Net-Zero America - nebraska 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).

List of Tables

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	1.79	2.3	0	0	0	0
Sales of cooking units - Electric Resistance (%)	74.2	79.7	96.5	99.8	100	100	100
Sales of cooking units - Gas (%)	25.8	20.3	3.47	0.175	0	0	0
Sales of space heating units - Electric Heat Pump (%)	6.37	12.2	35.2	81.9	90.3	90.9	90.6
Sales of space heating units - Electric Resistance (%)	16.5	22	17.4	7.5	5.7	5.65	5.9
Sales of space heating units - Fossil (%)	5.83	9.86	7.69	3.24	2.34	2.21	2.25
Sales of space heating units - Gas (%)	71.3	55.9	39.7	7.36	1.62	1.25	1.22
Sales of water heating units - Electric Heat Pump (%)	0	0.739	10.1	30.7	34.4	34.6	34.6
Sales of water heating units - Electric Resistance (%)	35.5	51.5	55.3	63.7	65.3	65.4	65.3
Sales of water heating units - Gas Furnace (%)	64.5	47.7	34.5	5.53	0.326	0	0
Sales of water heating units - Other (%)	0.03	0.032	0.032	0.032	0.032	0.032	0.032

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	377	964	1,565	2,370	2,580	2,460
Public EV charging plugs - DC Fast (1000 units)	0.061	0	0.695	0	3.07	0	4.98
Public EV charging plugs - L2 (1000 units)	0.164	0	16.7	0	74	0	120
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 (%)	1.66	1.92	1.3	0.418	0.076	0.013	0
Vehicle sales - Light-duty - EV (%)	3.53	14	44.6	81.1	96.2	99.3	100
Vehicle sales - Light-duty - gasoline (%)	90.5	79.4	50.7	17.3	3.39	0.593	0
Vehicle sales - Light-duty - hybrid (%)	4.05	4.27	3.08	1.16	0.28	0.06	0
Vehicle sales - Light-duty - hydrogen FC (%)	0.111	0.346	0.212	0.066	0.013	0.002	0
Vehicle sales - Light-duty - other (%)	0.107	0.103	0.068	0.024	0.005	0.001	0
Vehicle sales - Medium-duty - diesel (%)	64.7	59.7	42.3	14.4	2.59	0.384	0
Vehicle sales - Medium-duty - EV (%)	0.784	5.07	25.3	60.8	76.5	79.5	80
Vehicle sales - Medium-duty - gasoline (%)	33.7	33.3	25.5	9.32	1.77	0.277	0
Vehicle sales - Medium-duty - hybrid (%)	0.363	0.402	0.341	0.14	0.03	0.005	0
Vehicle sales - Medium-duty - hydrogen FC (%)	0.196	1.27	6.33	15.2	19.1	19.9	20
Vehicle sales - Medium-duty - other (%)	0.253	0.255	0.205	0.083	0.019	0.004	0

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

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Commercial (PJ)	70.8	69.4	66.6	62.4	57.8	54.2	52.1
Final energy use - Industry (PJ)	281	293	298	298	301	304	307
Final energy use - Residential (PJ)	86.4	81.9	77.8	69.7	60.5	53.3	48.7
Final energy use - Transportation (PJ)	182	170	150	125	103	89.2	83.4

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	5,541	6,031	0	0	0	0
Sales of cooking units - Electric Resistance (%)	44.8	57.1	84	89.3	89.6	89.6	89.6
Sales of cooking units - Gas (%)	55.2	42.9	16	10.7	10.4	10.4	10.4
Sales of space heating units - Electric Heat Pump (%)	3.92	7.61	30.1	78	86.6	87.1	87.1
Sales of space heating units - Electric Resistance (%)	6.31	5.8	8.21	11.8	12.4	12.4	12.4
Sales of space heating units - Fossil (%)	0	1.82	0.351	0.015	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 (%)	89.8	84.8	61.3	10.2	1.03	0.454	0.456
Sales of water heating units - Electric Heat Pump (%)	0.944	1.84	14.5	42	47	47.3	47.3
Sales of water heating units - Electric Resistance (%)	8.03	8	20.3	47	51.8	52.1	52.1
Sales of water heating units - Gas Furnace (%)	90.2	89.2	64.5	10.3	0.61	0	0
Sales of water heating units - Other (%)	0.788	0.941	0.732	0.684	0.681	0.683	0.683

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	1.62	1.68	2.88	3.08	2.81	2.96

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	0.013	0.004	0	0
Capital invested - Biomass w/ccu power plant (billion $2018)	0	0	0	0	0.005	0	0.597
Capital invested - Solar PV - Base (billion $2018)	0	2.03	11	9.43	6.82	5.94	15.3
Capital invested - Solar PV - Constrained (billion $2018)	0	3.44	13.4	6.07	7	7.8	11.1
Capital invested - Wind - Base (billion $2018)	0	0.55	11.5	23.7	25.9	28.6	37
Capital invested - Wind - Constrained (billion $2018)	0	17	13.9	23.4	20.3	25.7	27.6

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	13.1	17.1	17.1	17.1
Biomass w/ccu power plant (GWh)	0	0	0	0	5.71	5.71	676
Solar - Base land use assumptions (GWh)	3.05	2,886	17,500	16,511	12,674	11,749	32,035
Solar - Constrained land use assumptions (GWh)	0	5,512	13,421	11,662	11,432	16,132	28,383
Wind - Base land use assumptions (GWh)	13,033	1,310	30,087	66,059	74,417	85,745	117,331
Wind - Constrained land use assumptions (GWh)	13,033	19,444	38,260	65,181	60,818	77,662	83,575

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	47.4	122	699	3,814
Conversion capital investment - Cumulative 5-yr (million $2018)	0	0	0	687	1,056	8,178	62,939
Number of facilities - Allam power w ccu (quantity)	0	0	0	1	1	1	1
Number of facilities - Beccs hydrogen (quantity)	0	0	0	1	2	11	29
Number of facilities - Diesel (quantity)	0	0	0	0	0	0	0
Number of facilities - Diesel ccu (quantity)	0	0	0	1	1	1	1
Number of facilities - Power (quantity)	0	0	0	0	0	0	0
Number of facilities - Power ccu (quantity)	0	0	0	0	1	1	2
Number of facilities - Pyrolysis (quantity)	0	0	0	0	0	0	0
Number of facilities - Pyrolysis ccu (quantity)	0	0	0	1	1	1	33
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	0.86	2.21	12.7	56.8
Annual - BECCS (MMT)	0	0	0	0.86	2.21	12.7	56.8
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	0.86	3.07	15.8	72.6
Cumulative - BECCS (MMT)	0	0	0	0.86	3.07	15.8	72.6
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	276	678	573	1,227	4,968
Cumulative investment - All (million $2018)	0	0	1,459	2,992	2,939	3,694	6,651
Cumulative investment - Spur (million $2018)	0	0	0	72.9	19.6	775	3,732
Cumulative investment - Trunk (million $2018)	0	0	1,459	2,919	2,919	2,919	2,919
Spur (km)	0	0	0	126	21.5	675	4,416
Trunk (km)	0	0	276	552	552	552	552

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	-2,594
Carbon sink potential - Aggressive deployment - Cropland measures (1000 tCO2e/y)	0	0	-7,779
Carbon sink potential - Aggressive deployment - Permanent conservation cover (1000 tCO2e/y)	0	0	-286
Carbon sink potential - Aggressive deployment - Total (1000 tCO2e/y)	0	0	-10,659
Carbon sink potential - Moderate deployment - Corn-ethanol to energy grasses (1000 tCO2e/y)	0	0	-2,594
Carbon sink potential - Moderate deployment - Cropland measures (1000 tCO2e/y)	0	0	-4,000
Carbon sink potential - Moderate deployment - Permanent conservation cover (1000 tCO2e/y)	0	0	-143
Carbon sink potential - Moderate deployment - Total (1000 tCO2e/y)	0	0	-6,737
Land impacted for carbon sink - Aggressive deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	1,456
Land impacted for carbon sink - Aggressive deployment - Cropland measures (1000 hectares)	0	0	7,064
Land impacted for carbon sink - Aggressive deployment - Permanent conservation cover (1000 hectares)	0	0	489
Land impacted for carbon sink - Aggressive deployment - Total (1000 hectares)	0	0	9,008
Land impacted for carbon sink - Moderate deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	1,456

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	3,654
Land impacted for carbon sink - Moderate deployment - Permanent conservation cover (1000 hectares)	0	0	244
Land impacted for carbon sink - Moderate deployment - Total (1000 hectares)	0	0	5,354

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

Item	2020	2025	2050
Carbon sink potential - High - Accelerate regeneration (1000 tCO2e/y)	0	0	248
Carbon sink potential - High - All (not counting overlap) (1000 tCO2e/y)	0	0	17,146
Carbon sink potential - High - Avoid deforestation (1000 tCO2e/y)	0	0	947
Carbon sink potential - High - Extend rotation length (1000 tCO2e/y)	0	0	427
Carbon sink potential - High - Improve plantations (1000 tCO2e/y)	0	0	46.9
Carbon sink potential - High - Increase retention of HWP (1000 tCO2e/y)	0	0	285
Carbon sink potential - High - Increase trees outside forests (1000 tCO2e/y)	0	0	2,717
Carbon sink potential - High - Reforest cropland (1000 tCO2e/y)	0	0	7,855
Carbon sink potential - High - Reforest pasture (1000 tCO2e/y)	0	0	4,189
Carbon sink potential - High - Restore productivity (1000 tCO2e/y)	0	0	431
Carbon sink potential - Low - Accelerate regeneration (1000 tCO2e/y)	0	0	124
Carbon sink potential - Low - All (not counting overlap) (1000 tCO2e/y)	0	0	5,906
Carbon sink potential - Low - Avoid deforestation (1000 tCO2e/y)	0	0	158
Carbon sink potential - Low - Extend rotation length (1000 tCO2e/y)	0	0	164
Carbon sink potential - Low - Improve plantations (1000 tCO2e/y)	0	0	23.8
Carbon sink potential - Low - Increase retention of HWP (1000 tCO2e/y)	0	0	95
Carbon sink potential - Low - Increase trees outside forests (1000 tCO2e/y)	0	0	951
Carbon sink potential - Low - Reforest cropland (1000 tCO2e/y)	0	0	3,928
Carbon sink potential - Low - Reforest pasture (1000 tCO2e/y)	0	0	317
Carbon sink potential - Low - Restore productivity (1000 tCO2e/y)	0	0	145
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO2e/y)	0	0	186
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO2e/y)	0	0	11,526
Carbon sink potential - Mid - Avoid deforestation (1000 tCO2e/y)	0	0	553
Carbon sink potential - Mid - Extend rotation length (1000 tCO2e/y)	0	0	296
Carbon sink potential - Mid - Improve plantations (1000 tCO2e/y)	0	0	34.9
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO2e/y)	0	0	190

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	1,834
Carbon sink potential - Mid - Reforest cropland (1000 tCO2e/y)	0	0	5,891
Carbon sink potential - Mid - Reforest pasture (1000 tCO2e/y)	0	0	2,253
Carbon sink potential - Mid - Restore productivity (1000 tCO2e/y)	0	0	288
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)	0	0	40.5
Land impacted for carbon sink potential - High - Avoid deforestation (over 30 years) (1000 hectares)	0	0	128
Land impacted for carbon sink potential - High - Extend rotation length (1000 hectares)	0	0	218
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)	0	0	17.3
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	258
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)	0	0	519
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)	0	0	119
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)	0	0	143
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)	0	0	1,443
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)	0	0	20.2
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)	0	0	120
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)	0	0	83.4
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)	0	0	8.63
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	136
Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares)	0	0	260
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)	0	0	20.6
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)	0	0	86.4
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)	0	0	735
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)	0	0	30.4
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)	0	0	124
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)	0	0	151
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)	0	0	13
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	197

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	390
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)	0	0	149
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)	0	0	174
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)	0	0	1,228

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

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal (million 2019$)	0	126	0.123	0.116	0.092	0.062	0.001
Monetary damages from air pollution - Natural Gas (million 2019$)	0	73.5	43.7	18.5	11.7	7.14	3.49
Monetary damages from air pollution - Transportation (million 2019$)	0	195	183	140	81.3	37.2	14.7
Premature deaths from air pollution - Coal (deaths)	0	14.1	0.014	0.013	0.01	0.007	0
Premature deaths from air pollution - Natural Gas (deaths)	0	8.31	4.94	2.09	1.32	0.806	0.395
Premature deaths from air pollution - Transportation (deaths)	0	22	20.6	15.7	9.14	4.19	1.65

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

Item	2020	2025	2030	2035	2040	2045	2050
By economic sector - Agriculture (jobs)	3,679	3,679	3,685	3,623	2,083	1,054	3,462
By economic sector - Construction (jobs)	3,806	5,602	16,136	23,789	28,510	34,963	55,610
By economic sector - Manufacturing (jobs)	4,243	6,180	7,502	9,750	9,262	8,469	13,621
By economic sector - Mining (jobs)	1,411	1,054	702	481	303	184	105
By economic sector - Other (jobs)	272	586	2,339	3,234	3,948	4,846	8,590
By economic sector - Pipeline (jobs)	201	199	349	315	105	99.8	425
By economic sector - Professional (jobs)	2,927	3,529	8,228	13,833	18,367	24,472	40,728
By economic sector - Trade (jobs)	3,189	3,206	5,632	8,311	10,371	13,345	21,991
By economic sector - Utilities (jobs)	4,787	5,243	10,308	17,535	21,910	28,841	47,111
By education level - All sectors - Associates degree or some college (jobs)	6,529	8,127	16,530	25,051	30,079	37,368	61,009
By education level - All sectors - Bachelors degree (jobs)	4,635	5,488	10,348	15,757	19,124	24,036	39,535
By education level - All sectors - Doctoral degree (jobs)	159	188	397	627	797	1,035	1,715
By education level - All sectors - High school diploma or less (jobs)	12,058	14,142	25,005	35,392	39,857	47,457	78,860
By education level - All sectors - Masters or professional degree (jobs)	1,135	1,334	2,602	4,044	5,000	6,378	10,524
By resource sector - Biomass (jobs)	8,884	8,621	8,390	8,104	4,972	4,014	15,388
By resource sector - CO2 (jobs)	0	0	1,453	1,457	14.1	247	3,162
By resource sector - Coal (jobs)	1,639	1,025	257	0	0	0	0
By resource sector - Grid (jobs)	6,414	7,621	16,428	30,894	41,013	53,982	87,725
By resource sector - Natural Gas (jobs)	1,685	1,577	1,420	1,280	1,070	1,313	1,251
By resource sector - Nuclear (jobs)	411	404	398	231	0.007	0.015	0.026
By resource sector - Oil (jobs)	2,596	2,295	1,889	1,433	1,005	703	450
By resource sector - Solar (jobs)	683	3,760	14,627	15,670	15,382	15,001	29,215
By resource sector - Wind (jobs)	2,204	3,975	10,020	21,801	31,402	41,013	54,454
Median wages - Annual - All ($2019 per job)	53,266	53,898	55,469	57,289	58,995	60,632	61,479
On-Site or In-Plant Training - Total jobs - 1 to 4 years (jobs)	3,416	4,224	8,567	12,917	15,446	19,150	31,237
On-Site or In-Plant Training - Total jobs - 4 to 10 years (jobs)	1,329	1,641	3,637	5,562	6,755	8,490	13,771
On-Site or In-Plant Training - Total jobs - None (jobs)	3,847	4,653	8,875	13,119	15,487	19,057	31,441

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)	200	244	483	726	860	1,060	1,729
On-Site or In-Plant Training - Total jobs - Up to 1 year (jobs)	15,722	18,516	33,320	48,546	56,310	68,515	113,466
On-the-Job Training - All sectors - 1 to 4 years (jobs)	4,197	5,243	10,903	16,590	19,991	24,911	40,519
On-the-Job Training - All sectors - 4 to 10 years (jobs)	1,240	1,556	3,585	5,517	6,735	8,490	13,752
On-the-Job Training - All sectors - None (jobs)	1,402	1,652	3,065	4,436	5,168	6,301	10,438
On-the-Job Training - All sectors - Over 10 years (jobs)	207	269	531	766	885	1,057	1,706
On-the-Job Training - All sectors - Up to 1 year (jobs)	17,469	20,559	36,798	53,562	62,080	75,515	125,229
Related work experience - All sectors - 1 to 4 years (jobs)	8,174	9,814	18,898	28,302	33,735	41,852	68,915
Related work experience - All sectors - 4 to 10 years (jobs)	4,940	6,040	12,063	18,303	22,044	27,492	44,903
Related work experience - All sectors - None (jobs)	3,832	4,504	8,224	11,928	13,773	16,748	27,786
Related work experience - All sectors - Over 10 years (jobs)	1,332	1,645	3,158	4,764	5,689	7,031	11,460
Related work experience - All sectors - Up to 1 year (jobs)	6,236	7,275	12,540	17,573	19,616	23,150	38,579
Wage income - All (million $2019)	1,306	1,578	3,045	4,634	5,597	7,051	11,784

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

Item	2020	2025	2030	2035	2040	2045	2050
Natural gas consumption - Annual (tcf)	142	144	121	97.3	73.2	46.1	32
Natural gas consumption - Cumulative (tcf)	0	0	0	0	0	0	2,931
Natural gas production - Annual (tcf)	0.477	0.529	0.5	0.435	0.368	0.292	0.227
Oil consumption - Annual (million bbls)	48.1	46.1	40.8	32.6	24.4	18	12.3
Oil consumption - Cumulative (million bbls)	0	0	0	0	0	0	991
Oil production - Annual (million bbls)	2.46	2.66	2.67	2.67	2.12	1.72	1.14

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	1.78	2.27	0	0	0	0
Sales of cooking units - Electric Resistance (%)	74.1	74.8	77.2	83.4	92.1	97.4	99.3
Sales of cooking units - Gas (%)	25.9	25.2	22.8	16.6	7.91	2.55	0.687
Sales of space heating units - Electric Heat Pump (%)	6.37	11	13.7	22.5	43.2	68.9	83.6
Sales of space heating units - Electric Resistance (%)	16.5	22.2	21.5	19.8	15.5	10.2	7.2
Sales of space heating units - Fossil (%)	5.83	9.99	9.81	8.95	6.83	4.3	2.95
Sales of space heating units - Gas (%)	71.3	56.8	54.9	48.8	34.5	16.7	6.23
Sales of water heating units - Electric Heat Pump (%)	0	0.395	1.48	5.1	13.9	24.9	31.5
Sales of water heating units - Electric Resistance (%)	35.5	51.4	51.8	53.2	56.8	61.3	64
Sales of water heating units - Gas Furnace (%)	64.5	48.2	46.7	41.7	29.3	13.7	4.47
Sales of water heating units - Other (%)	0.03	0.032	0.032	0.032	0.032	0.032	0.032

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	60.7	128	432	1,362	1,983
Public EV charging plugs - DC Fast (1000 units)	0.061	0	0.212	0	1.14	0	3.19
Public EV charging plugs - L2 (1000 units)	0.164	0	5.1	0	27.4	0	76.8
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 (%)	1.68	2.07	2.08	1.66	1.07	0.552	0.236
Vehicle sales - Light-duty - EV (%)	1.75	4.38	11.2	24.9	47.3	71.3	87.3
Vehicle sales - Light-duty - gasoline (%)	92.2	88	80.6	67.9	47.4	25.6	11.3
Vehicle sales - Light-duty - hybrid (%)	4.19	5.02	5.67	5.21	3.97	2.38	1.16
Vehicle sales - Light-duty - hydrogen FC (%)	0.113	0.384	0.333	0.257	0.184	0.103	0.048
Vehicle sales - Light-duty - other (%)	0.108	0.111	0.102	0.089	0.065	0.036	0.016
Vehicle sales - Medium-duty - diesel (%)	64.8	62.2	57.7	49.4	35.6	19.6	8.37
Vehicle sales - Medium-duty - EV (%)	0.664	1.94	5.49	14.3	31.4	52.6	68
Vehicle sales - Medium-duty - gasoline (%)	33.8	34.7	34.7	31.9	24.4	14.2	6.33
Vehicle sales - Medium-duty - hybrid (%)	0.363	0.418	0.464	0.478	0.414	0.275	0.141
Vehicle sales - Medium-duty - hydrogen FC (%)	0.166	0.485	1.37	3.58	7.86	13.2	17
Vehicle sales - Medium-duty - other (%)	0.253	0.266	0.279	0.286	0.258	0.184	0.102

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

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Commercial (PJ)	70.8	69.4	67.5	65.7	63.5	60.8	58.1
Final energy use - Industry (PJ)	281	293	300	302	307	311	314
Final energy use - Residential (PJ)	86.4	82	78.8	75.5	71.4	65.8	59.3
Final energy use - Transportation (PJ)	182	171	156	144	135	124	111

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	5,540	6,039	0	0	0	0
Sales of cooking units - Electric Resistance (%)	44.8	49.3	53.1	63	76.9	85.5	88.5
Sales of cooking units - Gas (%)	55.2	50.7	46.9	37	23.1	14.5	11.5
Sales of space heating units - Electric Heat Pump (%)	3.92	6.69	9.32	17.9	38.6	64.5	79.7
Sales of space heating units - Electric Resistance (%)	6.31	5.58	5.85	6.72	8.6	10.7	11.9
Sales of space heating units - Fossil (%)	0	2.1	1.98	1.48	0.719	0.234	0.062
Sales of space heating units - Gas Furnace (%)	89.8	85.6	82.9	73.9	52.1	24.5	8.31
Sales of water heating units - Electric Heat Pump (%)	0.944	1.35	2.81	7.68	19.4	34.3	43
Sales of water heating units - Electric Resistance (%)	8.03	7.53	8.96	13.7	25.1	39.5	48
Sales of water heating units - Gas Furnace (%)	90.2	90.1	87.3	77.8	54.7	25.5	8.33
Sales of water heating units - Other (%)	0.788	0.981	0.957	0.887	0.782	0.716	0.691

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	1.33	1.36	1.77	1.84	2.53	2.68

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	-2,594
Carbon sink potential - Aggressive deployment - Cropland measures (1000 tCO2e/y)	0	0	-7,779
Carbon sink potential - Aggressive deployment - Permanent conservation cover (1000 tCO2e/y)	0	0	-286
Carbon sink potential - Aggressive deployment - Total (1000 tCO2e/y)	0	0	-10,659

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 tCO2e/y)	0	0	-2,594
Carbon sink potential - Moderate deployment - Cropland measures (1000 tCO2e/y)	0	0	-4,000
Carbon sink potential - Moderate deployment - Permanent conservation cover (1000 tCO2e/y)	0	0	-143
Carbon sink potential - Moderate deployment - Total (1000 tCO2e/y)	0	0	-6,737
Land impacted for carbon sink - Aggressive deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	1,456
Land impacted for carbon sink - Aggressive deployment - Cropland measures (1000 hectares)	0	0	7,064
Land impacted for carbon sink - Aggressive deployment - Permanent conservation cover (1000 hectares)	0	0	489
Land impacted for carbon sink - Aggressive deployment - Total (1000 hectares)	0	0	9,008
Land impacted for carbon sink - Moderate deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	1,456
Land impacted for carbon sink - Moderate deployment - Cropland measures (1000 hectares)	0	0	3,654
Land impacted for carbon sink - Moderate deployment - Permanent conservation cover (1000 hectares)	0	0	244
Land impacted for carbon sink - Moderate deployment - Total (1000 hectares)	0	0	5,354

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

Item	2020	2025	2050
Carbon sink potential - High - Accelerate regeneration (1000 tCO2e/y)	0	0	248
Carbon sink potential - High - All (not counting overlap) (1000 tCO2e/y)	0	0	17,146
Carbon sink potential - High - Avoid deforestation (1000 tCO2e/y)	0	0	947
Carbon sink potential - High - Extend rotation length (1000 tCO2e/y)	0	0	427
Carbon sink potential - High - Improve plantations (1000 tCO2e/y)	0	0	46.9
Carbon sink potential - High - Increase retention of HWP (1000 tCO2e/y)	0	0	285
Carbon sink potential - High - Increase trees outside forests (1000 tCO2e/y)	0	0	2,717
Carbon sink potential - High - Reforest cropland (1000 tCO2e/y)	0	0	7,855
Carbon sink potential - High - Reforest pasture (1000 tCO2e/y)	0	0	4,189
Carbon sink potential - High - Restore productivity (1000 tCO2e/y)	0	0	431
Carbon sink potential - Low - Accelerate regeneration (1000 tCO2e/y)	0	0	124
Carbon sink potential - Low - All (not counting overlap) (1000 tCO2e/y)	0	0	5,906
Carbon sink potential - Low - Avoid deforestation (1000 tCO2e/y)	0	0	158
Carbon sink potential - Low - Extend rotation length (1000 tCO2e/y)	0	0	164
Carbon sink potential - Low - Improve plantations (1000 tCO2e/y)	0	0	23.8

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

Item	2020	2025	2050
Carbon sink potential - Low - Increase retention of HWP (1000 tCO2e/y)	0	0	95
Carbon sink potential - Low - Increase trees outside forests (1000 tCO2e/y)	0	0	951
Carbon sink potential - Low - Reforest cropland (1000 tCO2e/y)	0	0	3,928
Carbon sink potential - Low - Reforest pasture (1000 tCO2e/y)	0	0	317
Carbon sink potential - Low - Restore productivity (1000 tCO2e/y)	0	0	145
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO2e/y)	0	0	186
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO2e/y)	0	0	11,526
Carbon sink potential - Mid - Avoid deforestation (1000 tCO2e/y)	0	0	553
Carbon sink potential - Mid - Extend rotation length (1000 tCO2e/y)	0	0	296
Carbon sink potential - Mid - Improve plantations (1000 tCO2e/y)	0	0	34.9
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO2e/y)	0	0	190
Carbon sink potential - Mid - Increase trees outside forests (1000 tCO2e/y)	0	0	1,834
Carbon sink potential - Mid - Reforest cropland (1000 tCO2e/y)	0	0	5,891
Carbon sink potential - Mid - Reforest pasture (1000 tCO2e/y)	0	0	2,253
Carbon sink potential - Mid - Restore productivity (1000 tCO2e/y)	0	0	288
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)	0	0	40.5
Land impacted for carbon sink potential - High - Avoid deforestation (over 30 years) (1000 hectares)	0	0	128
Land impacted for carbon sink potential - High - Extend rotation length (1000 hectares)	0	0	218
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)	0	0	17.3
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	258
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)	0	0	519
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)	0	0	119
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)	0	0	143
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)	0	0	1,443
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)	0	0	20.2
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)	0	0	120
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)	0	0	83.4
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)	0	0	8.63
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	136
Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares)	0	0	260
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)	0	0	20.6
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)	0	0	86.4
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)	0	0	735
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)	0	0	30.4
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)	0	0	124
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)	0	0	151
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)	0	0	13
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	197
Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares)	0	0	390
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)	0	0	149
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)	0	0	174
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)	0	0	1,228

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

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal (million 2019$)	0	126	0.123	0.116	0.092	0.062	0.001
Monetary damages from air pollution - Natural Gas (million 2019$)	0	81.7	39.4	14.4	6.66	2.65	2.09
Monetary damages from air pollution - Transportation (million 2019$)	0	198	202	197	179	143	98.4
Premature deaths from air pollution - Coal (deaths)	0	14.1	0.014	0.013	0.01	0.007	0
Premature deaths from air pollution - Natural Gas (deaths)	0	9.23	4.45	1.63	0.753	0.3	0.236
Premature deaths from air pollution - Transportation (deaths)	0	22.3	22.7	22.2	20.1	16.1	11.1

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	1.79	2.3	0	0	0	0
Sales of cooking units - Electric Resistance (%)	74.2	79.7	96.5	99.8	100	100	100
Sales of cooking units - Gas (%)	25.8	20.3	3.47	0.175	0	0	0
Sales of space heating units - Electric Heat Pump (%)	6.37	12.2	35.2	81.9	90.3	90.9	90.6
Sales of space heating units - Electric Resistance (%)	16.5	22	17.4	7.5	5.7	5.65	5.9
Sales of space heating units - Fossil (%)	5.83	9.86	7.69	3.24	2.34	2.21	2.25
Sales of space heating units - Gas (%)	71.3	55.9	39.7	7.36	1.62	1.25	1.22
Sales of water heating units - Electric Heat Pump (%)	0	0.739	10.1	30.7	34.4	34.6	34.6

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 (%)	35.5	51.5	55.3	63.7	65.3	65.4	65.3
Sales of water heating units - Gas Furnace (%)	64.5	47.7	34.5	5.53	0.326	0	0
Sales of water heating units - Other (%)	0.03	0.032	0.032	0.032	0.032	0.032	0.032

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	377	964	1,565	2,370	2,580	2,460
Public EV charging plugs - DC Fast (1000 units)	0.061	0	0.695	0	3.07	0	4.98
Public EV charging plugs - L2 (1000 units)	0.164	0	16.7	0	74	0	120
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 (%)	1.66	1.92	1.3	0.418	0.076	0.013	0
Vehicle sales - Light-duty - EV (%)	3.53	14	44.6	81.1	96.2	99.3	100
Vehicle sales - Light-duty - gasoline (%)	90.5	79.4	50.7	17.3	3.39	0.593	0
Vehicle sales - Light-duty - hybrid (%)	4.05	4.27	3.08	1.16	0.28	0.06	0
Vehicle sales - Light-duty - hydrogen FC (%)	0.111	0.346	0.212	0.066	0.013	0.002	0
Vehicle sales - Light-duty - other (%)	0.107	0.103	0.068	0.024	0.005	0.001	0
Vehicle sales - Medium-duty - diesel (%)	64.7	59.7	42.3	14.4	2.59	0.384	0
Vehicle sales - Medium-duty - EV (%)	0.784	5.07	25.3	60.8	76.5	79.5	80
Vehicle sales - Medium-duty - gasoline (%)	33.7	33.3	25.5	9.32	1.77	0.277	0
Vehicle sales - Medium-duty - hybrid (%)	0.363	0.402	0.341	0.14	0.03	0.005	0
Vehicle sales - Medium-duty - hydrogen FC (%)	0.196	1.27	6.33	15.2	19.1	19.9	20
Vehicle sales - Medium-duty - other (%)	0.253	0.255	0.205	0.083	0.019	0.004	0

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

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Commercial (PJ)	70.8	69.4	66.6	62.4	57.8	54.2	52.1
Final energy use - Industry (PJ)	281	293	298	298	301	304	307
Final energy use - Residential (PJ)	86.4	81.9	77.8	69.7	60.5	53.3	48.7
Final energy use - Transportation (PJ)	182	170	150	125	103	89.2	83.4

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	5,541	6,031	0	0	0	0
Sales of cooking units - Electric Resistance (%)	44.8	57.1	84	89.3	89.6	89.6	89.6
Sales of cooking units - Gas (%)	55.2	42.9	16	10.7	10.4	10.4	10.4
Sales of space heating units - Electric Heat Pump (%)	3.92	7.61	30.1	78	86.6	87.1	87.1
Sales of space heating units - Electric Resistance (%)	6.31	5.8	8.21	11.8	12.4	12.4	12.4
Sales of space heating units - Fossil (%)	0	1.82	0.351	0.015	0	0	0
Sales of space heating units - Gas Furnace (%)	89.8	84.8	61.3	10.2	1.03	0.454	0.456
Sales of water heating units - Electric Heat Pump (%)	0.944	1.84	14.5	42	47	47.3	47.3
Sales of water heating units - Electric Resistance (%)	8.03	8	20.3	47	51.8	52.1	52.1
Sales of water heating units - Gas Furnace (%)	90.2	89.2	64.5	10.3	0.61	0	0
Sales of water heating units - Other (%)	0.788	0.941	0.732	0.684	0.681	0.683	0.683

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	1.62	1.68	2.88	3.08	2.81	2.96

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	15.6	12	14.6	12.2	52.8
Capital invested - Wind - Base (billion $2018)	0	2.4	13.8	28.7	46.8	55.8	72.8

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

Item	2020	2025	2030	2035	2040	2045	2050
Solar - Base land use assumptions (GWh)	3.05	0	24,913	21,186	27,829	24,604	116,034
Solar - Constrained land use assumptions (GWh)	3.05	0	28,987	19,022	22,015	28,639	79,291
Wind - Base land use assumptions (GWh)	13,033	5,731	36,051	79,728	133,394	167,139	226,317
Wind - Constrained land use assumptions (GWh)	13,033	25,603	44,290	78,529	113,434	133,374	221,760

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	-2,594
Carbon sink potential - Aggressive deployment - Cropland measures (1000 tCO2e/y)	0	0	-7,779
Carbon sink potential - Aggressive deployment - Permanent conservation cover (1000 tCO2e/y)	0	0	-286
Carbon sink potential - Aggressive deployment - Total (1000 tCO2e/y)	0	0	-10,659
Carbon sink potential - Moderate deployment - Corn-ethanol to energy grasses (1000 tCO2e/y)	0	0	-2,594
Carbon sink potential - Moderate deployment - Cropland measures (1000 tCO2e/y)	0	0	-4,000
Carbon sink potential - Moderate deployment - Permanent conservation cover (1000 tCO2e/y)	0	0	-143
Carbon sink potential - Moderate deployment - Total (1000 tCO2e/y)	0	0	-6,737
Land impacted for carbon sink - Aggressive deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	1,456
Land impacted for carbon sink - Aggressive deployment - Cropland measures (1000 hectares)	0	0	7,064
Land impacted for carbon sink - Aggressive deployment - Permanent conservation cover (1000 hectares)	0	0	489
Land impacted for carbon sink - Aggressive deployment - Total (1000 hectares)	0	0	9,008
Land impacted for carbon sink - Moderate deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	1,456
Land impacted for carbon sink - Moderate deployment - Cropland measures (1000 hectares)	0	0	3,654
Land impacted for carbon sink - Moderate deployment - Permanent conservation cover (1000 hectares)	0	0	244
Land impacted for carbon sink - Moderate deployment - Total (1000 hectares)	0	0	5,354

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

Item	2020	2025	2050
Carbon sink potential - High - Accelerate regeneration (1000 tCO2e/y)	0	0	248
Carbon sink potential - High - All (not counting overlap) (1000 tCO2e/y)	0	0	17,146
Carbon sink potential - High - Avoid deforestation (1000 tCO2e/y)	0	0	947
Carbon sink potential - High - Extend rotation length (1000 tCO2e/y)	0	0	427
Carbon sink potential - High - Improve plantations (1000 tCO2e/y)	0	0	46.9
Carbon sink potential - High - Increase retention of HWP (1000 tCO2e/y)	0	0	285
Carbon sink potential - High - Increase trees outside forests (1000 tCO2e/y)	0	0	2,717
Carbon sink potential - High - Reforest cropland (1000 tCO2e/y)	0	0	7,855
Carbon sink potential - High - Reforest pasture (1000 tCO2e/y)	0	0	4,189
Carbon sink potential - High - Restore productivity (1000 tCO2e/y)	0	0	431
Carbon sink potential - Low - Accelerate regeneration (1000 tCO2e/y)	0	0	124
Carbon sink potential - Low - All (not counting overlap) (1000 tCO2e/y)	0	0	5,906
Carbon sink potential - Low - Avoid deforestation (1000 tCO2e/y)	0	0	158
Carbon sink potential - Low - Extend rotation length (1000 tCO2e/y)	0	0	164
Carbon sink potential - Low - Improve plantations (1000 tCO2e/y)	0	0	23.8
Carbon sink potential - Low - Increase retention of HWP (1000 tCO2e/y)	0	0	95
Carbon sink potential - Low - Increase trees outside forests (1000 tCO2e/y)	0	0	951
Carbon sink potential - Low - Reforest cropland (1000 tCO2e/y)	0	0	3,928
Carbon sink potential - Low - Reforest pasture (1000 tCO2e/y)	0	0	317
Carbon sink potential - Low - Restore productivity (1000 tCO2e/y)	0	0	145
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO2e/y)	0	0	186
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO2e/y)	0	0	11,526
Carbon sink potential - Mid - Avoid deforestation (1000 tCO2e/y)	0	0	553
Carbon sink potential - Mid - Extend rotation length (1000 tCO2e/y)	0	0	296
Carbon sink potential - Mid - Improve plantations (1000 tCO2e/y)	0	0	34.9
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO2e/y)	0	0	190
Carbon sink potential - Mid - Increase trees outside forests (1000 tCO2e/y)	0	0	1,834
Carbon sink potential - Mid - Reforest cropland (1000 tCO2e/y)	0	0	5,891
Carbon sink potential - Mid - Reforest pasture (1000 tCO2e/y)	0	0	2,253
Carbon sink potential - Mid - Restore productivity (1000 tCO2e/y)	0	0	288
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)	0	0	40.5

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	128
Land impacted for carbon sink potential - High - Extend rotation length (1000 hectares)	0	0	218
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)	0	0	17.3
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	258
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)	0	0	519
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)	0	0	119
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)	0	0	143
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)	0	0	1,443
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)	0	0	20.2
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)	0	0	120
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)	0	0	83.4
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)	0	0	8.63
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	136
Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares)	0	0	260
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)	0	0	20.6
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)	0	0	86.4
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)	0	0	735
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)	0	0	30.4
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)	0	0	124
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)	0	0	151
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)	0	0	13
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	197
Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares)	0	0	390
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)	0	0	149
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)	0	0	174
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)	0	0	1,228

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

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal (million 2019$)	0	126	0.123	0.116	0.092	0.062	0.001
Monetary damages from air pollution - Natural Gas (million 2019$)	0	68.4	37.8	10.9	6.51	2.87	1.88
Monetary damages from air pollution - Transportation (million 2019$)	0	195	183	140	81.3	37.2	14.7
Premature deaths from air pollution - Coal (deaths)	0	14.1	0.014	0.013	0.01	0.007	0
Premature deaths from air pollution - Natural Gas (deaths)	0	7.72	4.27	1.24	0.735	0.324	0.212
Premature deaths from air pollution - Transportation (deaths)	0	22	20.6	15.7	9.14	4.19	1.65

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	1.79	2.3	0	0	0	0
Sales of cooking units - Electric Resistance (%)	74.2	79.7	96.5	99.8	100	100	100
Sales of cooking units - Gas (%)	25.8	20.3	3.47	0.175	0	0	0
Sales of space heating units - Electric Heat Pump (%)	6.37	12.2	35.2	81.9	90.3	90.9	90.6
Sales of space heating units - Electric Resistance (%)	16.5	22	17.4	7.5	5.7	5.65	5.9
Sales of space heating units - Fossil (%)	5.83	9.86	7.69	3.24	2.34	2.21	2.25
Sales of space heating units - Gas (%)	71.3	55.9	39.7	7.36	1.62	1.25	1.22
Sales of water heating units - Electric Heat Pump (%)	0	0.739	10.1	30.7	34.4	34.6	34.6
Sales of water heating units - Electric Resistance (%)	35.5	51.5	55.3	63.7	65.3	65.4	65.3
Sales of water heating units - Gas Furnace (%)	64.5	47.7	34.5	5.53	0.326	0	0
Sales of water heating units - Other (%)	0.03	0.032	0.032	0.032	0.032	0.032	0.032

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	377	964	1,565	2,370	2,580	2,460
Public EV charging plugs - DC Fast (1000 units)	0.061	0	0.695	0	3.07	0	4.98
Public EV charging plugs - L2 (1000 units)	0.164	0	16.7	0	74	0	120
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 (%)	1.66	1.92	1.3	0.418	0.076	0.013	0
Vehicle sales - Light-duty - EV (%)	3.53	14	44.6	81.1	96.2	99.3	100
Vehicle sales - Light-duty - gasoline (%)	90.5	79.4	50.7	17.3	3.39	0.593	0
Vehicle sales - Light-duty - hybrid (%)	4.05	4.27	3.08	1.16	0.28	0.06	0
Vehicle sales - Light-duty - hydrogen FC (%)	0.111	0.346	0.212	0.066	0.013	0.002	0
Vehicle sales - Light-duty - other (%)	0.107	0.103	0.068	0.024	0.005	0.001	0
Vehicle sales - Medium-duty - diesel (%)	64.7	59.7	42.3	14.4	2.59	0.384	0
Vehicle sales - Medium-duty - EV (%)	0.784	5.07	25.3	60.8	76.5	79.5	80
Vehicle sales - Medium-duty - gasoline (%)	33.7	33.3	25.5	9.32	1.77	0.277	0
Vehicle sales - Medium-duty - hybrid (%)	0.363	0.402	0.341	0.14	0.03	0.005	0
Vehicle sales - Medium-duty - hydrogen FC (%)	0.196	1.27	6.33	15.2	19.1	19.9	20
Vehicle sales - Medium-duty - other (%)	0.253	0.255	0.205	0.083	0.019	0.004	0

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

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Commercial (PJ)	70.8	69.4	66.6	62.4	57.8	54.2	52.1
Final energy use - Industry (PJ)	281	293	298	298	301	304	307
Final energy use - Residential (PJ)	86.4	81.9	77.8	69.7	60.5	53.3	48.7
Final energy use - Transportation (PJ)	182	170	150	125	103	89.2	83.4

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	5,541	6,031	0	0	0	0
Sales of cooking units - Electric Resistance (%)	44.8	57.1	84	89.3	89.6	89.6	89.6
Sales of cooking units - Gas (%)	55.2	42.9	16	10.7	10.4	10.4	10.4
Sales of space heating units - Electric Heat Pump (%)	3.92	7.61	30.1	78	86.6	87.1	87.1
Sales of space heating units - Electric Resistance (%)	6.31	5.8	8.21	11.8	12.4	12.4	12.4
Sales of space heating units - Fossil (%)	0	1.82	0.351	0.015	0	0	0
Sales of space heating units - Gas Furnace (%)	89.8	84.8	61.3	10.2	1.03	0.454	0.456
Sales of water heating units - Electric Heat Pump (%)	0.944	1.84	14.5	42	47	47.3	47.3
Sales of water heating units - Electric Resistance (%)	8.03	8	20.3	47	51.8	52.1	52.1
Sales of water heating units - Gas Furnace (%)	90.2	89.2	64.5	10.3	0.61	0	0
Sales of water heating units - Other (%)	0.788	0.941	0.732	0.684	0.681	0.683	0.683

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	1.62	1.68	2.88	3.08	2.81	2.96

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	5.7	3.92	4.66	3.09	1.34	0
Capital invested - Solar PV - Constrained (billion $2018)	0	2.15	3.06	7.09	4.01	1.27	0
Capital invested - Wind - Base (billion $2018)	0	0	3.21	9.2	11.5	16.6	0.769
Capital invested - Wind - Constrained (billion $2018)	0	2.45	9.77	10.6	13.1	16.1	0.65

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

Item	2020	2025	2030	2035	2040	2045	2050
Solar - Base land use assumptions (GWh)	622	8,129	6,288	8,093	5,727	2,599	0
Solar - Constrained land use assumptions (GWh)	348	3,080	4,933	12,356	7,405	2,497	0
Wind - Base land use assumptions (GWh)	13,033	0	8,466	25,822	33,799	50,787	2,455
Wind - Constrained land use assumptions (GWh)	13,033	5,785	25,419	29,011	37,227	48,462	1,995

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	-2,594
Carbon sink potential - Aggressive deployment - Cropland measures (1000 tCO2e/y)	0	0	-7,779
Carbon sink potential - Aggressive deployment - Permanent conservation cover (1000 tCO2e/y)	0	0	-286
Carbon sink potential - Aggressive deployment - Total (1000 tCO2e/y)	0	0	-10,659
Carbon sink potential - Moderate deployment - Corn-ethanol to energy grasses (1000 tCO2e/y)	0	0	-2,594

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

Item	2020	2025	2050
Carbon sink potential - Moderate deployment - Cropland measures (1000 tCO2e/y)	0	0	-4,000
Carbon sink potential - Moderate deployment - Permanent conservation cover (1000 tCO2e/y)	0	0	-143
Carbon sink potential - Moderate deployment - Total (1000 tCO2e/y)	0	0	-6,737
Land impacted for carbon sink - Aggressive deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	1,456
Land impacted for carbon sink - Aggressive deployment - Cropland measures (1000 hectares)	0	0	7,064
Land impacted for carbon sink - Aggressive deployment - Permanent conservation cover (1000 hectares)	0	0	489
Land impacted for carbon sink - Aggressive deployment - Total (1000 hectares)	0	0	9,008
Land impacted for carbon sink - Moderate deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	1,456
Land impacted for carbon sink - Moderate deployment - Cropland measures (1000 hectares)	0	0	3,654
Land impacted for carbon sink - Moderate deployment - Permanent conservation cover (1000 hectares)	0	0	244
Land impacted for carbon sink - Moderate deployment - Total (1000 hectares)	0	0	5,354

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	248
Carbon sink potential - High - All (not counting overlap) (1000 tCO2e/y)	0	0	17,146
Carbon sink potential - High - Avoid deforestation (1000 tCO2e/y)	0	0	947
Carbon sink potential - High - Extend rotation length (1000 tCO2e/y)	0	0	427
Carbon sink potential - High - Improve plantations (1000 tCO2e/y)	0	0	46.9
Carbon sink potential - High - Increase retention of HWP (1000 tCO2e/y)	0	0	285
Carbon sink potential - High - Increase trees outside forests (1000 tCO2e/y)	0	0	2,717
Carbon sink potential - High - Reforest cropland (1000 tCO2e/y)	0	0	7,855
Carbon sink potential - High - Reforest pasture (1000 tCO2e/y)	0	0	4,189
Carbon sink potential - High - Restore productivity (1000 tCO2e/y)	0	0	431
Carbon sink potential - Low - Accelerate regeneration (1000 tCO2e/y)	0	0	124
Carbon sink potential - Low - All (not counting overlap) (1000 tCO2e/y)	0	0	5,906
Carbon sink potential - Low - Avoid deforestation (1000 tCO2e/y)	0	0	158
Carbon sink potential - Low - Extend rotation length (1000 tCO2e/y)	0	0	164
Carbon sink potential - Low - Improve plantations (1000 tCO2e/y)	0	0	23.8
Carbon sink potential - Low - Increase retention of HWP (1000 tCO2e/y)	0	0	95

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

Item	2020	2025	2050
Carbon sink potential - Low - Increase trees outside forests (1000 tCO2e/y)	0	0	951
Carbon sink potential - Low - Reforest cropland (1000 tCO2e/y)	0	0	3,928
Carbon sink potential - Low - Reforest pasture (1000 tCO2e/y)	0	0	317
Carbon sink potential - Low - Restore productivity (1000 tCO2e/y)	0	0	145
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO2e/y)	0	0	186
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO2e/y)	0	0	11,526
Carbon sink potential - Mid - Avoid deforestation (1000 tCO2e/y)	0	0	553
Carbon sink potential - Mid - Extend rotation length (1000 tCO2e/y)	0	0	296
Carbon sink potential - Mid - Improve plantations (1000 tCO2e/y)	0	0	34.9
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO2e/y)	0	0	190
Carbon sink potential - Mid - Increase trees outside forests (1000 tCO2e/y)	0	0	1,834
Carbon sink potential - Mid - Reforest cropland (1000 tCO2e/y)	0	0	5,891
Carbon sink potential - Mid - Reforest pasture (1000 tCO2e/y)	0	0	2,253
Carbon sink potential - Mid - Restore productivity (1000 tCO2e/y)	0	0	288
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)	0	0	40.5
Land impacted for carbon sink potential - High - Avoid deforestation (over 30 years) (1000 hectares)	0	0	128
Land impacted for carbon sink potential - High - Extend rotation length (1000 hectares)	0	0	218
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)	0	0	17.3
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	258
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)	0	0	519
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)	0	0	119
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)	0	0	143
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)	0	0	1,443
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)	0	0	20.2
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)	0	0	120
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)	0	0	83.4
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)	0	0	8.63
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	136

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	260
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)	0	0	20.6
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)	0	0	86.4
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)	0	0	735
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)	0	0	30.4
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)	0	0	124
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)	0	0	151
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)	0	0	13
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	197
Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares)	0	0	390
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)	0	0	149
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)	0	0	174
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)	0	0	1,228

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

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal (million 2019$)	0	126	0.123	0.116	0.092	0.062	0.001
Monetary damages from air pollution - Natural Gas (million 2019$)	0	75.3	34	42.7	25.1	10.1	4.53
Monetary damages from air pollution - Transportation (million 2019$)	0	195	183	140	81.3	37.2	14.7
Premature deaths from air pollution - Coal (deaths)	0	14.1	0.014	0.013	0.01	0.007	0
Premature deaths from air pollution - Natural Gas (deaths)	0	8.5	3.85	4.82	2.84	1.14	0.512
Premature deaths from air pollution - Transportation (deaths)	0	22	20.6	15.7	9.14	4.19	1.65

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	1.78	2.27	0	0	0	0
Sales of cooking units - Electric Resistance (%)	74.1	74.8	77.2	83.4	92.1	97.4	99.3
Sales of cooking units - Gas (%)	25.9	25.2	22.8	16.6	7.91	2.55	0.687
Sales of space heating units - Electric Heat Pump (%)	6.37	11	13.7	22.5	43.2	68.9	83.6
Sales of space heating units - Electric Resistance (%)	16.5	22.2	21.5	19.8	15.5	10.2	7.2
Sales of space heating units - Fossil (%)	5.83	9.99	9.81	8.95	6.83	4.3	2.95
Sales of space heating units - Gas (%)	71.3	56.8	54.9	48.8	34.5	16.7	6.23
Sales of water heating units - Electric Heat Pump (%)	0	0.395	1.48	5.1	13.9	24.9	31.5
Sales of water heating units - Electric Resistance (%)	35.5	51.4	51.8	53.2	56.8	61.3	64

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 (%)	64.5	48.2	46.7	41.7	29.3	13.7	4.47
Sales of water heating units - Other (%)	0.03	0.032	0.032	0.032	0.032	0.032	0.032

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	60.7	128	432	1,362	1,983
Public EV charging plugs - DC Fast (1000 units)	0.061	0	0.212	0	1.14	0	3.19
Public EV charging plugs - L2 (1000 units)	0.164	0	5.1	0	27.4	0	76.8
Vehicle sales - Heavy-duty - diesel (%)	97.4	96	91.3	79.8	58.2	32.1	13.7
Vehicle sales - Heavy-duty - EV (%)	0.498	1.45	4.11	10.8	23.6	39.5	51
Vehicle sales - Heavy-duty - gasoline (%)	0.228	0.236	0.239	0.225	0.179	0.109	0.051
Vehicle sales - Heavy-duty - hybrid (%)	0.083	0.094	0.104	0.107	0.092	0.06	0.03
Vehicle sales - Heavy-duty - hydrogen FC (%)	0.332	0.969	2.74	7.17	15.7	26.3	34
Vehicle sales - Heavy-duty - other (%)	1.5	1.28	1.46	1.95	2.25	1.96	1.14
Vehicle sales - Light-duty - diesel (%)	1.68	2.07	2.08	1.66	1.07	0.552	0.236
Vehicle sales - Light-duty - EV (%)	1.75	4.38	11.2	24.9	47.3	71.3	87.3
Vehicle sales - Light-duty - gasoline (%)	92.2	88	80.6	67.9	47.4	25.6	11.3
Vehicle sales - Light-duty - hybrid (%)	4.19	5.02	5.67	5.21	3.97	2.38	1.16
Vehicle sales - Light-duty - hydrogen FC (%)	0.113	0.384	0.333	0.257	0.184	0.103	0.048
Vehicle sales - Light-duty - other (%)	0.108	0.111	0.102	0.089	0.065	0.036	0.016
Vehicle sales - Medium-duty - diesel (%)	64.8	62.2	57.7	49.4	35.6	19.6	8.37
Vehicle sales - Medium-duty - EV (%)	0.664	1.94	5.49	14.3	31.4	52.6	68
Vehicle sales - Medium-duty - gasoline (%)	33.8	34.7	34.7	31.9	24.4	14.2	6.33
Vehicle sales - Medium-duty - hybrid (%)	0.363	0.418	0.464	0.478	0.414	0.275	0.141
Vehicle sales - Medium-duty - hydrogen FC (%)	0.166	0.485	1.37	3.58	7.86	13.2	17
Vehicle sales - Medium-duty - other (%)	0.253	0.266	0.279	0.286	0.258	0.184	0.102

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

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Commercial (PJ)	70.8	69.4	67.5	65.7	63.5	60.8	58.1
Final energy use - Industry (PJ)	281	293	300	302	307	311	314
Final energy use - Residential (PJ)	86.4	82	78.8	75.5	71.4	65.8	59.3
Final energy use - Transportation (PJ)	182	171	156	144	135	124	111

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	5,540	6,039	0	0	0	0
Sales of cooking units - Electric Resistance (%)	44.8	49.3	53.1	63	76.9	85.5	88.5
Sales of cooking units - Gas (%)	55.2	50.7	46.9	37	23.1	14.5	11.5
Sales of space heating units - Electric Heat Pump (%)	3.92	6.69	9.32	17.9	38.6	64.5	79.7
Sales of space heating units - Electric Resistance (%)	6.31	5.58	5.85	6.72	8.6	10.7	11.9
Sales of space heating units - Fossil (%)	0	2.1	1.98	1.48	0.719	0.234	0.062
Sales of space heating units - Gas Furnace (%)	89.8	85.6	82.9	73.9	52.1	24.5	8.31
Sales of water heating units - Electric Heat Pump (%)	0.944	1.35	2.81	7.68	19.4	34.3	43
Sales of water heating units - Electric Resistance (%)	8.03	7.53	8.96	13.7	25.1	39.5	48
Sales of water heating units - Gas Furnace (%)	90.2	90.1	87.3	77.8	54.7	25.5	8.33
Sales of water heating units - Other (%)	0.788	0.981	0.957	0.887	0.782	0.716	0.691

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	1.33	1.36	1.77	1.84	2.53	2.68

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

Item	2020	2025	2030	2035	2040	2045	2050
Capital invested - Biomass power plant (billion $2018)	0	0.003	0.032	0	0	0	0
Capital invested - Biomass w/ccu allam power plant (billion $2018)	0	0	0	0.024	0.006	0.01	0
Capital invested - Biomass w/ccu power plant (billion $2018)	0	0	0	0.061	0.002	0.208	0.095

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

Item	2020	2025	2030	2035	2040	2045	2050
Biomass power plant (GWh)	0	5.4	67.8	67.8	67.8	67.8	67.8
Biomass w/ccu allam power plant (GWh)	0	0	0	24.1	30.2	40.1	40.1
Biomass w/ccu power plant (GWh)	0	0	0	68	69.9	303	410

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

Item	2020	2025	2030	2035	2040	2045	2050
Biomass purchases (million $2018/year)	0	0.41	4.64	117	1,093	2,577	6,002
Conversion capital investment - Cumulative 5-yr (million $2018)	0	3.12	35.5	1,454	12,265	18,692	53,340
Number of facilities - Allam power w ccu (quantity)	0	0	0	1	2	3	3
Number of facilities - Beccs hydrogen (quantity)	0	0	0	1	15	35	41
Number of facilities - Diesel (quantity)	0	0	0	1	1	2	3
Number of facilities - Diesel ccu (quantity)	0	0	0	1	2	3	4
Number of facilities - Power (quantity)	0	1	1	1	1	1	1
Number of facilities - Power ccu (quantity)	0	0	0	1	2	3	3
Number of facilities - Pyrolysis (quantity)	0	0	0	1	1	2	32
Number of facilities - Pyrolysis ccu (quantity)	0	0	0	1	2	3	17
Number of facilities - Sng (quantity)	0	1	1	1	1	2	2
Number of facilities - Sng ccu (quantity)	0	0	0	0	0	1	2

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

Item	2020	2025	2030	2035	2040	2045	2050
Annual - All (MMT)	0	0	0	1.79	17.5	41.5	57.6
Annual - BECCS (MMT)	0	0	0	1.79	17.5	41.5	57.6
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	1.79	19.3	60.8	118
Cumulative - BECCS (MMT)	0	0	0	1.79	19.3	60.8	118
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	276	573	1,503	2,642	3,732
Cumulative investment - All (million $2018)	0	0	1,627	3,273	5,868	6,875	7,932
Cumulative investment - Spur (million $2018)	0	0	0	17.9	986	1,993	3,050
Cumulative investment - Trunk (million $2018)	0	0	1,627	3,255	4,882	4,882	4,882
Spur (km)	0	0	0	21.5	675	1,814	2,905
Trunk (km)	0	0	276	552	828	828	828

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	-2,881
Carbon sink potential - Aggressive deployment - Cropland measures (1000 tCO2e/y)	0	0	-7,608
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	-273
Carbon sink potential - Aggressive deployment - Total (1000 tCO2e/y)	0	0	-10,762
Carbon sink potential - Moderate deployment - Corn-ethanol to energy grasses (1000 tCO2e/y)	0	0	-2,881
Carbon sink potential - Moderate deployment - Cropland measures (1000 tCO2e/y)	0	0	-3,910
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	-136
Carbon sink potential - Moderate deployment - Total (1000 tCO2e/y)	0	0	-6,927
Land impacted for carbon sink - Aggressive deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	1,679
Land impacted for carbon sink - Aggressive deployment - Cropland measures (1000 hectares)	0	0	16,939
Land impacted for carbon sink - Aggressive deployment - Cropland to woody energy crops (1000 hectares)	0	0	15.7
Land impacted for carbon sink - Aggressive deployment - Pasture to energy crops (1000 hectares)	0	0	288
Land impacted for carbon sink - Aggressive deployment - Permanent conservation cover (1000 hectares)	0	0	466
Land impacted for carbon sink - Aggressive deployment - Total (1000 hectares)	0	0	19,388
Land impacted for carbon sink - Moderate deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	1,679
Land impacted for carbon sink - Moderate deployment - Cropland measures (1000 hectares)	0	0	3,547
Land impacted for carbon sink - Moderate deployment - Cropland to woody energy crops (1000 hectares)	0	0	15.7
Land impacted for carbon sink - Moderate deployment - Pasture to energy crops (1000 hectares)	0	0	288
Land impacted for carbon sink - Moderate deployment - Permanent conservation cover (1000 hectares)	0	0	233
Land impacted for carbon sink - Moderate deployment - Total (1000 hectares)	0	0	5,762

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	248
Carbon sink potential - High - All (not counting overlap) (1000 tCO2e/y)	0	0	17,146
Carbon sink potential - High - Avoid deforestation (1000 tCO2e/y)	0	0	947
Carbon sink potential - High - Extend rotation length (1000 tCO2e/y)	0	0	427
Carbon sink potential - High - Improve plantations (1000 tCO2e/y)	0	0	46.9
Carbon sink potential - High - Increase retention of HWP (1000 tCO2e/y)	0	0	285
Carbon sink potential - High - Increase trees outside forests (1000 tCO2e/y)	0	0	2,717
Carbon sink potential - High - Reforest cropland (1000 tCO2e/y)	0	0	7,855
Carbon sink potential - High - Reforest pasture (1000 tCO2e/y)	0	0	4,189
Carbon sink potential - High - Restore productivity (1000 tCO2e/y)	0	0	431
Carbon sink potential - Low - Accelerate regeneration (1000 tCO2e/y)	0	0	124
Carbon sink potential - Low - All (not counting overlap) (1000 tCO2e/y)	0	0	5,906
Carbon sink potential - Low - Avoid deforestation (1000 tCO2e/y)	0	0	158
Carbon sink potential - Low - Extend rotation length (1000 tCO2e/y)	0	0	164
Carbon sink potential - Low - Improve plantations (1000 tCO2e/y)	0	0	23.8
Carbon sink potential - Low - Increase retention of HWP (1000 tCO2e/y)	0	0	95
Carbon sink potential - Low - Increase trees outside forests (1000 tCO2e/y)	0	0	951
Carbon sink potential - Low - Reforest cropland (1000 tCO2e/y)	0	0	3,928
Carbon sink potential - Low - Reforest pasture (1000 tCO2e/y)	0	0	317
Carbon sink potential - Low - Restore productivity (1000 tCO2e/y)	0	0	145
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO2e/y)	0	0	186
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO2e/y)	0	0	11,526
Carbon sink potential - Mid - Avoid deforestation (1000 tCO2e/y)	0	0	553
Carbon sink potential - Mid - Extend rotation length (1000 tCO2e/y)	0	0	296
Carbon sink potential - Mid - Improve plantations (1000 tCO2e/y)	0	0	34.9
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO2e/y)	0	0	190
Carbon sink potential - Mid - Increase trees outside forests (1000 tCO2e/y)	0	0	1,834
Carbon sink potential - Mid - Reforest cropland (1000 tCO2e/y)	0	0	5,891
Carbon sink potential - Mid - Reforest pasture (1000 tCO2e/y)	0	0	2,253
Carbon sink potential - Mid - Restore productivity (1000 tCO2e/y)	0	0	288
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)	0	0	40.5

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	128
Land impacted for carbon sink potential - High - Extend rotation length (1000 hectares)	0	0	218
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)	0	0	17.3
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	258
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)	0	0	519
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)	0	0	119
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)	0	0	143
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)	0	0	1,443
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)	0	0	20.2
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)	0	0	120
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)	0	0	83.4
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)	0	0	8.63
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	136
Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares)	0	0	260
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)	0	0	20.6
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)	0	0	86.4
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)	0	0	735
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)	0	0	30.4
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)	0	0	124
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)	0	0	151
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)	0	0	13
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	197
Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares)	0	0	390
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)	0	0	149
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)	0	0	174
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)	0	0	1,228

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	1.71	1.81	0	0	0	0
Sales of cooking units - Electric Resistance (%)	73.9	73.9	73.9	73.9	73.9	73.9	73.9
Sales of cooking units - Gas (%)	26.1	26.1	26.1	26.1	26.1	26.1	26.1
Sales of space heating units - Electric Heat Pump (%)	5.61	14.1	14.5	15.1	15.7	16.4	17.4
Sales of space heating units - Electric Resistance (%)	16.7	21.4	21.2	20.9	20.5	19.8	18.9
Sales of space heating units - Fossil (%)	5.95	9.38	9.47	9.46	9.32	9.23	9.3
Sales of space heating units - Gas (%)	71.7	55	54.8	54.5	54.5	54.6	54.4
Sales of water heating units - Electric Heat Pump (%)	0	0	0	0	0	0	0
Sales of water heating units - Electric Resistance (%)	35.5	51.2	51.2	51.1	51.1	51	51
Sales of water heating units - Gas Furnace (%)	64.5	48.7	48.8	48.9	48.9	48.9	49
Sales of water heating units - Other (%)	0.03	0.032	0.032	0.032	0.032	0.032	0.032

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 (%)	1.67	2.06	2.2	2.05	1.85	1.72	1.64
Vehicle sales - Light-duty - EV (%)	3.18	5.11	5.84	7.15	8.75	10.2	11.4
Vehicle sales - Light-duty - gasoline (%)	90.9	87.4	85.4	83.7	81.8	79.8	78.2
Vehicle sales - Light-duty - hybrid (%)	4.06	4.93	6.05	6.62	7.22	7.85	8.38
Vehicle sales - Light-duty - hydrogen FC (%)	0.111	0.381	0.353	0.315	0.313	0.314	0.325
Vehicle sales - Light-duty - other (%)	0.107	0.111	0.108	0.108	0.108	0.107	0.11
Vehicle sales - Medium-duty - diesel (%)	65.2	63.5	61.6	59.6	58	56.5	55.2
Vehicle sales - Medium-duty - EV (%)	0.027	0.105	0.329	0.671	0.895	0.973	0.993
Vehicle sales - Medium-duty - gasoline (%)	34	35.5	37	38.5	39.7	40.8	41.7
Vehicle sales - Medium-duty - hybrid (%)	0.365	0.427	0.496	0.577	0.674	0.793	0.929
Vehicle sales - Medium-duty - hydrogen FC (%)	0.175	0.208	0.242	0.285	0.339	0.409	0.487
Vehicle sales - Medium-duty - other (%)	0.255	0.271	0.298	0.345	0.42	0.528	0.671

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

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Commercial (PJ)	70.8	71	71	70.2	69.4	70	71.9
Final energy use - Industry (PJ)	281	297	305	312	321	329	340
Final energy use - Residential (PJ)	86.4	82.5	80.6	79.4	79.2	79.6	79.9
Final energy use - Transportation (PJ)	182	171	157	149	149	153	158

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	5,476	5,633	0	0	0	0
Sales of cooking units - Electric Resistance (%)	44.8	47.8	47.9	47.8	47.9	47.9	48
Sales of cooking units - Gas (%)	55.2	52.2	52.1	52.2	52.1	52.1	52
Sales of space heating units - Electric Heat Pump (%)	3.92	13	44.6	70.5	74.8	75.2	75.2
Sales of space heating units - Electric Resistance (%)	6.31	6.4	10.8	18.4	23.4	24.2	24.3
Sales of space heating units - Fossil (%)	0	2.06	1.59	0.699	0.102	0.009	0
Sales of space heating units - Gas Furnace (%)	89.8	78.5	43	10.4	1.69	0.518	0.457
Sales of water heating units - Electric Heat Pump (%)	0.944	0.821	0.817	0.818	0.814	0.81	0.81

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 (%)	8.03	7.01	7.03	7.01	7.01	7.01	7.01
Sales of water heating units - Gas Furnace (%)	90.2	91.2	91.2	91.2	91.2	91.2	91.2
Sales of water heating units - Other (%)	0.788	0.989	0.989	0.988	0.987	0.991	0.991

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	1.36	1.39	1.46	1.5	1.63	1.69

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

Item	2020	2025	2030	2050
Business-as-usual carbon sink - Natural uptake (Mt CO2e/y)	-0.18	0	0.307	0.088
Business-as-usual carbon sink - Retained in Hardwood Products (Mt CO2e/y)	-0.078	0	-0.161	-0.17
Business-as-usual carbon sink - Total (Mt CO2e/y)	-0.258	0	0.146	-0.081
Carbon sink potential - High - Accelerate regeneration (1000 tCO2e/y)	0	0	0	248
Carbon sink potential - High - All (not counting overlap) (1000 tCO2e/y)	0	0	0	17,146
Carbon sink potential - High - Avoid deforestation (1000 tCO2e/y)	0	0	0	947
Carbon sink potential - High - Extend rotation length (1000 tCO2e/y)	0	0	0	427
Carbon sink potential - High - Improve plantations (1000 tCO2e/y)	0	0	0	46.9
Carbon sink potential - High - Increase retention of HWP (1000 tCO2e/y)	0	0	0	285
Carbon sink potential - High - Increase trees outside forests (1000 tCO2e/y)	0	0	0	2,717
Carbon sink potential - High - Reforest cropland (1000 tCO2e/y)	0	0	0	7,855
Carbon sink potential - High - Reforest pasture (1000 tCO2e/y)	0	0	0	4,189
Carbon sink potential - High - Restore productivity (1000 tCO2e/y)	0	0	0	431
Carbon sink potential - Low - Accelerate regeneration (1000 tCO2e/y)	0	0	0	124
Carbon sink potential - Low - All (not counting overlap) (1000 tCO2e/y)	0	0	0	5,906
Carbon sink potential - Low - Avoid deforestation (1000 tCO2e/y)	0	0	0	158
Carbon sink potential - Low - Extend rotation length (1000 tCO2e/y)	0	0	0	164
Carbon sink potential - Low - Improve plantations (1000 tCO2e/y)	0	0	0	23.8
Carbon sink potential - Low - Increase retention of HWP (1000 tCO2e/y)	0	0	0	95
Carbon sink potential - Low - Increase trees outside forests (1000 tCO2e/y)	0	0	0	951
Carbon sink potential - Low - Reforest cropland (1000 tCO2e/y)	0	0	0	3,928
Carbon sink potential - Low - Reforest pasture (1000 tCO2e/y)	0	0	0	317
Carbon sink potential - Low - Restore productivity (1000 tCO2e/y)	0	0	0	145
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO2e/y)	0	0	0	186
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO2e/y)	0	0	0	11,526

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	553
Carbon sink potential - Mid - Extend rotation length (1000 tCO2e/y)	0	0	0	296
Carbon sink potential - Mid - Improve plantations (1000 tCO2e/y)	0	0	0	34.9
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO2e/y)	0	0	0	190
Carbon sink potential - Mid - Increase trees outside forests (1000 tCO2e/y)	0	0	0	1,834
Carbon sink potential - Mid - Reforest cropland (1000 tCO2e/y)	0	0	0	5,891
Carbon sink potential - Mid - Reforest pasture (1000 tCO2e/y)	0	0	0	2,253
Carbon sink potential - Mid - Restore productivity (1000 tCO2e/y)	0	0	0	288
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)	0	0	0	40.5
Land impacted for carbon sink potential - High - Avoid deforestation (over 30 years) (1000 hectares)	0	0	0	128
Land impacted for carbon sink potential - High - Extend rotation length (1000 hectares)	0	0	0	218
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)	0	0	0	17.3
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	258
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)	0	0	0	519
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)	0	0	0	119
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)	0	0	0	143
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)	0	0	0	1,443
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)	0	0	0	20.2
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)	0	0	0	120
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)	0	0	0	83.4
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)	0	0	0	8.63
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	136
Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares)	0	0	0	260
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)	0	0	0	20.6
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)	0	0	0	86.4
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)	0	0	0	735
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)	0	0	0	30.4
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)	0	0	0	124

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	151
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)	0	0	0	13
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	197
Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares)	0	0	0	390
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)	0	0	0	149
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)	0	0	0	174
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)	0	0	0	1,228

Table 64: *REF scenario - IMPACTS - Health*

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal (million 2019$)	0	371	191	124	97.1	84.2	82
Monetary damages from air pollution - Natural Gas (million 2019$)	0	95.5	78.3	89.6	56.7	32.9	29.7
Monetary damages from air pollution - Transportation (million 2019$)	0	198	204	210	217	224	231
Premature deaths from air pollution - Coal (deaths)	0	41.6	21.4	13.9	10.9	9.45	9.2
Premature deaths from air pollution - Natural Gas (deaths)	0	10.8	8.84	10.1	6.41	3.72	3.36
Premature deaths from air pollution - Transportation (deaths)	0	22.3	23	23.6	24.4	25.2	26