Net-Zero America - kansas 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	3.01	4.04	0	0	0	0
Sales of cooking units - Electric Resistance (%)	66.4	73.6	95.5	99.8	100	100	100
Sales of cooking units - Gas (%)	33.6	26.4	4.52	0.228	0	0	0
Sales of space heating units - Electric Heat Pump (%)	4.79	20.7	76.2	90.8	91.9	91.9	91.7
Sales of space heating units - Electric Resistance (%)	11.9	15	6.62	4.42	4.27	4.39	4.55
Sales of space heating units - Fossil (%)	5.87	9.2	4.05	2.66	2.42	2.31	2.37
Sales of space heating units - Gas (%)	77.4	55.1	13.1	2.17	1.44	1.41	1.38
Sales of water heating units - Electric Heat Pump (%)	0	9.31	49.7	59.7	60.3	60.3	60.3
Sales of water heating units - Electric Resistance (%)	27.3	41.9	39.5	39.6	39.7	39.7	39.7
Sales of water heating units - Gas Furnace (%)	72.7	48.8	10.7	0.692	0.019	0	0
Sales of water heating units - Other (%)	0.024	0.027	0.027	0.027	0.027	0.027	0.027

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	515	1,320	2,139	3,240	3,527	3,363
Public EV charging plugs - DC Fast (1000 units)	0.119	0	0.964	0	4.24	0	6.85
Public EV charging plugs - L2 (1000 units)	0.786	0	23.3	0	102	0	165
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 (%)	1.63	1.89	1.29	0.414	0.076	0.013	0
Vehicle sales - Light-duty - EV (%)	3.63	14.3	45.1	81.3	96.3	99.3	100
Vehicle sales - Light-duty - gasoline (%)	90.4	79	50.2	17.1	3.36	0.592	0
Vehicle sales - Light-duty - hybrid (%)	4.15	4.34	3.12	1.17	0.283	0.061	0
Vehicle sales - Light-duty - hydrogen FC (%)	0.111	0.344	0.21	0.065	0.013	0.002	0
Vehicle sales - Light-duty - other (%)	0.105	0.102	0.067	0.024	0.005	0.001	0
Vehicle sales - Medium-duty - diesel (%)	64.7	59.7	42.3	14.4	2.59	0.384	0
Vehicle sales - Medium-duty - EV (%)	0.784	5.07	25.3	60.8	76.5	79.5	80
Vehicle sales - Medium-duty - gasoline (%)	33.7	33.3	25.5	9.32	1.77	0.277	0
Vehicle sales - Medium-duty - hybrid (%)	0.363	0.402	0.341	0.14	0.03	0.005	0
Vehicle sales - Medium-duty - hydrogen FC (%)	0.196	1.27	6.33	15.2	19.1	19.9	20
Vehicle sales - Medium-duty - other (%)	0.253	0.255	0.205	0.083	0.019	0.004	0

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

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Commercial (PJ)	110	107	101	92.6	85.5	81	78.6
Final energy use - Industry (PJ)	174	182	189	190	195	204	206
Final energy use - Residential (PJ)	120	113	102	86.8	74.3	66.4	62.6
Final energy use - Transportation (PJ)	286	268	235	195	160	139	131

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	8,255	8,955	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 (%)	2.13	24.7	71.3	88	89.8	89.9	89.8
Sales of space heating units - Electric Resistance (%)	4.54	5.67	7.02	9.23	9.68	9.7	9.71
Sales of space heating units - Fossil (%)	0	1.73	0.333	0.014	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 (%)	93.3	67.9	21.4	2.81	0.539	0.45	0.45
Sales of water heating units - Electric Heat Pump (%)	0.677	10.7	53.8	64.7	65.3	65.3	65.3
Sales of water heating units - Electric Resistance (%)	5.85	10.9	28.5	33.6	34	34	34
Sales of water heating units - Gas Furnace (%)	92.9	77.4	17	1.1	0.03	0	0
Sales of water heating units - Other (%)	0.567	0.935	0.728	0.68	0.677	0.679	0.679

Table 5: *E+ scenario - PILLAR 1: Efficiency/Electrification - Electricity demand*

Item	2020	2025	2030	2035	2040	2045	2050
Electricity distribution capital invested - Cumulative 5-yr (billion $2018)	0	1.98	2.05	3.35	3.56	3.35	3.52

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	0.042
Capital invested - Biomass w/ccu power plant (billion $2018)	0	0	0	0	0	0	0.171
Capital invested - Solar PV - Base (billion $2018)	0	0	0	0	0	0	0.072
Capital invested - Solar PV - Constrained (billion $2018)	0	0.03	0	0.231	0	0	0.072
Capital invested - Wind - Base (billion $2018)	0	0	0.43	1.58	2.73	3.71	0.208
Capital invested - Wind - Constrained (billion $2018)	0	0.552	0.572	3.14	5.93	6.23	0.442

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	41.8
Biomass w/ccu power plant (GWh)	0	0	0	0	0	0	192
Solar - Base land use assumptions (GWh)	58.5	0	0	0	0	0	151
Solar - Constrained land use assumptions (GWh)	45.5	0	0	404	0	0	0
Wind - Base land use assumptions (GWh)	31,394	0	1,203	4,680	8,362	11,889	693
Wind - Constrained land use assumptions (GWh)	31,394	0	1,808	6,462	15,395	17,716	1,272

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

Item	2020	2025	2030	2035	2040	2045	2050
Biomass purchases (million $2018/year)	0	0	0	461	461	853	1,051
Conversion capital investment - Cumulative 5-yr (million $2018)	0	0	0	6,624	0	5,640	2,843
Number of facilities - Allam power w ccu (quantity)	0	0	0	0	0	0	1
Number of facilities - Beccs hydrogen (quantity)	0	0	0	6	6	11	13
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	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	1
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	0.01	8.54	11.9	19.2	23
Annual - BECCS (MMT)	0	0	0	8.51	8.51	15.8	19.4
Annual - Cement and lime (MMT)	0	0	0	0	3.32	3.42	3.53
Annual - NGCC (MMT)	0	0	0.01	0.03	0.02	0.02	0.02
Cumulative - All (MMT)	0	0	0.01	8.55	20.4	39.6	62.6
Cumulative - BECCS (MMT)	0	0	0	8.51	17	32.8	52.2
Cumulative - Cement and lime (MMT)	0	0	0	0	3.32	6.74	10.3
Cumulative - NGCC (MMT)	0	0	0.01	0.04	0.06	0.08	0.1

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

Item	2020	2025	2030	2035	2040	2045	2050
CO2 storage (MMT)	0	0	0	1.76	2.71	4.3	5.59
Injection wells (wells)	0	0	1	3	6	10	12
Resource characterization, appraisal, permitting costs (million $2020)	0	77.2	185	216	216	216	216
Wells and facilities construction costs (million $2020)	0	0	25.7	100	178	298	371

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

Item	2020	2025	2030	2035	2040	2045	2050
All (km)	0	0	1,055	2,020	2,287	2,644	3,263
Cumulative investment - All (million $2018)	0	0	4,984	7,372	7,594	7,850	8,335
Cumulative investment - Spur (million $2018)	0	0	30.9	494	715	971	1,456
Cumulative investment - Trunk (million $2018)	0	0	4,953	6,879	6,879	6,879	6,879
Spur (km)	0	0	58.5	659	926	1,283	1,902
Trunk (km)	0	0	997	1,361	1,361	1,361	1,361

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	-696
Carbon sink potential - Aggressive deployment - Cropland measures (1000 tCO2e/y)	0	0	-10,263
Carbon sink potential - Aggressive deployment - Permanent conservation cover (1000 tCO2e/y)	0	0	-624
Carbon sink potential - Aggressive deployment - Total (1000 tCO2e/y)	0	0	-11,583
Carbon sink potential - Moderate deployment - Corn-ethanol to energy grasses (1000 tCO2e/y)	0	0	-696
Carbon sink potential - Moderate deployment - Cropland measures (1000 tCO2e/y)	0	0	-5,387
Carbon sink potential - Moderate deployment - Permanent conservation cover (1000 tCO2e/y)	0	0	-312
Carbon sink potential - Moderate deployment - Total (1000 tCO2e/y)	0	0	-6,395
Land impacted for carbon sink - Aggressive deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	413
Land impacted for carbon sink - Aggressive deployment - Cropland measures (1000 hectares)	0	0	10,336
Land impacted for carbon sink - Aggressive deployment - Permanent conservation cover (1000 hectares)	0	0	1,047
Land impacted for carbon sink - Aggressive deployment - Total (1000 hectares)	0	0	11,796
Land impacted for carbon sink - Moderate deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	413

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

Item	2020	2025	2050
Land impacted for carbon sink - Moderate deployment - Cropland measures (1000 hectares)	0	0	5,430
Land impacted for carbon sink - Moderate deployment - Permanent conservation cover (1000 hectares)	0	0	524
Land impacted for carbon sink - Moderate deployment - Total (1000 hectares)	0	0	6,366

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

Item	2020	2025	2050
Carbon sink potential - High - Accelerate regeneration (1000 tCO2e/y)	0	0	149
Carbon sink potential - High - All (not counting overlap) (1000 tCO2e/y)	0	0	41,112
Carbon sink potential - High - Avoid deforestation (1000 tCO2e/y)	0	0	1,700
Carbon sink potential - High - Extend rotation length (1000 tCO2e/y)	0	0	983
Carbon sink potential - High - Improve plantations (1000 tCO2e/y)	0	0	44.9
Carbon sink potential - High - Increase retention of HWP (1000 tCO2e/y)	0	0	536
Carbon sink potential - High - Increase trees outside forests (1000 tCO2e/y)	0	0	3,607
Carbon sink potential - High - Reforest cropland (1000 tCO2e/y)	0	0	26,772
Carbon sink potential - High - Reforest pasture (1000 tCO2e/y)	0	0	6,646
Carbon sink potential - High - Restore productivity (1000 tCO2e/y)	0	0	674
Carbon sink potential - Low - Accelerate regeneration (1000 tCO2e/y)	0	0	74.7
Carbon sink potential - Low - All (not counting overlap) (1000 tCO2e/y)	0	0	16,316
Carbon sink potential - Low - Avoid deforestation (1000 tCO2e/y)	0	0	283
Carbon sink potential - Low - Extend rotation length (1000 tCO2e/y)	0	0	378
Carbon sink potential - Low - Improve plantations (1000 tCO2e/y)	0	0	22.8
Carbon sink potential - Low - Increase retention of HWP (1000 tCO2e/y)	0	0	179
Carbon sink potential - Low - Increase trees outside forests (1000 tCO2e/y)	0	0	1,263
Carbon sink potential - Low - Reforest cropland (1000 tCO2e/y)	0	0	13,386
Carbon sink potential - Low - Reforest pasture (1000 tCO2e/y)	0	0	503
Carbon sink potential - Low - Restore productivity (1000 tCO2e/y)	0	0	227
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO2e/y)	0	0	112
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO2e/y)	0	0	28,714
Carbon sink potential - Mid - Avoid deforestation (1000 tCO2e/y)	0	0	992
Carbon sink potential - Mid - Extend rotation length (1000 tCO2e/y)	0	0	680
Carbon sink potential - Mid - Improve plantations (1000 tCO2e/y)	0	0	33.4
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO2e/y)	0	0	357

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

Item	2020	2025	2050
Carbon sink potential - Mid - Increase trees outside forests (1000 tCO2e/y)	0	0	2,435
Carbon sink potential - Mid - Reforest cropland (1000 tCO2e/y)	0	0	20,079
Carbon sink potential - Mid - Reforest pasture (1000 tCO2e/y)	0	0	3,575
Carbon sink potential - Mid - Restore productivity (1000 tCO2e/y)	0	0	451
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)	0	0	24.4
Land impacted for carbon sink potential - High - Avoid deforestation (over 30 years) (1000 hectares)	0	0	230
Land impacted for carbon sink potential - High - Extend rotation length (1000 hectares)	0	0	501
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)	0	0	16.5
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	343
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)	0	0	1,770
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)	0	0	189
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)	0	0	223
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)	0	0	3,297
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)	0	0	12.2
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)	0	0	216
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)	0	0	192
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)	0	0	8.26
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	180
Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares)	0	0	885
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)	0	0	32.7
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)	0	0	135
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)	0	0	1,662
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)	0	0	18.3
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)	0	0	223
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)	0	0	347
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)	0	0	12.4
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	262

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

Item	2020	2025	2050
Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares)	0	0	1,328
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)	0	0	237
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)	0	0	272
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)	0	0	2,699

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

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal (million 2019$)	0	198	0.196	0.189	0.157	0.102	0.002
Monetary damages from air pollution - Natural Gas (million 2019$)	0	124	61.4	29	22	13.5	6.87
Monetary damages from air pollution - Transportation (million 2019$)	0	408	381	291	169	78.3	32.6
Premature deaths from air pollution - Coal (deaths)	0	22.2	0.022	0.021	0.018	0.011	0
Premature deaths from air pollution - Natural Gas (deaths)	0	14	6.93	3.27	2.48	1.53	0.776
Premature deaths from air pollution - Transportation (deaths)	0	45.8	42.9	32.7	19	8.81	3.67

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

Item	2020	2025	2030	2035	2040	2045	2050
By economic sector - Agriculture (jobs)	859	859	862	1,542	1,069	1,011	967
By economic sector - Construction (jobs)	7,260	7,087	8,243	8,491	8,274	9,418	9,949
By economic sector - Manufacturing (jobs)	5,718	9,499	10,949	13,842	12,820	10,621	12,644
By economic sector - Mining (jobs)	6,924	5,896	4,715	3,680	2,449	1,671	1,018
By economic sector - Other (jobs)	607	589	604	795	998	1,266	1,675
By economic sector - Pipeline (jobs)	457	462	898	638	333	282	285
By economic sector - Professional (jobs)	4,807	4,808	4,519	5,658	5,807	7,081	7,424
By economic sector - Trade (jobs)	4,275	3,966	3,634	3,760	3,632	4,017	4,200
By economic sector - Utilities (jobs)	5,724	5,314	6,897	6,851	6,241	7,443	7,285
By education level - All sectors - Associates degree or some college (jobs)	10,710	11,362	12,518	13,637	12,731	13,228	14,164
By education level - All sectors - Bachelors degree (jobs)	8,378	8,681	8,921	9,627	8,800	9,042	9,460
By education level - All sectors - Doctoral degree (jobs)	300	298	285	318	301	337	348
By education level - All sectors - High school diploma or less (jobs)	15,205	16,075	17,520	19,421	17,711	17,987	19,178
By education level - All sectors - Masters or professional degree (jobs)	2,038	2,063	2,078	2,254	2,080	2,213	2,296
By resource sector - Biomass (jobs)	2,076	2,016	1,965	3,877	2,915	3,727	4,270
By resource sector - CO2 (jobs)	0	40.2	4,051	2,478	673	946	1,523
By resource sector - Coal (jobs)	1,461	375	0	0	0	0	0
By resource sector - Grid (jobs)	6,400	6,177	6,527	8,658	9,892	12,196	11,959
By resource sector - Natural Gas (jobs)	4,807	4,634	3,727	3,007	2,479	1,988	1,210
By resource sector - Nuclear (jobs)	650	640	630	365	0.013	0.015	0.026
By resource sector - Oil (jobs)	12,613	11,916	10,519	9,106	6,609	4,912	3,139
By resource sector - Solar (jobs)	3,534	4,543	5,079	7,264	8,239	8,410	12,458
By resource sector - Wind (jobs)	5,089	8,138	8,823	10,502	10,816	10,627	10,886
Median wages - Annual - All ($2019 per job)	56,238	56,394	56,747	56,900	57,507	58,686	58,809
On-Site or In-Plant Training - Total jobs - 1 to 4 years (jobs)	5,712	5,990	6,559	7,079	6,552	6,789	7,192
On-Site or In-Plant Training - Total jobs - 4 to 10 years (jobs)	2,288	2,286	2,537	2,643	2,457	2,663	2,767
On-Site or In-Plant Training - Total jobs - None (jobs)	5,944	6,281	6,694	7,399	6,834	7,049	7,535

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

Item	2020	2025	2030	2035	2040	2045	2050
On-Site or In-Plant Training - Total jobs - Over 10 years (jobs)	280	296	334	362	338	356	378
On-Site or In-Plant Training - Total jobs - Up to 1 year (jobs)	22,408	23,626	25,197	27,774	25,442	25,951	27,574
On-the-Job Training - All sectors - 1 to 4 years (jobs)	7,279	7,616	8,369	8,993	8,342	8,687	9,197
On-the-Job Training - All sectors - 4 to 10 years (jobs)	2,135	2,124	2,390	2,494	2,341	2,572	2,684
On-the-Job Training - All sectors - None (jobs)	2,081	2,151	2,243	2,438	2,238	2,308	2,466
On-the-Job Training - All sectors - Over 10 years (jobs)	354	391	426	464	427	422	459
On-the-Job Training - All sectors - Up to 1 year (jobs)	24,782	26,198	27,894	30,868	28,275	28,818	30,640
Related work experience - All sectors - 1 to 4 years (jobs)	13,331	13,916	14,859	16,205	14,916	15,393	16,241
Related work experience - All sectors - 4 to 10 years (jobs)	8,469	8,861	9,535	10,294	9,513	9,860	10,418
Related work experience - All sectors - None (jobs)	5,171	5,414	5,885	6,454	5,918	6,112	6,499
Related work experience - All sectors - Over 10 years (jobs)	2,325	2,492	2,665	2,895	2,663	2,691	2,862
Related work experience - All sectors - Up to 1 year (jobs)	7,335	7,797	8,378	9,408	8,613	8,752	9,427
Wage income - All (million $2019)	2,060	2,170	2,345	2,575	2,394	2,512	2,673

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

Item	2020	2025	2030	2035	2040	2045	2050
Natural gas consumption - Annual (tcf)	236	240	202	162	122	76.7	53.2
Natural gas consumption - Cumulative (tcf)	0	0	0	0	0	0	4,880
Natural gas production - Annual (tcf)	201	223	211	184	155	123	95.6
Oil consumption - Annual (million bbls)	85.4	82.3	73.3	59.2	45.7	35.1	26.3
Oil consumption - Cumulative (million bbls)	0	0	0	0	0	0	1,813
Oil production - Annual (million bbls)	41.6	45	45.1	45.1	35.7	29	19.3

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

Item	2020	2025	2030	2035	2040	2045	2050
Residential HVAC investment in 2020s vs. REF - Cumulative 5-yr (billion $2018)	0	2.99	4.02	0	0	0	0
Sales of cooking units - Electric Resistance (%)	66.3	67.2	70.2	78.4	89.7	96.7	99.1
Sales of cooking units - Gas (%)	33.7	32.8	29.8	21.6	10.3	3.33	0.895
Sales of space heating units - Electric Heat Pump (%)	4.79	10.1	16.5	34.7	63.2	82.5	89.3
Sales of space heating units - Electric Resistance (%)	11.9	16.6	15.6	12.9	8.54	5.65	4.74
Sales of space heating units - Fossil (%)	5.87	10.2	9.69	7.94	5.1	3.2	2.63
Sales of space heating units - Gas (%)	77.4	63	58.2	44.5	23.1	8.65	3.34
Sales of water heating units - Electric Heat Pump (%)	0	1.62	6.21	19.5	40	53.6	58.5
Sales of water heating units - Electric Resistance (%)	27.3	42.3	42	41.2	40.3	39.8	39.7
Sales of water heating units - Gas Furnace (%)	72.7	56	51.8	39.3	19.8	6.56	1.76
Sales of water heating units - Other (%)	0.024	0.027	0.027	0.027	0.027	0.027	0.027

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	83.3	175	591	1,861	2,710
Public EV charging plugs - DC Fast (1000 units)	0.119	0	0.298	0	1.57	0	4.39
Public EV charging plugs - L2 (1000 units)	0.786	0	7.18	0	37.9	0	106
Vehicle sales - Heavy-duty - diesel (%)	97.4	96	91.3	79.8	58.2	32.1	13.7

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

Item	2020	2025	2030	2035	2040	2045	2050
Vehicle sales - Heavy-duty - EV (%)	0.498	1.45	4.11	10.8	23.6	39.5	51
Vehicle sales - Heavy-duty - gasoline (%)	0.228	0.236	0.239	0.225	0.179	0.109	0.051
Vehicle sales - Heavy-duty - hybrid (%)	0.083	0.094	0.104	0.107	0.092	0.06	0.03
Vehicle sales - Heavy-duty - hydrogen FC (%)	0.332	0.969	2.74	7.17	15.7	26.3	34
Vehicle sales - Heavy-duty - other (%)	1.5	1.28	1.46	1.95	2.25	1.96	1.14
Vehicle sales - Light-duty - diesel (%)	1.65	2.04	2.07	1.65	1.06	0.548	0.234
Vehicle sales - Light-duty - EV (%)	1.79	4.46	11.4	25.1	47.6	71.5	87.4
Vehicle sales - Light-duty - gasoline (%)	92.1	87.9	80.3	67.6	47.1	25.4	11.2
Vehicle sales - Light-duty - hybrid (%)	4.29	5.12	5.77	5.3	4.01	2.39	1.17
Vehicle sales - Light-duty - hydrogen FC (%)	0.113	0.383	0.331	0.254	0.182	0.101	0.047
Vehicle sales - Light-duty - other (%)	0.107	0.11	0.101	0.088	0.064	0.035	0.016
Vehicle sales - Medium-duty - diesel (%)	64.8	62.2	57.7	49.4	35.6	19.6	8.37
Vehicle sales - Medium-duty - EV (%)	0.664	1.94	5.49	14.3	31.4	52.6	68
Vehicle sales - Medium-duty - gasoline (%)	33.8	34.7	34.7	31.9	24.4	14.2	6.33
Vehicle sales - Medium-duty - hybrid (%)	0.363	0.418	0.464	0.478	0.414	0.275	0.141
Vehicle sales - Medium-duty - hydrogen FC (%)	0.166	0.485	1.37	3.58	7.86	13.2	17
Vehicle sales - Medium-duty - other (%)	0.253	0.266	0.279	0.286	0.258	0.184	0.102

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

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Commercial (PJ)	110	107	104	99.9	95.2	90.4	86.3
Final energy use - Industry (PJ)	174	182	190	193	200	209	211
Final energy use - Residential (PJ)	120	114	109	103	93.6	83.1	73.8
Final energy use - Transportation (PJ)	287	270	245	226	212	195	175

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	8,253	8,961	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 (%)	2.13	16	21.4	36.9	61.7	79.8	87
Sales of space heating units - Electric Resistance (%)	4.54	5.5	5.66	6.18	7.29	8.59	9.36
Sales of space heating units - Fossil (%)	0	2	1.88	1.4	0.684	0.222	0.059
Sales of space heating units - Gas Furnace (%)	93.3	76.5	71.1	55.5	30.3	11.4	3.55
Sales of water heating units - Electric Heat Pump (%)	0.677	2.54	7.44	21.6	43.5	58.2	63.4
Sales of water heating units - Electric Resistance (%)	5.85	7.67	9.68	15.4	24.5	30.8	33.1
Sales of water heating units - Gas Furnace (%)	92.9	88.8	81.9	62.1	31.2	10.4	2.79
Sales of water heating units - Other (%)	0.567	0.974	0.953	0.882	0.777	0.711	0.687

Table 21: *E- scenario - PILLAR 1: Efficiency/Electrification - Electricity demand*

Item	2020	2025	2030	2035	2040	2045	2050
Electricity distribution capital invested - Cumulative 5-yr (billion $2018)	0	1.64	1.66	2.05	2.12	3.02	3.19

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	-696
Carbon sink potential - Aggressive deployment - Cropland measures (1000 tCO2e/y)	0	0	-10,263
Carbon sink potential - Aggressive deployment - Permanent conservation cover (1000 tCO2e/y)	0	0	-624
Carbon sink potential - Aggressive deployment - Total (1000 tCO2e/y)	0	0	-11,583

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

Item	2020	2025	2050
Carbon sink potential - Moderate deployment - Corn-ethanol to energy grasses (1000 tCO2e/y)	0	0	-696
Carbon sink potential - Moderate deployment - Cropland measures (1000 tCO2e/y)	0	0	-5,387
Carbon sink potential - Moderate deployment - Permanent conservation cover (1000 tCO2e/y)	0	0	-312
Carbon sink potential - Moderate deployment - Total (1000 tCO2e/y)	0	0	-6,395
Land impacted for carbon sink - Aggressive deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	413
Land impacted for carbon sink - Aggressive deployment - Cropland measures (1000 hectares)	0	0	10,336
Land impacted for carbon sink - Aggressive deployment - Permanent conservation cover (1000 hectares)	0	0	1,047
Land impacted for carbon sink - Aggressive deployment - Total (1000 hectares)	0	0	11,796
Land impacted for carbon sink - Moderate deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	413
Land impacted for carbon sink - Moderate deployment - Cropland measures (1000 hectares)	0	0	5,430
Land impacted for carbon sink - Moderate deployment - Permanent conservation cover (1000 hectares)	0	0	524
Land impacted for carbon sink - Moderate deployment - Total (1000 hectares)	0	0	6,366

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

Item	2020	2025	2050
Carbon sink potential - High - Accelerate regeneration (1000 tCO2e/y)	0	0	149
Carbon sink potential - High - All (not counting overlap) (1000 tCO2e/y)	0	0	41,112
Carbon sink potential - High - Avoid deforestation (1000 tCO2e/y)	0	0	1,700
Carbon sink potential - High - Extend rotation length (1000 tCO2e/y)	0	0	983
Carbon sink potential - High - Improve plantations (1000 tCO2e/y)	0	0	44.9
Carbon sink potential - High - Increase retention of HWP (1000 tCO2e/y)	0	0	536
Carbon sink potential - High - Increase trees outside forests (1000 tCO2e/y)	0	0	3,607
Carbon sink potential - High - Reforest cropland (1000 tCO2e/y)	0	0	26,772
Carbon sink potential - High - Reforest pasture (1000 tCO2e/y)	0	0	6,646
Carbon sink potential - High - Restore productivity (1000 tCO2e/y)	0	0	674
Carbon sink potential - Low - Accelerate regeneration (1000 tCO2e/y)	0	0	74.7
Carbon sink potential - Low - All (not counting overlap) (1000 tCO2e/y)	0	0	16,316
Carbon sink potential - Low - Avoid deforestation (1000 tCO2e/y)	0	0	283
Carbon sink potential - Low - Extend rotation length (1000 tCO2e/y)	0	0	378
Carbon sink potential - Low - Improve plantations (1000 tCO2e/y)	0	0	22.8

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

Item	2020	2025	2050
Carbon sink potential - Low - Increase retention of HWP (1000 tCO2e/y)	0	0	179
Carbon sink potential - Low - Increase trees outside forests (1000 tCO2e/y)	0	0	1,263
Carbon sink potential - Low - Reforest cropland (1000 tCO2e/y)	0	0	13,386
Carbon sink potential - Low - Reforest pasture (1000 tCO2e/y)	0	0	503
Carbon sink potential - Low - Restore productivity (1000 tCO2e/y)	0	0	227
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO2e/y)	0	0	112
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO2e/y)	0	0	28,714
Carbon sink potential - Mid - Avoid deforestation (1000 tCO2e/y)	0	0	992
Carbon sink potential - Mid - Extend rotation length (1000 tCO2e/y)	0	0	680
Carbon sink potential - Mid - Improve plantations (1000 tCO2e/y)	0	0	33.4
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO2e/y)	0	0	357
Carbon sink potential - Mid - Increase trees outside forests (1000 tCO2e/y)	0	0	2,435
Carbon sink potential - Mid - Reforest cropland (1000 tCO2e/y)	0	0	20,079
Carbon sink potential - Mid - Reforest pasture (1000 tCO2e/y)	0	0	3,575
Carbon sink potential - Mid - Restore productivity (1000 tCO2e/y)	0	0	451
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)	0	0	24.4
Land impacted for carbon sink potential - High - Avoid deforestation (over 30 years) (1000 hectares)	0	0	230
Land impacted for carbon sink potential - High - Extend rotation length (1000 hectares)	0	0	501
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)	0	0	16.5
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	343
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)	0	0	1,770
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)	0	0	189
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)	0	0	223
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)	0	0	3,297
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)	0	0	12.2
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)	0	0	216
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)	0	0	192
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)	0	0	8.26
Land impacted for carbon sink potential - Low - Increase retention of HWP (1000 hectares)	0	0	0

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

Item	2020	2025	2050
Land impacted for carbon sink potential - Low - Increase trees outside forests (1000 hectares)	0	0	180
Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares)	0	0	885
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)	0	0	32.7
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)	0	0	135
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)	0	0	1,662
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)	0	0	18.3
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)	0	0	223
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)	0	0	347
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)	0	0	12.4
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	262
Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares)	0	0	1,328
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)	0	0	237
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)	0	0	272
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)	0	0	2,699

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

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal (million 2019$)	0	198	0.196	0.189	0.157	0.102	0.002
Monetary damages from air pollution - Natural Gas (million 2019$)	0	122	51.1	25.4	13.5	5.34	4.06
Monetary damages from air pollution - Transportation (million 2019$)	0	414	419	410	371	297	205
Premature deaths from air pollution - Coal (deaths)	0	22.2	0.022	0.021	0.018	0.011	0
Premature deaths from air pollution - Natural Gas (deaths)	0	13.8	5.77	2.87	1.52	0.604	0.459
Premature deaths from air pollution - Transportation (deaths)	0	46.6	47.1	46.1	41.7	33.4	23

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	3.01	4.04	0	0	0	0
Sales of cooking units - Electric Resistance (%)	66.4	73.6	95.5	99.8	100	100	100
Sales of cooking units - Gas (%)	33.6	26.4	4.52	0.228	0	0	0
Sales of space heating units - Electric Heat Pump (%)	4.79	20.7	76.2	90.8	91.9	91.9	91.7
Sales of space heating units - Electric Resistance (%)	11.9	15	6.62	4.42	4.27	4.39	4.55
Sales of space heating units - Fossil (%)	5.87	9.2	4.05	2.66	2.42	2.31	2.37
Sales of space heating units - Gas (%)	77.4	55.1	13.1	2.17	1.44	1.41	1.38
Sales of water heating units - Electric Heat Pump (%)	0	9.31	49.7	59.7	60.3	60.3	60.3

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

Item	2020	2025	2030	2035	2040	2045	2050
Sales of water heating units - Electric Resistance (%)	27.3	41.9	39.5	39.6	39.7	39.7	39.7
Sales of water heating units - Gas Furnace (%)	72.7	48.8	10.7	0.692	0.019	0	0
Sales of water heating units - Other (%)	0.024	0.027	0.027	0.027	0.027	0.027	0.027

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	515	1,320	2,139	3,240	3,527	3,363
Public EV charging plugs - DC Fast (1000 units)	0.119	0	0.964	0	4.24	0	6.85
Public EV charging plugs - L2 (1000 units)	0.786	0	23.3	0	102	0	165
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 (%)	1.63	1.89	1.29	0.414	0.076	0.013	0
Vehicle sales - Light-duty - EV (%)	3.63	14.3	45.1	81.3	96.3	99.3	100
Vehicle sales - Light-duty - gasoline (%)	90.4	79	50.2	17.1	3.36	0.592	0
Vehicle sales - Light-duty - hybrid (%)	4.15	4.34	3.12	1.17	0.283	0.061	0
Vehicle sales - Light-duty - hydrogen FC (%)	0.111	0.344	0.21	0.065	0.013	0.002	0
Vehicle sales - Light-duty - other (%)	0.105	0.102	0.067	0.024	0.005	0.001	0
Vehicle sales - Medium-duty - diesel (%)	64.7	59.7	42.3	14.4	2.59	0.384	0
Vehicle sales - Medium-duty - EV (%)	0.784	5.07	25.3	60.8	76.5	79.5	80
Vehicle sales - Medium-duty - gasoline (%)	33.7	33.3	25.5	9.32	1.77	0.277	0
Vehicle sales - Medium-duty - hybrid (%)	0.363	0.402	0.341	0.14	0.03	0.005	0
Vehicle sales - Medium-duty - hydrogen FC (%)	0.196	1.27	6.33	15.2	19.1	19.9	20
Vehicle sales - Medium-duty - other (%)	0.253	0.255	0.205	0.083	0.019	0.004	0

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

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Commercial (PJ)	110	107	101	92.6	85.5	81	78.6
Final energy use - Industry (PJ)	174	182	189	190	195	204	206
Final energy use - Residential (PJ)	120	113	102	86.8	74.3	66.4	62.6
Final energy use - Transportation (PJ)	286	268	235	195	160	139	131

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	8,255	8,955	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 (%)	2.13	24.7	71.3	88	89.8	89.9	89.8
Sales of space heating units - Electric Resistance (%)	4.54	5.67	7.02	9.23	9.68	9.7	9.71
Sales of space heating units - Fossil (%)	0	1.73	0.333	0.014	0	0	0
Sales of space heating units - Gas Furnace (%)	93.3	67.9	21.4	2.81	0.539	0.45	0.45
Sales of water heating units - Electric Heat Pump (%)	0.677	10.7	53.8	64.7	65.3	65.3	65.3
Sales of water heating units - Electric Resistance (%)	5.85	10.9	28.5	33.6	34	34	34
Sales of water heating units - Gas Furnace (%)	92.9	77.4	17	1.1	0.03	0	0
Sales of water heating units - Other (%)	0.567	0.935	0.728	0.68	0.677	0.679	0.679

Table 29: *E+RE+ scenario - PILLAR 1: Efficiency/Electrification - Electricity demand*

Item	2020	2025	2030	2035	2040	2045	2050
Electricity distribution capital invested - Cumulative 5-yr (billion $2018)	0	1.98	2.05	3.35	3.56	3.35	3.52

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

Item	2020	2025	2030	2035	2040	2045	2050
Capital invested - Solar PV - Base (billion $2018)	0	0	0	0	0	0	0.093
Capital invested - Wind - Base (billion $2018)	0	0.117	0.849	4.31	12.7	27.9	36.6

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

Item	2020	2025	2030	2035	2040	2045	2050
Solar - Base land use assumptions (GWh)	58.5	0	0	0	0	0	215
Solar - Constrained land use assumptions (GWh)	58.5	0	0	0	0	1,038	1,379
Wind - Base land use assumptions (GWh)	31,394	298	2,369	12,623	38,092	86,979	119,344
Wind - Constrained land use assumptions (GWh)	31,394	826	1,988	22,890	47,949	92,177	83,533

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	-696
Carbon sink potential - Aggressive deployment - Cropland measures (1000 tCO2e/y)	0	0	-10,263
Carbon sink potential - Aggressive deployment - Permanent conservation cover (1000 tCO2e/y)	0	0	-624
Carbon sink potential - Aggressive deployment - Total (1000 tCO2e/y)	0	0	-11,583
Carbon sink potential - Moderate deployment - Corn-ethanol to energy grasses (1000 tCO2e/y)	0	0	-696
Carbon sink potential - Moderate deployment - Cropland measures (1000 tCO2e/y)	0	0	-5,387
Carbon sink potential - Moderate deployment - Permanent conservation cover (1000 tCO2e/y)	0	0	-312
Carbon sink potential - Moderate deployment - Total (1000 tCO2e/y)	0	0	-6,395
Land impacted for carbon sink - Aggressive deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	413
Land impacted for carbon sink - Aggressive deployment - Cropland measures (1000 hectares)	0	0	10,336
Land impacted for carbon sink - Aggressive deployment - Permanent conservation cover (1000 hectares)	0	0	1,047
Land impacted for carbon sink - Aggressive deployment - Total (1000 hectares)	0	0	11,796
Land impacted for carbon sink - Moderate deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	413
Land impacted for carbon sink - Moderate deployment - Cropland measures (1000 hectares)	0	0	5,430
Land impacted for carbon sink - Moderate deployment - Permanent conservation cover (1000 hectares)	0	0	524
Land impacted for carbon sink - Moderate deployment - Total (1000 hectares)	0	0	6,366

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	149
Carbon sink potential - High - All (not counting overlap) (1000 tCO2e/y)	0	0	41,112
Carbon sink potential - High - Avoid deforestation (1000 tCO2e/y)	0	0	1,700
Carbon sink potential - High - Extend rotation length (1000 tCO2e/y)	0	0	983
Carbon sink potential - High - Improve plantations (1000 tCO2e/y)	0	0	44.9
Carbon sink potential - High - Increase retention of HWP (1000 tCO2e/y)	0	0	536
Carbon sink potential - High - Increase trees outside forests (1000 tCO2e/y)	0	0	3,607
Carbon sink potential - High - Reforest cropland (1000 tCO2e/y)	0	0	26,772
Carbon sink potential - High - Reforest pasture (1000 tCO2e/y)	0	0	6,646
Carbon sink potential - High - Restore productivity (1000 tCO2e/y)	0	0	674
Carbon sink potential - Low - Accelerate regeneration (1000 tCO2e/y)	0	0	74.7
Carbon sink potential - Low - All (not counting overlap) (1000 tCO2e/y)	0	0	16,316
Carbon sink potential - Low - Avoid deforestation (1000 tCO2e/y)	0	0	283
Carbon sink potential - Low - Extend rotation length (1000 tCO2e/y)	0	0	378
Carbon sink potential - Low - Improve plantations (1000 tCO2e/y)	0	0	22.8
Carbon sink potential - Low - Increase retention of HWP (1000 tCO2e/y)	0	0	179
Carbon sink potential - Low - Increase trees outside forests (1000 tCO2e/y)	0	0	1,263
Carbon sink potential - Low - Reforest cropland (1000 tCO2e/y)	0	0	13,386
Carbon sink potential - Low - Reforest pasture (1000 tCO2e/y)	0	0	503
Carbon sink potential - Low - Restore productivity (1000 tCO2e/y)	0	0	227
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO2e/y)	0	0	112
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO2e/y)	0	0	28,714
Carbon sink potential - Mid - Avoid deforestation (1000 tCO2e/y)	0	0	992
Carbon sink potential - Mid - Extend rotation length (1000 tCO2e/y)	0	0	680
Carbon sink potential - Mid - Improve plantations (1000 tCO2e/y)	0	0	33.4
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO2e/y)	0	0	357
Carbon sink potential - Mid - Increase trees outside forests (1000 tCO2e/y)	0	0	2,435
Carbon sink potential - Mid - Reforest cropland (1000 tCO2e/y)	0	0	20,079
Carbon sink potential - Mid - Reforest pasture (1000 tCO2e/y)	0	0	3,575
Carbon sink potential - Mid - Restore productivity (1000 tCO2e/y)	0	0	451
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)	0	0	24.4

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

Item	2020	2025	2050
Land impacted for carbon sink potential - High - Avoid deforestation (over 30 years) (1000 hectares)	0	0	230
Land impacted for carbon sink potential - High - Extend rotation length (1000 hectares)	0	0	501
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)	0	0	16.5
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	343
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)	0	0	1,770
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)	0	0	189
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)	0	0	223
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)	0	0	3,297
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)	0	0	12.2
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)	0	0	216
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)	0	0	192
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)	0	0	8.26
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	180
Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares)	0	0	885
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)	0	0	32.7
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)	0	0	135
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)	0	0	1,662
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)	0	0	18.3
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)	0	0	223
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)	0	0	347
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)	0	0	12.4
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	262
Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares)	0	0	1,328
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)	0	0	237
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)	0	0	272
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)	0	0	2,699

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

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal (million 2019$)	0	198	0.196	0.189	0.157	0.102	0.002
Monetary damages from air pollution - Natural Gas (million 2019$)	0	116	56.3	17.7	12.2	5.66	3.59
Monetary damages from air pollution - Transportation (million 2019$)	0	408	381	291	169	78.3	32.6
Premature deaths from air pollution - Coal (deaths)	0	22.2	0.022	0.021	0.018	0.011	0
Premature deaths from air pollution - Natural Gas (deaths)	0	13.1	6.36	2	1.38	0.639	0.405
Premature deaths from air pollution - Transportation (deaths)	0	45.8	42.9	32.7	19	8.81	3.67

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	3.01	4.04	0	0	0	0
Sales of cooking units - Electric Resistance (%)	66.4	73.6	95.5	99.8	100	100	100
Sales of cooking units - Gas (%)	33.6	26.4	4.52	0.228	0	0	0
Sales of space heating units - Electric Heat Pump (%)	4.79	20.7	76.2	90.8	91.9	91.9	91.7
Sales of space heating units - Electric Resistance (%)	11.9	15	6.62	4.42	4.27	4.39	4.55
Sales of space heating units - Fossil (%)	5.87	9.2	4.05	2.66	2.42	2.31	2.37
Sales of space heating units - Gas (%)	77.4	55.1	13.1	2.17	1.44	1.41	1.38
Sales of water heating units - Electric Heat Pump (%)	0	9.31	49.7	59.7	60.3	60.3	60.3
Sales of water heating units - Electric Resistance (%)	27.3	41.9	39.5	39.6	39.7	39.7	39.7
Sales of water heating units - Gas Furnace (%)	72.7	48.8	10.7	0.692	0.019	0	0
Sales of water heating units - Other (%)	0.024	0.027	0.027	0.027	0.027	0.027	0.027

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	515	1,320	2,139	3,240	3,527	3,363
Public EV charging plugs - DC Fast (1000 units)	0.119	0	0.964	0	4.24	0	6.85
Public EV charging plugs - L2 (1000 units)	0.786	0	23.3	0	102	0	165
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 (%)	1.63	1.89	1.29	0.414	0.076	0.013	0
Vehicle sales - Light-duty - EV (%)	3.63	14.3	45.1	81.3	96.3	99.3	100
Vehicle sales - Light-duty - gasoline (%)	90.4	79	50.2	17.1	3.36	0.592	0
Vehicle sales - Light-duty - hybrid (%)	4.15	4.34	3.12	1.17	0.283	0.061	0
Vehicle sales - Light-duty - hydrogen FC (%)	0.111	0.344	0.21	0.065	0.013	0.002	0
Vehicle sales - Light-duty - other (%)	0.105	0.102	0.067	0.024	0.005	0.001	0
Vehicle sales - Medium-duty - diesel (%)	64.7	59.7	42.3	14.4	2.59	0.384	0
Vehicle sales - Medium-duty - EV (%)	0.784	5.07	25.3	60.8	76.5	79.5	80
Vehicle sales - Medium-duty - gasoline (%)	33.7	33.3	25.5	9.32	1.77	0.277	0
Vehicle sales - Medium-duty - hybrid (%)	0.363	0.402	0.341	0.14	0.03	0.005	0
Vehicle sales - Medium-duty - hydrogen FC (%)	0.196	1.27	6.33	15.2	19.1	19.9	20
Vehicle sales - Medium-duty - other (%)	0.253	0.255	0.205	0.083	0.019	0.004	0

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

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Commercial (PJ)	110	107	101	92.6	85.5	81	78.6
Final energy use - Industry (PJ)	174	182	189	190	195	204	206
Final energy use - Residential (PJ)	120	113	102	86.8	74.3	66.4	62.6
Final energy use - Transportation (PJ)	286	268	235	195	160	139	131

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	8,255	8,955	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 (%)	2.13	24.7	71.3	88	89.8	89.9	89.8
Sales of space heating units - Electric Resistance (%)	4.54	5.67	7.02	9.23	9.68	9.7	9.71
Sales of space heating units - Fossil (%)	0	1.73	0.333	0.014	0	0	0
Sales of space heating units - Gas Furnace (%)	93.3	67.9	21.4	2.81	0.539	0.45	0.45
Sales of water heating units - Electric Heat Pump (%)	0.677	10.7	53.8	64.7	65.3	65.3	65.3
Sales of water heating units - Electric Resistance (%)	5.85	10.9	28.5	33.6	34	34	34
Sales of water heating units - Gas Furnace (%)	92.9	77.4	17	1.1	0.03	0	0
Sales of water heating units - Other (%)	0.567	0.935	0.728	0.68	0.677	0.679	0.679

Table 39: *E+RE- scenario - PILLAR 1: Efficiency/Electrification - Electricity demand*

Item	2020	2025	2030	2035	2040	2045	2050
Electricity distribution capital invested - Cumulative 5-yr (billion $2018)	0	1.98	2.05	3.35	3.56	3.35	3.52

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	0
Capital invested - Solar PV - Constrained (billion $2018)	0	0	0	0	0	0	0
Capital invested - Wind - Base (billion $2018)	0	0	0	0.447	0.999	0.435	0
Capital invested - Wind - Constrained (billion $2018)	0	0	0	0.7	1.06	0.879	0

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

Item	2020	2025	2035	2040	2045
Solar - Base land use assumptions (GWh)	58.5	0	0	0	0
Solar - Constrained land use assumptions (GWh)	58.5	0	0	0	0
Wind - Base land use assumptions (GWh)	31,394	0	1,343	3,117	1,423
Wind - Constrained land use assumptions (GWh)	31,394	0	2,076	3,243	2,823

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	-696
Carbon sink potential - Aggressive deployment - Cropland measures (1000 tCO2e/y)	0	0	-10,263
Carbon sink potential - Aggressive deployment - Permanent conservation cover (1000 tCO2e/y)	0	0	-624
Carbon sink potential - Aggressive deployment - Total (1000 tCO2e/y)	0	0	-11,583
Carbon sink potential - Moderate deployment - Corn-ethanol to energy grasses (1000 tCO2e/y)	0	0	-696

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

Item	2020	2025	2050
Carbon sink potential - Moderate deployment - Cropland measures (1000 tCO2e/y)	0	0	-5,387
Carbon sink potential - Moderate deployment - Permanent conservation cover (1000 tCO2e/y)	0	0	-312
Carbon sink potential - Moderate deployment - Total (1000 tCO2e/y)	0	0	-6,395
Land impacted for carbon sink - Aggressive deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	413
Land impacted for carbon sink - Aggressive deployment - Cropland measures (1000 hectares)	0	0	10,336
Land impacted for carbon sink - Aggressive deployment - Permanent conservation cover (1000 hectares)	0	0	1,047
Land impacted for carbon sink - Aggressive deployment - Total (1000 hectares)	0	0	11,796
Land impacted for carbon sink - Moderate deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	413
Land impacted for carbon sink - Moderate deployment - Cropland measures (1000 hectares)	0	0	5,430
Land impacted for carbon sink - Moderate deployment - Permanent conservation cover (1000 hectares)	0	0	524
Land impacted for carbon sink - Moderate deployment - Total (1000 hectares)	0	0	6,366

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	149
Carbon sink potential - High - All (not counting overlap) (1000 tCO2e/y)	0	0	41,112
Carbon sink potential - High - Avoid deforestation (1000 tCO2e/y)	0	0	1,700
Carbon sink potential - High - Extend rotation length (1000 tCO2e/y)	0	0	983
Carbon sink potential - High - Improve plantations (1000 tCO2e/y)	0	0	44.9
Carbon sink potential - High - Increase retention of HWP (1000 tCO2e/y)	0	0	536
Carbon sink potential - High - Increase trees outside forests (1000 tCO2e/y)	0	0	3,607
Carbon sink potential - High - Reforest cropland (1000 tCO2e/y)	0	0	26,772
Carbon sink potential - High - Reforest pasture (1000 tCO2e/y)	0	0	6,646
Carbon sink potential - High - Restore productivity (1000 tCO2e/y)	0	0	674
Carbon sink potential - Low - Accelerate regeneration (1000 tCO2e/y)	0	0	74.7
Carbon sink potential - Low - All (not counting overlap) (1000 tCO2e/y)	0	0	16,316
Carbon sink potential - Low - Avoid deforestation (1000 tCO2e/y)	0	0	283
Carbon sink potential - Low - Extend rotation length (1000 tCO2e/y)	0	0	378
Carbon sink potential - Low - Improve plantations (1000 tCO2e/y)	0	0	22.8
Carbon sink potential - Low - Increase retention of HWP (1000 tCO2e/y)	0	0	179

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

Item	2020	2025	2050
Carbon sink potential - Low - Increase trees outside forests (1000 tCO2e/y)	0	0	1,263
Carbon sink potential - Low - Reforest cropland (1000 tCO2e/y)	0	0	13,386
Carbon sink potential - Low - Reforest pasture (1000 tCO2e/y)	0	0	503
Carbon sink potential - Low - Restore productivity (1000 tCO2e/y)	0	0	227
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO2e/y)	0	0	112
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO2e/y)	0	0	28,714
Carbon sink potential - Mid - Avoid deforestation (1000 tCO2e/y)	0	0	992
Carbon sink potential - Mid - Extend rotation length (1000 tCO2e/y)	0	0	680
Carbon sink potential - Mid - Improve plantations (1000 tCO2e/y)	0	0	33.4
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO2e/y)	0	0	357
Carbon sink potential - Mid - Increase trees outside forests (1000 tCO2e/y)	0	0	2,435
Carbon sink potential - Mid - Reforest cropland (1000 tCO2e/y)	0	0	20,079
Carbon sink potential - Mid - Reforest pasture (1000 tCO2e/y)	0	0	3,575
Carbon sink potential - Mid - Restore productivity (1000 tCO2e/y)	0	0	451
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)	0	0	24.4
Land impacted for carbon sink potential - High - Avoid deforestation (over 30 years) (1000 hectares)	0	0	230
Land impacted for carbon sink potential - High - Extend rotation length (1000 hectares)	0	0	501
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)	0	0	16.5
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	343
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)	0	0	1,770
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)	0	0	189
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)	0	0	223
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)	0	0	3,297
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)	0	0	12.2
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)	0	0	216
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)	0	0	192
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)	0	0	8.26
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	180

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

Item	2020	2025	2050
Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares)	0	0	885
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)	0	0	32.7
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)	0	0	135
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)	0	0	1,662
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)	0	0	18.3
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)	0	0	223
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)	0	0	347
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)	0	0	12.4
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	262
Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares)	0	0	1,328
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)	0	0	237
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)	0	0	272
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)	0	0	2,699

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

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal (million 2019$)	0	198	0.196	0.189	0.157	0.102	0.002
Monetary damages from air pollution - Natural Gas (million 2019$)	0	129	56.7	58.2	44.1	18.6	7.41
Monetary damages from air pollution - Transportation (million 2019$)	0	408	381	291	169	78.3	32.6
Premature deaths from air pollution - Coal (deaths)	0	22.2	0.022	0.021	0.018	0.011	0
Premature deaths from air pollution - Natural Gas (deaths)	0	14.6	6.4	6.57	4.98	2.1	0.837
Premature deaths from air pollution - Transportation (deaths)	0	45.8	42.9	32.7	19	8.81	3.67

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

Item	2020	2025	2030	2035	2040	2045	2050
Residential HVAC investment in 2020s vs. REF - Cumulative 5-yr (billion $2018)	0	2.99	4.02	0	0	0	0
Sales of cooking units - Electric Resistance (%)	66.3	67.2	70.2	78.4	89.7	96.7	99.1
Sales of cooking units - Gas (%)	33.7	32.8	29.8	21.6	10.3	3.33	0.895
Sales of space heating units - Electric Heat Pump (%)	4.79	10.1	16.5	34.7	63.2	82.5	89.3
Sales of space heating units - Electric Resistance (%)	11.9	16.6	15.6	12.9	8.54	5.65	4.74
Sales of space heating units - Fossil (%)	5.87	10.2	9.69	7.94	5.1	3.2	2.63
Sales of space heating units - Gas (%)	77.4	63	58.2	44.5	23.1	8.65	3.34
Sales of water heating units - Electric Heat Pump (%)	0	1.62	6.21	19.5	40	53.6	58.5
Sales of water heating units - Electric Resistance (%)	27.3	42.3	42	41.2	40.3	39.8	39.7

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

Item	2020	2025	2030	2035	2040	2045	2050
Sales of water heating units - Gas Furnace (%)	72.7	56	51.8	39.3	19.8	6.56	1.76
Sales of water heating units - Other (%)	0.024	0.027	0.027	0.027	0.027	0.027	0.027

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	83.3	175	591	1,861	2,710
Public EV charging plugs - DC Fast (1000 units)	0.119	0	0.298	0	1.57	0	4.39
Public EV charging plugs - L2 (1000 units)	0.786	0	7.18	0	37.9	0	106
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 (%)	1.65	2.04	2.07	1.65	1.06	0.548	0.234
Vehicle sales - Light-duty - EV (%)	1.79	4.46	11.4	25.1	47.6	71.5	87.4
Vehicle sales - Light-duty - gasoline (%)	92.1	87.9	80.3	67.6	47.1	25.4	11.2
Vehicle sales - Light-duty - hybrid (%)	4.29	5.12	5.77	5.3	4.01	2.39	1.17
Vehicle sales - Light-duty - hydrogen FC (%)	0.113	0.383	0.331	0.254	0.182	0.101	0.047
Vehicle sales - Light-duty - other (%)	0.107	0.11	0.101	0.088	0.064	0.035	0.016
Vehicle sales - Medium-duty - diesel (%)	64.8	62.2	57.7	49.4	35.6	19.6	8.37
Vehicle sales - Medium-duty - EV (%)	0.664	1.94	5.49	14.3	31.4	52.6	68
Vehicle sales - Medium-duty - gasoline (%)	33.8	34.7	34.7	31.9	24.4	14.2	6.33
Vehicle sales - Medium-duty - hybrid (%)	0.363	0.418	0.464	0.478	0.414	0.275	0.141
Vehicle sales - Medium-duty - hydrogen FC (%)	0.166	0.485	1.37	3.58	7.86	13.2	17
Vehicle sales - Medium-duty - other (%)	0.253	0.266	0.279	0.286	0.258	0.184	0.102

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

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Commercial (PJ)	110	107	104	99.9	95.2	90.4	86.3
Final energy use - Industry (PJ)	174	182	190	193	200	209	211
Final energy use - Residential (PJ)	120	114	109	103	93.6	83.1	73.8
Final energy use - Transportation (PJ)	287	270	245	226	212	195	175

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	8,253	8,961	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 (%)	2.13	16	21.4	36.9	61.7	79.8	87
Sales of space heating units - Electric Resistance (%)	4.54	5.5	5.66	6.18	7.29	8.59	9.36
Sales of space heating units - Fossil (%)	0	2	1.88	1.4	0.684	0.222	0.059
Sales of space heating units - Gas Furnace (%)	93.3	76.5	71.1	55.5	30.3	11.4	3.55
Sales of water heating units - Electric Heat Pump (%)	0.677	2.54	7.44	21.6	43.5	58.2	63.4
Sales of water heating units - Electric Resistance (%)	5.85	7.67	9.68	15.4	24.5	30.8	33.1
Sales of water heating units - Gas Furnace (%)	92.9	88.8	81.9	62.1	31.2	10.4	2.79
Sales of water heating units - Other (%)	0.567	0.974	0.953	0.882	0.777	0.711	0.687

Table 49: *E-B+ scenario - PILLAR 1: Efficiency/Electrification - Electricity demand*

Item	2020	2025	2030	2035	2040	2045	2050
Electricity distribution capital invested - Cumulative 5-yr (billion $2018)	0	1.64	1.66	2.05	2.12	3.02	3.19

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

Item	2020	2025	2030	2035	2040	2045	2050
Capital invested - Biomass power plant (billion $2018)	0	0.004	0.02	0	0	0	0
Capital invested - Biomass w/ccu allam power plant (billion $2018)	0	0	0	0	0	0.009	0
Capital invested - Biomass w/ccu power plant (billion $2018)	0	0	0	0	13.7	21.5	9.82

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

Item	2020	2025	2030	2035	2040	2045	2050
Biomass power plant (GWh)	0	7.3	46.3	46.3	46.3	46.3	46.3
Biomass w/ccu allam power plant (GWh)	0	0	0	0	0	8.96	8.96
Biomass w/ccu power plant (GWh)	0	0	0	0	15,353	39,484	50,500

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

Item	2020	2025	2030	2035	2040	2045	2050
Biomass purchases (million $2018/year)	0	60	154	156	1,144	3,772	4,531
Conversion capital investment - Cumulative 5-yr (million $2018)	0	4.25	22.2	27.7	12,551	31,594	9,940
Number of facilities - Allam power w ccu (quantity)	0	0	0	0	0	1	1
Number of facilities - Beccs hydrogen (quantity)	0	0	0	0	0	14	14
Number of facilities - Diesel (quantity)	0	0	0	1	1	1	1
Number of facilities - Diesel ccu (quantity)	0	0	0	0	0	1	1
Number of facilities - Power (quantity)	0	1	1	1	1	1	1
Number of facilities - Power ccu (quantity)	0	0	0	0	12	32	40
Number of facilities - Pyrolysis (quantity)	0	0	0	1	1	1	1
Number of facilities - Pyrolysis ccu (quantity)	0	0	0	0	0	1	2
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	0.03	18.5	57.7	69
Annual - BECCS (MMT)	0	0	0	0	15.2	54.3	65.5
Annual - Cement and lime (MMT)	0	0	0	0	3.32	3.42	3.53
Annual - NGCC (MMT)	0	0	0	0.03	0.03	0.02	0.02
Cumulative - All (MMT)	0	0	0	0.03	18.6	76.3	145
Cumulative - BECCS (MMT)	0	0	0	0	15.2	69.5	135
Cumulative - Cement and lime (MMT)	0	0	0	0	3.32	6.74	10.3
Cumulative - NGCC (MMT)	0	0	0	0.03	0.06	0.08	0.1

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

Item	2020	2025	2030	2035	2040	2045	2050
CO2 storage (MMT)	0	0	0.92	3.21	7.13	9.85	10
Injection wells (wells)	0	0	2	7	12	20	25
Resource characterization, appraisal, permitting costs (million $2020)	0	77.2	216	278	278	278	278
Wells and facilities construction costs (million $2020)	0	0	51.4	200	357	597	741

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

Item	2020	2025	2030	2035	2040	2045	2050
All (km)	0	0	1,055	1,478	2,751	4,720	5,048
Cumulative investment - All (million $2018)	0	0	5,205	7,550	10,712	12,651	13,109
Cumulative investment - Spur (million $2018)	0	0	30.8	61.8	951	2,889	3,347
Cumulative investment - Trunk (million $2018)	0	0	5,174	7,488	9,761	9,761	9,761
Spur (km)	0	0	58.5	117	1,026	2,994	3,323
Trunk (km)	0	0	997	1,361	1,725	1,725	1,725

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

Item	2020	2025	2050
Carbon sink potential - Aggressive deployment - Corn-ethanol to energy grasses (1000 tCO2e/y)	0	0	-2,596
Carbon sink potential - Aggressive deployment - Cropland measures (1000 tCO2e/y)	0	0	-9,241
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	-556
Carbon sink potential - Aggressive deployment - Total (1000 tCO2e/y)	0	0	-12,393
Carbon sink potential - Moderate deployment - Corn-ethanol to energy grasses (1000 tCO2e/y)	0	0	-2,596
Carbon sink potential - Moderate deployment - Cropland measures (1000 tCO2e/y)	0	0	-4,848
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	-278
Carbon sink potential - Moderate deployment - Total (1000 tCO2e/y)	0	0	-7,721
Land impacted for carbon sink - Aggressive deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	1,528
Land impacted for carbon sink - Aggressive deployment - Cropland measures (1000 hectares)	0	0	22,937
Land impacted for carbon sink - Aggressive deployment - Cropland to woody energy crops (1000 hectares)	0	0	496
Land impacted for carbon sink - Aggressive deployment - Pasture to energy crops (1000 hectares)	0	0	1,272
Land impacted for carbon sink - Aggressive deployment - Permanent conservation cover (1000 hectares)	0	0	931
Land impacted for carbon sink - Aggressive deployment - Total (1000 hectares)	0	0	27,165
Land impacted for carbon sink - Moderate deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	1,528
Land impacted for carbon sink - Moderate deployment - Cropland measures (1000 hectares)	0	0	4,878
Land impacted for carbon sink - Moderate deployment - Cropland to woody energy crops (1000 hectares)	0	0	496
Land impacted for carbon sink - Moderate deployment - Pasture to energy crops (1000 hectares)	0	0	1,272
Land impacted for carbon sink - Moderate deployment - Permanent conservation cover (1000 hectares)	0	0	466
Land impacted for carbon sink - Moderate deployment - Total (1000 hectares)	0	0	8,639

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	149
Carbon sink potential - High - All (not counting overlap) (1000 tCO2e/y)	0	0	41,112
Carbon sink potential - High - Avoid deforestation (1000 tCO2e/y)	0	0	1,700
Carbon sink potential - High - Extend rotation length (1000 tCO2e/y)	0	0	983
Carbon sink potential - High - Improve plantations (1000 tCO2e/y)	0	0	44.9
Carbon sink potential - High - Increase retention of HWP (1000 tCO2e/y)	0	0	536
Carbon sink potential - High - Increase trees outside forests (1000 tCO2e/y)	0	0	3,607
Carbon sink potential - High - Reforest cropland (1000 tCO2e/y)	0	0	26,772
Carbon sink potential - High - Reforest pasture (1000 tCO2e/y)	0	0	6,646
Carbon sink potential - High - Restore productivity (1000 tCO2e/y)	0	0	674
Carbon sink potential - Low - Accelerate regeneration (1000 tCO2e/y)	0	0	74.7
Carbon sink potential - Low - All (not counting overlap) (1000 tCO2e/y)	0	0	16,316
Carbon sink potential - Low - Avoid deforestation (1000 tCO2e/y)	0	0	283
Carbon sink potential - Low - Extend rotation length (1000 tCO2e/y)	0	0	378
Carbon sink potential - Low - Improve plantations (1000 tCO2e/y)	0	0	22.8
Carbon sink potential - Low - Increase retention of HWP (1000 tCO2e/y)	0	0	179
Carbon sink potential - Low - Increase trees outside forests (1000 tCO2e/y)	0	0	1,263
Carbon sink potential - Low - Reforest cropland (1000 tCO2e/y)	0	0	13,386
Carbon sink potential - Low - Reforest pasture (1000 tCO2e/y)	0	0	503
Carbon sink potential - Low - Restore productivity (1000 tCO2e/y)	0	0	227
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO2e/y)	0	0	112
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO2e/y)	0	0	28,714
Carbon sink potential - Mid - Avoid deforestation (1000 tCO2e/y)	0	0	992
Carbon sink potential - Mid - Extend rotation length (1000 tCO2e/y)	0	0	680
Carbon sink potential - Mid - Improve plantations (1000 tCO2e/y)	0	0	33.4
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO2e/y)	0	0	357
Carbon sink potential - Mid - Increase trees outside forests (1000 tCO2e/y)	0	0	2,435
Carbon sink potential - Mid - Reforest cropland (1000 tCO2e/y)	0	0	20,079
Carbon sink potential - Mid - Reforest pasture (1000 tCO2e/y)	0	0	3,575
Carbon sink potential - Mid - Restore productivity (1000 tCO2e/y)	0	0	451
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)	0	0	24.4

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

Item	2020	2025	2050
Land impacted for carbon sink potential - High - Avoid deforestation (over 30 years) (1000 hectares)	0	0	230
Land impacted for carbon sink potential - High - Extend rotation length (1000 hectares)	0	0	501
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)	0	0	16.5
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	343
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)	0	0	1,770
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)	0	0	189
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)	0	0	223
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)	0	0	3,297
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)	0	0	12.2
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)	0	0	216
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)	0	0	192
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)	0	0	8.26
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	180
Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares)	0	0	885
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)	0	0	32.7
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)	0	0	135
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)	0	0	1,662
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)	0	0	18.3
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)	0	0	223
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)	0	0	347
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)	0	0	12.4
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	262
Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares)	0	0	1,328
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)	0	0	237
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)	0	0	272
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)	0	0	2,699

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

Item	2020	2025	2030	2035	2040	2045	2050
Residential HVAC investment in 2020s vs. REF - Cumulative 5-yr (billion $2018)	0	2.83	3.07	0	0	0	0
Sales of cooking units - Electric Resistance (%)	66	66	66	66	66	66	66
Sales of cooking units - Gas (%)	34	34	34	34	34	34	34
Sales of space heating units - Electric Heat Pump (%)	2.8	27.6	29.1	31.3	32.6	33.7	35
Sales of space heating units - Electric Resistance (%)	12.4	13.9	13.6	13.3	13.1	12.1	10.6
Sales of space heating units - Fossil (%)	6.08	6.99	7.07	7.06	6.83	6.72	6.86
Sales of space heating units - Gas (%)	78.7	51.5	50.2	48.4	47.5	47.5	47.5
Sales of water heating units - Electric Heat Pump (%)	0	0	0	0	0	0	0
Sales of water heating units - Electric Resistance (%)	27.3	42.4	42.3	42.2	42.2	42.2	42.1
Sales of water heating units - Gas Furnace (%)	72.7	57.5	57.6	57.7	57.7	57.8	57.8
Sales of water heating units - Other (%)	0.024	0.027	0.027	0.027	0.027	0.027	0.027

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 (%)	1.64	2.04	2.2	2.05	1.85	1.72	1.64
Vehicle sales - Light-duty - EV (%)	3.28	5.24	5.99	7.34	8.97	10.4	11.6
Vehicle sales - Light-duty - gasoline (%)	90.7	87.2	85.2	83.5	81.4	79.5	77.9
Vehicle sales - Light-duty - hybrid (%)	4.16	5.02	6.16	6.74	7.32	7.94	8.45
Vehicle sales - Light-duty - hydrogen FC (%)	0.111	0.38	0.351	0.313	0.311	0.312	0.323
Vehicle sales - Light-duty - other (%)	0.106	0.11	0.106	0.107	0.107	0.105	0.108
Vehicle sales - Medium-duty - diesel (%)	65.2	63.5	61.6	59.6	58	56.5	55.2
Vehicle sales - Medium-duty - EV (%)	0.027	0.105	0.329	0.671	0.895	0.973	0.993
Vehicle sales - Medium-duty - gasoline (%)	34	35.5	37	38.5	39.7	40.8	41.7
Vehicle sales - Medium-duty - hybrid (%)	0.365	0.427	0.496	0.577	0.674	0.793	0.929
Vehicle sales - Medium-duty - hydrogen FC (%)	0.175	0.208	0.242	0.285	0.339	0.409	0.487
Vehicle sales - Medium-duty - other (%)	0.255	0.271	0.298	0.345	0.42	0.528	0.671

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

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Commercial (PJ)	110	110	109	108	107	108	111
Final energy use - Industry (PJ)	174	186	192	198	205	212	220
Final energy use - Residential (PJ)	120	113	109	106	105	106	106
Final energy use - Transportation (PJ)	286	270	247	233	233	241	250

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	8,160	8,377	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 (%)	2.13	20.6	48.3	71.1	74.8	75.3	75.3
Sales of space heating units - Electric Resistance (%)	4.54	6.37	10.8	18.4	23.4	24.2	24.3
Sales of space heating units - Fossil (%)	0	1.96	1.54	0.687	0.101	0.009	0
Sales of space heating units - Gas Furnace (%)	93.3	71.1	39.4	9.85	1.63	0.515	0.452
Sales of water heating units - Electric Heat Pump (%)	0.677	0.816	0.812	0.813	0.809	0.806	0.805

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

Item	2020	2025	2030	2035	2040	2045	2050
Sales of water heating units - Electric Resistance (%)	5.85	6.96	6.99	6.96	6.96	6.97	6.97
Sales of water heating units - Gas Furnace (%)	92.9	91.2	91.2	91.2	91.2	91.2	91.2
Sales of water heating units - Other (%)	0.567	0.983	0.985	0.982	0.982	0.985	0.986

Table 62: *REF scenario - PILLAR 1: Efficiency/Electrification - Electricity demand*

Item	2020	2025	2030	2035	2040	2045	2050
Electricity distribution capital invested - Cumulative 5-yr (billion $2018)	0	1.74	1.77	1.9	1.95	2.5	2.61

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

Item	2020	2025	2030	2050
Business-as-usual carbon sink - Natural uptake (Mt CO2e/y)	-6.75	0	0.507	0.145
Business-as-usual carbon sink - Retained in Hardwood Products (Mt CO2e/y)	-0.146	0	-0.303	-0.319
Business-as-usual carbon sink - Total (Mt CO2e/y)	-6.9	0	0.204	-0.174
Carbon sink potential - High - Accelerate regeneration (1000 tCO2e/y)	0	0	0	149
Carbon sink potential - High - All (not counting overlap) (1000 tCO2e/y)	0	0	0	41,112
Carbon sink potential - High - Avoid deforestation (1000 tCO2e/y)	0	0	0	1,700
Carbon sink potential - High - Extend rotation length (1000 tCO2e/y)	0	0	0	983
Carbon sink potential - High - Improve plantations (1000 tCO2e/y)	0	0	0	44.9
Carbon sink potential - High - Increase retention of HWP (1000 tCO2e/y)	0	0	0	536
Carbon sink potential - High - Increase trees outside forests (1000 tCO2e/y)	0	0	0	3,607
Carbon sink potential - High - Reforest cropland (1000 tCO2e/y)	0	0	0	26,772
Carbon sink potential - High - Reforest pasture (1000 tCO2e/y)	0	0	0	6,646
Carbon sink potential - High - Restore productivity (1000 tCO2e/y)	0	0	0	674
Carbon sink potential - Low - Accelerate regeneration (1000 tCO2e/y)	0	0	0	74.7
Carbon sink potential - Low - All (not counting overlap) (1000 tCO2e/y)	0	0	0	16,316
Carbon sink potential - Low - Avoid deforestation (1000 tCO2e/y)	0	0	0	283
Carbon sink potential - Low - Extend rotation length (1000 tCO2e/y)	0	0	0	378
Carbon sink potential - Low - Improve plantations (1000 tCO2e/y)	0	0	0	22.8
Carbon sink potential - Low - Increase retention of HWP (1000 tCO2e/y)	0	0	0	179
Carbon sink potential - Low - Increase trees outside forests (1000 tCO2e/y)	0	0	0	1,263
Carbon sink potential - Low - Reforest cropland (1000 tCO2e/y)	0	0	0	13,386
Carbon sink potential - Low - Reforest pasture (1000 tCO2e/y)	0	0	0	503
Carbon sink potential - Low - Restore productivity (1000 tCO2e/y)	0	0	0	227
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO2e/y)	0	0	0	112
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO2e/y)	0	0	0	28,714

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

Item	2020	2025	2030	2050
Carbon sink potential - Mid - Avoid deforestation (1000 tCO2e/y)	0	0	0	992
Carbon sink potential - Mid - Extend rotation length (1000 tCO2e/y)	0	0	0	680
Carbon sink potential - Mid - Improve plantations (1000 tCO2e/y)	0	0	0	33.4
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO2e/y)	0	0	0	357
Carbon sink potential - Mid - Increase trees outside forests (1000 tCO2e/y)	0	0	0	2,435
Carbon sink potential - Mid - Reforest cropland (1000 tCO2e/y)	0	0	0	20,079
Carbon sink potential - Mid - Reforest pasture (1000 tCO2e/y)	0	0	0	3,575
Carbon sink potential - Mid - Restore productivity (1000 tCO2e/y)	0	0	0	451
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)	0	0	0	24.4
Land impacted for carbon sink potential - High - Avoid deforestation (over 30 years) (1000 hectares)	0	0	0	230
Land impacted for carbon sink potential - High - Extend rotation length (1000 hectares)	0	0	0	501
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)	0	0	0	16.5
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	343
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)	0	0	0	1,770
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)	0	0	0	189
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)	0	0	0	223
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)	0	0	0	3,297
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)	0	0	0	12.2
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)	0	0	0	216
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)	0	0	0	192
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)	0	0	0	8.26
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	180
Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares)	0	0	0	885
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)	0	0	0	32.7
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)	0	0	0	135
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)	0	0	0	1,662
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)	0	0	0	18.3
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)	0	0	0	223

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

Item	2020	2025	2030	2050
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)	0	0	0	347
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)	0	0	0	12.4
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	262
Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares)	0	0	0	1,328
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)	0	0	0	237
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)	0	0	0	272
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)	0	0	0	2,699

Table 64: *REF scenario - IMPACTS - Health*

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal (million 2019$)	0	691	347	219	173	152	148
Monetary damages from air pollution - Natural Gas (million 2019$)	0	127	113	117	81.3	73.6	62.2
Monetary damages from air pollution - Transportation (million 2019$)	0	414	425	437	452	465	479
Premature deaths from air pollution - Coal (deaths)	0	77.6	39	24.5	19.5	17	16.6
Premature deaths from air pollution - Natural Gas (deaths)	0	14.4	12.7	13.2	9.19	8.31	7.03
Premature deaths from air pollution - Transportation (deaths)	0	46.6	47.8	49.2	50.8	52.3	53.9