Net-Zero America - south dakota 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).

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	0.653	0.813	0	0	0	0
Sales of cooking units - Electric Resistance (%)	71.5	77.5	96.2	99.8	100	100	100
Sales of cooking units - Gas (%)	28.5	22.5	3.84	0.193	0	0	0
Sales of space heating units - Electric Heat Pump (%)	6.73	12	35.6	81.1	89.5	90.1	89.6
Sales of space heating units - Electric Resistance (%)	18.5	23.6	18.7	8.06	6.1	6.05	6.33
Sales of space heating units - Fossil (%)	15.6	21.1	15.1	5.2	3.21	2.91	3.1
Sales of space heating units - Gas (%)	59.2	43.3	30.6	5.66	1.24	0.955	0.922
Sales of water heating units - Electric Heat Pump (%)	0	0.703	9.63	29.2	32.7	32.9	33
Sales of water heating units - Electric Resistance (%)	41.1	57.1	59.9	65.9	67	67.1	67
Sales of water heating units - Gas Furnace (%)	58.8	42.1	30.5	4.89	0.289	0	0
Sales of water heating units - Other (%)	0.032	0.033	0.033	0.033	0.033	0.033	0.033

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	244	624	1,015	1,535	1,673	1,594
Public EV charging plugs - DC Fast (1000 units)	0.054	0	0.519	0	2.31	0	3.75
Public EV charging plugs - L2 (1000 units)	0.074	0	12.5	0	55.8	0	90.3
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 (%)	1.86	2.08	1.38	0.446	0.08	0.013	0
Vehicle sales - Light-duty - EV (%)	2.89	12.1	41.5	79.8	96.1	99.3	100
Vehicle sales - Light-duty - gasoline (%)	91.6	81.6	53.9	18.5	3.55	0.598	0
Vehicle sales - Light-duty - hybrid (%)	3.42	3.82	2.86	1.1	0.261	0.055	0
Vehicle sales - Light-duty - hydrogen FC (%)	0.112	0.357	0.228	0.072	0.014	0.002	0
Vehicle sales - Light-duty - other (%)	0.116	0.112	0.076	0.027	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)	30.2	29.7	28.5	26.9	25.1	23.7	22.9
Final energy use - Industry (PJ)	163	170	174	174	176	178	179
Final energy use - Residential (PJ)	41.4	39	36.9	32.9	28.4	24.9	22.5
Final energy use - Transportation (PJ)	91.4	85.5	75.8	64.3	53.8	47.5	44.9

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	2,507	2,731	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 (%)	4.48	7.71	30.2	77.8	86.2	86.8	86.8
Sales of space heating units - Electric Resistance (%)	7.28	5.82	8.4	12	12.7	12.7	12.7
Sales of space heating units - Fossil (%)	6.1	2.18	0.424	0.018	0	0	0

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

Item	2020	2025	2030	2035	2040	2045	2050
Sales of space heating units - Gas Furnace (%)	82.1	84.3	61	10.1	1.04	0.469	0.47
Sales of water heating units - Electric Heat Pump (%)	1.15	1.83	14.5	42	46.9	47.2	47.2
Sales of water heating units - Electric Resistance (%)	9.7	8.05	20.3	47	51.8	52.1	52.1
Sales of water heating units - Gas Furnace (%)	87.4	89.2	64.4	10.3	0.61	0	0
Sales of water heating units - Other (%)	1.76	0.95	0.735	0.688	0.684	0.687	0.687

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	0.836	0.87	1.6	1.72	1.54	1.62

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	0.023	0	0	0	0
Capital invested - Solar PV - Base (billion $2018)	0	0	0	0	0	0.094	0
Capital invested - Wind - Base (billion $2018)	0	0.537	4.5	4.27	2.85	6.72	12.7
Capital invested - Wind - Constrained (billion $2018)	0	1.93	4.75	8.88	18.1	29.2	41.3

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	26	26	26	26	26
Solar - Base land use assumptions (GWh)	0	0	0	0	0	185	0
Solar - Constrained land use assumptions (GWh)	0	0	0	0	0	146	0
Wind - Base land use assumptions (GWh)	10,866	1,365	12,405	12,406	8,591	21,350	41,871
Wind - Constrained land use assumptions (GWh)	10,866	3,284	8,231	27,096	47,943	83,897	131,679

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

Item	2020	2025	2030	2035	2040	2045	2050
Biomass purchases (million $2018/year)	0	0	1.37	78.9	78.9	98.7	1,354
Conversion capital investment - Cumulative 5-yr (million $2018)	0	0	21.3	1,107	0	283	24,538
Number of facilities - Allam power w ccu (quantity)	0	0	0	0	0	0	0
Number of facilities - Beccs hydrogen (quantity)	0	0	0	2	2	3	12
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	1	1	1	1	1
Number of facilities - Pyrolysis (quantity)	0	0	0	0	0	0	0
Number of facilities - Pyrolysis ccu (quantity)	0	0	0	0	0	0	10
Number of facilities - Sng (quantity)	0	0	0	0	0	0	0
Number of facilities - Sng ccu (quantity)	0	0	1	1	1	1	1

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

Item	2020	2025	2030	2035	2040	2045	2050
Annual - All (MMT)	0	0	0.03	1.45	1.45	1.81	20.4
Annual - BECCS (MMT)	0	0	0.03	1.45	1.45	1.81	20.4

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

Item	2020	2025	2030	2035	2040	2045	2050
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	0.03	1.48	2.93	4.74	25.1
Cumulative - BECCS (MMT)	0	0	0.03	1.48	2.93	4.74	25.1
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	1.1	1.76	3.61	6.02	8.39
Injection wells (wells)	0	0	1	5	9	14	18
Resource characterization, appraisal, permitting costs (million $2020)	0	44.3	133	177	177	177	177
Wells and facilities construction costs (million $2020)	0	0	36.9	144	256	428	531

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

Item	2020	2025	2030	2035	2040	2045	2050
All (km)	0	0	160	637	637	851	3,475
Cumulative investment - All (million $2018)	0	0	82.3	1,853	1,853	1,971	3,961
Cumulative investment - Spur (million $2018)	0	0	82.3	191	191	309	2,299
Cumulative investment - Trunk (million $2018)	0	0	0	1,662	1,662	1,662	1,662
Spur (km)	0	0	160	302	302	516	3,140
Trunk (km)	0	0	0	335	335	335	335

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	-1,155
Carbon sink potential - Aggressive deployment - Cropland measures (1000 tCO2e/y)	0	0	-7,394
Carbon sink potential - Aggressive deployment - Permanent conservation cover (1000 tCO2e/y)	0	0	-431
Carbon sink potential - Aggressive deployment - Total (1000 tCO2e/y)	0	0	-8,980
Carbon sink potential - Moderate deployment - Corn-ethanol to energy grasses (1000 tCO2e/y)	0	0	-1,155
Carbon sink potential - Moderate deployment - Cropland measures (1000 tCO2e/y)	0	0	-3,896
Carbon sink potential - Moderate deployment - Permanent conservation cover (1000 tCO2e/y)	0	0	-215
Carbon sink potential - Moderate deployment - Total (1000 tCO2e/y)	0	0	-5,266
Land impacted for carbon sink - Aggressive deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	699
Land impacted for carbon sink - Aggressive deployment - Cropland measures (1000 hectares)	0	0	6,610
Land impacted for carbon sink - Aggressive deployment - Permanent conservation cover (1000 hectares)	0	0	716
Land impacted for carbon sink - Aggressive deployment - Total (1000 hectares)	0	0	8,024
Land impacted for carbon sink - Moderate deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	699
Land impacted for carbon sink - Moderate deployment - Cropland measures (1000 hectares)	0	0	3,484

Table 12: *E+ 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	358
Land impacted for carbon sink - Moderate deployment - Total (1000 hectares)	0	0	4,540

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

Item	2020	2025	2050
Carbon sink potential - High - Accelerate regeneration (1000 tCO2e/y)	0	0	378
Carbon sink potential - High - All (not counting overlap) (1000 tCO2e/y)	0	0	14,326
Carbon sink potential - High - Avoid deforestation (1000 tCO2e/y)	0	0	771
Carbon sink potential - High - Extend rotation length (1000 tCO2e/y)	0	0	301
Carbon sink potential - High - Improve plantations (1000 tCO2e/y)	0	0	41.4
Carbon sink potential - High - Increase retention of HWP (1000 tCO2e/y)	0	0	444
Carbon sink potential - High - Increase trees outside forests (1000 tCO2e/y)	0	0	2,415
Carbon sink potential - High - Reforest cropland (1000 tCO2e/y)	0	0	4,571
Carbon sink potential - High - Reforest pasture (1000 tCO2e/y)	0	0	4,746
Carbon sink potential - High - Restore productivity (1000 tCO2e/y)	0	0	658
Carbon sink potential - Low - Accelerate regeneration (1000 tCO2e/y)	0	0	190
Carbon sink potential - Low - All (not counting overlap) (1000 tCO2e/y)	0	0	4,315
Carbon sink potential - Low - Avoid deforestation (1000 tCO2e/y)	0	0	129
Carbon sink potential - Low - Extend rotation length (1000 tCO2e/y)	0	0	115
Carbon sink potential - Low - Improve plantations (1000 tCO2e/y)	0	0	21.1
Carbon sink potential - Low - Increase retention of HWP (1000 tCO2e/y)	0	0	148
Carbon sink potential - Low - Increase trees outside forests (1000 tCO2e/y)	0	0	845
Carbon sink potential - Low - Reforest cropland (1000 tCO2e/y)	0	0	2,286
Carbon sink potential - Low - Reforest pasture (1000 tCO2e/y)	0	0	360
Carbon sink potential - Low - Restore productivity (1000 tCO2e/y)	0	0	222
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO2e/y)	0	0	284
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO2e/y)	0	0	9,320
Carbon sink potential - Mid - Avoid deforestation (1000 tCO2e/y)	0	0	450
Carbon sink potential - Mid - Extend rotation length (1000 tCO2e/y)	0	0	208
Carbon sink potential - Mid - Improve plantations (1000 tCO2e/y)	0	0	30.9
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO2e/y)	0	0	296
Carbon sink potential - Mid - Increase trees outside forests (1000 tCO2e/y)	0	0	1,630

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

Item	2020	2025	2050
Carbon sink potential - Mid - Reforest cropland (1000 tCO2e/y)	0	0	3,429
Carbon sink potential - Mid - Reforest pasture (1000 tCO2e/y)	0	0	2,553
Carbon sink potential - Mid - Restore productivity (1000 tCO2e/y)	0	0	440
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)	0	0	61.9
Land impacted for carbon sink potential - High - Avoid deforestation (over 30 years) (1000 hectares)	0	0	104
Land impacted for carbon sink potential - High - Extend rotation length (1000 hectares)	0	0	153
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)	0	0	15.3
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	229
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)	0	0	302
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)	0	0	135
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)	0	0	218
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)	0	0	1,219
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)	0	0	31
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)	0	0	98
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)	0	0	58.7
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)	0	0	7.63
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	121
Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares)	0	0	151
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)	0	0	23.4
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)	0	0	132
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)	0	0	622
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)	0	0	46.4
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)	0	0	101
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)	0	0	106
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)	0	0	11.5
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	175
Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares)	0	0	227

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

Item	2020	2025	2050
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)	0	0	169
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)	0	0	266
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)	0	0	1,102

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

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal (million 2019$)	0	43	0.034	0.033	0.024	0.015	0
Monetary damages from air pollution - Natural Gas (million 2019$)	0	12.4	6.95	3.89	3.19	1.99	0.891
Monetary damages from air pollution - Transportation (million 2019$)	0	37.9	34.9	26.2	14.9	6.62	2.51
Premature deaths from air pollution - Coal (deaths)	0	4.82	0.004	0.004	0.003	0.002	0
Premature deaths from air pollution - Natural Gas (deaths)	0	1.4	0.785	0.44	0.361	0.225	0.101
Premature deaths from air pollution - Transportation (deaths)	0	4.26	3.93	2.95	1.67	0.744	0.282

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

Item	2020	2025	2030	2035	2040	2045	2050
By economic sector - Agriculture (jobs)	1,821	1,821	1,822	1,879	1,056	252	1,242
By economic sector - Construction (jobs)	1,977	2,383	3,423	5,290	4,971	6,712	11,980
By economic sector - Manufacturing (jobs)	1,943	2,681	3,033	3,657	3,137	2,500	4,114
By economic sector - Mining (jobs)	623	502	400	311	228	204	175
By economic sector - Other (jobs)	138	174	279	400	454	654	1,077
By economic sector - Pipeline (jobs)	103	103	89.5	303	86.8	111	497
By economic sector - Professional (jobs)	1,432	1,674	2,468	3,439	3,651	4,891	9,469
By economic sector - Trade (jobs)	1,526	1,499	1,772	2,110	2,048	2,596	4,558
By economic sector - Utilities (jobs)	1,831	2,189	2,837	4,802	4,446	6,191	11,659
By education level - All sectors - Associates degree or some college (jobs)	2,994	3,550	4,569	6,609	6,148	7,728	14,138
By education level - All sectors - Bachelors degree (jobs)	2,133	2,449	3,097	4,278	4,048	5,035	9,332
By education level - All sectors - Doctoral degree (jobs)	76	86.3	118	161	162	210	399
By education level - All sectors - High school diploma or less (jobs)	5,664	6,337	7,559	10,063	8,678	9,819	18,435
By education level - All sectors - Masters or professional degree (jobs)	526	602	780	1,081	1,042	1,319	2,465
By resource sector - Biomass (jobs)	4,393	4,261	4,146	4,254	2,536	1,006	5,600
By resource sector - CO2 (jobs)	0	23.5	60.7	1,988	356	750	4,100
By resource sector - Coal (jobs)	190	60.9	0	0	0	0	0
By resource sector - Grid (jobs)	2,725	3,464	4,769	6,848	7,761	10,845	18,517
By resource sector - Natural Gas (jobs)	810	804	634	560	468	448	321
By resource sector - Nuclear (jobs)	0	0	0	0	0	0	0
By resource sector - Oil (jobs)	1,376	1,229	1,023	789	581	431	312
By resource sector - Solar (jobs)	219	522	613	897	930	917	1,173
By resource sector - Wind (jobs)	1,680	2,660	4,876	6,854	7,447	9,714	14,746
Median wages - Annual - All ($2019 per job)	52,887	53,946	55,470	57,237	59,079	61,497	62,411
On-Site or In-Plant Training - Total jobs - 1 to 4 years (jobs)	1,572	1,850	2,369	3,417	3,160	3,963	7,256
On-Site or In-Plant Training - Total jobs - 4 to 10 years (jobs)	618	722	954	1,428	1,326	1,734	3,187
On-Site or In-Plant Training - Total jobs - None (jobs)	1,796	2,065	2,583	3,563	3,260	3,938	7,335
On-Site or In-Plant Training - Total jobs - Over 10 years (jobs)	93.2	109	138	197	178	220	405

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

Item	2020	2025	2030	2035	2040	2045	2050
On-Site or In-Plant Training - Total jobs - Up to 1 year (jobs)	7,313	8,279	10,079	13,585	12,154	14,256	26,586
On-the-Job Training - All sectors - 1 to 4 years (jobs)	1,926	2,288	2,970	4,349	4,055	5,156	9,421
On-the-Job Training - All sectors - 4 to 10 years (jobs)	576	680	913	1,392	1,301	1,722	3,160
On-the-Job Training - All sectors - None (jobs)	658	736	900	1,202	1,085	1,287	2,390
On-the-Job Training - All sectors - Over 10 years (jobs)	97.8	117	148	206	186	221	397
On-the-Job Training - All sectors - Up to 1 year (jobs)	8,133	9,203	11,191	15,043	13,451	15,724	29,401
Related work experience - All sectors - 1 to 4 years (jobs)	3,764	4,338	5,449	7,633	7,046	8,676	16,089
Related work experience - All sectors - 4 to 10 years (jobs)	2,274	2,662	3,411	4,877	4,552	5,718	10,515
Related work experience - All sectors - None (jobs)	1,792	2,017	2,446	3,331	2,939	3,460	6,487
Related work experience - All sectors - Over 10 years (jobs)	611	724	918	1,291	1,204	1,482	2,700
Related work experience - All sectors - Up to 1 year (jobs)	2,951	3,284	3,898	5,058	4,337	4,774	8,978
Wage income - All (million $2019)	603	703	894	1,270	1,186	1,483	2,794

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

Item	2020	2025	2030	2035	2040	2045	2050
Natural gas consumption - Annual (tcf)	68.2	69.2	58.4	46.8	35.2	22.2	15.4
Natural gas consumption - Cumulative (tcf)	0	0	0	0	0	0	1,410
Natural gas production - Annual (tcf)	0.475	0.526	0.497	0.433	0.366	0.29	0.226
Oil consumption - Annual (million bbls)	26.7	26	23.4	19.3	15.3	12.1	9.45
Oil consumption - Cumulative (million bbls)	0	0	0	0	0	0	589
Oil production - Annual (million bbls)	1.53	1.65	1.66	1.65	1.31	1.06	0.708

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	0.651	0.8	0	0	0	0
Sales of cooking units - Electric Resistance (%)	71.4	72.1	74.7	81.6	91.2	97.2	99.2
Sales of cooking units - Gas (%)	28.6	27.9	25.3	18.4	8.76	2.83	0.76
Sales of space heating units - Electric Heat Pump (%)	6.73	10.2	11.7	16.8	28.5	42.8	50.8
Sales of space heating units - Electric Resistance (%)	18.5	23.9	23.5	22.4	19.7	16.4	14.8
Sales of space heating units - Fossil (%)	15.6	21.7	21.5	20.2	17.1	13.7	12.1
Sales of space heating units - Gas (%)	59.2	44.2	43.2	40.6	34.7	27.1	22.3
Sales of water heating units - Electric Heat Pump (%)	0	0.211	0.789	2.72	7.4	13.3	16.8
Sales of water heating units - Electric Resistance (%)	41.1	57	57.1	57.5	59	60.8	61.9
Sales of water heating units - Gas Furnace (%)	58.8	42.8	42.1	39.7	33.6	25.8	21.3
Sales of water heating units - Other (%)	0.032	0.033	0.033	0.033	0.033	0.033	0.033

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	39.1	83.1	280	883	1,285
Public EV charging plugs - DC Fast (1000 units)	0.054	0	0.156	0	0.855	0	2.4
Public EV charging plugs - L2 (1000 units)	0.074	0	3.75	0	20.6	0	57.9
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

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

Item	2020	2025	2030	2035	2040	2045	2050
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 (%)	1.87	2.23	2.11	1.7	1.11	0.578	0.246
Vehicle sales - Light-duty - EV (%)	1.53	3.89	10.2	23.2	45.4	70	86.8
Vehicle sales - Light-duty - gasoline (%)	92.9	89	82.2	70.1	49.6	27	11.8
Vehicle sales - Light-duty - hybrid (%)	3.52	4.4	5	4.71	3.68	2.26	1.13
Vehicle sales - Light-duty - hydrogen FC (%)	0.114	0.389	0.344	0.27	0.196	0.111	0.051
Vehicle sales - Light-duty - other (%)	0.116	0.12	0.111	0.098	0.072	0.04	0.018
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)	30.2	29.7	28.9	28.2	27.4	26.7	26
Final energy use - Industry (PJ)	163	171	174	176	179	181	183
Final energy use - Residential (PJ)	41.4	39.1	37.4	35.9	34.3	32.5	30.6
Final energy use - Transportation (PJ)	91.5	86	78.8	73.1	68.9	64	58.1

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	2,507	2,735	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 (%)	4.48	6.34	7.8	12.5	23.6	37.7	45.9
Sales of space heating units - Electric Resistance (%)	7.28	5.52	5.66	6.19	7.32	8.52	9.17
Sales of space heating units - Fossil (%)	6.1	2.55	2.51	2.23	1.76	1.38	1.26
Sales of space heating units - Gas Furnace (%)	82.1	85.6	84	79.1	67.3	52.4	43.6
Sales of water heating units - Electric Heat Pump (%)	1.15	1.12	1.94	4.67	11.3	19.6	24.5
Sales of water heating units - Electric Resistance (%)	9.7	7.35	8.16	10.8	17.2	25.3	30
Sales of water heating units - Gas Furnace (%)	87.4	90.5	88.9	83.6	70.7	54.3	44.7
Sales of water heating units - Other (%)	1.76	0.994	0.977	0.938	0.876	0.841	0.828

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	0.676	0.691	0.924	0.965	1.37	1.46

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	-1,155
Carbon sink potential - Aggressive deployment - Cropland measures (1000 tCO2e/y)	0	0	-7,394
Carbon sink potential - Aggressive deployment - Permanent conservation cover (1000 tCO2e/y)	0	0	-431
Carbon sink potential - Aggressive deployment - Total (1000 tCO2e/y)	0	0	-8,980
Carbon sink potential - Moderate deployment - Corn-ethanol to energy grasses (1000 tCO2e/y)	0	0	-1,155

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

Item	2020	2025	2050
Carbon sink potential - Moderate deployment - Cropland measures (1000 tCO2e/y)	0	0	-3,896
Carbon sink potential - Moderate deployment - Permanent conservation cover (1000 tCO2e/y)	0	0	-215
Carbon sink potential - Moderate deployment - Total (1000 tCO2e/y)	0	0	-5,266
Land impacted for carbon sink - Aggressive deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	699
Land impacted for carbon sink - Aggressive deployment - Cropland measures (1000 hectares)	0	0	6,610
Land impacted for carbon sink - Aggressive deployment - Permanent conservation cover (1000 hectares)	0	0	716
Land impacted for carbon sink - Aggressive deployment - Total (1000 hectares)	0	0	8,024
Land impacted for carbon sink - Moderate deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	699
Land impacted for carbon sink - Moderate deployment - Cropland measures (1000 hectares)	0	0	3,484
Land impacted for carbon sink - Moderate deployment - Permanent conservation cover (1000 hectares)	0	0	358
Land impacted for carbon sink - Moderate deployment - Total (1000 hectares)	0	0	4,540

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

Item	2020	2025	2050
Carbon sink potential - High - Accelerate regeneration (1000 tCO2e/y)	0	0	378
Carbon sink potential - High - All (not counting overlap) (1000 tCO2e/y)	0	0	14,326
Carbon sink potential - High - Avoid deforestation (1000 tCO2e/y)	0	0	771
Carbon sink potential - High - Extend rotation length (1000 tCO2e/y)	0	0	301
Carbon sink potential - High - Improve plantations (1000 tCO2e/y)	0	0	41.4
Carbon sink potential - High - Increase retention of HWP (1000 tCO2e/y)	0	0	444
Carbon sink potential - High - Increase trees outside forests (1000 tCO2e/y)	0	0	2,415
Carbon sink potential - High - Reforest cropland (1000 tCO2e/y)	0	0	4,571
Carbon sink potential - High - Reforest pasture (1000 tCO2e/y)	0	0	4,746
Carbon sink potential - High - Restore productivity (1000 tCO2e/y)	0	0	658
Carbon sink potential - Low - Accelerate regeneration (1000 tCO2e/y)	0	0	190
Carbon sink potential - Low - All (not counting overlap) (1000 tCO2e/y)	0	0	4,315
Carbon sink potential - Low - Avoid deforestation (1000 tCO2e/y)	0	0	129
Carbon sink potential - Low - Extend rotation length (1000 tCO2e/y)	0	0	115
Carbon sink potential - Low - Improve plantations (1000 tCO2e/y)	0	0	21.1
Carbon sink potential - Low - Increase retention of HWP (1000 tCO2e/y)	0	0	148

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

Item	2020	2025	2050
Carbon sink potential - Low - Increase trees outside forests (1000 tCO2e/y)	0	0	845
Carbon sink potential - Low - Reforest cropland (1000 tCO2e/y)	0	0	2,286
Carbon sink potential - Low - Reforest pasture (1000 tCO2e/y)	0	0	360
Carbon sink potential - Low - Restore productivity (1000 tCO2e/y)	0	0	222
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO2e/y)	0	0	284
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO2e/y)	0	0	9,320
Carbon sink potential - Mid - Avoid deforestation (1000 tCO2e/y)	0	0	450
Carbon sink potential - Mid - Extend rotation length (1000 tCO2e/y)	0	0	208
Carbon sink potential - Mid - Improve plantations (1000 tCO2e/y)	0	0	30.9
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO2e/y)	0	0	296
Carbon sink potential - Mid - Increase trees outside forests (1000 tCO2e/y)	0	0	1,630
Carbon sink potential - Mid - Reforest cropland (1000 tCO2e/y)	0	0	3,429
Carbon sink potential - Mid - Reforest pasture (1000 tCO2e/y)	0	0	2,553
Carbon sink potential - Mid - Restore productivity (1000 tCO2e/y)	0	0	440
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)	0	0	61.9
Land impacted for carbon sink potential - High - Avoid deforestation (over 30 years) (1000 hectares)	0	0	104
Land impacted for carbon sink potential - High - Extend rotation length (1000 hectares)	0	0	153
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)	0	0	15.3
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	229
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)	0	0	302
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)	0	0	135
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)	0	0	218
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)	0	0	1,219
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)	0	0	31
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)	0	0	98
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)	0	0	58.7
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)	0	0	7.63
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	121

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

Item	2020	2025	2050
Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares)	0	0	151
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)	0	0	23.4
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)	0	0	132
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)	0	0	622
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)	0	0	46.4
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)	0	0	101
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)	0	0	106
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)	0	0	11.5
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	175
Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares)	0	0	227
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)	0	0	169
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)	0	0	266
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)	0	0	1,102

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

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal (million 2019$)	0	43	0.034	0.033	0.024	0.015	0
Monetary damages from air pollution - Natural Gas (million 2019$)	0	12.4	6.24	3.12	1.74	0.804	0.566
Monetary damages from air pollution - Transportation (million 2019$)	0	38.4	38.2	36.8	32.7	25.7	17.4
Premature deaths from air pollution - Coal (deaths)	0	4.82	0.004	0.004	0.003	0.002	0
Premature deaths from air pollution - Natural Gas (deaths)	0	1.4	0.705	0.353	0.196	0.091	0.064
Premature deaths from air pollution - Transportation (deaths)	0	4.32	4.3	4.14	3.68	2.9	1.96

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	0.653	0.813	0	0	0	0
Sales of cooking units - Electric Resistance (%)	71.5	77.5	96.2	99.8	100	100	100
Sales of cooking units - Gas (%)	28.5	22.5	3.84	0.193	0	0	0
Sales of space heating units - Electric Heat Pump (%)	6.73	12	35.6	81.1	89.5	90.1	89.6
Sales of space heating units - Electric Resistance (%)	18.5	23.6	18.7	8.06	6.1	6.05	6.33
Sales of space heating units - Fossil (%)	15.6	21.1	15.1	5.2	3.21	2.91	3.1
Sales of space heating units - Gas (%)	59.2	43.3	30.6	5.66	1.24	0.955	0.922
Sales of water heating units - Electric Heat Pump (%)	0	0.703	9.63	29.2	32.7	32.9	33
Sales of water heating units - Electric Resistance (%)	41.1	57.1	59.9	65.9	67	67.1	67

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

Item	2020	2025	2030	2035	2040	2045	2050
Sales of water heating units - Gas Furnace (%)	58.8	42.1	30.5	4.89	0.289	0	0
Sales of water heating units - Other (%)	0.032	0.033	0.033	0.033	0.033	0.033	0.033

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	244	624	1,015	1,535	1,673	1,594
Public EV charging plugs - DC Fast (1000 units)	0.054	0	0.519	0	2.31	0	3.75
Public EV charging plugs - L2 (1000 units)	0.074	0	12.5	0	55.8	0	90.3
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 (%)	1.86	2.08	1.38	0.446	0.08	0.013	0
Vehicle sales - Light-duty - EV (%)	2.89	12.1	41.5	79.8	96.1	99.3	100
Vehicle sales - Light-duty - gasoline (%)	91.6	81.6	53.9	18.5	3.55	0.598	0
Vehicle sales - Light-duty - hybrid (%)	3.42	3.82	2.86	1.1	0.261	0.055	0
Vehicle sales - Light-duty - hydrogen FC (%)	0.112	0.357	0.228	0.072	0.014	0.002	0
Vehicle sales - Light-duty - other (%)	0.116	0.112	0.076	0.027	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)	30.2	29.7	28.5	26.9	25.1	23.7	22.9
Final energy use - Industry (PJ)	163	170	174	174	176	178	179
Final energy use - Residential (PJ)	41.4	39	36.9	32.9	28.4	24.9	22.5
Final energy use - Transportation (PJ)	91.4	85.5	75.8	64.3	53.8	47.5	44.9

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	2,507	2,731	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 (%)	4.48	7.71	30.2	77.8	86.2	86.8	86.8
Sales of space heating units - Electric Resistance (%)	7.28	5.82	8.4	12	12.7	12.7	12.7
Sales of space heating units - Fossil (%)	6.1	2.18	0.424	0.018	0	0	0
Sales of space heating units - Gas Furnace (%)	82.1	84.3	61	10.1	1.04	0.469	0.47
Sales of water heating units - Electric Heat Pump (%)	1.15	1.83	14.5	42	46.9	47.2	47.2
Sales of water heating units - Electric Resistance (%)	9.7	8.05	20.3	47	51.8	52.1	52.1
Sales of water heating units - Gas Furnace (%)	87.4	89.2	64.4	10.3	0.61	0	0
Sales of water heating units - Other (%)	1.76	0.95	0.735	0.688	0.684	0.687	0.687

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	0.836	0.87	1.6	1.72	1.54	1.62

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

Item	2020	2025	2030	2035	2040	2045	2050
Capital invested - Solar PV - Base (billion $2018)	0	0	0	0.519	0.39	0	0.205
Capital invested - Wind - Base (billion $2018)	0	1.96	9.01	7.52	15	42.8	106

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

Item	2020	2025	2030	2035	2040	2045	2050
Solar - Base land use assumptions (GWh)	0	0	0	891	708	0	417
Solar - Constrained land use assumptions (GWh)	0	0	0	745	1,708	0	1,815
Wind - Base land use assumptions (GWh)	10,866	2,745	13,772	12,080	25,089	73,446	188,261
Wind - Constrained land use assumptions (GWh)	10,866	3,803	12,946	32,182	110,300	159,712	64,258

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	-1,155
Carbon sink potential - Aggressive deployment - Cropland measures (1000 tCO2e/y)	0	0	-7,394
Carbon sink potential - Aggressive deployment - Permanent conservation cover (1000 tCO2e/y)	0	0	-431
Carbon sink potential - Aggressive deployment - Total (1000 tCO2e/y)	0	0	-8,980
Carbon sink potential - Moderate deployment - Corn-ethanol to energy grasses (1000 tCO2e/y)	0	0	-1,155
Carbon sink potential - Moderate deployment - Cropland measures (1000 tCO2e/y)	0	0	-3,896
Carbon sink potential - Moderate deployment - Permanent conservation cover (1000 tCO2e/y)	0	0	-215
Carbon sink potential - Moderate deployment - Total (1000 tCO2e/y)	0	0	-5,266
Land impacted for carbon sink - Aggressive deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	699
Land impacted for carbon sink - Aggressive deployment - Cropland measures (1000 hectares)	0	0	6,610
Land impacted for carbon sink - Aggressive deployment - Permanent conservation cover (1000 hectares)	0	0	716
Land impacted for carbon sink - Aggressive deployment - Total (1000 hectares)	0	0	8,024
Land impacted for carbon sink - Moderate deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	699
Land impacted for carbon sink - Moderate deployment - Cropland measures (1000 hectares)	0	0	3,484
Land impacted for carbon sink - Moderate deployment - Permanent conservation cover (1000 hectares)	0	0	358
Land impacted for carbon sink - Moderate deployment - Total (1000 hectares)	0	0	4,540

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	378
Carbon sink potential - High - All (not counting overlap) (1000 tCO2e/y)	0	0	14,326
Carbon sink potential - High - Avoid deforestation (1000 tCO2e/y)	0	0	771

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

Item	2020	2025	2050
Carbon sink potential - High - Extend rotation length (1000 tCO2e/y)	0	0	301
Carbon sink potential - High - Improve plantations (1000 tCO2e/y)	0	0	41.4
Carbon sink potential - High - Increase retention of HWP (1000 tCO2e/y)	0	0	444
Carbon sink potential - High - Increase trees outside forests (1000 tCO2e/y)	0	0	2,415
Carbon sink potential - High - Reforest cropland (1000 tCO2e/y)	0	0	4,571
Carbon sink potential - High - Reforest pasture (1000 tCO2e/y)	0	0	4,746
Carbon sink potential - High - Restore productivity (1000 tCO2e/y)	0	0	658
Carbon sink potential - Low - Accelerate regeneration (1000 tCO2e/y)	0	0	190
Carbon sink potential - Low - All (not counting overlap) (1000 tCO2e/y)	0	0	4,315
Carbon sink potential - Low - Avoid deforestation (1000 tCO2e/y)	0	0	129
Carbon sink potential - Low - Extend rotation length (1000 tCO2e/y)	0	0	115
Carbon sink potential - Low - Improve plantations (1000 tCO2e/y)	0	0	21.1
Carbon sink potential - Low - Increase retention of HWP (1000 tCO2e/y)	0	0	148
Carbon sink potential - Low - Increase trees outside forests (1000 tCO2e/y)	0	0	845
Carbon sink potential - Low - Reforest cropland (1000 tCO2e/y)	0	0	2,286
Carbon sink potential - Low - Reforest pasture (1000 tCO2e/y)	0	0	360
Carbon sink potential - Low - Restore productivity (1000 tCO2e/y)	0	0	222
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO2e/y)	0	0	284
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO2e/y)	0	0	9,320
Carbon sink potential - Mid - Avoid deforestation (1000 tCO2e/y)	0	0	450
Carbon sink potential - Mid - Extend rotation length (1000 tCO2e/y)	0	0	208
Carbon sink potential - Mid - Improve plantations (1000 tCO2e/y)	0	0	30.9
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO2e/y)	0	0	296
Carbon sink potential - Mid - Increase trees outside forests (1000 tCO2e/y)	0	0	1,630
Carbon sink potential - Mid - Reforest cropland (1000 tCO2e/y)	0	0	3,429
Carbon sink potential - Mid - Reforest pasture (1000 tCO2e/y)	0	0	2,553
Carbon sink potential - Mid - Restore productivity (1000 tCO2e/y)	0	0	440
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)	0	0	61.9
Land impacted for carbon sink potential - High - Avoid deforestation (over 30 years) (1000 hectares)	0	0	104
Land impacted for carbon sink potential - High - Extend rotation length (1000 hectares)	0	0	153
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)	0	0	15.3

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

Item	2020	2025	2050
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	229
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)	0	0	302
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)	0	0	135
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)	0	0	218
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)	0	0	1,219
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)	0	0	31
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)	0	0	98
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)	0	0	58.7
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)	0	0	7.63
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	121
Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares)	0	0	151
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)	0	0	23.4
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)	0	0	132
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)	0	0	622
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)	0	0	46.4
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)	0	0	101
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)	0	0	106
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)	0	0	11.5
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	175
Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares)	0	0	227
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)	0	0	169
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)	0	0	266
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)	0	0	1,102

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

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal (million 2019$)	0	43	0.034	0.033	0.024	0.015	0
Monetary damages from air pollution - Natural Gas (million 2019$)	0	11.4	6.21	2.37	1.72	0.866	0.495
Monetary damages from air pollution - Transportation (million 2019$)	0	37.9	34.9	26.2	14.9	6.62	2.51

Table 34: *E+RE+ scenario - IMPACTS - Health (continued)*

Item	2020	2025	2030	2035	2040	2045	2050
Premature deaths from air pollution - Coal (deaths)	0	4.82	0.004	0.004	0.003	0.002	0
Premature deaths from air pollution - Natural Gas (deaths)	0	1.29	0.701	0.268	0.194	0.098	0.056
Premature deaths from air pollution - Transportation (deaths)	0	4.26	3.93	2.95	1.67	0.744	0.282

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	0.653	0.813	0	0	0	0
Sales of cooking units - Electric Resistance (%)	71.5	77.5	96.2	99.8	100	100	100
Sales of cooking units - Gas (%)	28.5	22.5	3.84	0.193	0	0	0
Sales of space heating units - Electric Heat Pump (%)	6.73	12	35.6	81.1	89.5	90.1	89.6
Sales of space heating units - Electric Resistance (%)	18.5	23.6	18.7	8.06	6.1	6.05	6.33
Sales of space heating units - Fossil (%)	15.6	21.1	15.1	5.2	3.21	2.91	3.1
Sales of space heating units - Gas (%)	59.2	43.3	30.6	5.66	1.24	0.955	0.922
Sales of water heating units - Electric Heat Pump (%)	0	0.703	9.63	29.2	32.7	32.9	33
Sales of water heating units - Electric Resistance (%)	41.1	57.1	59.9	65.9	67	67.1	67
Sales of water heating units - Gas Furnace (%)	58.8	42.1	30.5	4.89	0.289	0	0
Sales of water heating units - Other (%)	0.032	0.033	0.033	0.033	0.033	0.033	0.033

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	244	624	1,015	1,535	1,673	1,594
Public EV charging plugs - DC Fast (1000 units)	0.054	0	0.519	0	2.31	0	3.75
Public EV charging plugs - L2 (1000 units)	0.074	0	12.5	0	55.8	0	90.3
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 (%)	1.86	2.08	1.38	0.446	0.08	0.013	0
Vehicle sales - Light-duty - EV (%)	2.89	12.1	41.5	79.8	96.1	99.3	100
Vehicle sales - Light-duty - gasoline (%)	91.6	81.6	53.9	18.5	3.55	0.598	0
Vehicle sales - Light-duty - hybrid (%)	3.42	3.82	2.86	1.1	0.261	0.055	0
Vehicle sales - Light-duty - hydrogen FC (%)	0.112	0.357	0.228	0.072	0.014	0.002	0
Vehicle sales - Light-duty - other (%)	0.116	0.112	0.076	0.027	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)	30.2	29.7	28.5	26.9	25.1	23.7	22.9
Final energy use - Industry (PJ)	163	170	174	174	176	178	179
Final energy use - Residential (PJ)	41.4	39	36.9	32.9	28.4	24.9	22.5
Final energy use - Transportation (PJ)	91.4	85.5	75.8	64.3	53.8	47.5	44.9

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	2,507	2,731	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 (%)	4.48	7.71	30.2	77.8	86.2	86.8	86.8
Sales of space heating units - Electric Resistance (%)	7.28	5.82	8.4	12	12.7	12.7	12.7
Sales of space heating units - Fossil (%)	6.1	2.18	0.424	0.018	0	0	0
Sales of space heating units - Gas Furnace (%)	82.1	84.3	61	10.1	1.04	0.469	0.47
Sales of water heating units - Electric Heat Pump (%)	1.15	1.83	14.5	42	46.9	47.2	47.2
Sales of water heating units - Electric Resistance (%)	9.7	8.05	20.3	47	51.8	52.1	52.1
Sales of water heating units - Gas Furnace (%)	87.4	89.2	64.4	10.3	0.61	0	0
Sales of water heating units - Other (%)	1.76	0.95	0.735	0.688	0.684	0.687	0.687

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	0.836	0.87	1.6	1.72	1.54	1.62

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

Item	2020	2025	2030	2035	2040	2045	2050
Capital invested - Solar PV - Base (billion $2018)	0	0	0	0	0	0.075	0
Capital invested - Wind - Base (billion $2018)	0	0	1.36	3.83	2.22	1.94	0.034
Capital invested - Wind - Constrained (billion $2018)	0	0.574	1.01	3.01	5	6.14	0.24

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

Item	2020	2025	2030	2035	2040	2045	2050
Solar - Base land use assumptions (GWh)	0	0	0	0	0	146	0
Wind - Base land use assumptions (GWh)	10,866	0	3,776	11,318	6,792	6,164	114
Wind - Constrained land use assumptions (GWh)	10,866	1,442	2,765	8,768	15,215	18,878	764

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	-1,155
Carbon sink potential - Aggressive deployment - Cropland measures (1000 tCO2e/y)	0	0	-7,394
Carbon sink potential - Aggressive deployment - Permanent conservation cover (1000 tCO2e/y)	0	0	-431
Carbon sink potential - Aggressive deployment - Total (1000 tCO2e/y)	0	0	-8,980
Carbon sink potential - Moderate deployment - Corn-ethanol to energy grasses (1000 tCO2e/y)	0	0	-1,155
Carbon sink potential - Moderate deployment - Cropland measures (1000 tCO2e/y)	0	0	-3,896
Carbon sink potential - Moderate deployment - Permanent conservation cover (1000 tCO2e/y)	0	0	-215
Carbon sink potential - Moderate deployment - Total (1000 tCO2e/y)	0	0	-5,266
Land impacted for carbon sink - Aggressive deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	699
Land impacted for carbon sink - Aggressive deployment - Cropland measures (1000 hectares)	0	0	6,610

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

Item	2020	2025	2050
Land impacted for carbon sink - Aggressive deployment - Permanent conservation cover (1000 hectares)	0	0	716
Land impacted for carbon sink - Aggressive deployment - Total (1000 hectares)	0	0	8,024
Land impacted for carbon sink - Moderate deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	699
Land impacted for carbon sink - Moderate deployment - Cropland measures (1000 hectares)	0	0	3,484
Land impacted for carbon sink - Moderate deployment - Permanent conservation cover (1000 hectares)	0	0	358
Land impacted for carbon sink - Moderate deployment - Total (1000 hectares)	0	0	4,540

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	378
Carbon sink potential - High - All (not counting overlap) (1000 tCO2e/y)	0	0	14,326
Carbon sink potential - High - Avoid deforestation (1000 tCO2e/y)	0	0	771
Carbon sink potential - High - Extend rotation length (1000 tCO2e/y)	0	0	301
Carbon sink potential - High - Improve plantations (1000 tCO2e/y)	0	0	41.4
Carbon sink potential - High - Increase retention of HWP (1000 tCO2e/y)	0	0	444
Carbon sink potential - High - Increase trees outside forests (1000 tCO2e/y)	0	0	2,415
Carbon sink potential - High - Reforest cropland (1000 tCO2e/y)	0	0	4,571
Carbon sink potential - High - Reforest pasture (1000 tCO2e/y)	0	0	4,746
Carbon sink potential - High - Restore productivity (1000 tCO2e/y)	0	0	658
Carbon sink potential - Low - Accelerate regeneration (1000 tCO2e/y)	0	0	190
Carbon sink potential - Low - All (not counting overlap) (1000 tCO2e/y)	0	0	4,315
Carbon sink potential - Low - Avoid deforestation (1000 tCO2e/y)	0	0	129
Carbon sink potential - Low - Extend rotation length (1000 tCO2e/y)	0	0	115
Carbon sink potential - Low - Improve plantations (1000 tCO2e/y)	0	0	21.1
Carbon sink potential - Low - Increase retention of HWP (1000 tCO2e/y)	0	0	148
Carbon sink potential - Low - Increase trees outside forests (1000 tCO2e/y)	0	0	845
Carbon sink potential - Low - Reforest cropland (1000 tCO2e/y)	0	0	2,286
Carbon sink potential - Low - Reforest pasture (1000 tCO2e/y)	0	0	360
Carbon sink potential - Low - Restore productivity (1000 tCO2e/y)	0	0	222
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO2e/y)	0	0	284
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO2e/y)	0	0	9,320

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

Item	2020	2025	2050
Carbon sink potential - Mid - Avoid deforestation (1000 tCO2e/y)	0	0	450
Carbon sink potential - Mid - Extend rotation length (1000 tCO2e/y)	0	0	208
Carbon sink potential - Mid - Improve plantations (1000 tCO2e/y)	0	0	30.9
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO2e/y)	0	0	296
Carbon sink potential - Mid - Increase trees outside forests (1000 tCO2e/y)	0	0	1,630
Carbon sink potential - Mid - Reforest cropland (1000 tCO2e/y)	0	0	3,429
Carbon sink potential - Mid - Reforest pasture (1000 tCO2e/y)	0	0	2,553
Carbon sink potential - Mid - Restore productivity (1000 tCO2e/y)	0	0	440
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)	0	0	61.9
Land impacted for carbon sink potential - High - Avoid deforestation (over 30 years) (1000 hectares)	0	0	104
Land impacted for carbon sink potential - High - Extend rotation length (1000 hectares)	0	0	153
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)	0	0	15.3
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	229
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)	0	0	302
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)	0	0	135
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)	0	0	218
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)	0	0	1,219
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)	0	0	31
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)	0	0	98
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)	0	0	58.7
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)	0	0	7.63
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	121
Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares)	0	0	151
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)	0	0	23.4
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)	0	0	132
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)	0	0	622
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)	0	0	46.4
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)	0	0	101

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

Item	2020	2025	2050
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)	0	0	106
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)	0	0	11.5
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	175
Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares)	0	0	227
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)	0	0	169
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)	0	0	266
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)	0	0	1,102

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

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal (million 2019$)	0	43	0.034	0.033	0.024	0.015	0
Monetary damages from air pollution - Natural Gas (million 2019$)	0	12.6	6.82	7	6.05	2.7	1.01
Monetary damages from air pollution - Transportation (million 2019$)	0	37.9	34.9	26.2	14.9	6.62	2.51
Premature deaths from air pollution - Coal (deaths)	0	4.82	0.004	0.004	0.003	0.002	0
Premature deaths from air pollution - Natural Gas (deaths)	0	1.42	0.77	0.791	0.683	0.305	0.114
Premature deaths from air pollution - Transportation (deaths)	0	4.26	3.93	2.95	1.67	0.744	0.282

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	0.651	0.8	0	0	0	0
Sales of cooking units - Electric Resistance (%)	71.4	72.1	74.7	81.6	91.2	97.2	99.2
Sales of cooking units - Gas (%)	28.6	27.9	25.3	18.4	8.76	2.83	0.76
Sales of space heating units - Electric Heat Pump (%)	6.73	10.2	11.7	16.8	28.5	42.8	50.8
Sales of space heating units - Electric Resistance (%)	18.5	23.9	23.5	22.4	19.7	16.4	14.8
Sales of space heating units - Fossil (%)	15.6	21.7	21.5	20.2	17.1	13.7	12.1
Sales of space heating units - Gas (%)	59.2	44.2	43.2	40.6	34.7	27.1	22.3
Sales of water heating units - Electric Heat Pump (%)	0	0.211	0.789	2.72	7.4	13.3	16.8
Sales of water heating units - Electric Resistance (%)	41.1	57	57.1	57.5	59	60.8	61.9
Sales of water heating units - Gas Furnace (%)	58.8	42.8	42.1	39.7	33.6	25.8	21.3
Sales of water heating units - Other (%)	0.032	0.033	0.033	0.033	0.033	0.033	0.033

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	39.1	83.1	280	883	1,285
Public EV charging plugs - DC Fast (1000 units)	0.054	0	0.156	0	0.855	0	2.4
Public EV charging plugs - L2 (1000 units)	0.074	0	3.75	0	20.6	0	57.9
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

Table 46: *E-B+ scenario - PILLAR 1: Efficiency/Electrification - Transportation (continued)*

Item	2020	2025	2030	2035	2040	2045	2050
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 (%)	1.87	2.23	2.11	1.7	1.11	0.578	0.246
Vehicle sales - Light-duty - EV (%)	1.53	3.89	10.2	23.2	45.4	70	86.8
Vehicle sales - Light-duty - gasoline (%)	92.9	89	82.2	70.1	49.6	27	11.8
Vehicle sales - Light-duty - hybrid (%)	3.52	4.4	5	4.71	3.68	2.26	1.13
Vehicle sales - Light-duty - hydrogen FC (%)	0.114	0.389	0.344	0.27	0.196	0.111	0.051
Vehicle sales - Light-duty - other (%)	0.116	0.12	0.111	0.098	0.072	0.04	0.018
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)	30.2	29.7	28.9	28.2	27.4	26.7	26
Final energy use - Industry (PJ)	163	171	174	176	179	181	183
Final energy use - Residential (PJ)	41.4	39.1	37.4	35.9	34.3	32.5	30.6
Final energy use - Transportation (PJ)	91.5	86	78.8	73.1	68.9	64	58.1

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	2,507	2,735	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 (%)	4.48	6.34	7.8	12.5	23.6	37.7	45.9
Sales of space heating units - Electric Resistance (%)	7.28	5.52	5.66	6.19	7.32	8.52	9.17
Sales of space heating units - Fossil (%)	6.1	2.55	2.51	2.23	1.76	1.38	1.26
Sales of space heating units - Gas Furnace (%)	82.1	85.6	84	79.1	67.3	52.4	43.6
Sales of water heating units - Electric Heat Pump (%)	1.15	1.12	1.94	4.67	11.3	19.6	24.5
Sales of water heating units - Electric Resistance (%)	9.7	7.35	8.16	10.8	17.2	25.3	30
Sales of water heating units - Gas Furnace (%)	87.4	90.5	88.9	83.6	70.7	54.3	44.7
Sales of water heating units - Other (%)	1.76	0.994	0.977	0.938	0.876	0.841	0.828

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	0.676	0.691	0.924	0.965	1.37	1.46

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	0.03	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	34	34	34	34	34

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	2.19	190	243	1,415	1,991
Conversion capital investment - Cumulative 5-yr (million $2018)	0	0	28	2,268	651	14,187	7,387
Number of facilities - Allam power w ccu (quantity)	0	0	0	0	0	0	0
Number of facilities - Beccs hydrogen (quantity)	0	0	0	3	4	19	19
Number of facilities - Diesel (quantity)	0	0	0	0	0	0	0
Number of facilities - Diesel ccu (quantity)	0	0	0	0	0	1	1
Number of facilities - Power (quantity)	0	0	0	0	0	0	0
Number of facilities - Power ccu (quantity)	0	0	1	1	1	1	1
Number of facilities - Pyrolysis (quantity)	0	0	0	0	0	0	8
Number of facilities - Pyrolysis ccu (quantity)	0	0	0	0	0	1	1
Number of facilities - Sng (quantity)	0	0	0	0	0	0	0
Number of facilities - Sng ccu (quantity)	0	0	1	1	1	2	2

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

Item	2020	2025	2030	2035	2040	2045	2050
Annual - All (MMT)	0	0	0.03	2.95	3.79	22	22.3
Annual - BECCS (MMT)	0	0	0.03	2.95	3.79	22	22.3
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	0.03	2.98	6.77	28.8	51.1
Cumulative - BECCS (MMT)	0	0	0.03	2.98	6.77	28.8	51.1
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	1.85	6.42	13.1	18.7	19.2
Injection wells (wells)	0	0	3	12	22	37	46
Resource characterization, appraisal, permitting costs (million $2020)	0	44.3	204	319	319	319	319
Wells and facilities construction costs (million $2020)	0	0	95.8	373	666	1,113	1,382

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

Item	2020	2025	2030	2035	2040	2045	2050
All (km)	0	0	125	707	845	2,492	2,422
Cumulative investment - All (million $2018)	0	0	64	2,061	2,139	3,632	3,611
Cumulative investment - Spur (million $2018)	0	0	64	295	373	1,866	1,845
Cumulative investment - Trunk (million $2018)	0	0	0	1,766	1,766	1,766	1,766
Spur (km)	0	0	125	372	511	2,157	2,087
Trunk (km)	0	0	0	335	335	335	335

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	-1,508
Carbon sink potential - Aggressive deployment - Cropland measures (1000 tCO2e/y)	0	0	-7,051
Carbon sink potential - Aggressive deployment - Cropland to woody energy crops (1000 tCO2e/y)	0	0	0

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

Item	2020	2025	2050
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	-406
Carbon sink potential - Aggressive deployment - Total (1000 tCO2e/y)	0	0	-8,966
Carbon sink potential - Moderate deployment - Corn-ethanol to energy grasses (1000 tCO2e/y)	0	0	-1,508
Carbon sink potential - Moderate deployment - Cropland measures (1000 tCO2e/y)	0	0	-3,715
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	-203
Carbon sink potential - Moderate deployment - Total (1000 tCO2e/y)	0	0	-5,426
Land impacted for carbon sink - Aggressive deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	1,080
Land impacted for carbon sink - Aggressive deployment - Cropland measures (1000 hectares)	0	0	15,438
Land impacted for carbon sink - Aggressive deployment - Cropland to woody energy crops (1000 hectares)	0	0	16.4
Land impacted for carbon sink - Aggressive deployment - Pasture to energy crops (1000 hectares)	0	0	84.8
Land impacted for carbon sink - Aggressive deployment - Permanent conservation cover (1000 hectares)	0	0	676
Land impacted for carbon sink - Aggressive deployment - Total (1000 hectares)	0	0	17,295
Land impacted for carbon sink - Moderate deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	1,080
Land impacted for carbon sink - Moderate deployment - Cropland measures (1000 hectares)	0	0	3,295
Land impacted for carbon sink - Moderate deployment - Cropland to woody energy crops (1000 hectares)	0	0	16.4
Land impacted for carbon sink - Moderate deployment - Pasture to energy crops (1000 hectares)	0	0	84.8
Land impacted for carbon sink - Moderate deployment - Permanent conservation cover (1000 hectares)	0	0	338
Land impacted for carbon sink - Moderate deployment - Total (1000 hectares)	0	0	4,814

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	378
Carbon sink potential - High - All (not counting overlap) (1000 tCO2e/y)	0	0	14,326
Carbon sink potential - High - Avoid deforestation (1000 tCO2e/y)	0	0	771
Carbon sink potential - High - Extend rotation length (1000 tCO2e/y)	0	0	301

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

Item	2020	2025	2050
Carbon sink potential - High - Improve plantations (1000 tCO2e/y)	0	0	41.4
Carbon sink potential - High - Increase retention of HWP (1000 tCO2e/y)	0	0	444
Carbon sink potential - High - Increase trees outside forests (1000 tCO2e/y)	0	0	2,415
Carbon sink potential - High - Reforest cropland (1000 tCO2e/y)	0	0	4,571
Carbon sink potential - High - Reforest pasture (1000 tCO2e/y)	0	0	4,746
Carbon sink potential - High - Restore productivity (1000 tCO2e/y)	0	0	658
Carbon sink potential - Low - Accelerate regeneration (1000 tCO2e/y)	0	0	190
Carbon sink potential - Low - All (not counting overlap) (1000 tCO2e/y)	0	0	4,315
Carbon sink potential - Low - Avoid deforestation (1000 tCO2e/y)	0	0	129
Carbon sink potential - Low - Extend rotation length (1000 tCO2e/y)	0	0	115
Carbon sink potential - Low - Improve plantations (1000 tCO2e/y)	0	0	21.1
Carbon sink potential - Low - Increase retention of HWP (1000 tCO2e/y)	0	0	148
Carbon sink potential - Low - Increase trees outside forests (1000 tCO2e/y)	0	0	845
Carbon sink potential - Low - Reforest cropland (1000 tCO2e/y)	0	0	2,286
Carbon sink potential - Low - Reforest pasture (1000 tCO2e/y)	0	0	360
Carbon sink potential - Low - Restore productivity (1000 tCO2e/y)	0	0	222
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO2e/y)	0	0	284
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO2e/y)	0	0	9,320
Carbon sink potential - Mid - Avoid deforestation (1000 tCO2e/y)	0	0	450
Carbon sink potential - Mid - Extend rotation length (1000 tCO2e/y)	0	0	208
Carbon sink potential - Mid - Improve plantations (1000 tCO2e/y)	0	0	30.9
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO2e/y)	0	0	296
Carbon sink potential - Mid - Increase trees outside forests (1000 tCO2e/y)	0	0	1,630
Carbon sink potential - Mid - Reforest cropland (1000 tCO2e/y)	0	0	3,429
Carbon sink potential - Mid - Reforest pasture (1000 tCO2e/y)	0	0	2,553
Carbon sink potential - Mid - Restore productivity (1000 tCO2e/y)	0	0	440
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)	0	0	61.9
Land impacted for carbon sink potential - High - Avoid deforestation (over 30 years) (1000 hectares)	0	0	104
Land impacted for carbon sink potential - High - Extend rotation length (1000 hectares)	0	0	153
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)	0	0	15.3
Land impacted for carbon sink potential - High - Increase retention of HWP (1000 hectares)	0	0	0

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

Item	2020	2025	2050
Land impacted for carbon sink potential - High - Increase trees outside forests (1000 hectares)	0	0	229
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)	0	0	302
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)	0	0	135
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)	0	0	218
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)	0	0	1,219
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)	0	0	31
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)	0	0	98
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)	0	0	58.7
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)	0	0	7.63
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	121
Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares)	0	0	151
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)	0	0	23.4
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)	0	0	132
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)	0	0	622
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)	0	0	46.4
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)	0	0	101
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)	0	0	106
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)	0	0	11.5
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	175
Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares)	0	0	227
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)	0	0	169
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)	0	0	266
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)	0	0	1,102

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	0.63	0.659	0	0	0	0
Sales of cooking units - Electric Resistance (%)	71.1	71.1	71.1	71.1	71.1	71.1	71.1
Sales of cooking units - Gas (%)	28.9	28.9	28.9	28.9	28.9	28.9	28.9
Sales of space heating units - Electric Heat Pump (%)	5.86	14.1	14.5	15	15.7	16.5	17.4
Sales of space heating units - Electric Resistance (%)	18.7	23	22.7	22.5	21.9	21.1	20.3

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

Item	2020	2025	2030	2035	2040	2045	2050
Sales of space heating units - Fossil (%)	15.7	20.1	19.3	18.7	18.3	18	18.2
Sales of space heating units - Gas (%)	59.7	42.8	43.5	43.8	44.2	44.4	44
Sales of water heating units - Electric Heat Pump (%)	0	0	0	0	0	0	0
Sales of water heating units - Electric Resistance (%)	41.1	56.9	56.9	56.7	56.6	56.6	56.5
Sales of water heating units - Gas Furnace (%)	58.8	43.1	43.1	43.3	43.4	43.4	43.5
Sales of water heating units - Other (%)	0.032	0.033	0.033	0.033	0.033	0.033	0.034

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 (%)	1.86	2.23	2.24	2.08	1.89	1.76	1.68
Vehicle sales - Light-duty - EV (%)	2.54	4.29	4.93	5.97	7.34	8.69	9.8
Vehicle sales - Light-duty - gasoline (%)	91.9	88.6	87	85.6	83.8	81.8	80.1
Vehicle sales - Light-duty - hybrid (%)	3.43	4.34	5.33	5.92	6.55	7.26	7.93
Vehicle sales - Light-duty - hydrogen FC (%)	0.112	0.388	0.364	0.328	0.328	0.332	0.343
Vehicle sales - Light-duty - other (%)	0.116	0.12	0.117	0.118	0.118	0.118	0.121
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)	30.2	30.3	30.4	30.1	29.9	30.1	31
Final energy use - Industry (PJ)	163	172	176	178	183	186	191
Final energy use - Residential (PJ)	41.4	39.2	38.1	37.3	36.9	36.9	36.9
Final energy use - Transportation (PJ)	91.4	86.1	79.4	75.5	75.4	77.5	80.1

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	2,478	2,548	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 (%)	4.48	13.1	44.5	70.3	74.5	75	75
Sales of space heating units - Electric Resistance (%)	7.28	6.37	10.8	18.4	23.7	24.5	24.5
Sales of space heating units - Fossil (%)	6.1	2.47	1.92	0.869	0.131	0.011	0
Sales of space heating units - Gas Furnace (%)	82.1	78.1	42.8	10.4	1.7	0.533	0.471
Sales of water heating units - Electric Heat Pump (%)	1.15	0.821	0.819	0.82	0.818	0.815	0.812
Sales of water heating units - Electric Resistance (%)	9.7	7.06	7.08	7.05	7.05	7.05	7.05
Sales of water heating units - Gas Furnace (%)	87.4	91.1	91.1	91.1	91.1	91.1	91.1
Sales of water heating units - Other (%)	1.76	0.999	0.996	0.994	0.992	0.996	0.997

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	0.688	0.705	0.782	0.806	0.832	0.856

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

Item	2020	2025	2030	2050
Business-as-usual carbon sink - Natural uptake (Mt CO2e/y)	-2.82	0	0.391	0.112
Business-as-usual carbon sink - Retained in Hardwood Products (Mt CO2e/y)	-0.121	0	-0.251	-0.264
Business-as-usual carbon sink - Total (Mt CO2e/y)	-2.94	0	0.14	-0.152
Carbon sink potential - High - Accelerate regeneration (1000 tCO2e/y)	0	0	0	378
Carbon sink potential - High - All (not counting overlap) (1000 tCO2e/y)	0	0	0	14,326
Carbon sink potential - High - Avoid deforestation (1000 tCO2e/y)	0	0	0	771
Carbon sink potential - High - Extend rotation length (1000 tCO2e/y)	0	0	0	301
Carbon sink potential - High - Improve plantations (1000 tCO2e/y)	0	0	0	41.4
Carbon sink potential - High - Increase retention of HWP (1000 tCO2e/y)	0	0	0	444
Carbon sink potential - High - Increase trees outside forests (1000 tCO2e/y)	0	0	0	2,415
Carbon sink potential - High - Reforest cropland (1000 tCO2e/y)	0	0	0	4,571
Carbon sink potential - High - Reforest pasture (1000 tCO2e/y)	0	0	0	4,746
Carbon sink potential - High - Restore productivity (1000 tCO2e/y)	0	0	0	658
Carbon sink potential - Low - Accelerate regeneration (1000 tCO2e/y)	0	0	0	190
Carbon sink potential - Low - All (not counting overlap) (1000 tCO2e/y)	0	0	0	4,315
Carbon sink potential - Low - Avoid deforestation (1000 tCO2e/y)	0	0	0	129
Carbon sink potential - Low - Extend rotation length (1000 tCO2e/y)	0	0	0	115
Carbon sink potential - Low - Improve plantations (1000 tCO2e/y)	0	0	0	21.1
Carbon sink potential - Low - Increase retention of HWP (1000 tCO2e/y)	0	0	0	148
Carbon sink potential - Low - Increase trees outside forests (1000 tCO2e/y)	0	0	0	845
Carbon sink potential - Low - Reforest cropland (1000 tCO2e/y)	0	0	0	2,286
Carbon sink potential - Low - Reforest pasture (1000 tCO2e/y)	0	0	0	360
Carbon sink potential - Low - Restore productivity (1000 tCO2e/y)	0	0	0	222
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO2e/y)	0	0	0	284
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO2e/y)	0	0	0	9,320
Carbon sink potential - Mid - Avoid deforestation (1000 tCO2e/y)	0	0	0	450
Carbon sink potential - Mid - Extend rotation length (1000 tCO2e/y)	0	0	0	208
Carbon sink potential - Mid - Improve plantations (1000 tCO2e/y)	0	0	0	30.9
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO2e/y)	0	0	0	296

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

Item	2020	2025	2030	2050
Carbon sink potential - Mid - Increase trees outside forests (1000 tCO2e/y)	0	0	0	1,630
Carbon sink potential - Mid - Reforest cropland (1000 tCO2e/y)	0	0	0	3,429
Carbon sink potential - Mid - Reforest pasture (1000 tCO2e/y)	0	0	0	2,553
Carbon sink potential - Mid - Restore productivity (1000 tCO2e/y)	0	0	0	440
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)	0	0	0	61.9
Land impacted for carbon sink potential - High - Avoid deforestation (over 30 years) (1000 hectares)	0	0	0	104
Land impacted for carbon sink potential - High - Extend rotation length (1000 hectares)	0	0	0	153
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)	0	0	0	15.3
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	229
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)	0	0	0	302
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)	0	0	0	135
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)	0	0	0	218
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)	0	0	0	1,219
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)	0	0	0	31
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)	0	0	0	98
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)	0	0	0	58.7
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)	0	0	0	7.63
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	121
Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares)	0	0	0	151
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)	0	0	0	23.4
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)	0	0	0	132
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)	0	0	0	622
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)	0	0	0	46.4
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)	0	0	0	101
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)	0	0	0	106
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)	0	0	0	11.5
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	175

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

Item	2020	2025	2030	2050
Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares)	0	0	0	227
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)	0	0	0	169
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)	0	0	0	266
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)	0	0	0	1,102

Table 64: *REF scenario - IMPACTS - Health*

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal (million 2019$)	0	132	64.2	41	32.2	28	26.9
Monetary damages from air pollution - Natural Gas (million 2019$)	0	13.9	12.9	13.6	9.38	7.66	6.65
Monetary damages from air pollution - Transportation (million 2019$)	0	38.5	38.8	39.2	39.8	40.4	41
Premature deaths from air pollution - Coal (deaths)	0	14.8	7.2	4.6	3.61	3.14	3.02
Premature deaths from air pollution - Natural Gas (deaths)	0	1.57	1.46	1.54	1.06	0.865	0.751
Premature deaths from air pollution - Transportation (deaths)	0	4.33	4.37	4.41	4.48	4.54	4.61