
Oil consumption - Cumulative (million bbls)	0	0	0	0	0	0	1,173
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	2.53	2.65	0	0	0	0
Sales of cooking units - Electric Resistance (%)	65.5	66.4	69.6	77.9	89.5	96.6	99.1
Sales of cooking units - Gas (%)	34.5	33.6	30.4	22.1	10.5	3.4	0.915
Sales of space heating units - Electric Heat Pump (%)	12.4	20.2	22.9	30.9	43.8	53.4	57.2
Sales of space heating units - Electric Resistance (%)	31	37.9	37.5	36.3	34.2	32.4	31.5
Sales of space heating units - Fossil (%)	8.35	14	13.7	12.7	11	9.88	9.53
Sales of space heating units - Gas (%)	48.3	27.9	25.9	20.1	10.9	4.35	1.81
Sales of water heating units - Electric Heat Pump (%)	0	1.35	5.19	16.3	33.7	45.7	50.1
Sales of water heating units - Electric Resistance (%)	40.2	56.7	55.5	52.2	47.4	44.4	43.4
Sales of water heating units - Gas Furnace (%)	53.4	36.6	34	26.2	13.7	4.82	1.35
Sales of water heating units - Other (%)	6.41	5.35	5.33	5.3	5.21	5.14	5.13

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	130	249	865	2,649	3,885
Public EV charging plugs - DC Fast (1000 units)	0.347	0	0.57	0	2.25	0	5.96
Public EV charging plugs - L2 (1000 units)	1.3	0	13.7	0	54.1	0	144
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 (%)	1.63	2.03	2.07	1.65	1.06	0.547	0.234
Vehicle sales - Light-duty - EV (%)	1.8	4.49	11.5	25.2	47.7	71.6	87.4
Vehicle sales - Light-duty - gasoline (%)	92	87.8	80.2	67.5	47	25.3	11.2
Vehicle sales - Light-duty - hybrid (%)	4.33	5.15	5.81	5.32	4.03	2.4	1.17
Vehicle sales - Light-duty - hydrogen FC (%)	0.113	0.382	0.33	0.254	0.181	0.101	0.047
Vehicle sales - Light-duty - other (%)	0.106	0.11	0.1	0.087	0.063	0.035	0.016
Vehicle sales - Medium-duty - diesel (%)	64.8	62.2	57.7	49.4	35.6	19.6	8.37
Vehicle sales - Medium-duty - EV (%)	0.664	1.94	5.49	14.3	31.4	52.6	68
Vehicle sales - Medium-duty - gasoline (%)	33.8	34.7	34.7	31.9	24.4	14.2	6.33
Vehicle sales - Medium-duty - hybrid (%)	0.363	0.418	0.464	0.478	0.414	0.275	0.141
Vehicle sales - Medium-duty - hydrogen FC (%)	0.166	0.485	1.37	3.58	7.86	13.2	17
Vehicle sales - Medium-duty - other (%)	0.253	0.266	0.279	0.286	0.258	0.184	0.102

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

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Commercial (PJ)	93.8	95.2	96.6	96.8	95.9	94.4	93.4
Final energy use - Industry (PJ)	209	215	215	222	230	234	240
Final energy use - Residential (PJ)	151	140	128	117	105	92.8	81.8
Final energy use - Transportation (PJ)	334	315	290	270	254	235	213

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	13,324	14,288	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 (%)	2.5	12.5	15.3	23.6	37.7	49.3	54.5
Sales of space heating units - Electric Resistance (%)	16.7	13.9	16.1	22.4	32.2	39	41.6
Sales of space heating units - Fossil (%)	0	0	0	0	0	0	0
Sales of space heating units - Gas Furnace (%)	80.8	73.6	68.6	54	30.1	11.7	3.87
Sales of water heating units - Electric Heat Pump (%)	1	2.5	7.27	21.1	42.9	58.1	63.8
Sales of water heating units - Electric Resistance (%)	3.08	3.16	5.27	11.4	21.5	29	32.1
Sales of water heating units - Gas Furnace (%)	95.1	93.7	86.8	66.8	35	12.3	3.44
Sales of water heating units - Other (%)	0.791	0.625	0.628	0.63	0.63	0.629	0.629

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	1.88	1.92	2.22	2.29	3.56	3.78

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 tCO ₂ e/y)	0	0	-1,084
Carbon sink potential - Aggressive deployment - Permanent conservation cover (1000 tCO ₂ e/y)	0	0	-74.1
Carbon sink potential - Aggressive deployment - Total (1000 tCO ₂ e/y)	0	0	-1,158
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	-558
Carbon sink potential - Moderate deployment - Permanent conservation cover (1000 tCO ₂ e/y)	0	0	-37
Carbon sink potential - Moderate deployment - Total (1000 tCO ₂ e/y)	0	0	-595
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	1,788
Land impacted for carbon sink - Aggressive deployment - Permanent conservation cover (1000 hectares)	0	0	126
Land impacted for carbon sink - Aggressive deployment - Total (1000 hectares)	0	0	1,914
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	926
Land impacted for carbon sink - Moderate deployment - Permanent conservation cover (1000 hectares)	0	0	62.8
Land impacted for carbon sink - Moderate deployment - Total (1000 hectares)	0	0	988

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	3,070
Carbon sink potential - High - All (not counting overlap) (1000 tCO ₂ e/y)	0	0	60,233
Carbon sink potential - High - Avoid deforestation (1000 tCO ₂ e/y)	0	0	1,267
Carbon sink potential - High - Extend rotation length (1000 tCO ₂ e/y)	0	0	11,025
Carbon sink potential - High - Improve plantations (1000 tCO ₂ e/y)	0	0	5,746
Carbon sink potential - High - Increase retention of HWP (1000 tCO ₂ e/y)	0	0	20,097
Carbon sink potential - High - Increase trees outside forests (1000 tCO ₂ e/y)	0	0	660
Carbon sink potential - High - Reforest cropland (1000 tCO ₂ e/y)	0	0	6,564
Carbon sink potential - High - Reforest pasture (1000 tCO ₂ e/y)	0	0	3,779
Carbon sink potential - High - Restore productivity (1000 tCO ₂ e/y)	0	0	8,025
Carbon sink potential - Low - Accelerate regeneration (1000 tCO ₂ e/y)	0	0	1,538
Carbon sink potential - Low - All (not counting overlap) (1000 tCO ₂ e/y)	0	0	22,111

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	211
Carbon sink potential - Low - Extend rotation length (1000 tCO2e/y)	0	0	4,235
Carbon sink potential - Low - Improve plantations (1000 tCO2e/y)	0	0	2,923
Carbon sink potential - Low - Increase retention of HWP (1000 tCO2e/y)	0	0	6,699
Carbon sink potential - Low - Increase trees outside forests (1000 tCO2e/y)	0	0	231
Carbon sink potential - Low - Reforest cropland (1000 tCO2e/y)	0	0	3,282
Carbon sink potential - Low - Reforest pasture (1000 tCO2e/y)	0	0	286
Carbon sink potential - Low - Restore productivity (1000 tCO2e/y)	0	0	2,705
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO2e/y)	0	0	2,304
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO2e/y)	0	0	41,121
Carbon sink potential - Mid - Avoid deforestation (1000 tCO2e/y)	0	0	739
Carbon sink potential - Mid - Extend rotation length (1000 tCO2e/y)	0	0	7,630
Carbon sink potential - Mid - Improve plantations (1000 tCO2e/y)	0	0	4,284
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO2e/y)	0	0	13,398
Carbon sink potential - Mid - Increase trees outside forests (1000 tCO2e/y)	0	0	446
Carbon sink potential - Mid - Reforest cropland (1000 tCO2e/y)	0	0	4,923
Carbon sink potential - Mid - Reforest pasture (1000 tCO2e/y)	0	0	2,033
Carbon sink potential - Mid - Restore productivity (1000 tCO2e/y)	0	0	5,365
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)	0	0	502
Land impacted for carbon sink potential - High - Avoid deforestation (over 30 years) (1000 hectares)	0	0	172
Land impacted for carbon sink potential - High - Extend rotation length (1000 hectares)	0	0	5,622
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)	0	0	2,117
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	62.7
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)	0	0	434
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)	0	0	107
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)	0	0	2,660
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)	0	0	11,677
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)	0	0	251
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)	0	0	161

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	2,154
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)	0	0	1,058
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	33
Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares)	0	0	217
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)	0	0	18.6
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)	0	0	1,609
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)	0	0	5,503
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)	0	0	377
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)	0	0	166
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)	0	0	3,888
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)	0	0	1,593
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	47.9
Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares)	0	0	325
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)	0	0	135
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)	0	0	3,241
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)	0	0	9,773

Table 24: E- scenario - IMPACTS - Health

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal (million 2019\$)	0	36.7	0.043	0.043	0.027	0.016	0
Monetary damages from air pollution - Natural Gas (million 2019\$)	0	40.6	21	13.7	9.95	7.56	7.55
Monetary damages from air pollution - Transportation (million 2019\$)	0	421	425	414	372	296	204
Premature deaths from air pollution - Coal (deaths)	0	4.12	0.005	0.005	0.003	0.002	0
Premature deaths from air pollution - Natural Gas (deaths)	0	4.58	2.37	1.55	1.12	0.854	0.853
Premature deaths from air pollution - Transportation (deaths)	0	47.3	47.8	46.5	41.9	33.3	22.9

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	2.54	2.66	0	0	0	0
Sales of cooking units - Electric Resistance (%)	65.6	73	95.4	99.8	100	100	100
Sales of cooking units - Gas (%)	34.4	27	4.63	0.233	0	0	0
Sales of space heating units - Electric Heat Pump (%)	12.4	24.5	48.3	57.6	58.8	58.8	58.7

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 (%)	31	37.4	34.1	31.4	31	31.2	31.3
Sales of space heating units - Fossil (%)	8.35	13.5	10.5	9.63	9.42	9.21	9.21
Sales of space heating units - Gas (%)	48.3	24.7	7.17	1.4	0.846	0.812	0.816
Sales of water heating units - Electric Heat Pump (%)	0	7.68	41.4	51	51.8	51.8	51.8
Sales of water heating units - Electric Resistance (%)	40.2	54.8	44.8	43.1	43.1	43.1	43.1
Sales of water heating units - Gas Furnace (%)	53.4	32.3	8.69	0.78	0.033	0	0
Sales of water heating units - Other (%)	6.41	5.3	5.09	5.09	5.1	5.11	5.12

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	737	1,953	3,062	4,679	5,048	4,837
Public EV charging plugs - DC Fast (1000 units)	0.347	0	1.51	0	5.84	0	9.31
Public EV charging plugs - L2 (1000 units)	1.3	0	36.3	0	141	0	224
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 (%)	1.62	1.88	1.29	0.412	0.076	0.013	0
Vehicle sales - Light-duty - EV (%)	3.67	14.4	45.3	81.3	96.3	99.3	100
Vehicle sales - Light-duty - gasoline (%)	90.3	78.9	50	17	3.35	0.592	0
Vehicle sales - Light-duty - hybrid (%)	4.18	4.37	3.13	1.17	0.284	0.062	0
Vehicle sales - Light-duty - hydrogen FC (%)	0.111	0.344	0.209	0.065	0.013	0.002	0
Vehicle sales - Light-duty - other (%)	0.105	0.101	0.067	0.023	0.005	0.001	0
Vehicle sales - Medium-duty - diesel (%)	64.7	59.7	42.3	14.4	2.59	0.384	0
Vehicle sales - Medium-duty - EV (%)	0.784	5.07	25.3	60.8	76.5	79.5	80
Vehicle sales - Medium-duty - gasoline (%)	33.7	33.3	25.5	9.32	1.77	0.277	0
Vehicle sales - Medium-duty - hybrid (%)	0.363	0.402	0.341	0.14	0.03	0.005	0
Vehicle sales - Medium-duty - hydrogen FC (%)	0.196	1.27	6.33	15.2	19.1	19.9	20
Vehicle sales - Medium-duty - other (%)	0.253	0.255	0.205	0.083	0.019	0.004	0

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

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Commercial (PJ)	93.8	95	93.3	89	85.5	84.8	85.9
Final energy use - Industry (PJ)	209	215	214	219	226	230	236
Final energy use - Residential (PJ)	151	140	123	104	88.4	78.3	72.2
Final energy use - Transportation (PJ)	334	313	278	236	197	173	163

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	13,358	14,518	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 (%)	2.5	16.7	41.2	54.8	56.6	56.7	56.7
Sales of space heating units - Electric Resistance (%)	16.7	17.5	36.3	42	42.6	42.6	42.6
Sales of space heating units - Fossil (%)	0	0	0	0	0	0	0
Sales of space heating units - Gas Furnace (%)	80.8	65.8	22.5	3.25	0.79	0.695	0.695
Sales of water heating units - Electric Heat Pump (%)	1	10.3	52.2	64.9	66	66	66
Sales of water heating units - Electric Resistance (%)	3.08	6.46	25	32.5	33.3	33.3	33.3
Sales of water heating units - Gas Furnace (%)	95.1	82.6	22.2	1.99	0.085	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 (%)	0.791	0.625	0.628	0.63	0.63	0.629	0.629

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	2.38	2.48	3.93	4.2	3.62	3.78

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	0.417	0	0	0.179	0.218	26.6
Capital invested - Solar PV - Base (billion \$2018)	0	0	0	0	0	0	16.9
Capital invested - Wind - Base (billion \$2018)	0	0	2.58	2.21	4.06	5.44	5.95

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	522	0	0	422	630	89,410
OffshoreWind - Constrained land use assumptions (GWh)	0	568	0	0	155	6,699	82,519
Solar - Base land use assumptions (GWh)	2,011	0	0	0	0	0	36,264
Solar - Constrained land use assumptions (GWh)	2,011	0	0	0	0	0	39,529
Wind - Base land use assumptions (GWh)	14,258	0	5,415	4,691	8,281	11,072	12,342
Wind - Constrained land use assumptions (GWh)	14,129	0	5,088	14,930	31,319	24,381	49,963

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	-1,084
Carbon sink potential - Aggressive deployment - Permanent conservation cover (1000 tCO2e/y)	0	0	-74.1
Carbon sink potential - Aggressive deployment - Total (1000 tCO2e/y)	0	0	-1,158
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	-558
Carbon sink potential - Moderate deployment - Permanent conservation cover (1000 tCO2e/y)	0	0	-37
Carbon sink potential - Moderate deployment - Total (1000 tCO2e/y)	0	0	-595
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	1,788
Land impacted for carbon sink - Aggressive deployment - Permanent conservation cover (1000 hectares)	0	0	126
Land impacted for carbon sink - Aggressive deployment - Total (1000 hectares)	0	0	1,914
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	926

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	62.8
Land impacted for carbon sink - Moderate deployment - Total (1000 hectares)	0	0	988

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	3,070
Carbon sink potential - High - All (not counting overlap) (1000 tCO ₂ e/y)	0	0	60,233
Carbon sink potential - High - Avoid deforestation (1000 tCO ₂ e/y)	0	0	1,267
Carbon sink potential - High - Extend rotation length (1000 tCO ₂ e/y)	0	0	11,025
Carbon sink potential - High - Improve plantations (1000 tCO ₂ e/y)	0	0	5,746
Carbon sink potential - High - Increase retention of HWP (1000 tCO ₂ e/y)	0	0	20,097
Carbon sink potential - High - Increase trees outside forests (1000 tCO ₂ e/y)	0	0	660
Carbon sink potential - High - Reforest cropland (1000 tCO ₂ e/y)	0	0	6,564
Carbon sink potential - High - Reforest pasture (1000 tCO ₂ e/y)	0	0	3,779
Carbon sink potential - High - Restore productivity (1000 tCO ₂ e/y)	0	0	8,025
Carbon sink potential - Low - Accelerate regeneration (1000 tCO ₂ e/y)	0	0	1,538
Carbon sink potential - Low - All (not counting overlap) (1000 tCO ₂ e/y)	0	0	22,111
Carbon sink potential - Low - Avoid deforestation (1000 tCO ₂ e/y)	0	0	211
Carbon sink potential - Low - Extend rotation length (1000 tCO ₂ e/y)	0	0	4,235
Carbon sink potential - Low - Improve plantations (1000 tCO ₂ e/y)	0	0	2,923
Carbon sink potential - Low - Increase retention of HWP (1000 tCO ₂ e/y)	0	0	6,699
Carbon sink potential - Low - Increase trees outside forests (1000 tCO ₂ e/y)	0	0	231
Carbon sink potential - Low - Reforest cropland (1000 tCO ₂ e/y)	0	0	3,282
Carbon sink potential - Low - Reforest pasture (1000 tCO ₂ e/y)	0	0	286
Carbon sink potential - Low - Restore productivity (1000 tCO ₂ e/y)	0	0	2,705
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO ₂ e/y)	0	0	2,304
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO ₂ e/y)	0	0	41,121
Carbon sink potential - Mid - Avoid deforestation (1000 tCO ₂ e/y)	0	0	739
Carbon sink potential - Mid - Extend rotation length (1000 tCO ₂ e/y)	0	0	7,630
Carbon sink potential - Mid - Improve plantations (1000 tCO ₂ e/y)	0	0	4,284
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO ₂ e/y)	0	0	13,398
Carbon sink potential - Mid - Increase trees outside forests (1000 tCO ₂ e/y)	0	0	446

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

Item	2020	2025	2050
Carbon sink potential - Mid - Reforest cropland (1000 tCO ₂ e/y)	0	0	4,923
Carbon sink potential - Mid - Reforest pasture (1000 tCO ₂ e/y)	0	0	2,033
Carbon sink potential - Mid - Restore productivity (1000 tCO ₂ e/y)	0	0	5,365
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)	0	0	502
Land impacted for carbon sink potential - High - Avoid deforestation (over 30 years) (1000 hectares)	0	0	172
Land impacted for carbon sink potential - High - Extend rotation length (1000 hectares)	0	0	5,622
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)	0	0	2,117
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	62.7
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)	0	0	434
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)	0	0	107
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)	0	0	2,660
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)	0	0	11,677
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)	0	0	251
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)	0	0	161
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)	0	0	2,154
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)	0	0	1,058
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	33
Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares)	0	0	217
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)	0	0	18.6
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)	0	0	1,609
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)	0	0	5,503
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)	0	0	377
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)	0	0	166
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)	0	0	3,888
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)	0	0	1,593
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	47.9
Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares)	0	0	325

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	135
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)	0	0	3,241
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)	0	0	9,773

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

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal (million 2019\$)	0	36.7	0.043	0.043	0.027	0.016	0
Monetary damages from air pollution - Natural Gas (million 2019\$)	0	35.6	16.4	9.85	8.49	6.96	1.27
Monetary damages from air pollution - Transportation (million 2019\$)	0	414	387	294	170	77.9	31.3
Premature deaths from air pollution - Coal (deaths)	0	4.12	0.005	0.005	0.003	0.002	0
Premature deaths from air pollution - Natural Gas (deaths)	0	4.02	1.85	1.11	0.958	0.786	0.143
Premature deaths from air pollution - Transportation (deaths)	0	46.6	43.5	33.1	19.1	8.76	3.52

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	2.54	2.66	0	0	0	0
Sales of cooking units - Electric Resistance (%)	65.6	73	95.4	99.8	100	100	100
Sales of cooking units - Gas (%)	34.4	27	4.63	0.233	0	0	0
Sales of space heating units - Electric Heat Pump (%)	12.4	24.5	48.3	57.6	58.8	58.8	58.7
Sales of space heating units - Electric Resistance (%)	31	37.4	34.1	31.4	31	31.2	31.3
Sales of space heating units - Fossil (%)	8.35	13.5	10.5	9.63	9.42	9.21	9.21
Sales of space heating units - Gas (%)	48.3	24.7	7.17	1.4	0.846	0.812	0.816
Sales of water heating units - Electric Heat Pump (%)	0	7.68	41.4	51	51.8	51.8	51.8
Sales of water heating units - Electric Resistance (%)	40.2	54.8	44.8	43.1	43.1	43.1	43.1
Sales of water heating units - Gas Furnace (%)	53.4	32.3	8.69	0.78	0.033	0	0
Sales of water heating units - Other (%)	6.41	5.3	5.09	5.09	5.1	5.11	5.12

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	737	1,953	3,062	4,679	5,048	4,837
Public EV charging plugs - DC Fast (1000 units)	0.347	0	1.51	0	5.84	0	9.31
Public EV charging plugs - L2 (1000 units)	1.3	0	36.3	0	141	0	224
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 (%)	1.62	1.88	1.29	0.412	0.076	0.013	0
Vehicle sales - Light-duty - EV (%)	3.67	14.4	45.3	81.3	96.3	99.3	100
Vehicle sales - Light-duty - gasoline (%)	90.3	78.9	50	17	3.35	0.592	0
Vehicle sales - Light-duty - hybrid (%)	4.18	4.37	3.13	1.17	0.284	0.062	0
Vehicle sales - Light-duty - hydrogen FC (%)	0.111	0.344	0.209	0.065	0.013	0.002	0
Vehicle sales - Light-duty - other (%)	0.105	0.101	0.067	0.023	0.005	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)	93.8	95	93.3	89	85.5	84.8	85.9
Final energy use - Industry (PJ)	209	215	214	219	226	230	236
Final energy use - Residential (PJ)	151	140	123	104	88.4	78.3	72.2
Final energy use - Transportation (PJ)	334	313	278	236	197	173	163

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	13,358	14,518	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 (%)	2.5	16.7	41.2	54.8	56.6	56.7	56.7
Sales of space heating units - Electric Resistance (%)	16.7	17.5	36.3	42	42.6	42.6	42.6
Sales of space heating units - Fossil (%)	0	0	0	0	0	0	0
Sales of space heating units - Gas Furnace (%)	80.8	65.8	22.5	3.25	0.79	0.695	0.695
Sales of water heating units - Electric Heat Pump (%)	1	10.3	52.2	64.9	66	66	66
Sales of water heating units - Electric Resistance (%)	3.08	6.46	25	32.5	33.3	33.3	33.3
Sales of water heating units - Gas Furnace (%)	95.1	82.6	22.2	1.99	0.085	0	0
Sales of water heating units - Other (%)	0.791	0.625	0.628	0.63	0.63	0.629	0.629

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	2.38	2.48	3.93	4.2	3.62	3.78

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	0.417	0	0	0	0	1.04
Capital invested - Offshore Wind - Constrained (billion \$2018)	0	0.46	0	0	0	0	1.11
Capital invested - Solar PV - Base (billion \$2018)	0	2.37	0.587	0.212	0.709	2.04	1.48
Capital invested - Solar PV - Constrained (billion \$2018)	0	1.33	1.51	1.35	1.07	2.88	1.77
Capital invested - Wind - Base (billion \$2018)	0	0.067	1.42	0.908	1.46	0.52	0
Capital invested - Wind - Constrained (billion \$2018)	0	0.084	2.07	0.174	2.85	3.08	0

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	522	0	0	0	0	3,767
OffshoreWind - Constrained land use assumptions (GWh)	0	568	0	0	0	0	3,254
Solar - Base land use assumptions (GWh)	4,444	3,547	958	382	1,364	4,114	3,186
Solar - Constrained land use assumptions (GWh)	3,569	1,983	2,524	2,396	2,034	5,837	3,876

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)	14,258	131	3,023	2,007	3,288	1,213	0
Wind - Constrained land use assumptions (GWh)	14,129	159	4,239	361	5,627	6,037	0

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	-1,084
Carbon sink potential - Aggressive deployment - Permanent conservation cover (1000 tCO2e/y)	0	0	-74.1
Carbon sink potential - Aggressive deployment - Total (1000 tCO2e/y)	0	0	-1,158
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	-558
Carbon sink potential - Moderate deployment - Permanent conservation cover (1000 tCO2e/y)	0	0	-37
Carbon sink potential - Moderate deployment - Total (1000 tCO2e/y)	0	0	-595
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	1,788
Land impacted for carbon sink - Aggressive deployment - Permanent conservation cover (1000 hectares)	0	0	126
Land impacted for carbon sink - Aggressive deployment - Total (1000 hectares)	0	0	1,914
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	926
Land impacted for carbon sink - Moderate deployment - Permanent conservation cover (1000 hectares)	0	0	62.8
Land impacted for carbon sink - Moderate deployment - Total (1000 hectares)	0	0	988

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	3,070
Carbon sink potential - High - All (not counting overlap) (1000 tCO2e/y)	0	0	60,233
Carbon sink potential - High - Avoid deforestation (1000 tCO2e/y)	0	0	1,267
Carbon sink potential - High - Extend rotation length (1000 tCO2e/y)	0	0	11,025
Carbon sink potential - High - Improve plantations (1000 tCO2e/y)	0	0	5,746
Carbon sink potential - High - Increase retention of HWP (1000 tCO2e/y)	0	0	20,097
Carbon sink potential - High - Increase trees outside forests (1000 tCO2e/y)	0	0	660
Carbon sink potential - High - Reforest cropland (1000 tCO2e/y)	0	0	6,564

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	3,779
Carbon sink potential - High - Restore productivity (1000 tCO2e/y)	0	0	8,025
Carbon sink potential - Low - Accelerate regeneration (1000 tCO2e/y)	0	0	1,538
Carbon sink potential - Low - All (not counting overlap) (1000 tCO2e/y)	0	0	22,111
Carbon sink potential - Low - Avoid deforestation (1000 tCO2e/y)	0	0	211
Carbon sink potential - Low - Extend rotation length (1000 tCO2e/y)	0	0	4,235
Carbon sink potential - Low - Improve plantations (1000 tCO2e/y)	0	0	2,923
Carbon sink potential - Low - Increase retention of HWP (1000 tCO2e/y)	0	0	6,699
Carbon sink potential - Low - Increase trees outside forests (1000 tCO2e/y)	0	0	231
Carbon sink potential - Low - Reforest cropland (1000 tCO2e/y)	0	0	3,282
Carbon sink potential - Low - Reforest pasture (1000 tCO2e/y)	0	0	286
Carbon sink potential - Low - Restore productivity (1000 tCO2e/y)	0	0	2,705
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO2e/y)	0	0	2,304
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO2e/y)	0	0	41,121
Carbon sink potential - Mid - Avoid deforestation (1000 tCO2e/y)	0	0	739
Carbon sink potential - Mid - Extend rotation length (1000 tCO2e/y)	0	0	7,630
Carbon sink potential - Mid - Improve plantations (1000 tCO2e/y)	0	0	4,284
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO2e/y)	0	0	13,398
Carbon sink potential - Mid - Increase trees outside forests (1000 tCO2e/y)	0	0	446
Carbon sink potential - Mid - Reforest cropland (1000 tCO2e/y)	0	0	4,923
Carbon sink potential - Mid - Reforest pasture (1000 tCO2e/y)	0	0	2,033
Carbon sink potential - Mid - Restore productivity (1000 tCO2e/y)	0	0	5,365
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)	0	0	502
Land impacted for carbon sink potential - High - Avoid deforestation (over 30 years) (1000 hectares)	0	0	172
Land impacted for carbon sink potential - High - Extend rotation length (1000 hectares)	0	0	5,622
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)	0	0	2,117
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	62.7
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)	0	0	434
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)	0	0	107
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)	0	0	2,660

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	11,677
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)	0	0	251
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)	0	0	161
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)	0	0	2,154
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)	0	0	1,058
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	33
Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares)	0	0	217
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)	0	0	18.6
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)	0	0	1,609
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)	0	0	5,503
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)	0	0	377
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)	0	0	166
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)	0	0	3,888
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)	0	0	1,593
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	47.9
Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares)	0	0	325
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)	0	0	135
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)	0	0	3,241
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)	0	0	9,773

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

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal (million 2019\$)	0	36.7	0.043	0.043	0.027	0.016	0
Monetary damages from air pollution - Natural Gas (million 2019\$)	0	38	17.4	19.9	22.8	14.5	6.62
Monetary damages from air pollution - Transportation (million 2019\$)	0	414	387	294	170	77.9	31.3
Premature deaths from air pollution - Coal (deaths)	0	4.12	0.005	0.005	0.003	0.002	0
Premature deaths from air pollution - Natural Gas (deaths)	0	4.29	1.96	2.25	2.57	1.64	0.748
Premature deaths from air pollution - Transportation (deaths)	0	46.6	43.5	33.1	19.1	8.76	3.52

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	2.53	2.65	0	0	0	0
Sales of cooking units - Electric Resistance (%)	65.5	66.4	69.6	77.9	89.5	96.6	99.1
Sales of cooking units - Gas (%)	34.5	33.6	30.4	22.1	10.5	3.4	0.915
Sales of space heating units - Electric Heat Pump (%)	12.4	20.2	22.9	30.9	43.8	53.4	57.2
Sales of space heating units - Electric Resistance (%)	31	37.9	37.5	36.3	34.2	32.4	31.5
Sales of space heating units - Fossil (%)	8.35	14	13.7	12.7	11	9.88	9.53
Sales of space heating units - Gas (%)	48.3	27.9	25.9	20.1	10.9	4.35	1.81
Sales of water heating units - Electric Heat Pump (%)	0	1.35	5.19	16.3	33.7	45.7	50.1
Sales of water heating units - Electric Resistance (%)	40.2	56.7	55.5	52.2	47.4	44.4	43.4
Sales of water heating units - Gas Furnace (%)	53.4	36.6	34	26.2	13.7	4.82	1.35
Sales of water heating units - Other (%)	6.41	5.35	5.33	5.3	5.21	5.14	5.13

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	130	249	865	2,649	3,885
Public EV charging plugs - DC Fast (1000 units)	0.347	0	0.57	0	2.25	0	5.96
Public EV charging plugs - L2 (1000 units)	1.3	0	13.7	0	54.1	0	144
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 (%)	1.63	2.03	2.07	1.65	1.06	0.547	0.234
Vehicle sales - Light-duty - EV (%)	1.8	4.49	11.5	25.2	47.7	71.6	87.4
Vehicle sales - Light-duty - gasoline (%)	92	87.8	80.2	67.5	47	25.3	11.2
Vehicle sales - Light-duty - hybrid (%)	4.33	5.15	5.81	5.32	4.03	2.4	1.17
Vehicle sales - Light-duty - hydrogen FC (%)	0.113	0.382	0.33	0.254	0.181	0.101	0.047
Vehicle sales - Light-duty - other (%)	0.106	0.11	0.1	0.087	0.063	0.035	0.016
Vehicle sales - Medium-duty - diesel (%)	64.8	62.2	57.7	49.4	35.6	19.6	8.37
Vehicle sales - Medium-duty - EV (%)	0.664	1.94	5.49	14.3	31.4	52.6	68
Vehicle sales - Medium-duty - gasoline (%)	33.8	34.7	34.7	31.9	24.4	14.2	6.33
Vehicle sales - Medium-duty - hybrid (%)	0.363	0.418	0.464	0.478	0.414	0.275	0.141
Vehicle sales - Medium-duty - hydrogen FC (%)	0.166	0.485	1.37	3.58	7.86	13.2	17
Vehicle sales - Medium-duty - other (%)	0.253	0.266	0.279	0.286	0.258	0.184	0.102

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

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Commercial (PJ)	93.8	95.2	96.6	96.8	95.9	94.4	93.4
Final energy use - Industry (PJ)	209	215	215	222	230	234	240
Final energy use - Residential (PJ)	151	140	128	117	105	92.8	81.8
Final energy use - Transportation (PJ)	334	315	290	270	254	235	213

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	13,324	14,288	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 (%)	2.5	12.5	15.3	23.6	37.7	49.3	54.5
Sales of space heating units - Electric Resistance (%)	16.7	13.9	16.1	22.4	32.2	39	41.6
Sales of space heating units - Fossil (%)	0	0	0	0	0	0	0

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 (%)	80.8	73.6	68.6	54	30.1	11.7	3.87
Sales of water heating units - Electric Heat Pump (%)	1	2.5	7.27	21.1	42.9	58.1	63.8
Sales of water heating units - Electric Resistance (%)	3.08	3.16	5.27	11.4	21.5	29	32.1
Sales of water heating units - Gas Furnace (%)	95.1	93.7	86.8	66.8	35	12.3	3.44
Sales of water heating units - Other (%)	0.791	0.625	0.628	0.63	0.63	0.629	0.629

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	1.88	1.92	2.22	2.29	3.56	3.78

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	0	0	234	604	650
Conversion capital investment - Cumulative 5-yr (million \$2018)	0	0	0	0	3,120	4,937	607
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	4	9	10
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	0
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	0	4.01	10.4	11.1
Annual - BECCS (MMT)	0	0	0	0	4.01	10.4	11.1
Annual - Cement and lime (MMT)	0	0	0	0	0	0	0
Annual - NGCC (MMT)	0	0	0	0	0	0	0
Cumulative - All (MMT)	0	0	0	0	4.01	14.4	25.5
Cumulative - BECCS (MMT)	0	0	0	0	4.01	14.4	25.5
Cumulative - Cement and lime (MMT)	0	0	0	0	0	0	0
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	497	871	1,159	1,234
Cumulative investment - All (million \$2018)	0	0	0	1,561	1,809	2,020	2,068
Cumulative investment - Spur (million \$2018)	0	0	0	0	248	460	507
Cumulative investment - Trunk (million \$2018)	0	0	0	1,561	1,561	1,561	1,561
Spur (km)	0	0	0	0	373	662	737
Trunk (km)	0	0	0	497	497	497	497

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
Carbon sink potential - Aggressive deployment - Cropland measures (1000 tCO2e/y)	0	0	-1,084
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	-74.1
Carbon sink potential - Aggressive deployment - Total (1000 tCO2e/y)	0	0	-1,158
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	-558
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	-37
Carbon sink potential - Moderate deployment - Total (1000 tCO2e/y)	0	0	-595
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	4,416
Land impacted for carbon sink - Aggressive deployment - Cropland to woody energy crops (1000 hectares)	0	0	0.006
Land impacted for carbon sink - Aggressive deployment - Pasture to energy crops (1000 hectares)	0	0	4.06
Land impacted for carbon sink - Aggressive deployment - Permanent conservation cover (1000 hectares)	0	0	126
Land impacted for carbon sink - Aggressive deployment - Total (1000 hectares)	0	0	4,546
Land impacted for carbon sink - Moderate deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	0

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	926
Land impacted for carbon sink - Moderate deployment - Cropland to woody energy crops (1000 hectares)	0	0	0.006
Land impacted for carbon sink - Moderate deployment - Pasture to energy crops (1000 hectares)	0	0	4.06
Land impacted for carbon sink - Moderate deployment - Permanent conservation cover (1000 hectares)	0	0	62.8
Land impacted for carbon sink - Moderate deployment - Total (1000 hectares)	0	0	993

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

Item	2020	2025	2050
Carbon sink potential - High - Accelerate regeneration (1000 tCO ₂ e/y)	0	0	3,070
Carbon sink potential - High - All (not counting overlap) (1000 tCO ₂ e/y)	0	0	60,233
Carbon sink potential - High - Avoid deforestation (1000 tCO ₂ e/y)	0	0	1,267
Carbon sink potential - High - Extend rotation length (1000 tCO ₂ e/y)	0	0	11,025
Carbon sink potential - High - Improve plantations (1000 tCO ₂ e/y)	0	0	5,746
Carbon sink potential - High - Increase retention of HWP (1000 tCO ₂ e/y)	0	0	20,097
Carbon sink potential - High - Increase trees outside forests (1000 tCO ₂ e/y)	0	0	660
Carbon sink potential - High - Reforest cropland (1000 tCO ₂ e/y)	0	0	6,564
Carbon sink potential - High - Reforest pasture (1000 tCO ₂ e/y)	0	0	3,779
Carbon sink potential - High - Restore productivity (1000 tCO ₂ e/y)	0	0	8,025
Carbon sink potential - Low - Accelerate regeneration (1000 tCO ₂ e/y)	0	0	1,538
Carbon sink potential - Low - All (not counting overlap) (1000 tCO ₂ e/y)	0	0	22,111
Carbon sink potential - Low - Avoid deforestation (1000 tCO ₂ e/y)	0	0	211
Carbon sink potential - Low - Extend rotation length (1000 tCO ₂ e/y)	0	0	4,235
Carbon sink potential - Low - Improve plantations (1000 tCO ₂ e/y)	0	0	2,923
Carbon sink potential - Low - Increase retention of HWP (1000 tCO ₂ e/y)	0	0	6,699
Carbon sink potential - Low - Increase trees outside forests (1000 tCO ₂ e/y)	0	0	231
Carbon sink potential - Low - Reforest cropland (1000 tCO ₂ e/y)	0	0	3,282
Carbon sink potential - Low - Reforest pasture (1000 tCO ₂ e/y)	0	0	286
Carbon sink potential - Low - Restore productivity (1000 tCO ₂ e/y)	0	0	2,705
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO ₂ e/y)	0	0	2,304
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO ₂ e/y)	0	0	41,121
Carbon sink potential - Mid - Avoid deforestation (1000 tCO ₂ e/y)	0	0	739

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

Item	2020	2025	2050
Carbon sink potential - Mid - Extend rotation length (1000 tCO ₂ e/y)	0	0	7,630
Carbon sink potential - Mid - Improve plantations (1000 tCO ₂ e/y)	0	0	4,284
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO ₂ e/y)	0	0	13,398
Carbon sink potential - Mid - Increase trees outside forests (1000 tCO ₂ e/y)	0	0	446
Carbon sink potential - Mid - Reforest cropland (1000 tCO ₂ e/y)	0	0	4,923
Carbon sink potential - Mid - Reforest pasture (1000 tCO ₂ e/y)	0	0	2,033
Carbon sink potential - Mid - Restore productivity (1000 tCO ₂ e/y)	0	0	5,365
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)	0	0	502
Land impacted for carbon sink potential - High - Avoid deforestation (over 30 years) (1000 hectares)	0	0	172
Land impacted for carbon sink potential - High - Extend rotation length (1000 hectares)	0	0	5,622
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)	0	0	2,117
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	62.7
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)	0	0	434
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)	0	0	107
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)	0	0	2,660
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)	0	0	11,677
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)	0	0	251
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)	0	0	161
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)	0	0	2,154
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)	0	0	1,058
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	33
Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares)	0	0	217
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)	0	0	18.6
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)	0	0	1,609
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)	0	0	5,503
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)	0	0	377
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)	0	0	166
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)	0	0	3,888

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	1,593
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	47.9
Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares)	0	0	325
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)	0	0	135
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)	0	0	3,241
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)	0	0	9,773

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	2.54	2.44	0	0	0	0
Sales of cooking units - Electric Resistance (%)	65.2	65.2	65.2	65.2	65.2	65.2	65.2
Sales of cooking units - Gas (%)	34.8	34.8	34.8	34.8	34.8	34.8	34.8
Sales of space heating units - Electric Heat Pump (%)	10.6	29.2	30	31.3	32.8	34.9	37.8
Sales of space heating units - Electric Resistance (%)	31.7	33	32.6	31.9	30.8	28.9	25.7
Sales of space heating units - Fossil (%)	8.51	13	11.8	11	10.8	10.7	10.8
Sales of space heating units - Gas (%)	49.2	24.7	25.6	25.8	25.6	25.6	25.6
Sales of water heating units - Electric Heat Pump (%)	0	0	0	0	0	0	0
Sales of water heating units - Electric Resistance (%)	40.2	57.1	57	57	56.9	56.9	56.9
Sales of water heating units - Gas Furnace (%)	53.4	37.5	37.6	37.6	37.6	37.7	37.7
Sales of water heating units - Other (%)	6.41	5.36	5.36	5.41	5.42	5.43	5.44

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 (%)	1.63	2.03	2.2	2.04	1.84	1.72	1.63
Vehicle sales - Light-duty - EV (%)	3.32	5.28	6.04	7.41	9.04	10.5	11.7
Vehicle sales - Light-duty - gasoline (%)	90.6	87.1	85.1	83.4	81.3	79.4	77.8
Vehicle sales - Light-duty - hybrid (%)	4.2	5.06	6.2	6.77	7.36	7.98	8.47
Vehicle sales - Light-duty - hydrogen FC (%)	0.111	0.379	0.35	0.312	0.31	0.311	0.322
Vehicle sales - Light-duty - other (%)	0.105	0.109	0.106	0.106	0.106	0.105	0.108
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)	93.8	96.3	99.1	101	104	110	118
Final energy use - Industry (PJ)	209	222	230	240	253	268	285
Final energy use - Residential (PJ)	151	140	129	121	115	111	107

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

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Transportation (PJ)	334	316	295	284	286	295	308

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	13,236	13,602	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 (%)	2.5	22.4	55	63.9	64.6	64.7	64.7
Sales of space heating units - Electric Resistance (%)	16.7	16.3	26	31	34.1	34.6	34.6
Sales of space heating units - Fossil (%)	0	0	0	0	0	0	0
Sales of space heating units - Gas Furnace (%)	80.8	61.3	19	5.16	1.26	0.741	0.694
Sales of water heating units - Electric Heat Pump (%)	1	0.818	0.818	0.822	0.828	0.831	0.832
Sales of water heating units - Electric Resistance (%)	3.08	2.41	2.42	2.43	2.43	2.43	2.43
Sales of water heating units - Gas Furnace (%)	95.1	96.1	96.1	96.1	96.1	96.1	96.1
Sales of water heating units - Other (%)	0.791	0.625	0.628	0.63	0.63	0.629	0.629

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	2.31	2.4	2.04	2.08	2.23	2.28

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

Item	2020	2025	2030	2050
Business-as-usual carbon sink - Natural uptake (Mt CO2e/y)	-34.3	0	-7.18	-5.98
Business-as-usual carbon sink - Retained in Hardwood Products (Mt CO2e/y)	-5.47	0	-9.18	-9.66
Business-as-usual carbon sink - Total (Mt CO2e/y)	-39.7	0	-16.4	-15.6
Carbon sink potential - High - Accelerate regeneration (1000 tCO2e/y)	0	0	0	3,070
Carbon sink potential - High - All (not counting overlap) (1000 tCO2e/y)	0	0	0	60,233
Carbon sink potential - High - Avoid deforestation (1000 tCO2e/y)	0	0	0	1,267
Carbon sink potential - High - Extend rotation length (1000 tCO2e/y)	0	0	0	11,025
Carbon sink potential - High - Improve plantations (1000 tCO2e/y)	0	0	0	5,746
Carbon sink potential - High - Increase retention of HWP (1000 tCO2e/y)	0	0	0	20,097
Carbon sink potential - High - Increase trees outside forests (1000 tCO2e/y)	0	0	0	660
Carbon sink potential - High - Reforest cropland (1000 tCO2e/y)	0	0	0	6,564
Carbon sink potential - High - Reforest pasture (1000 tCO2e/y)	0	0	0	3,779
Carbon sink potential - High - Restore productivity (1000 tCO2e/y)	0	0	0	8,025
Carbon sink potential - Low - Accelerate regeneration (1000 tCO2e/y)	0	0	0	1,538
Carbon sink potential - Low - All (not counting overlap) (1000 tCO2e/y)	0	0	0	22,111
Carbon sink potential - Low - Avoid deforestation (1000 tCO2e/y)	0	0	0	211

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	4,235
Carbon sink potential - Low - Improve plantations (1000 tCO2e/y)	0	0	0	2,923
Carbon sink potential - Low - Increase retention of HWP (1000 tCO2e/y)	0	0	0	6,699
Carbon sink potential - Low - Increase trees outside forests (1000 tCO2e/y)	0	0	0	231
Carbon sink potential - Low - Reforest cropland (1000 tCO2e/y)	0	0	0	3,282
Carbon sink potential - Low - Reforest pasture (1000 tCO2e/y)	0	0	0	286
Carbon sink potential - Low - Restore productivity (1000 tCO2e/y)	0	0	0	2,705
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO2e/y)	0	0	0	2,304
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO2e/y)	0	0	0	41,121
Carbon sink potential - Mid - Avoid deforestation (1000 tCO2e/y)	0	0	0	739
Carbon sink potential - Mid - Extend rotation length (1000 tCO2e/y)	0	0	0	7,630
Carbon sink potential - Mid - Improve plantations (1000 tCO2e/y)	0	0	0	4,284
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO2e/y)	0	0	0	13,398
Carbon sink potential - Mid - Increase trees outside forests (1000 tCO2e/y)	0	0	0	446
Carbon sink potential - Mid - Reforest cropland (1000 tCO2e/y)	0	0	0	4,923
Carbon sink potential - Mid - Reforest pasture (1000 tCO2e/y)	0	0	0	2,033
Carbon sink potential - Mid - Restore productivity (1000 tCO2e/y)	0	0	0	5,365
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)	0	0	0	502
Land impacted for carbon sink potential - High - Avoid deforestation (over 30 years) (1000 hectares)	0	0	0	172
Land impacted for carbon sink potential - High - Extend rotation length (1000 hectares)	0	0	0	5,622
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)	0	0	0	2,117
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	62.7
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)	0	0	0	434
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)	0	0	0	107
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)	0	0	0	2,660
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)	0	0	0	11,677
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)	0	0	0	251
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)	0	0	0	161
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)	0	0	0	2,154

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	1,058
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	33
Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares)	0	0	0	217
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)	0	0	0	18.6
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)	0	0	0	1,609
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)	0	0	0	5,503
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)	0	0	0	377
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)	0	0	0	166
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)	0	0	0	3,888
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)	0	0	0	1,593
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	47.9
Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares)	0	0	0	325
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)	0	0	0	135
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)	0	0	0	3,241
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)	0	0	0	9,773

Table 64: *REF scenario - IMPACTS - Health*

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal (million 2019\$)	0	101	64.1	18.4	13.9	12.7	11.9
Monetary damages from air pollution - Natural Gas (million 2019\$)	0	47.1	44.8	42	35.4	32.9	31.9
Monetary damages from air pollution - Transportation (million 2019\$)	0	421	431	441	453	464	476
Premature deaths from air pollution - Coal (deaths)	0	11.3	7.2	2.07	1.56	1.42	1.34
Premature deaths from air pollution - Natural Gas (deaths)	0	5.32	5.06	4.75	4	3.72	3.6
Premature deaths from air pollution - Transportation (deaths)	0	47.3	48.5	49.6	50.9	52.2	53.6