Net-Zero America - north carolina state report

Larson et al. 2020

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

Notes

- These data are a subset of all data from the study available at https://netzeroamerica.princeton.edu.
- The Net-Zero America study describes five pathways to reach net-zero emissions and one "no new policies" reference scenario. In this document, state-level results are grouped by scenario. For some scenarios, the study generated national, but not state-level results.
- Within results for a given scenario, data tables are organized into corresponding sections of the full net-zero study (e.g., Pillar 1, Pillar 2, etc.)
- Some results are not model outputs, but rather they are limits that apply across all scenarios (e.g., maximum carbon storage potential in agricultural soils).

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

Item	2020	2025	2030	2035	2040	2045	2050
Residential HVAC investment in 2020s vs. REF - Cumulative 5-yr (billion $2018)	0	7.62	7.56	0	0	0	0
Sales of cooking units - Electric Resistance (%)	75.4	80.6	96.7	99.8	100	100	100
Sales of cooking units - Gas (%)	24.6	19.4	3.31	0.167	0	0	0
Sales of space heating units - Electric Heat Pump (%)	32.3	47.7	81.1	88.9	89.3	89.3	89.2
Sales of space heating units - Electric Resistance (%)	22.7	22.3	9.54	6.48	6.3	6.42	6.45
Sales of space heating units - Fossil (%)	11.5	13.1	4.52	2.55	2.46	2.42	2.41
Sales of space heating units - Gas (%)	33.5	16.9	4.84	2.03	1.91	1.91	1.9
Sales of water heating units - Electric Heat Pump (%)	0	10	53.3	63.1	63.6	63.6	63.6
Sales of water heating units - Electric Resistance (%)	61.4	68.3	40.5	34.3	34	34	34
Sales of water heating units - Gas Furnace (%)	34.3	18.9	3.74	0.187	0.002	0	0
Sales of water heating units - Other (%)	4.29	2.81	2.47	2.4	2.41	2.42	2.43

Table 2: *E+ scenario - PILLAR 1: Efficiency/Electrification - Transportation*

Item	2020	2025	2030	2035	2040	2045	2050
Light-duty vehicle capital costs - Cumulative 5-yr (million $2018)	0	1,572	4,040	6,528	9,896	10,763	10,266
Public EV charging plugs - DC Fast (1000 units)	0.286	0	3.07	0	13.3	0	21.5
Public EV charging plugs - L2 (1000 units)	1.4	0	73.8	0	320	0	517
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 (%)	1.48	1.75	1.23	0.393	0.073	0.013	0
Vehicle sales - Light-duty - EV (%)	4.15	15.9	47.5	82.2	96.4	99.3	100
Vehicle sales - Light-duty - gasoline (%)	89.5	77.2	47.7	16.1	3.23	0.588	0
Vehicle sales - Light-duty - hybrid (%)	4.65	4.71	3.29	1.21	0.297	0.065	0
Vehicle sales - Light-duty - hydrogen FC (%)	0.11	0.336	0.197	0.061	0.012	0.002	0
Vehicle sales - Light-duty - other (%)	0.099	0.094	0.061	0.021	0.004	0.001	0
Vehicle sales - Medium-duty - diesel (%)	64.7	59.7	42.3	14.4	2.59	0.384	0
Vehicle sales - Medium-duty - EV (%)	0.784	5.07	25.3	60.8	76.5	79.5	80
Vehicle sales - Medium-duty - gasoline (%)	33.7	33.3	25.5	9.32	1.77	0.277	0
Vehicle sales - Medium-duty - hybrid (%)	0.363	0.402	0.341	0.14	0.03	0.005	0
Vehicle sales - Medium-duty - hydrogen FC (%)	0.196	1.27	6.33	15.2	19.1	19.9	20
Vehicle sales - Medium-duty - other (%)	0.253	0.255	0.205	0.083	0.019	0.004	0

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

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Commercial (PJ)	253	254	245	233	223	220	224
Final energy use - Industry (PJ)	343	347	348	344	341	338	339
Final energy use - Residential (PJ)	355	335	313	283	260	247	242
Final energy use - Transportation (PJ)	917	853	749	620	504	431	398

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	34,334	38,227	0	0	0	0
Sales of cooking units - Electric Resistance (%)	32	46	79.9	86.5	86.9	86.9	86.9
Sales of cooking units - Gas (%)	68	54	20.1	13.5	13.1	13.1	13.1
Sales of space heating units - Electric Heat Pump (%)	8.09	27.7	70	83.7	85	85.1	85.1
Sales of space heating units - Electric Resistance (%)	7.4	8.38	10.5	12.6	13	13	13
Sales of space heating units - Fossil (%)	6.11	4.04	0.768	0.033	0	0	0

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

Item	2020	2025	2030	2035	2040	2045	2050
Sales of space heating units - Gas Furnace (%)	78.4	59.9	18.7	3.71	1.95	1.9	1.9
Sales of water heating units - Electric Heat Pump (%)	0.257	10.4	53.9	64	64.5	64.5	64.5
Sales of water heating units - Electric Resistance (%)	6.38	10.9	28.3	32.5	32.8	32.8	32.8
Sales of water heating units - Gas Furnace (%)	88.8	74.6	14.8	0.738	0.009	0	0
Sales of water heating units - Other (%)	4.56	4.13	3.01	2.74	2.74	2.73	2.73

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	6.1	6.25	10.2	10.8	10.4	10.8

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	0.041
Capital invested - Biomass w/ccu power plant (billion $2018)	0	0	0	0	0	0	0
Capital invested - Offshore Wind - Base (billion $2018)	0	0	0	0	7.29	3.33	0
Capital invested - Offshore Wind - Constrained (billion $2018)	0	0	0	0	6.79	2.75	0
Capital invested - Solar PV - Base (billion $2018)	0	0.319	11.5	13.4	8.86	6.87	4.82
Capital invested - Solar PV - Constrained (billion $2018)	0	2.3	9.86	12.9	9.89	4.44	3.52
Capital invested - Wind - Base (billion $2018)	0	0	0.15	0	0.121	0	0
Capital invested - Wind - Constrained (billion $2018)	0	0	0.252	0	0	0	0.037

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	41.1
Biomass w/ccu power plant (GWh)	0	0	0	0	0	0	0
OffshoreWind - Base land use assumptions (GWh)	0	0	0	0	17,825	8,896	0
OffshoreWind - Constrained land use assumptions (GWh)	0	0	0	0	17,825	8,896	0
Solar - Base land use assumptions (GWh)	4,358	457	18,636	23,584	16,533	13,601	10,077
Solar - Constrained land use assumptions (GWh)	1,582	1,152	15,424	25,126	13,050	10,317	17,301
Wind - Base land use assumptions (GWh)	734	0	381	0	282	0	0
Wind - Constrained land use assumptions (GWh)	734	0	570	0	0	0	127

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

Item	2020	2025	2030	2035	2040	2045	2050
Biomass purchases (million $2018/year)	0	0	218	218	218	218	920
Conversion capital investment - Cumulative 5-yr (million $2018)	0	0	0	0	0	0	14,438
Number of facilities - Allam power w ccu (quantity)	0	0	0	0	0	0	1
Number of facilities - Beccs hydrogen (quantity)	0	0	0	0	0	0	16
Number of facilities - Diesel (quantity)	0	0	0	0	0	0	0
Number of facilities - Diesel ccu (quantity)	0	0	0	0	0	0	1
Number of facilities - Power (quantity)	0	0	0	0	0	0	0
Number of facilities - Power ccu (quantity)	0	0	0	0	0	0	0
Number of facilities - Pyrolysis (quantity)	0	0	0	0	0	0	0
Number of facilities - Pyrolysis ccu (quantity)	0	0	0	0	0	0	0

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

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

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

Item	2020	2025	2030	2035	2040	2045	2050
Annual - All (MMT)	0	0	0	0.55	4.91	0.67	24.7
Annual - BECCS (MMT)	0	0	0	0	0	0	18.5
Annual - Cement and lime (MMT)	0	0	0	0	0	0	0
Annual - NGCC (MMT)	0	0	0	0.55	4.91	0.67	6.19
Cumulative - All (MMT)	0	0	0	0.55	5.46	6.13	30.9
Cumulative - BECCS (MMT)	0	0	0	0	0	0	18.5
Cumulative - Cement and lime (MMT)	0	0	0	0	0	0	0
Cumulative - NGCC (MMT)	0	0	0	0.55	5.46	6.13	12.3

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

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

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

Item	2020	2025	2030	2035	2040	2045	2050
All (km)	0	0	0	243	245	374	1,682
Cumulative investment - All (million $2018)	0	0	0	1,364	1,366	1,458	2,604
Cumulative investment - Spur (million $2018)	0	0	0	9.11	11.6	104	1,250
Cumulative investment - Trunk (million $2018)	0	0	0	1,354	1,354	1,354	1,354
Spur (km)	0	0	0	15.4	17.9	146	1,455
Trunk (km)	0	0	0	227	227	227	227

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	-207
Carbon sink potential - Aggressive deployment - Cropland measures (1000 tCO2e/y)	0	0	-2,978
Carbon sink potential - Aggressive deployment - Permanent conservation cover (1000 tCO2e/y)	0	0	-102
Carbon sink potential - Aggressive deployment - Total (1000 tCO2e/y)	0	0	-3,287
Carbon sink potential - Moderate deployment - Corn-ethanol to energy grasses (1000 tCO2e/y)	0	0	-207
Carbon sink potential - Moderate deployment - Cropland measures (1000 tCO2e/y)	0	0	-1,569
Carbon sink potential - Moderate deployment - Permanent conservation cover (1000 tCO2e/y)	0	0	-51
Carbon sink potential - Moderate deployment - Total (1000 tCO2e/y)	0	0	-1,827
Land impacted for carbon sink - Aggressive deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	117
Land impacted for carbon sink - Aggressive deployment - Cropland measures (1000 hectares)	0	0	1,723
Land impacted for carbon sink - Aggressive deployment - Permanent conservation cover (1000 hectares)	0	0	186

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

Item	2020	2025	2050
Land impacted for carbon sink - Aggressive deployment - Total (1000 hectares)	0	0	2,025
Land impacted for carbon sink - Moderate deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	117
Land impacted for carbon sink - Moderate deployment - Cropland measures (1000 hectares)	0	0	908
Land impacted for carbon sink - Moderate deployment - Permanent conservation cover (1000 hectares)	0	0	92.8
Land impacted for carbon sink - Moderate deployment - Total (1000 hectares)	0	0	1,118

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

Item	2020	2025	2050
Carbon sink potential - High - Accelerate regeneration (1000 tCO2e/y)	0	0	370
Carbon sink potential - High - All (not counting overlap) (1000 tCO2e/y)	0	0	44,532
Carbon sink potential - High - Avoid deforestation (1000 tCO2e/y)	0	0	3,061
Carbon sink potential - High - Extend rotation length (1000 tCO2e/y)	0	0	10,827
Carbon sink potential - High - Improve plantations (1000 tCO2e/y)	0	0	2,556
Carbon sink potential - High - Increase retention of HWP (1000 tCO2e/y)	0	0	17,779
Carbon sink potential - High - Increase trees outside forests (1000 tCO2e/y)	0	0	1,133
Carbon sink potential - High - Reforest cropland (1000 tCO2e/y)	0	0	567
Carbon sink potential - High - Reforest pasture (1000 tCO2e/y)	0	0	4,291
Carbon sink potential - High - Restore productivity (1000 tCO2e/y)	0	0	3,947
Carbon sink potential - Low - Accelerate regeneration (1000 tCO2e/y)	0	0	186
Carbon sink potential - Low - All (not counting overlap) (1000 tCO2e/y)	0	0	14,417
Carbon sink potential - Low - Avoid deforestation (1000 tCO2e/y)	0	0	510
Carbon sink potential - Low - Extend rotation length (1000 tCO2e/y)	0	0	4,159
Carbon sink potential - Low - Improve plantations (1000 tCO2e/y)	0	0	1,300
Carbon sink potential - Low - Increase retention of HWP (1000 tCO2e/y)	0	0	5,926
Carbon sink potential - Low - Increase trees outside forests (1000 tCO2e/y)	0	0	397
Carbon sink potential - Low - Reforest cropland (1000 tCO2e/y)	0	0	284
Carbon sink potential - Low - Reforest pasture (1000 tCO2e/y)	0	0	325
Carbon sink potential - Low - Restore productivity (1000 tCO2e/y)	0	0	1,331
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO2e/y)	0	0	278
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO2e/y)	0	0	29,452
Carbon sink potential - Mid - Avoid deforestation (1000 tCO2e/y)	0	0	1,785

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

Item	2020	2025	2050
Carbon sink potential - Mid - Extend rotation length (1000 tCO2e/y)	0	0	7,493
Carbon sink potential - Mid - Improve plantations (1000 tCO2e/y)	0	0	1,906
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO2e/y)	0	0	11,852
Carbon sink potential - Mid - Increase trees outside forests (1000 tCO2e/y)	0	0	765
Carbon sink potential - Mid - Reforest cropland (1000 tCO2e/y)	0	0	426
Carbon sink potential - Mid - Reforest pasture (1000 tCO2e/y)	0	0	2,308
Carbon sink potential - Mid - Restore productivity (1000 tCO2e/y)	0	0	2,639
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)	0	0	60.6
Land impacted for carbon sink potential - High - Avoid deforestation (over 30 years) (1000 hectares)	0	0	414
Land impacted for carbon sink potential - High - Extend rotation length (1000 hectares)	0	0	5,521
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)	0	0	942
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	108
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)	0	0	37.5
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)	0	0	122
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)	0	0	1,308
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)	0	0	8,513
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)	0	0	30.3
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)	0	0	389
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)	0	0	2,115
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)	0	0	471
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	56.7
Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares)	0	0	18.8
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)	0	0	21.1
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)	0	0	792
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)	0	0	3,894
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)	0	0	45.5
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)	0	0	402
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)	0	0	3,818

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

Item	2020	2025	2050
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)	0	0	708
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	82.2
Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares)	0	0	28.1
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)	0	0	153
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)	0	0	1,594
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)	0	0	6,831

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

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal (million 2019$)	0	698	0.953	0.922	0.77	0.547	0.048
Monetary damages from air pollution - Natural Gas (million 2019$)	0	506	354	208	161	83.7	31.2
Monetary damages from air pollution - Transportation (million 2019$)	0	2,831	2,683	2,069	1,209	552	210
Premature deaths from air pollution - Coal (deaths)	0	78.4	0.107	0.103	0.086	0.061	0.005
Premature deaths from air pollution - Natural Gas (deaths)	0	57.1	39.9	23.5	18.2	9.46	3.53
Premature deaths from air pollution - Transportation (deaths)	0	318	302	233	136	62	23.6

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

Item	2020	2025	2030	2035	2040	2045	2050
By economic sector - Agriculture (jobs)	171	197	583	636	538	432	1,266
By economic sector - Construction (jobs)	8,746	7,710	15,129	19,400	20,839	20,299	21,048
By economic sector - Manufacturing (jobs)	7,124	12,055	22,072	22,363	18,103	20,209	16,696
By economic sector - Mining (jobs)	4,161	2,824	2,017	1,298	785	442	248
By economic sector - Other (jobs)	751	606	2,321	3,208	3,534	3,697	4,221
By economic sector - Pipeline (jobs)	637	624	529	580	306	214	266
By economic sector - Professional (jobs)	4,961	4,232	6,771	8,277	9,663	9,830	11,785
By economic sector - Trade (jobs)	4,254	3,119	4,611	5,448	6,161	6,321	7,179
By economic sector - Utilities (jobs)	12,193	11,455	12,267	15,939	18,359	17,676	17,594
By education level - All sectors - Associates degree or some college (jobs)	13,319	13,392	20,878	24,615	25,196	25,524	25,661
By education level - All sectors - Bachelors degree (jobs)	9,284	9,152	13,335	15,121	15,273	15,436	15,777
By education level - All sectors - Doctoral degree (jobs)	299	270	400	460	492	492	555
By education level - All sectors - High school diploma or less (jobs)	17,889	17,902	28,670	33,470	33,694	34,012	34,450
By education level - All sectors - Masters or professional degree (jobs)	2,207	2,107	3,018	3,481	3,634	3,656	3,861
By resource sector - Biomass (jobs)	709	846	1,607	1,811	1,621	1,574	5,404
By resource sector - CO2 (jobs)	0	0	0	1,361	15.5	132	1,102
By resource sector - Coal (jobs)	4,162	1,272	0	0	0	0	0
By resource sector - Grid (jobs)	13,317	12,301	16,441	24,419	32,083	32,774	31,857
By resource sector - Natural Gas (jobs)	5,878	6,808	5,312	4,485	4,655	3,135	3,014
By resource sector - Nuclear (jobs)	2,767	2,723	2,679	1,990	804	265	0
By resource sector - Oil (jobs)	8,051	6,905	5,452	3,846	2,563	1,651	1,037
By resource sector - Solar (jobs)	7,984	11,788	33,795	38,427	31,805	30,735	29,173
By resource sector - Wind (jobs)	129	178	1,013	810	4,744	8,853	8,715
Median wages - Annual - All ($2019 per job)	58,064	58,191	56,638	57,274	58,525	59,152	60,278

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

Item	2020	2025	2030	2035	2040	2045	2050
On-Site or In-Plant Training - Total jobs - 1 to 4 years (jobs)	6,936	6,898	10,660	12,567	12,874	12,975	13,046
On-Site or In-Plant Training - Total jobs - 4 to 10 years (jobs)	2,791	2,612	3,938	4,823	5,147	5,102	5,264
On-Site or In-Plant Training - Total jobs - None (jobs)	6,921	6,966	10,945	12,640	12,725	12,884	13,129
On-Site or In-Plant Training - Total jobs - Over 10 years (jobs)	350	350	540	653	685	691	702
On-Site or In-Plant Training - Total jobs - Up to 1 year (jobs)	26,000	25,996	40,218	46,465	46,857	47,467	48,162
On-the-Job Training - All sectors - 1 to 4 years (jobs)	8,911	8,849	13,610	16,096	16,548	16,660	16,751
On-the-Job Training - All sectors - 4 to 10 years (jobs)	2,684	2,495	3,821	4,741	5,104	5,057	5,228
On-the-Job Training - All sectors - None (jobs)	2,345	2,295	3,591	4,141	4,176	4,216	4,337
On-the-Job Training - All sectors - Over 10 years (jobs)	406	435	722	818	789	802	784
On-the-Job Training - All sectors - Up to 1 year (jobs)	28,651	28,748	44,557	51,353	51,671	52,383	53,203
Related work experience - All sectors - 1 to 4 years (jobs)	15,669	15,457	23,564	27,397	27,890	28,148	28,581
Related work experience - All sectors - 4 to 10 years (jobs)	10,057	9,983	15,144	17,664	18,040	18,200	18,395
Related work experience - All sectors - None (jobs)	6,132	6,102	9,462	11,124	11,363	11,463	11,716
Related work experience - All sectors - Over 10 years (jobs)	2,719	2,800	4,272	4,887	4,881	4,960	4,918
Related work experience - All sectors - Up to 1 year (jobs)	8,421	8,481	13,858	16,077	16,115	16,347	16,693
Wage income - All (million $2019)	2,497	2,492	3,756	4,419	4,582	4,681	4,841

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

Item	2020	2025	2030	2035	2040	2045	2050
Natural gas consumption - Annual (tcf)	444	451	380	305	229	144	100
Natural gas consumption - Cumulative (tcf)	0	0	0	0	0	0	9,180
Natural gas production - Annual (tcf)	0	0	0	0	0	0	0
Oil consumption - Annual (million bbls)	165	155	134	102	73.3	50.5	33.8
Oil consumption - Cumulative (million bbls)	0	0	0	0	0	0	3,171
Oil production - Annual (million bbls)	0	0	0	0	0	0	0

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

Item	2020	2025	2030	2035	2040	2045	2050
Residential HVAC investment in 2020s vs. REF - Cumulative 5-yr (billion $2018)	0	7.58	7.45	0	0	0	0
Sales of cooking units - Electric Resistance (%)	75.3	75.9	78.2	84.2	92.5	97.6	99.3
Sales of cooking units - Gas (%)	24.7	24.1	21.8	15.8	7.55	2.44	0.656
Sales of space heating units - Electric Heat Pump (%)	32.3	41.3	45.1	56.1	73	84	87.9
Sales of space heating units - Electric Resistance (%)	22.7	24.7	23.3	18.9	12.4	8.34	6.89
Sales of space heating units - Fossil (%)	11.5	14.8	13.8	11	6.65	3.78	2.79
Sales of space heating units - Gas (%)	33.5	19.2	17.8	13.9	7.91	3.85	2.41
Sales of water heating units - Electric Heat Pump (%)	0	1.73	6.65	20.8	42.6	56.9	61.8
Sales of water heating units - Electric Resistance (%)	61.4	73.6	70.5	61.3	47.3	38.2	35.1
Sales of water heating units - Gas Furnace (%)	34.3	21.8	20	15.2	7.52	2.43	0.641
Sales of water heating units - Other (%)	4.29	2.87	2.83	2.74	2.59	2.48	2.44

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	256	534	1,808	5,675	8,272
Public EV charging plugs - DC Fast (1000 units)	0.286	0	0.97	0	4.96	0	13.8
Public EV charging plugs - L2 (1000 units)	1.4	0	23.3	0	119	0	331
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 (%)	1.49	1.92	2.04	1.62	1.03	0.529	0.227
Vehicle sales - Light-duty - EV (%)	1.97	4.86	12.2	26.4	49	72.4	87.7
Vehicle sales - Light-duty - gasoline (%)	91.5	87.1	79	65.9	45.5	24.4	10.8
Vehicle sales - Light-duty - hybrid (%)	4.83	5.62	6.28	5.69	4.23	2.48	1.19
Vehicle sales - Light-duty - hydrogen FC (%)	0.112	0.378	0.322	0.244	0.172	0.095	0.044
Vehicle sales - Light-duty - other (%)	0.1	0.103	0.094	0.081	0.058	0.032	0.015
Vehicle sales - Medium-duty - diesel (%)	64.8	62.2	57.7	49.4	35.6	19.6	8.37
Vehicle sales - Medium-duty - EV (%)	0.664	1.94	5.49	14.3	31.4	52.6	68
Vehicle sales - Medium-duty - gasoline (%)	33.8	34.7	34.7	31.9	24.4	14.2	6.33
Vehicle sales - Medium-duty - hybrid (%)	0.363	0.418	0.464	0.478	0.414	0.275	0.141
Vehicle sales - Medium-duty - hydrogen FC (%)	0.166	0.485	1.37	3.58	7.86	13.2	17
Vehicle sales - Medium-duty - other (%)	0.253	0.266	0.279	0.286	0.258	0.184	0.102

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

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Commercial (PJ)	253	255	252	248	242	237	235
Final energy use - Industry (PJ)	343	348	349	349	350	347	346
Final energy use - Residential (PJ)	355	336	326	315	300	282	265
Final energy use - Transportation (PJ)	918	861	785	722	672	613	544

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	34,313	38,231	0	0	0	0
Sales of cooking units - Electric Resistance (%)	32	36.2	40.9	53.4	71	81.7	85.5
Sales of cooking units - Gas (%)	68	63.8	59.1	46.6	29	18.3	14.5
Sales of space heating units - Electric Heat Pump (%)	8.09	19.7	24.6	38.6	60.7	76.6	82.8
Sales of space heating units - Electric Resistance (%)	7.4	8.06	8.29	9.07	10.5	11.9	12.7
Sales of space heating units - Fossil (%)	6.11	4.68	4.33	3.28	1.62	0.513	0.134
Sales of space heating units - Gas Furnace (%)	78.4	67.5	62.8	49.1	27.1	11	4.45
Sales of water heating units - Electric Heat Pump (%)	0.257	2.02	6.97	21.3	43.2	57.6	62.7
Sales of water heating units - Electric Resistance (%)	6.38	7.55	9.45	15.2	24.1	29.9	32
Sales of water heating units - Gas Furnace (%)	88.8	86.1	79.3	59.7	29.4	9.53	2.51
Sales of water heating units - Other (%)	4.56	4.35	4.31	3.87	3.3	2.91	2.77

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	5.28	5.33	6.71	6.92	9.8	10.3

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	-207

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

Item	2020	2025	2050
Carbon sink potential - Aggressive deployment - Cropland measures (1000 tCO2e/y)	0	0	-2,978
Carbon sink potential - Aggressive deployment - Permanent conservation cover (1000 tCO2e/y)	0	0	-102
Carbon sink potential - Aggressive deployment - Total (1000 tCO2e/y)	0	0	-3,287
Carbon sink potential - Moderate deployment - Corn-ethanol to energy grasses (1000 tCO2e/y)	0	0	-207
Carbon sink potential - Moderate deployment - Cropland measures (1000 tCO2e/y)	0	0	-1,569
Carbon sink potential - Moderate deployment - Permanent conservation cover (1000 tCO2e/y)	0	0	-51
Carbon sink potential - Moderate deployment - Total (1000 tCO2e/y)	0	0	-1,827
Land impacted for carbon sink - Aggressive deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	117
Land impacted for carbon sink - Aggressive deployment - Cropland measures (1000 hectares)	0	0	1,723
Land impacted for carbon sink - Aggressive deployment - Permanent conservation cover (1000 hectares)	0	0	186
Land impacted for carbon sink - Aggressive deployment - Total (1000 hectares)	0	0	2,025
Land impacted for carbon sink - Moderate deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	117
Land impacted for carbon sink - Moderate deployment - Cropland measures (1000 hectares)	0	0	908
Land impacted for carbon sink - Moderate deployment - Permanent conservation cover (1000 hectares)	0	0	92.8
Land impacted for carbon sink - Moderate deployment - Total (1000 hectares)	0	0	1,118

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

Item	2020	2025	2050
Carbon sink potential - High - Accelerate regeneration (1000 tCO2e/y)	0	0	370
Carbon sink potential - High - All (not counting overlap) (1000 tCO2e/y)	0	0	44,532
Carbon sink potential - High - Avoid deforestation (1000 tCO2e/y)	0	0	3,061
Carbon sink potential - High - Extend rotation length (1000 tCO2e/y)	0	0	10,827
Carbon sink potential - High - Improve plantations (1000 tCO2e/y)	0	0	2,556
Carbon sink potential - High - Increase retention of HWP (1000 tCO2e/y)	0	0	17,779
Carbon sink potential - High - Increase trees outside forests (1000 tCO2e/y)	0	0	1,133
Carbon sink potential - High - Reforest cropland (1000 tCO2e/y)	0	0	567
Carbon sink potential - High - Reforest pasture (1000 tCO2e/y)	0	0	4,291
Carbon sink potential - High - Restore productivity (1000 tCO2e/y)	0	0	3,947
Carbon sink potential - Low - Accelerate regeneration (1000 tCO2e/y)	0	0	186
Carbon sink potential - Low - All (not counting overlap) (1000 tCO2e/y)	0	0	14,417

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

Item	2020	2025	2050
Carbon sink potential - Low - Avoid deforestation (1000 tCO2e/y)	0	0	510
Carbon sink potential - Low - Extend rotation length (1000 tCO2e/y)	0	0	4,159
Carbon sink potential - Low - Improve plantations (1000 tCO2e/y)	0	0	1,300
Carbon sink potential - Low - Increase retention of HWP (1000 tCO2e/y)	0	0	5,926
Carbon sink potential - Low - Increase trees outside forests (1000 tCO2e/y)	0	0	397
Carbon sink potential - Low - Reforest cropland (1000 tCO2e/y)	0	0	284
Carbon sink potential - Low - Reforest pasture (1000 tCO2e/y)	0	0	325
Carbon sink potential - Low - Restore productivity (1000 tCO2e/y)	0	0	1,331
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO2e/y)	0	0	278
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO2e/y)	0	0	29,452
Carbon sink potential - Mid - Avoid deforestation (1000 tCO2e/y)	0	0	1,785
Carbon sink potential - Mid - Extend rotation length (1000 tCO2e/y)	0	0	7,493
Carbon sink potential - Mid - Improve plantations (1000 tCO2e/y)	0	0	1,906
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO2e/y)	0	0	11,852
Carbon sink potential - Mid - Increase trees outside forests (1000 tCO2e/y)	0	0	765
Carbon sink potential - Mid - Reforest cropland (1000 tCO2e/y)	0	0	426
Carbon sink potential - Mid - Reforest pasture (1000 tCO2e/y)	0	0	2,308
Carbon sink potential - Mid - Restore productivity (1000 tCO2e/y)	0	0	2,639
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)	0	0	60.6
Land impacted for carbon sink potential - High - Avoid deforestation (over 30 years) (1000 hectares)	0	0	414
Land impacted for carbon sink potential - High - Extend rotation length (1000 hectares)	0	0	5,521
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)	0	0	942
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	108
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)	0	0	37.5
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)	0	0	122
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)	0	0	1,308
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)	0	0	8,513
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)	0	0	30.3
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)	0	0	389

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

Item	2020	2025	2050
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)	0	0	2,115
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)	0	0	471
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	56.7
Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares)	0	0	18.8
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)	0	0	21.1
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)	0	0	792
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)	0	0	3,894
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)	0	0	45.5
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)	0	0	402
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)	0	0	3,818
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)	0	0	708
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	82.2
Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares)	0	0	28.1
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)	0	0	153
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)	0	0	1,594
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)	0	0	6,831

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

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal (million 2019$)	0	698	0.953	0.922	0.77	0.547	0.048
Monetary damages from air pollution - Natural Gas (million 2019$)	0	474	317	122	48.3	17.1	9.1
Monetary damages from air pollution - Transportation (million 2019$)	0	2,881	2,959	2,922	2,667	2,149	1,488
Premature deaths from air pollution - Coal (deaths)	0	78.4	0.107	0.103	0.086	0.061	0.005
Premature deaths from air pollution - Natural Gas (deaths)	0	53.5	35.8	13.7	5.46	1.94	1.03
Premature deaths from air pollution - Transportation (deaths)	0	324	333	329	300	242	167

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	7.62	7.56	0	0	0	0
Sales of cooking units - Electric Resistance (%)	75.4	80.6	96.7	99.8	100	100	100
Sales of cooking units - Gas (%)	24.6	19.4	3.31	0.167	0	0	0
Sales of space heating units - Electric Heat Pump (%)	32.3	47.7	81.1	88.9	89.3	89.3	89.2

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

Item	2020	2025	2030	2035	2040	2045	2050
Sales of space heating units - Electric Resistance (%)	22.7	22.3	9.54	6.48	6.3	6.42	6.45
Sales of space heating units - Fossil (%)	11.5	13.1	4.52	2.55	2.46	2.42	2.41
Sales of space heating units - Gas (%)	33.5	16.9	4.84	2.03	1.91	1.91	1.9
Sales of water heating units - Electric Heat Pump (%)	0	10	53.3	63.1	63.6	63.6	63.6
Sales of water heating units - Electric Resistance (%)	61.4	68.3	40.5	34.3	34	34	34
Sales of water heating units - Gas Furnace (%)	34.3	18.9	3.74	0.187	0.002	0	0
Sales of water heating units - Other (%)	4.29	2.81	2.47	2.4	2.41	2.42	2.43

Table 26: *E+RE+ scenario - PILLAR 1: Efficiency/Electrification - Transportation*

Item	2020	2025	2030	2035	2040	2045	2050
Light-duty vehicle capital costs - Cumulative 5-yr (million $2018)	0	1,572	4,040	6,528	9,896	10,763	10,266
Public EV charging plugs - DC Fast (1000 units)	0.286	0	3.07	0	13.3	0	21.5
Public EV charging plugs - L2 (1000 units)	1.4	0	73.8	0	320	0	517
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 (%)	1.48	1.75	1.23	0.393	0.073	0.013	0
Vehicle sales - Light-duty - EV (%)	4.15	15.9	47.5	82.2	96.4	99.3	100
Vehicle sales - Light-duty - gasoline (%)	89.5	77.2	47.7	16.1	3.23	0.588	0
Vehicle sales - Light-duty - hybrid (%)	4.65	4.71	3.29	1.21	0.297	0.065	0
Vehicle sales - Light-duty - hydrogen FC (%)	0.11	0.336	0.197	0.061	0.012	0.002	0
Vehicle sales - Light-duty - other (%)	0.099	0.094	0.061	0.021	0.004	0.001	0
Vehicle sales - Medium-duty - diesel (%)	64.7	59.7	42.3	14.4	2.59	0.384	0
Vehicle sales - Medium-duty - EV (%)	0.784	5.07	25.3	60.8	76.5	79.5	80
Vehicle sales - Medium-duty - gasoline (%)	33.7	33.3	25.5	9.32	1.77	0.277	0
Vehicle sales - Medium-duty - hybrid (%)	0.363	0.402	0.341	0.14	0.03	0.005	0
Vehicle sales - Medium-duty - hydrogen FC (%)	0.196	1.27	6.33	15.2	19.1	19.9	20
Vehicle sales - Medium-duty - other (%)	0.253	0.255	0.205	0.083	0.019	0.004	0

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

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Commercial (PJ)	253	254	245	233	223	220	224
Final energy use - Industry (PJ)	343	347	348	344	341	338	339
Final energy use - Residential (PJ)	355	335	313	283	260	247	242
Final energy use - Transportation (PJ)	917	853	749	620	504	431	398

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	34,334	38,227	0	0	0	0
Sales of cooking units - Electric Resistance (%)	32	46	79.9	86.5	86.9	86.9	86.9
Sales of cooking units - Gas (%)	68	54	20.1	13.5	13.1	13.1	13.1
Sales of space heating units - Electric Heat Pump (%)	8.09	27.7	70	83.7	85	85.1	85.1
Sales of space heating units - Electric Resistance (%)	7.4	8.38	10.5	12.6	13	13	13
Sales of space heating units - Fossil (%)	6.11	4.04	0.768	0.033	0	0	0
Sales of space heating units - Gas Furnace (%)	78.4	59.9	18.7	3.71	1.95	1.9	1.9
Sales of water heating units - Electric Heat Pump (%)	0.257	10.4	53.9	64	64.5	64.5	64.5
Sales of water heating units - Electric Resistance (%)	6.38	10.9	28.3	32.5	32.8	32.8	32.8
Sales of water heating units - Gas Furnace (%)	88.8	74.6	14.8	0.738	0.009	0	0

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

Item	2020	2025	2030	2035	2040	2045	2050
Sales of water heating units - Other (%)	4.56	4.13	3.01	2.74	2.74	2.73	2.73

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	6.1	6.25	10.2	10.8	10.4	10.8

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

Item	2020	2025	2030	2035	2040	2045	2050
Capital invested - Offshore Wind - Base (billion $2018)	0	0	0	11.4	17.2	57.9	14.5
Capital invested - Solar PV - Base (billion $2018)	0	4.49	12.2	19	6.47	9.14	7.8
Capital invested - Wind - Base (billion $2018)	0	0	0.15	0.078	0.046	0	0

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

Item	2020	2025	2030	2035	2040	2045	2050
OffshoreWind - Base land use assumptions (GWh)	0	0	0	23,197	42,394	163,125	48,099
OffshoreWind - Constrained land use assumptions (GWh)	0	0	0	19,916	6,805	0	246,279
Solar - Base land use assumptions (GWh)	4,688	6,532	19,814	33,357	12,143	18,047	16,222
Solar - Constrained land use assumptions (GWh)	3,990	4,618	20,627	39,021	15,784	23,677	21,317
Wind - Base land use assumptions (GWh)	734	0	381	172	111	0	0
Wind - Constrained land use assumptions (GWh)	734	0	570	0	0	0	552

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	-207
Carbon sink potential - Aggressive deployment - Cropland measures (1000 tCO2e/y)	0	0	-2,978
Carbon sink potential - Aggressive deployment - Permanent conservation cover (1000 tCO2e/y)	0	0	-102
Carbon sink potential - Aggressive deployment - Total (1000 tCO2e/y)	0	0	-3,287
Carbon sink potential - Moderate deployment - Corn-ethanol to energy grasses (1000 tCO2e/y)	0	0	-207
Carbon sink potential - Moderate deployment - Cropland measures (1000 tCO2e/y)	0	0	-1,569
Carbon sink potential - Moderate deployment - Permanent conservation cover (1000 tCO2e/y)	0	0	-51
Carbon sink potential - Moderate deployment - Total (1000 tCO2e/y)	0	0	-1,827
Land impacted for carbon sink - Aggressive deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	117
Land impacted for carbon sink - Aggressive deployment - Cropland measures (1000 hectares)	0	0	1,723
Land impacted for carbon sink - Aggressive deployment - Permanent conservation cover (1000 hectares)	0	0	186
Land impacted for carbon sink - Aggressive deployment - Total (1000 hectares)	0	0	2,025
Land impacted for carbon sink - Moderate deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	117
Land impacted for carbon sink - Moderate deployment - Cropland measures (1000 hectares)	0	0	908

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

Item	2020	2025	2050
Land impacted for carbon sink - Moderate deployment - Permanent conservation cover (1000 hectares)	0	0	92.8
Land impacted for carbon sink - Moderate deployment - Total (1000 hectares)	0	0	1,118

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	370
Carbon sink potential - High - All (not counting overlap) (1000 tCO2e/y)	0	0	44,532
Carbon sink potential - High - Avoid deforestation (1000 tCO2e/y)	0	0	3,061
Carbon sink potential - High - Extend rotation length (1000 tCO2e/y)	0	0	10,827
Carbon sink potential - High - Improve plantations (1000 tCO2e/y)	0	0	2,556
Carbon sink potential - High - Increase retention of HWP (1000 tCO2e/y)	0	0	17,779
Carbon sink potential - High - Increase trees outside forests (1000 tCO2e/y)	0	0	1,133
Carbon sink potential - High - Reforest cropland (1000 tCO2e/y)	0	0	567
Carbon sink potential - High - Reforest pasture (1000 tCO2e/y)	0	0	4,291
Carbon sink potential - High - Restore productivity (1000 tCO2e/y)	0	0	3,947
Carbon sink potential - Low - Accelerate regeneration (1000 tCO2e/y)	0	0	186
Carbon sink potential - Low - All (not counting overlap) (1000 tCO2e/y)	0	0	14,417
Carbon sink potential - Low - Avoid deforestation (1000 tCO2e/y)	0	0	510
Carbon sink potential - Low - Extend rotation length (1000 tCO2e/y)	0	0	4,159
Carbon sink potential - Low - Improve plantations (1000 tCO2e/y)	0	0	1,300
Carbon sink potential - Low - Increase retention of HWP (1000 tCO2e/y)	0	0	5,926
Carbon sink potential - Low - Increase trees outside forests (1000 tCO2e/y)	0	0	397
Carbon sink potential - Low - Reforest cropland (1000 tCO2e/y)	0	0	284
Carbon sink potential - Low - Reforest pasture (1000 tCO2e/y)	0	0	325
Carbon sink potential - Low - Restore productivity (1000 tCO2e/y)	0	0	1,331
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO2e/y)	0	0	278
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO2e/y)	0	0	29,452
Carbon sink potential - Mid - Avoid deforestation (1000 tCO2e/y)	0	0	1,785
Carbon sink potential - Mid - Extend rotation length (1000 tCO2e/y)	0	0	7,493
Carbon sink potential - Mid - Improve plantations (1000 tCO2e/y)	0	0	1,906
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO2e/y)	0	0	11,852
Carbon sink potential - Mid - Increase trees outside forests (1000 tCO2e/y)	0	0	765

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

Item	2020	2025	2050
Carbon sink potential - Mid - Reforest cropland (1000 tCO2e/y)	0	0	426
Carbon sink potential - Mid - Reforest pasture (1000 tCO2e/y)	0	0	2,308
Carbon sink potential - Mid - Restore productivity (1000 tCO2e/y)	0	0	2,639
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)	0	0	60.6
Land impacted for carbon sink potential - High - Avoid deforestation (over 30 years) (1000 hectares)	0	0	414
Land impacted for carbon sink potential - High - Extend rotation length (1000 hectares)	0	0	5,521
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)	0	0	942
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	108
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)	0	0	37.5
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)	0	0	122
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)	0	0	1,308
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)	0	0	8,513
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)	0	0	30.3
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)	0	0	389
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)	0	0	2,115
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)	0	0	471
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	56.7
Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares)	0	0	18.8
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)	0	0	21.1
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)	0	0	792
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)	0	0	3,894
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)	0	0	45.5
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)	0	0	402
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)	0	0	3,818
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)	0	0	708
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	82.2
Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares)	0	0	28.1

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

Item	2020	2025	2050
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)	0	0	153
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)	0	0	1,594
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)	0	0	6,831

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

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal (million 2019$)	0	698	0.953	0.922	0.77	0.547	0.048
Monetary damages from air pollution - Natural Gas (million 2019$)	0	419	347	198	120	31.9	9.23
Monetary damages from air pollution - Transportation (million 2019$)	0	2,831	2,683	2,069	1,209	552	210
Premature deaths from air pollution - Coal (deaths)	0	78.4	0.107	0.103	0.086	0.061	0.005
Premature deaths from air pollution - Natural Gas (deaths)	0	47.3	39.2	22.3	13.6	3.61	1.04
Premature deaths from air pollution - Transportation (deaths)	0	318	302	233	136	62	23.6

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	7.62	7.56	0	0	0	0
Sales of cooking units - Electric Resistance (%)	75.4	80.6	96.7	99.8	100	100	100
Sales of cooking units - Gas (%)	24.6	19.4	3.31	0.167	0	0	0
Sales of space heating units - Electric Heat Pump (%)	32.3	47.7	81.1	88.9	89.3	89.3	89.2
Sales of space heating units - Electric Resistance (%)	22.7	22.3	9.54	6.48	6.3	6.42	6.45
Sales of space heating units - Fossil (%)	11.5	13.1	4.52	2.55	2.46	2.42	2.41
Sales of space heating units - Gas (%)	33.5	16.9	4.84	2.03	1.91	1.91	1.9
Sales of water heating units - Electric Heat Pump (%)	0	10	53.3	63.1	63.6	63.6	63.6
Sales of water heating units - Electric Resistance (%)	61.4	68.3	40.5	34.3	34	34	34
Sales of water heating units - Gas Furnace (%)	34.3	18.9	3.74	0.187	0.002	0	0
Sales of water heating units - Other (%)	4.29	2.81	2.47	2.4	2.41	2.42	2.43

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

Item	2020	2025	2030	2035	2040	2045	2050
Light-duty vehicle capital costs - Cumulative 5-yr (million $2018)	0	1,572	4,040	6,528	9,896	10,763	10,266
Public EV charging plugs - DC Fast (1000 units)	0.286	0	3.07	0	13.3	0	21.5
Public EV charging plugs - L2 (1000 units)	1.4	0	73.8	0	320	0	517
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 (%)	1.48	1.75	1.23	0.393	0.073	0.013	0
Vehicle sales - Light-duty - EV (%)	4.15	15.9	47.5	82.2	96.4	99.3	100
Vehicle sales - Light-duty - gasoline (%)	89.5	77.2	47.7	16.1	3.23	0.588	0
Vehicle sales - Light-duty - hybrid (%)	4.65	4.71	3.29	1.21	0.297	0.065	0
Vehicle sales - Light-duty - hydrogen FC (%)	0.11	0.336	0.197	0.061	0.012	0.002	0
Vehicle sales - Light-duty - other (%)	0.099	0.094	0.061	0.021	0.004	0.001	0
Vehicle sales - Medium-duty - diesel (%)	64.7	59.7	42.3	14.4	2.59	0.384	0

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

Item	2020	2025	2030	2035	2040	2045	2050
Vehicle sales - Medium-duty - EV (%)	0.784	5.07	25.3	60.8	76.5	79.5	80
Vehicle sales - Medium-duty - gasoline (%)	33.7	33.3	25.5	9.32	1.77	0.277	0
Vehicle sales - Medium-duty - hybrid (%)	0.363	0.402	0.341	0.14	0.03	0.005	0
Vehicle sales - Medium-duty - hydrogen FC (%)	0.196	1.27	6.33	15.2	19.1	19.9	20
Vehicle sales - Medium-duty - other (%)	0.253	0.255	0.205	0.083	0.019	0.004	0

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

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Commercial (PJ)	253	254	245	233	223	220	224
Final energy use - Industry (PJ)	343	347	348	344	341	338	339
Final energy use - Residential (PJ)	355	335	313	283	260	247	242
Final energy use - Transportation (PJ)	917	853	749	620	504	431	398

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	34,334	38,227	0	0	0	0
Sales of cooking units - Electric Resistance (%)	32	46	79.9	86.5	86.9	86.9	86.9
Sales of cooking units - Gas (%)	68	54	20.1	13.5	13.1	13.1	13.1
Sales of space heating units - Electric Heat Pump (%)	8.09	27.7	70	83.7	85	85.1	85.1
Sales of space heating units - Electric Resistance (%)	7.4	8.38	10.5	12.6	13	13	13
Sales of space heating units - Fossil (%)	6.11	4.04	0.768	0.033	0	0	0
Sales of space heating units - Gas Furnace (%)	78.4	59.9	18.7	3.71	1.95	1.9	1.9
Sales of water heating units - Electric Heat Pump (%)	0.257	10.4	53.9	64	64.5	64.5	64.5
Sales of water heating units - Electric Resistance (%)	6.38	10.9	28.3	32.5	32.8	32.8	32.8
Sales of water heating units - Gas Furnace (%)	88.8	74.6	14.8	0.738	0.009	0	0
Sales of water heating units - Other (%)	4.56	4.13	3.01	2.74	2.74	2.73	2.73

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	6.1	6.25	10.2	10.8	10.4	10.8

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	0.351	0.989	7.64	7.58	5.7	1.48
Capital invested - Solar PV - Constrained (billion $2018)	0	1.15	0.299	6.56	6.89	6.54	0
Capital invested - Wind - Base (billion $2018)	0	0.052	0	0	0.056	0	0
Capital invested - Wind - Constrained (billion $2018)	0	0.049	0.06	0	0	0	0

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

Item	2020	2025	2030	2035	2040	2045	2050
Solar - Base land use assumptions (GWh)	3,833	510	1,609	13,501	14,099	11,285	3,070
Solar - Constrained land use assumptions (GWh)	3,350	1,650	487	11,596	12,828	12,962	0
Wind - Base land use assumptions (GWh)	734	127	0	0	152	0	0
Wind - Constrained land use assumptions (GWh)	734	119	145	0	0	0	0

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

Item	2020	2025	2050
Carbon sink potential - Aggressive deployment - Corn-ethanol to energy grasses (1000 tCO2e/y)	0	0	-207
Carbon sink potential - Aggressive deployment - Cropland measures (1000 tCO2e/y)	0	0	-2,978
Carbon sink potential - Aggressive deployment - Permanent conservation cover (1000 tCO2e/y)	0	0	-102
Carbon sink potential - Aggressive deployment - Total (1000 tCO2e/y)	0	0	-3,287
Carbon sink potential - Moderate deployment - Corn-ethanol to energy grasses (1000 tCO2e/y)	0	0	-207
Carbon sink potential - Moderate deployment - Cropland measures (1000 tCO2e/y)	0	0	-1,569
Carbon sink potential - Moderate deployment - Permanent conservation cover (1000 tCO2e/y)	0	0	-51
Carbon sink potential - Moderate deployment - Total (1000 tCO2e/y)	0	0	-1,827
Land impacted for carbon sink - Aggressive deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	117
Land impacted for carbon sink - Aggressive deployment - Cropland measures (1000 hectares)	0	0	1,723
Land impacted for carbon sink - Aggressive deployment - Permanent conservation cover (1000 hectares)	0	0	186
Land impacted for carbon sink - Aggressive deployment - Total (1000 hectares)	0	0	2,025
Land impacted for carbon sink - Moderate deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	117
Land impacted for carbon sink - Moderate deployment - Cropland measures (1000 hectares)	0	0	908
Land impacted for carbon sink - Moderate deployment - Permanent conservation cover (1000 hectares)	0	0	92.8
Land impacted for carbon sink - Moderate deployment - Total (1000 hectares)	0	0	1,118

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	370
Carbon sink potential - High - All (not counting overlap) (1000 tCO2e/y)	0	0	44,532
Carbon sink potential - High - Avoid deforestation (1000 tCO2e/y)	0	0	3,061
Carbon sink potential - High - Extend rotation length (1000 tCO2e/y)	0	0	10,827
Carbon sink potential - High - Improve plantations (1000 tCO2e/y)	0	0	2,556
Carbon sink potential - High - Increase retention of HWP (1000 tCO2e/y)	0	0	17,779
Carbon sink potential - High - Increase trees outside forests (1000 tCO2e/y)	0	0	1,133
Carbon sink potential - High - Reforest cropland (1000 tCO2e/y)	0	0	567
Carbon sink potential - High - Reforest pasture (1000 tCO2e/y)	0	0	4,291
Carbon sink potential - High - Restore productivity (1000 tCO2e/y)	0	0	3,947
Carbon sink potential - Low - Accelerate regeneration (1000 tCO2e/y)	0	0	186

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

Item	2020	2025	2050
Carbon sink potential - Low - All (not counting overlap) (1000 tCO2e/y)	0	0	14,417
Carbon sink potential - Low - Avoid deforestation (1000 tCO2e/y)	0	0	510
Carbon sink potential - Low - Extend rotation length (1000 tCO2e/y)	0	0	4,159
Carbon sink potential - Low - Improve plantations (1000 tCO2e/y)	0	0	1,300
Carbon sink potential - Low - Increase retention of HWP (1000 tCO2e/y)	0	0	5,926
Carbon sink potential - Low - Increase trees outside forests (1000 tCO2e/y)	0	0	397
Carbon sink potential - Low - Reforest cropland (1000 tCO2e/y)	0	0	284
Carbon sink potential - Low - Reforest pasture (1000 tCO2e/y)	0	0	325
Carbon sink potential - Low - Restore productivity (1000 tCO2e/y)	0	0	1,331
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO2e/y)	0	0	278
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO2e/y)	0	0	29,452
Carbon sink potential - Mid - Avoid deforestation (1000 tCO2e/y)	0	0	1,785
Carbon sink potential - Mid - Extend rotation length (1000 tCO2e/y)	0	0	7,493
Carbon sink potential - Mid - Improve plantations (1000 tCO2e/y)	0	0	1,906
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO2e/y)	0	0	11,852
Carbon sink potential - Mid - Increase trees outside forests (1000 tCO2e/y)	0	0	765
Carbon sink potential - Mid - Reforest cropland (1000 tCO2e/y)	0	0	426
Carbon sink potential - Mid - Reforest pasture (1000 tCO2e/y)	0	0	2,308
Carbon sink potential - Mid - Restore productivity (1000 tCO2e/y)	0	0	2,639
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)	0	0	60.6
Land impacted for carbon sink potential - High - Avoid deforestation (over 30 years) (1000 hectares)	0	0	414
Land impacted for carbon sink potential - High - Extend rotation length (1000 hectares)	0	0	5,521
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)	0	0	942
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	108
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)	0	0	37.5
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)	0	0	122
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)	0	0	1,308
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)	0	0	8,513
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)	0	0	30.3

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

Item	2020	2025	2050
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)	0	0	389
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)	0	0	2,115
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)	0	0	471
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	56.7
Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares)	0	0	18.8
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)	0	0	21.1
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)	0	0	792
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)	0	0	3,894
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)	0	0	45.5
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)	0	0	402
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)	0	0	3,818
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)	0	0	708
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	82.2
Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares)	0	0	28.1
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)	0	0	153
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)	0	0	1,594
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)	0	0	6,831

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

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal (million 2019$)	0	698	0.953	0.922	0.77	0.547	0.048
Monetary damages from air pollution - Natural Gas (million 2019$)	0	578	457	461	351	107	36
Monetary damages from air pollution - Transportation (million 2019$)	0	2,831	2,683	2,069	1,209	552	210
Premature deaths from air pollution - Coal (deaths)	0	78.4	0.107	0.103	0.086	0.061	0.005
Premature deaths from air pollution - Natural Gas (deaths)	0	65.3	51.6	52	39.6	12.1	4.07
Premature deaths from air pollution - Transportation (deaths)	0	318	302	233	136	62	23.6

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	7.58	7.45	0	0	0	0
Sales of cooking units - Electric Resistance (%)	75.3	75.9	78.2	84.2	92.5	97.6	99.3

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

Item	2020	2025	2030	2035	2040	2045	2050
Sales of cooking units - Gas (%)	24.7	24.1	21.8	15.8	7.55	2.44	0.656
Sales of space heating units - Electric Heat Pump (%)	32.3	41.3	45.1	56.1	73	84	87.9
Sales of space heating units - Electric Resistance (%)	22.7	24.7	23.3	18.9	12.4	8.34	6.89
Sales of space heating units - Fossil (%)	11.5	14.8	13.8	11	6.65	3.78	2.79
Sales of space heating units - Gas (%)	33.5	19.2	17.8	13.9	7.91	3.85	2.41
Sales of water heating units - Electric Heat Pump (%)	0	1.73	6.65	20.8	42.6	56.9	61.8
Sales of water heating units - Electric Resistance (%)	61.4	73.6	70.5	61.3	47.3	38.2	35.1
Sales of water heating units - Gas Furnace (%)	34.3	21.8	20	15.2	7.52	2.43	0.641
Sales of water heating units - Other (%)	4.29	2.87	2.83	2.74	2.59	2.48	2.44

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	256	534	1,808	5,675	8,272
Public EV charging plugs - DC Fast (1000 units)	0.286	0	0.97	0	4.96	0	13.8
Public EV charging plugs - L2 (1000 units)	1.4	0	23.3	0	119	0	331
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 (%)	1.49	1.92	2.04	1.62	1.03	0.529	0.227
Vehicle sales - Light-duty - EV (%)	1.97	4.86	12.2	26.4	49	72.4	87.7
Vehicle sales - Light-duty - gasoline (%)	91.5	87.1	79	65.9	45.5	24.4	10.8
Vehicle sales - Light-duty - hybrid (%)	4.83	5.62	6.28	5.69	4.23	2.48	1.19
Vehicle sales - Light-duty - hydrogen FC (%)	0.112	0.378	0.322	0.244	0.172	0.095	0.044
Vehicle sales - Light-duty - other (%)	0.1	0.103	0.094	0.081	0.058	0.032	0.015
Vehicle sales - Medium-duty - diesel (%)	64.8	62.2	57.7	49.4	35.6	19.6	8.37
Vehicle sales - Medium-duty - EV (%)	0.664	1.94	5.49	14.3	31.4	52.6	68
Vehicle sales - Medium-duty - gasoline (%)	33.8	34.7	34.7	31.9	24.4	14.2	6.33
Vehicle sales - Medium-duty - hybrid (%)	0.363	0.418	0.464	0.478	0.414	0.275	0.141
Vehicle sales - Medium-duty - hydrogen FC (%)	0.166	0.485	1.37	3.58	7.86	13.2	17
Vehicle sales - Medium-duty - other (%)	0.253	0.266	0.279	0.286	0.258	0.184	0.102

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

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Commercial (PJ)	253	255	252	248	242	237	235
Final energy use - Industry (PJ)	343	348	349	349	350	347	346
Final energy use - Residential (PJ)	355	336	326	315	300	282	265
Final energy use - Transportation (PJ)	918	861	785	722	672	613	544

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	34,313	38,231	0	0	0	0
Sales of cooking units - Electric Resistance (%)	32	36.2	40.9	53.4	71	81.7	85.5
Sales of cooking units - Gas (%)	68	63.8	59.1	46.6	29	18.3	14.5
Sales of space heating units - Electric Heat Pump (%)	8.09	19.7	24.6	38.6	60.7	76.6	82.8
Sales of space heating units - Electric Resistance (%)	7.4	8.06	8.29	9.07	10.5	11.9	12.7
Sales of space heating units - Fossil (%)	6.11	4.68	4.33	3.28	1.62	0.513	0.134
Sales of space heating units - Gas Furnace (%)	78.4	67.5	62.8	49.1	27.1	11	4.45
Sales of water heating units - Electric Heat Pump (%)	0.257	2.02	6.97	21.3	43.2	57.6	62.7

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

Item	2020	2025	2030	2035	2040	2045	2050
Sales of water heating units - Electric Resistance (%)	6.38	7.55	9.45	15.2	24.1	29.9	32
Sales of water heating units - Gas Furnace (%)	88.8	86.1	79.3	59.7	29.4	9.53	2.51
Sales of water heating units - Other (%)	4.56	4.35	4.31	3.87	3.3	2.91	2.77

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	5.28	5.33	6.71	6.92	9.8	10.3

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	0.006	0.925	0	0	0	0
Capital invested - Biomass w/ccu allam power plant (billion $2018)	0	0	0	0	0	0	0
Capital invested - Biomass w/ccu power plant (billion $2018)	0	0	0	0	0	0	0

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

Item	2020	2025	2030	2035	2040	2045	2050
Biomass power plant (GWh)	0	11.5	1,827	1,827	1,827	1,827	1,827
Biomass w/ccu allam power plant (GWh)	0	0	0	0	0	0	0
Biomass w/ccu power plant (GWh)	0	0	0	0	0	0	0

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

Item	2020	2025	2030	2035	2040	2045	2050
Biomass purchases (million $2018/year)	0	314	656	656	656	656	656
Conversion capital investment - Cumulative 5-yr (million $2018)	0	6.65	0	0	0	0	0
Number of facilities - Allam power w ccu (quantity)	0	0	0	0	0	0	0
Number of facilities - Beccs hydrogen (quantity)	0	0	0	0	0	0	0
Number of facilities - Diesel (quantity)	0	0	0	1	1	1	1
Number of facilities - Diesel ccu (quantity)	0	0	0	0	0	0	0
Number of facilities - Power (quantity)	0	1	1	1	1	1	1
Number of facilities - Power ccu (quantity)	0	0	0	0	0	0	0
Number of facilities - Pyrolysis (quantity)	0	0	0	1	1	1	1
Number of facilities - Pyrolysis ccu (quantity)	0	0	0	0	0	0	0
Number of facilities - Sng (quantity)	0	1	1	1	1	1	1
Number of facilities - Sng ccu (quantity)	0	0	0	0	0	0	0

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

Item	2020	2025	2030	2035	2040	2045	2050
Annual - All (MMT)	0	0	0	0	0	0	0
Annual - BECCS (MMT)	0	0	0	0	0	0	0
Annual - Cement and lime (MMT)	0	0	0	0	0	0	0
Annual - NGCC (MMT)	0	0	0	0	0	0	0
Cumulative - All (MMT)	0	0	0	0	0	0	0
Cumulative - BECCS (MMT)	0	0	0	0	0	0	0
Cumulative - Cement and lime (MMT)	0	0	0	0	0	0	0
Cumulative - NGCC (MMT)	0	0	0	0	0	0	0

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

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

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

Item	2020	2025	2030	2035	2040	2045	2050
All (km)	0	0	0	227	227	227	358
Cumulative investment - All (million $2018)	0	0	0	1,354	1,354	1,354	1,459
Cumulative investment - Spur (million $2018)	0	0	0	0	0	0	105
Cumulative investment - Trunk (million $2018)	0	0	0	1,354	1,354	1,354	1,354
Spur (km)	0	0	0	0	0	0	130
Trunk (km)	0	0	0	227	227	227	227

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	-639
Carbon sink potential - Aggressive deployment - Cropland measures (1000 tCO2e/y)	0	0	-2,559
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	-86.7
Carbon sink potential - Aggressive deployment - Total (1000 tCO2e/y)	0	0	-3,285
Carbon sink potential - Moderate deployment - Corn-ethanol to energy grasses (1000 tCO2e/y)	0	0	-639
Carbon sink potential - Moderate deployment - Cropland measures (1000 tCO2e/y)	0	0	-1,348
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	-43.3
Carbon sink potential - Moderate deployment - Total (1000 tCO2e/y)	0	0	-2,030
Land impacted for carbon sink - Aggressive deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	379
Land impacted for carbon sink - Aggressive deployment - Cropland measures (1000 hectares)	0	0	3,635
Land impacted for carbon sink - Aggressive deployment - Cropland to woody energy crops (1000 hectares)	0	0	104
Land impacted for carbon sink - Aggressive deployment - Pasture to energy crops (1000 hectares)	0	0	134
Land impacted for carbon sink - Aggressive deployment - Permanent conservation cover (1000 hectares)	0	0	158
Land impacted for carbon sink - Aggressive deployment - Total (1000 hectares)	0	0	4,410
Land impacted for carbon sink - Moderate deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	379

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

Item	2020	2025	2050
Land impacted for carbon sink - Moderate deployment - Cropland measures (1000 hectares)	0	0	775
Land impacted for carbon sink - Moderate deployment - Cropland to woody energy crops (1000 hectares)	0	0	104
Land impacted for carbon sink - Moderate deployment - Pasture to energy crops (1000 hectares)	0	0	134
Land impacted for carbon sink - Moderate deployment - Permanent conservation cover (1000 hectares)	0	0	78.8
Land impacted for carbon sink - Moderate deployment - Total (1000 hectares)	0	0	1,472

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	370
Carbon sink potential - High - All (not counting overlap) (1000 tCO2e/y)	0	0	44,532
Carbon sink potential - High - Avoid deforestation (1000 tCO2e/y)	0	0	3,061
Carbon sink potential - High - Extend rotation length (1000 tCO2e/y)	0	0	10,827
Carbon sink potential - High - Improve plantations (1000 tCO2e/y)	0	0	2,556
Carbon sink potential - High - Increase retention of HWP (1000 tCO2e/y)	0	0	17,779
Carbon sink potential - High - Increase trees outside forests (1000 tCO2e/y)	0	0	1,133
Carbon sink potential - High - Reforest cropland (1000 tCO2e/y)	0	0	567
Carbon sink potential - High - Reforest pasture (1000 tCO2e/y)	0	0	4,291
Carbon sink potential - High - Restore productivity (1000 tCO2e/y)	0	0	3,947
Carbon sink potential - Low - Accelerate regeneration (1000 tCO2e/y)	0	0	186
Carbon sink potential - Low - All (not counting overlap) (1000 tCO2e/y)	0	0	14,417
Carbon sink potential - Low - Avoid deforestation (1000 tCO2e/y)	0	0	510
Carbon sink potential - Low - Extend rotation length (1000 tCO2e/y)	0	0	4,159
Carbon sink potential - Low - Improve plantations (1000 tCO2e/y)	0	0	1,300
Carbon sink potential - Low - Increase retention of HWP (1000 tCO2e/y)	0	0	5,926
Carbon sink potential - Low - Increase trees outside forests (1000 tCO2e/y)	0	0	397
Carbon sink potential - Low - Reforest cropland (1000 tCO2e/y)	0	0	284
Carbon sink potential - Low - Reforest pasture (1000 tCO2e/y)	0	0	325
Carbon sink potential - Low - Restore productivity (1000 tCO2e/y)	0	0	1,331
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO2e/y)	0	0	278
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO2e/y)	0	0	29,452
Carbon sink potential - Mid - Avoid deforestation (1000 tCO2e/y)	0	0	1,785

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

Item	2020	2025	2050
Carbon sink potential - Mid - Extend rotation length (1000 tCO2e/y)	0	0	7,493
Carbon sink potential - Mid - Improve plantations (1000 tCO2e/y)	0	0	1,906
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO2e/y)	0	0	11,852
Carbon sink potential - Mid - Increase trees outside forests (1000 tCO2e/y)	0	0	765
Carbon sink potential - Mid - Reforest cropland (1000 tCO2e/y)	0	0	426
Carbon sink potential - Mid - Reforest pasture (1000 tCO2e/y)	0	0	2,308
Carbon sink potential - Mid - Restore productivity (1000 tCO2e/y)	0	0	2,639
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)	0	0	60.6
Land impacted for carbon sink potential - High - Avoid deforestation (over 30 years) (1000 hectares)	0	0	414
Land impacted for carbon sink potential - High - Extend rotation length (1000 hectares)	0	0	5,521
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)	0	0	942
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	108
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)	0	0	37.5
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)	0	0	122
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)	0	0	1,308
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)	0	0	8,513
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)	0	0	30.3
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)	0	0	389
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)	0	0	2,115
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)	0	0	471
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	56.7
Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares)	0	0	18.8
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)	0	0	21.1
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)	0	0	792
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)	0	0	3,894
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)	0	0	45.5
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)	0	0	402
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)	0	0	3,818

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

Item	2020	2025	2050
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)	0	0	708
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	82.2
Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares)	0	0	28.1
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)	0	0	153
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)	0	0	1,594
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)	0	0	6,831

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	7.46	6.79	0	0	0	0
Sales of cooking units - Electric Resistance (%)	75.1	75.1	75.1	75.1	75.1	75.1	75.1
Sales of cooking units - Gas (%)	24.9	24.9	24.9	24.9	24.9	24.9	24.9
Sales of space heating units - Electric Heat Pump (%)	30.3	53.9	54.7	55.8	56.8	58.1	60.1
Sales of space heating units - Electric Resistance (%)	23.3	20.2	19.9	19.3	18.5	17.3	15.2
Sales of space heating units - Fossil (%)	11.8	10.1	7.34	6.13	5.97	5.93	5.99
Sales of space heating units - Gas (%)	34.5	15.8	18.1	18.8	18.7	18.7	18.7
Sales of water heating units - Electric Heat Pump (%)	0	0	0	0	0	0	0
Sales of water heating units - Electric Resistance (%)	61.4	74.7	74.8	74.6	74.5	74.5	74.4
Sales of water heating units - Gas Furnace (%)	34.3	22.4	22.4	22.5	22.6	22.6	22.7
Sales of water heating units - Other (%)	4.29	2.88	2.88	2.9	2.93	2.93	2.94

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 (%)	1.48	1.91	2.17	2.02	1.82	1.69	1.61
Vehicle sales - Light-duty - EV (%)	3.79	5.9	6.7	8.25	10	11.5	12.7
Vehicle sales - Light-duty - gasoline (%)	89.8	86.2	84	82	79.9	78	76.5
Vehicle sales - Light-duty - hybrid (%)	4.67	5.5	6.72	7.28	7.83	8.38	8.78
Vehicle sales - Light-duty - hydrogen FC (%)	0.11	0.374	0.342	0.303	0.299	0.299	0.31
Vehicle sales - Light-duty - other (%)	0.099	0.103	0.099	0.099	0.099	0.098	0.1
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)	253	258	261	264	267	276	291
Final energy use - Industry (PJ)	344	359	375	389	406	422	442
Final energy use - Residential (PJ)	355	338	334	334	339	348	357

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

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Transportation (PJ)	917	863	796	756	756	778	806

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	33,829	35,143	0	0	0	0
Sales of cooking units - Electric Resistance (%)	32	34.3	34.3	34.3	34.4	34.3	34.3
Sales of cooking units - Gas (%)	68	65.7	65.7	65.7	65.6	65.7	65.7
Sales of space heating units - Electric Heat Pump (%)	8.09	26.8	56.4	70.2	72	72.2	72.3
Sales of space heating units - Electric Resistance (%)	7.4	9.19	13.8	20.2	25.1	25.8	25.8
Sales of space heating units - Fossil (%)	6.11	4.41	2.99	1.35	0.201	0.017	0
Sales of space heating units - Gas Furnace (%)	78.4	59.6	26.8	8.28	2.71	1.96	1.9
Sales of water heating units - Electric Heat Pump (%)	0.257	0.277	0.272	0.274	0.275	0.273	0.274
Sales of water heating units - Electric Resistance (%)	6.38	6.85	6.76	6.78	6.8	6.76	6.77
Sales of water heating units - Gas Furnace (%)	88.8	88.5	88.5	88.5	88.5	88.5	88.5
Sales of water heating units - Other (%)	4.56	4.4	4.5	4.42	4.47	4.48	4.45

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	6.29	6.46	8.19	8.55	7.99	8.24

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

Item	2020	2025	2030	2050
Business-as-usual carbon sink - Natural uptake (Mt CO2e/y)	-30.9	0	-14.5	-11.7
Business-as-usual carbon sink - Retained in Hardwood Products (Mt CO2e/y)	-4.84	0	-8.07	-8.49
Business-as-usual carbon sink - Total (Mt CO2e/y)	-35.8	0	-22.6	-20.2
Carbon sink potential - High - Accelerate regeneration (1000 tCO2e/y)	0	0	0	370
Carbon sink potential - High - All (not counting overlap) (1000 tCO2e/y)	0	0	0	44,532
Carbon sink potential - High - Avoid deforestation (1000 tCO2e/y)	0	0	0	3,061
Carbon sink potential - High - Extend rotation length (1000 tCO2e/y)	0	0	0	10,827
Carbon sink potential - High - Improve plantations (1000 tCO2e/y)	0	0	0	2,556
Carbon sink potential - High - Increase retention of HWP (1000 tCO2e/y)	0	0	0	17,779
Carbon sink potential - High - Increase trees outside forests (1000 tCO2e/y)	0	0	0	1,133
Carbon sink potential - High - Reforest cropland (1000 tCO2e/y)	0	0	0	567
Carbon sink potential - High - Reforest pasture (1000 tCO2e/y)	0	0	0	4,291
Carbon sink potential - High - Restore productivity (1000 tCO2e/y)	0	0	0	3,947
Carbon sink potential - Low - Accelerate regeneration (1000 tCO2e/y)	0	0	0	186
Carbon sink potential - Low - All (not counting overlap) (1000 tCO2e/y)	0	0	0	14,417
Carbon sink potential - Low - Avoid deforestation (1000 tCO2e/y)	0	0	0	510

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

Item	2020	2025	2030	2050
Carbon sink potential - Low - Extend rotation length (1000 tCO2e/y)	0	0	0	4,159
Carbon sink potential - Low - Improve plantations (1000 tCO2e/y)	0	0	0	1,300
Carbon sink potential - Low - Increase retention of HWP (1000 tCO2e/y)	0	0	0	5,926
Carbon sink potential - Low - Increase trees outside forests (1000 tCO2e/y)	0	0	0	397
Carbon sink potential - Low - Reforest cropland (1000 tCO2e/y)	0	0	0	284
Carbon sink potential - Low - Reforest pasture (1000 tCO2e/y)	0	0	0	325
Carbon sink potential - Low - Restore productivity (1000 tCO2e/y)	0	0	0	1,331
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO2e/y)	0	0	0	278
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO2e/y)	0	0	0	29,452
Carbon sink potential - Mid - Avoid deforestation (1000 tCO2e/y)	0	0	0	1,785
Carbon sink potential - Mid - Extend rotation length (1000 tCO2e/y)	0	0	0	7,493
Carbon sink potential - Mid - Improve plantations (1000 tCO2e/y)	0	0	0	1,906
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO2e/y)	0	0	0	11,852
Carbon sink potential - Mid - Increase trees outside forests (1000 tCO2e/y)	0	0	0	765
Carbon sink potential - Mid - Reforest cropland (1000 tCO2e/y)	0	0	0	426
Carbon sink potential - Mid - Reforest pasture (1000 tCO2e/y)	0	0	0	2,308
Carbon sink potential - Mid - Restore productivity (1000 tCO2e/y)	0	0	0	2,639
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)	0	0	0	60.6
Land impacted for carbon sink potential - High - Avoid deforestation (over 30 years) (1000 hectares)	0	0	0	414
Land impacted for carbon sink potential - High - Extend rotation length (1000 hectares)	0	0	0	5,521
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)	0	0	0	942
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	108
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)	0	0	0	37.5
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)	0	0	0	122
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)	0	0	0	1,308
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)	0	0	0	8,513
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)	0	0	0	30.3
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)	0	0	0	389
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)	0	0	0	2,115

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

Item	2020	2025	2030	2050
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)	0	0	0	471
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	56.7
Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares)	0	0	0	18.8
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)	0	0	0	21.1
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)	0	0	0	792
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)	0	0	0	3,894
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)	0	0	0	45.5
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)	0	0	0	402
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)	0	0	0	3,818
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)	0	0	0	708
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	82.2
Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares)	0	0	0	28.1
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)	0	0	0	153
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)	0	0	0	1,594
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)	0	0	0	6,831

Table 64: *REF scenario - IMPACTS - Health*

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal (million 2019$)	0	2,290	1,493	1,300	1,212	1,176	1,119
Monetary damages from air pollution - Natural Gas (million 2019$)	0	397	445	518	510	562	542
Monetary damages from air pollution - Transportation (million 2019$)	0	2,876	2,995	3,110	3,238	3,364	3,495
Premature deaths from air pollution - Coal (deaths)	0	257	168	146	136	132	126
Premature deaths from air pollution - Natural Gas (deaths)	0	44.9	50.3	58.5	57.6	63.5	61.2
Premature deaths from air pollution - Transportation (deaths)	0	323	337	350	364	378	393