Net-Zero America - minnesota state report

Larson et al. 2020

February 2021

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

Notes

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

List of Tables

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

Item	2020	2025	2030	2035	2040	2045	2050
Residential HVAC investment in 2020s vs. REF - Cumulative 5-yr (billion $2018)	0	4.14	4.85	0	0	0	0
Sales of cooking units - Electric Resistance (%)	58.9	67.6	94.5	99.7	100	100	100
Sales of cooking units - Gas (%)	41.1	32.4	5.54	0.279	0	0	0
Sales of space heating units - Electric Heat Pump (%)	3.41	7.97	30.9	76.7	90.3	91.9	91.7
Sales of space heating units - Electric Resistance (%)	9.83	13.9	11.3	5.52	3.76	3.59	3.79
Sales of space heating units - Fossil (%)	8.97	15.5	11.4	5.34	3.47	3.15	3.18
Sales of space heating units - Gas (%)	77.8	62.6	46.3	12.4	2.5	1.41	1.31
Sales of water heating units - Electric Heat Pump (%)	0	0.704	9.95	31.7	37.9	38.6	38.6
Sales of water heating units - Electric Resistance (%)	20.7	35.3	41.3	56	60.8	61.3	61.3
Sales of water heating units - Gas Furnace (%)	79.2	64	48.7	12.3	1.29	0.072	0
Sales of water heating units - Other (%)	0.018	0.021	0.021	0.021	0.02	0.02	0.02

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	1,035	2,659	4,300	6,517	7,089	6,761
Public EV charging plugs - DC Fast (1000 units)	0.168	0	1.92	0	8.36	0	13.5
Public EV charging plugs - L2 (1000 units)	0.739	0	46.2	0	201	0	325
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 (%)	1.59	1.85	1.27	0.408	0.075	0.013	0
Vehicle sales - Light-duty - EV (%)	3.78	14.8	45.8	81.6	96.3	99.3	100
Vehicle sales - Light-duty - gasoline (%)	90.1	78.5	49.5	16.8	3.32	0.591	0
Vehicle sales - Light-duty - hybrid (%)	4.29	4.45	3.17	1.18	0.287	0.062	0
Vehicle sales - Light-duty - hydrogen FC (%)	0.111	0.342	0.206	0.064	0.013	0.002	0
Vehicle sales - Light-duty - other (%)	0.103	0.1	0.065	0.023	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)	221	216	207	194	179	168	160
Final energy use - Industry (PJ)	391	405	406	401	400	399	401
Final energy use - Residential (PJ)	296	280	265	236	202	173	153
Final energy use - Transportation (PJ)	552	519	460	389	325	285	269

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	15,866	17,271	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 (%)	1.8	6.82	26.5	71.8	85.3	86.8	86.9
Sales of space heating units - Electric Resistance (%)	3.09	5.73	8.18	11.9	12.6	12.6	12.6
Sales of space heating units - Fossil (%)	4.77	2.09	0.407	0.017	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 (%)	90.3	85.4	64.9	16.3	2.07	0.546	0.457
Sales of water heating units - Electric Heat Pump (%)	0.491	1.66	12.6	38.5	46.3	47.1	47.2
Sales of water heating units - Electric Resistance (%)	4.33	7.76	18.5	43.6	51.2	52.1	52.2
Sales of water heating units - Gas Furnace (%)	94.1	89.6	68.2	17.2	1.81	0.101	0
Sales of water heating units - Other (%)	1.03	0.934	0.727	0.678	0.674	0.676	0.676

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	3.87	3.99	7.91	8.48	7.13	7.47

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	0.049	0.493	0	0	0	0
Capital invested - Biomass w/ccu allam power plant (billion $2018)	0	0	0	0	0	0	0
Capital invested - Biomass w/ccu power plant (billion $2018)	0	0	0	0	0	0	0
Capital invested - Solar PV - Base (billion $2018)	0	0	0	0	0	0	0
Capital invested - Solar PV - Constrained (billion $2018)	0	0.395	0	0	0	0	0
Capital invested - Wind - Base (billion $2018)	0	11.3	7.51	14.5	14.5	18.7	27.2
Capital invested - Wind - Constrained (billion $2018)	0	2.2	2.94	6.21	4.37	4.58	5.58

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

Item	2020	2025	2030	2035	2040	2045	2050
Biomass power plant (GWh)	0	93.4	1,062	1,062	1,062	1,062	1,062
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
Solar - Base land use assumptions (GWh)	558	0	0	0	0	0	0
Solar - Constrained land use assumptions (GWh)	148	0	0	0	0	0	0
Wind - Base land use assumptions (GWh)	20,531	27,664	19,819	40,198	41,506	55,748	85,298
Wind - Constrained land use assumptions (GWh)	20,531	3,413	7,721	15,650	12,315	12,706	16,842

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

Item	2020	2025	2030	2035	2040	2045	2050
Biomass purchases (million $2018/year)	0	27.2	161	399	483	1,328	4,925
Conversion capital investment - Cumulative 5-yr (million $2018)	0	53.2	550	3,269	1,168	11,639	78,446
Number of facilities - Allam power w ccu (quantity)	0	0	0	0	0	0	0
Number of facilities - Beccs hydrogen (quantity)	0	0	0	3	5	20	24
Number of facilities - Diesel (quantity)	0	0	0	1	1	1	2
Number of facilities - Diesel ccu (quantity)	0	0	0	0	0	0	1
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	7
Number of facilities - Pyrolysis ccu (quantity)	0	0	0	0	0	0	45
Number of facilities - Sng (quantity)	0	1	1	1	1	1	2
Number of facilities - Sng ccu (quantity)	0	0	0	0	0	0	1

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

Item	2020	2025	2030	2035	2040	2045	2050
Annual - All (MMT)	0	0	0	4.17	5.67	20.6	58.9
Annual - BECCS (MMT)	0	0	0	4.17	5.67	20.6	58.9
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	4.17	9.84	30.5	89.4
Cumulative - BECCS (MMT)	0	0	0	4.17	9.84	30.5	89.4
Cumulative - Cement and lime (MMT)	0	0	0	0	0	0	0
Cumulative - NGCC (MMT)	0	0	0	0	0	0	0

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

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

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

Item	2020	2025	2030	2035	2040	2045	2050
All (km)	0	0	0	105	245	422	4,209
Cumulative investment - All (million $2018)	0	0	0	459	564	713	3,731
Cumulative investment - Spur (million $2018)	0	0	0	22.3	127	275	3,294
Cumulative investment - Trunk (million $2018)	0	0	0	437	437	437	437
Spur (km)	0	0	0	16.7	157	334	4,121
Trunk (km)	0	0	0	88.1	88.1	88.1	88.1

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

Item	2020	2025	2050
Carbon sink potential - Aggressive deployment - Corn-ethanol to energy grasses (1000 tCO2e/y)	0	0	-2,423
Carbon sink potential - Aggressive deployment - Cropland measures (1000 tCO2e/y)	0	0	-13,821
Carbon sink potential - Aggressive deployment - Permanent conservation cover (1000 tCO2e/y)	0	0	-414
Carbon sink potential - Aggressive deployment - Total (1000 tCO2e/y)	0	0	-16,658
Carbon sink potential - Moderate deployment - Corn-ethanol to energy grasses (1000 tCO2e/y)	0	0	-2,423
Carbon sink potential - Moderate deployment - Cropland measures (1000 tCO2e/y)	0	0	-7,283
Carbon sink potential - Moderate deployment - Permanent conservation cover (1000 tCO2e/y)	0	0	-207
Carbon sink potential - Moderate deployment - Total (1000 tCO2e/y)	0	0	-9,914
Land impacted for carbon sink - Aggressive deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	1,097
Land impacted for carbon sink - Aggressive deployment - Cropland measures (1000 hectares)	0	0	6,974
Land impacted for carbon sink - Aggressive deployment - Permanent conservation cover (1000 hectares)	0	0	753
Land impacted for carbon sink - Aggressive deployment - Total (1000 hectares)	0	0	8,824
Land impacted for carbon sink - Moderate deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	1,097

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

Item	2020	2025	2050
Land impacted for carbon sink - Moderate deployment - Cropland measures (1000 hectares)	0	0	3,675
Land impacted for carbon sink - Moderate deployment - Permanent conservation cover (1000 hectares)	0	0	376
Land impacted for carbon sink - Moderate deployment - Total (1000 hectares)	0	0	5,149

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

Item	2020	2025	2050
Carbon sink potential - High - Accelerate regeneration (1000 tCO2e/y)	0	0	479
Carbon sink potential - High - All (not counting overlap) (1000 tCO2e/y)	0	0	40,029
Carbon sink potential - High - Avoid deforestation (1000 tCO2e/y)	0	0	1,871
Carbon sink potential - High - Extend rotation length (1000 tCO2e/y)	0	0	8,507
Carbon sink potential - High - Improve plantations (1000 tCO2e/y)	0	0	793
Carbon sink potential - High - Increase retention of HWP (1000 tCO2e/y)	0	0	4,667
Carbon sink potential - High - Increase trees outside forests (1000 tCO2e/y)	0	0	3,012
Carbon sink potential - High - Reforest cropland (1000 tCO2e/y)	0	0	8,069
Carbon sink potential - High - Reforest pasture (1000 tCO2e/y)	0	0	8,313
Carbon sink potential - High - Restore productivity (1000 tCO2e/y)	0	0	4,318
Carbon sink potential - Low - Accelerate regeneration (1000 tCO2e/y)	0	0	240
Carbon sink potential - Low - All (not counting overlap) (1000 tCO2e/y)	0	0	12,952
Carbon sink potential - Low - Avoid deforestation (1000 tCO2e/y)	0	0	312
Carbon sink potential - Low - Extend rotation length (1000 tCO2e/y)	0	0	3,267
Carbon sink potential - Low - Improve plantations (1000 tCO2e/y)	0	0	404
Carbon sink potential - Low - Increase retention of HWP (1000 tCO2e/y)	0	0	1,556
Carbon sink potential - Low - Increase trees outside forests (1000 tCO2e/y)	0	0	1,054
Carbon sink potential - Low - Reforest cropland (1000 tCO2e/y)	0	0	4,034
Carbon sink potential - Low - Reforest pasture (1000 tCO2e/y)	0	0	630
Carbon sink potential - Low - Restore productivity (1000 tCO2e/y)	0	0	1,455
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO2e/y)	0	0	359
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO2e/y)	0	0	26,484
Carbon sink potential - Mid - Avoid deforestation (1000 tCO2e/y)	0	0	1,091
Carbon sink potential - Mid - Extend rotation length (1000 tCO2e/y)	0	0	5,887
Carbon sink potential - Mid - Improve plantations (1000 tCO2e/y)	0	0	591
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO2e/y)	0	0	3,112

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	2,033
Carbon sink potential - Mid - Reforest cropland (1000 tCO2e/y)	0	0	6,052
Carbon sink potential - Mid - Reforest pasture (1000 tCO2e/y)	0	0	4,472
Carbon sink potential - Mid - Restore productivity (1000 tCO2e/y)	0	0	2,887
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)	0	0	78.3
Land impacted for carbon sink potential - High - Avoid deforestation (over 30 years) (1000 hectares)	0	0	253
Land impacted for carbon sink potential - High - Extend rotation length (1000 hectares)	0	0	4,338
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)	0	0	292
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	286
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)	0	0	533
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)	0	0	236
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)	0	0	1,431
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)	0	0	7,449
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)	0	0	39.1
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)	0	0	238
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)	0	0	1,662
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)	0	0	146
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	151
Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares)	0	0	267
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)	0	0	40.9
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)	0	0	866
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)	0	0	3,409
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)	0	0	58.7
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)	0	0	246
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)	0	0	3,000
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)	0	0	220
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	218

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	400
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)	0	0	296
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)	0	0	1,744
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)	0	0	6,183

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

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal (million 2019$)	0	291	0.21	0.201	0.164	0.11	0.003
Monetary damages from air pollution - Natural Gas (million 2019$)	0	104	66.9	30.5	19.8	14.9	7.09
Monetary damages from air pollution - Transportation (million 2019$)	0	1,518	1,442	1,116	659	315	138
Premature deaths from air pollution - Coal (deaths)	0	32.6	0.024	0.023	0.018	0.012	0
Premature deaths from air pollution - Natural Gas (deaths)	0	11.8	7.55	3.44	2.24	1.68	0.801
Premature deaths from air pollution - Transportation (deaths)	0	171	162	126	74.2	35.4	15.6

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

Item	2020	2025	2030	2035	2040	2045	2050
By economic sector - Agriculture (jobs)	2,150	2,172	2,429	2,657	1,770	1,636	4,380
By economic sector - Construction (jobs)	6,327	10,124	10,809	15,600	19,028	23,443	33,116
By economic sector - Manufacturing (jobs)	4,761	8,752	10,321	13,567	13,228	11,761	17,131
By economic sector - Mining (jobs)	2,729	2,121	1,497	1,016	663	417	271
By economic sector - Other (jobs)	447	751	858	1,350	1,780	2,340	3,371
By economic sector - Pipeline (jobs)	489	486	417	391	259	181	534
By economic sector - Professional (jobs)	4,065	6,640	7,484	10,912	13,467	18,109	28,926
By economic sector - Trade (jobs)	3,639	4,469	4,542	5,998	7,142	9,205	13,772
By economic sector - Utilities (jobs)	7,172	9,756	10,126	14,670	18,330	23,000	32,692
By education level - All sectors - Associates degree or some college (jobs)	9,233	13,638	14,676	20,444	23,899	28,615	41,887
By education level - All sectors - Bachelors degree (jobs)	6,547	9,291	9,907	13,443	15,505	18,797	28,216
By education level - All sectors - Doctoral degree (jobs)	227	335	364	503	596	772	1,209
By education level - All sectors - High school diploma or less (jobs)	14,178	19,727	21,094	28,418	31,738	37,020	55,459
By education level - All sectors - Masters or professional degree (jobs)	1,594	2,278	2,443	3,353	3,929	4,889	7,423
By resource sector - Biomass (jobs)	5,430	5,397	5,727	6,357	4,618	6,060	19,035
By resource sector - CO2 (jobs)	0	0	0	457	14.3	21.8	3,367
By resource sector - Coal (jobs)	1,636	886	204	0	0	0	0
By resource sector - Grid (jobs)	8,204	13,435	14,668	24,240	32,876	41,812	57,453
By resource sector - Natural Gas (jobs)	4,450	4,133	3,754	3,166	2,912	2,869	2,726
By resource sector - Nuclear (jobs)	960	944	929	539	0	0	0
By resource sector - Oil (jobs)	5,381	4,752	3,903	2,946	2,166	1,601	1,202
By resource sector - Solar (jobs)	2,190	3,438	3,703	5,325	5,610	5,112	7,367
By resource sector - Wind (jobs)	3,528	12,284	15,595	23,130	27,470	32,617	43,043
Median wages - Annual - All ($2019 per job)	63,416	64,390	65,103	66,419	68,261	70,124	70,957
On-Site or In-Plant Training - Total jobs - 1 to 4 years (jobs)	4,835	7,058	7,563	10,490	12,238	14,649	21,412
On-Site or In-Plant Training - Total jobs - 4 to 10 years (jobs)	1,963	2,856	3,032	4,259	5,094	6,257	9,110
On-Site or In-Plant Training - Total jobs - None (jobs)	5,086	7,342	7,905	10,796	12,338	14,747	22,096

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)	260	383	412	575	673	807	1,183
On-Site or In-Plant Training - Total jobs - Up to 1 year (jobs)	19,635	27,631	29,572	40,040	45,324	53,633	80,393
On-the-Job Training - All sectors - 1 to 4 years (jobs)	6,119	9,006	9,657	13,459	15,799	18,988	27,670
On-the-Job Training - All sectors - 4 to 10 years (jobs)	1,869	2,755	2,933	4,163	5,023	6,197	8,987
On-the-Job Training - All sectors - None (jobs)	1,778	2,482	2,637	3,546	4,018	4,797	7,213
On-the-Job Training - All sectors - Over 10 years (jobs)	288	434	469	635	713	819	1,193
On-the-Job Training - All sectors - Up to 1 year (jobs)	21,726	30,593	32,787	44,357	50,113	59,292	89,131
Related work experience - All sectors - 1 to 4 years (jobs)	11,165	15,942	17,056	23,387	27,004	32,414	48,164
Related work experience - All sectors - 4 to 10 years (jobs)	7,027	10,218	10,940	15,102	17,592	21,172	31,213
Related work experience - All sectors - None (jobs)	4,719	6,610	7,062	9,597	10,909	12,948	19,374
Related work experience - All sectors - Over 10 years (jobs)	1,881	2,758	2,965	4,063	4,673	5,532	8,132
Related work experience - All sectors - Up to 1 year (jobs)	6,987	9,742	10,459	14,011	15,489	18,027	27,312
Wage income - All (million $2019)	2,015	2,915	3,157	4,395	5,165	6,318	9,523

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

Item	2020	2025	2030	2035	2040	2045	2050
Natural gas consumption - Annual (tcf)	374	380	320	257	193	122	84.3
Natural gas consumption - Cumulative (tcf)	0	0	0	0	0	0	7,731
Natural gas production - Annual (tcf)	0	0	0	0	0	0	0
Oil consumption - Annual (million bbls)	110	107	95.7	78.2	61.9	49	39.2
Oil consumption - Cumulative (million bbls)	0	0	0	0	0	0	2,407
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	4.12	4.74	0	0	0	0
Sales of cooking units - Electric Resistance (%)	58.7	59.8	63.6	73.5	87.4	95.9	98.9
Sales of cooking units - Gas (%)	41.3	40.2	36.4	26.5	12.6	4.07	1.1
Sales of space heating units - Electric Heat Pump (%)	3.41	6.07	7.47	11.9	22.3	35.6	44
Sales of space heating units - Electric Resistance (%)	9.83	14.1	13.8	13.3	12.1	10.4	9.55
Sales of space heating units - Fossil (%)	8.97	16.1	15.9	15.1	13.3	11.3	10.2
Sales of space heating units - Gas (%)	77.8	63.8	62.8	59.6	52.3	42.7	36.3
Sales of water heating units - Electric Heat Pump (%)	0	0.188	0.757	2.61	7.15	13.2	17.1
Sales of water heating units - Electric Resistance (%)	20.7	35	35.3	36.5	39.6	43.7	46.5
Sales of water heating units - Gas Furnace (%)	79.2	64.8	63.9	60.9	53.3	43.1	36.4
Sales of water heating units - Other (%)	0.018	0.021	0.021	0.021	0.021	0.021	0.02

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	168	352	1,190	3,738	5,448
Public EV charging plugs - DC Fast (1000 units)	0.168	0	0.604	0	3.11	0	8.65
Public EV charging plugs - L2 (1000 units)	0.739	0	14.5	0	74.8	0	208
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 (%)	1.6	2.01	2.06	1.64	1.06	0.542	0.232
Vehicle sales - Light-duty - EV (%)	1.84	4.58	11.6	25.5	48	71.8	87.5
Vehicle sales - Light-duty - gasoline (%)	91.9	87.7	79.9	67.1	46.6	25.1	11.1
Vehicle sales - Light-duty - hybrid (%)	4.45	5.26	5.92	5.41	4.07	2.42	1.17
Vehicle sales - Light-duty - hydrogen FC (%)	0.113	0.381	0.328	0.252	0.179	0.1	0.046
Vehicle sales - Light-duty - other (%)	0.105	0.108	0.098	0.086	0.062	0.034	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)	221	216	210	204	198	192	187
Final energy use - Industry (PJ)	391	406	408	408	409	409	410
Final energy use - Residential (PJ)	296	280	269	259	249	237	223
Final energy use - Transportation (PJ)	552	523	479	445	418	387	350

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	15,866	17,291	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 (%)	1.8	5.6	6.81	10.6	19.8	32.1	40.2
Sales of space heating units - Electric Resistance (%)	3.09	5.44	5.57	6.02	6.98	8.07	8.69
Sales of space heating units - Fossil (%)	4.77	2.45	2.43	2.18	1.78	1.47	1.36
Sales of space heating units - Gas Furnace (%)	90.3	86.5	85.2	81.2	71.4	58.3	49.7
Sales of water heating units - Electric Heat Pump (%)	0.491	1.03	1.71	3.92	9.33	16.6	21.3
Sales of water heating units - Electric Resistance (%)	4.33	7.15	7.85	9.96	15.2	22.3	26.9
Sales of water heating units - Gas Furnace (%)	94.1	90.8	89.5	85.2	74.6	60.3	50.9
Sales of water heating units - Other (%)	1.03	0.978	0.967	0.931	0.876	0.845	0.834

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	3.06	3.08	4.07	4.2	6.25	6.61

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

Item	2020	2025	2050
Carbon sink potential - Aggressive deployment - Corn-ethanol to energy grasses (1000 tCO2e/y)	0	0	-2,423
Carbon sink potential - Aggressive deployment - Cropland measures (1000 tCO2e/y)	0	0	-13,821
Carbon sink potential - Aggressive deployment - Permanent conservation cover (1000 tCO2e/y)	0	0	-414
Carbon sink potential - Aggressive deployment - Total (1000 tCO2e/y)	0	0	-16,658

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

Item	2020	2025	2050
Carbon sink potential - Moderate deployment - Corn-ethanol to energy grasses (1000 tCO2e/y)	0	0	-2,423
Carbon sink potential - Moderate deployment - Cropland measures (1000 tCO2e/y)	0	0	-7,283
Carbon sink potential - Moderate deployment - Permanent conservation cover (1000 tCO2e/y)	0	0	-207
Carbon sink potential - Moderate deployment - Total (1000 tCO2e/y)	0	0	-9,914
Land impacted for carbon sink - Aggressive deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	1,097
Land impacted for carbon sink - Aggressive deployment - Cropland measures (1000 hectares)	0	0	6,974
Land impacted for carbon sink - Aggressive deployment - Permanent conservation cover (1000 hectares)	0	0	753
Land impacted for carbon sink - Aggressive deployment - Total (1000 hectares)	0	0	8,824
Land impacted for carbon sink - Moderate deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	1,097
Land impacted for carbon sink - Moderate deployment - Cropland measures (1000 hectares)	0	0	3,675
Land impacted for carbon sink - Moderate deployment - Permanent conservation cover (1000 hectares)	0	0	376
Land impacted for carbon sink - Moderate deployment - Total (1000 hectares)	0	0	5,149

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

Item	2020	2025	2050
Carbon sink potential - High - Accelerate regeneration (1000 tCO2e/y)	0	0	479
Carbon sink potential - High - All (not counting overlap) (1000 tCO2e/y)	0	0	40,029
Carbon sink potential - High - Avoid deforestation (1000 tCO2e/y)	0	0	1,871
Carbon sink potential - High - Extend rotation length (1000 tCO2e/y)	0	0	8,507
Carbon sink potential - High - Improve plantations (1000 tCO2e/y)	0	0	793
Carbon sink potential - High - Increase retention of HWP (1000 tCO2e/y)	0	0	4,667
Carbon sink potential - High - Increase trees outside forests (1000 tCO2e/y)	0	0	3,012
Carbon sink potential - High - Reforest cropland (1000 tCO2e/y)	0	0	8,069
Carbon sink potential - High - Reforest pasture (1000 tCO2e/y)	0	0	8,313
Carbon sink potential - High - Restore productivity (1000 tCO2e/y)	0	0	4,318
Carbon sink potential - Low - Accelerate regeneration (1000 tCO2e/y)	0	0	240
Carbon sink potential - Low - All (not counting overlap) (1000 tCO2e/y)	0	0	12,952
Carbon sink potential - Low - Avoid deforestation (1000 tCO2e/y)	0	0	312
Carbon sink potential - Low - Extend rotation length (1000 tCO2e/y)	0	0	3,267
Carbon sink potential - Low - Improve plantations (1000 tCO2e/y)	0	0	404

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	1,556
Carbon sink potential - Low - Increase trees outside forests (1000 tCO2e/y)	0	0	1,054
Carbon sink potential - Low - Reforest cropland (1000 tCO2e/y)	0	0	4,034
Carbon sink potential - Low - Reforest pasture (1000 tCO2e/y)	0	0	630
Carbon sink potential - Low - Restore productivity (1000 tCO2e/y)	0	0	1,455
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO2e/y)	0	0	359
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO2e/y)	0	0	26,484
Carbon sink potential - Mid - Avoid deforestation (1000 tCO2e/y)	0	0	1,091
Carbon sink potential - Mid - Extend rotation length (1000 tCO2e/y)	0	0	5,887
Carbon sink potential - Mid - Improve plantations (1000 tCO2e/y)	0	0	591
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO2e/y)	0	0	3,112
Carbon sink potential - Mid - Increase trees outside forests (1000 tCO2e/y)	0	0	2,033
Carbon sink potential - Mid - Reforest cropland (1000 tCO2e/y)	0	0	6,052
Carbon sink potential - Mid - Reforest pasture (1000 tCO2e/y)	0	0	4,472
Carbon sink potential - Mid - Restore productivity (1000 tCO2e/y)	0	0	2,887
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)	0	0	78.3
Land impacted for carbon sink potential - High - Avoid deforestation (over 30 years) (1000 hectares)	0	0	253
Land impacted for carbon sink potential - High - Extend rotation length (1000 hectares)	0	0	4,338
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)	0	0	292
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	286
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)	0	0	533
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)	0	0	236
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)	0	0	1,431
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)	0	0	7,449
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)	0	0	39.1
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)	0	0	238
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)	0	0	1,662
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)	0	0	146
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	151
Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares)	0	0	267
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)	0	0	40.9
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)	0	0	866
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)	0	0	3,409
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)	0	0	58.7
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)	0	0	246
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)	0	0	3,000
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)	0	0	220
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	218
Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares)	0	0	400
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)	0	0	296
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)	0	0	1,744
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)	0	0	6,183

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

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal (million 2019$)	0	291	0.21	0.201	0.164	0.11	0.003
Monetary damages from air pollution - Natural Gas (million 2019$)	0	103	55.1	21.4	10.1	4.7	4.49
Monetary damages from air pollution - Transportation (million 2019$)	0	1,543	1,586	1,574	1,446	1,174	823
Premature deaths from air pollution - Coal (deaths)	0	32.6	0.024	0.023	0.018	0.012	0
Premature deaths from air pollution - Natural Gas (deaths)	0	11.6	6.23	2.42	1.14	0.531	0.508
Premature deaths from air pollution - Transportation (deaths)	0	174	178	177	163	132	92.6

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	4.14	4.85	0	0	0	0
Sales of cooking units - Electric Resistance (%)	58.9	67.6	94.5	99.7	100	100	100
Sales of cooking units - Gas (%)	41.1	32.4	5.54	0.279	0	0	0
Sales of space heating units - Electric Heat Pump (%)	3.41	7.97	30.9	76.7	90.3	91.9	91.7
Sales of space heating units - Electric Resistance (%)	9.83	13.9	11.3	5.52	3.76	3.59	3.79
Sales of space heating units - Fossil (%)	8.97	15.5	11.4	5.34	3.47	3.15	3.18
Sales of space heating units - Gas (%)	77.8	62.6	46.3	12.4	2.5	1.41	1.31
Sales of water heating units - Electric Heat Pump (%)	0	0.704	9.95	31.7	37.9	38.6	38.6

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

Item	2020	2025	2030	2035	2040	2045	2050
Sales of water heating units - Electric Resistance (%)	20.7	35.3	41.3	56	60.8	61.3	61.3
Sales of water heating units - Gas Furnace (%)	79.2	64	48.7	12.3	1.29	0.072	0
Sales of water heating units - Other (%)	0.018	0.021	0.021	0.021	0.02	0.02	0.02

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	1,035	2,659	4,300	6,517	7,089	6,761
Public EV charging plugs - DC Fast (1000 units)	0.168	0	1.92	0	8.36	0	13.5
Public EV charging plugs - L2 (1000 units)	0.739	0	46.2	0	201	0	325
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 (%)	1.59	1.85	1.27	0.408	0.075	0.013	0
Vehicle sales - Light-duty - EV (%)	3.78	14.8	45.8	81.6	96.3	99.3	100
Vehicle sales - Light-duty - gasoline (%)	90.1	78.5	49.5	16.8	3.32	0.591	0
Vehicle sales - Light-duty - hybrid (%)	4.29	4.45	3.17	1.18	0.287	0.062	0
Vehicle sales - Light-duty - hydrogen FC (%)	0.111	0.342	0.206	0.064	0.013	0.002	0
Vehicle sales - Light-duty - other (%)	0.103	0.1	0.065	0.023	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)	221	216	207	194	179	168	160
Final energy use - Industry (PJ)	391	405	406	401	400	399	401
Final energy use - Residential (PJ)	296	280	265	236	202	173	153
Final energy use - Transportation (PJ)	552	519	460	389	325	285	269

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	15,866	17,271	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 (%)	1.8	6.82	26.5	71.8	85.3	86.8	86.9
Sales of space heating units - Electric Resistance (%)	3.09	5.73	8.18	11.9	12.6	12.6	12.6
Sales of space heating units - Fossil (%)	4.77	2.09	0.407	0.017	0	0	0
Sales of space heating units - Gas Furnace (%)	90.3	85.4	64.9	16.3	2.07	0.546	0.457
Sales of water heating units - Electric Heat Pump (%)	0.491	1.66	12.6	38.5	46.3	47.1	47.2
Sales of water heating units - Electric Resistance (%)	4.33	7.76	18.5	43.6	51.2	52.1	52.2
Sales of water heating units - Gas Furnace (%)	94.1	89.6	68.2	17.2	1.81	0.101	0
Sales of water heating units - Other (%)	1.03	0.934	0.727	0.678	0.674	0.676	0.676

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	3.87	3.99	7.91	8.48	7.13	7.47

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	0.529	0	2.4
Capital invested - Wind - Base (billion $2018)	0	12.8	8.51	17.6	27.5	39.7	39.1

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

Item	2020	2025	2030	2035	2040	2045	2050
Solar - Base land use assumptions (GWh)	558	0	0	0	895	0	4,558
Solar - Constrained land use assumptions (GWh)	558	0	0	0	1,585	421	12,478
Wind - Base land use assumptions (GWh)	20,531	31,117	22,381	48,644	78,088	117,104	117,665
Wind - Constrained land use assumptions (GWh)	20,531	4,801	7,556	19,161	19,554	20,030	135,954

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

Item	2020	2025	2050
Carbon sink potential - Aggressive deployment - Corn-ethanol to energy grasses (1000 tCO2e/y)	0	0	-2,423
Carbon sink potential - Aggressive deployment - Cropland measures (1000 tCO2e/y)	0	0	-13,821
Carbon sink potential - Aggressive deployment - Permanent conservation cover (1000 tCO2e/y)	0	0	-414
Carbon sink potential - Aggressive deployment - Total (1000 tCO2e/y)	0	0	-16,658
Carbon sink potential - Moderate deployment - Corn-ethanol to energy grasses (1000 tCO2e/y)	0	0	-2,423
Carbon sink potential - Moderate deployment - Cropland measures (1000 tCO2e/y)	0	0	-7,283
Carbon sink potential - Moderate deployment - Permanent conservation cover (1000 tCO2e/y)	0	0	-207
Carbon sink potential - Moderate deployment - Total (1000 tCO2e/y)	0	0	-9,914
Land impacted for carbon sink - Aggressive deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	1,097
Land impacted for carbon sink - Aggressive deployment - Cropland measures (1000 hectares)	0	0	6,974
Land impacted for carbon sink - Aggressive deployment - Permanent conservation cover (1000 hectares)	0	0	753
Land impacted for carbon sink - Aggressive deployment - Total (1000 hectares)	0	0	8,824
Land impacted for carbon sink - Moderate deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	1,097
Land impacted for carbon sink - Moderate deployment - Cropland measures (1000 hectares)	0	0	3,675
Land impacted for carbon sink - Moderate deployment - Permanent conservation cover (1000 hectares)	0	0	376
Land impacted for carbon sink - Moderate deployment - Total (1000 hectares)	0	0	5,149

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	479
Carbon sink potential - High - All (not counting overlap) (1000 tCO2e/y)	0	0	40,029
Carbon sink potential - High - Avoid deforestation (1000 tCO2e/y)	0	0	1,871
Carbon sink potential - High - Extend rotation length (1000 tCO2e/y)	0	0	8,507
Carbon sink potential - High - Improve plantations (1000 tCO2e/y)	0	0	793
Carbon sink potential - High - Increase retention of HWP (1000 tCO2e/y)	0	0	4,667
Carbon sink potential - High - Increase trees outside forests (1000 tCO2e/y)	0	0	3,012
Carbon sink potential - High - Reforest cropland (1000 tCO2e/y)	0	0	8,069
Carbon sink potential - High - Reforest pasture (1000 tCO2e/y)	0	0	8,313
Carbon sink potential - High - Restore productivity (1000 tCO2e/y)	0	0	4,318
Carbon sink potential - Low - Accelerate regeneration (1000 tCO2e/y)	0	0	240
Carbon sink potential - Low - All (not counting overlap) (1000 tCO2e/y)	0	0	12,952
Carbon sink potential - Low - Avoid deforestation (1000 tCO2e/y)	0	0	312
Carbon sink potential - Low - Extend rotation length (1000 tCO2e/y)	0	0	3,267
Carbon sink potential - Low - Improve plantations (1000 tCO2e/y)	0	0	404
Carbon sink potential - Low - Increase retention of HWP (1000 tCO2e/y)	0	0	1,556
Carbon sink potential - Low - Increase trees outside forests (1000 tCO2e/y)	0	0	1,054
Carbon sink potential - Low - Reforest cropland (1000 tCO2e/y)	0	0	4,034
Carbon sink potential - Low - Reforest pasture (1000 tCO2e/y)	0	0	630
Carbon sink potential - Low - Restore productivity (1000 tCO2e/y)	0	0	1,455
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO2e/y)	0	0	359
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO2e/y)	0	0	26,484
Carbon sink potential - Mid - Avoid deforestation (1000 tCO2e/y)	0	0	1,091
Carbon sink potential - Mid - Extend rotation length (1000 tCO2e/y)	0	0	5,887
Carbon sink potential - Mid - Improve plantations (1000 tCO2e/y)	0	0	591
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO2e/y)	0	0	3,112
Carbon sink potential - Mid - Increase trees outside forests (1000 tCO2e/y)	0	0	2,033
Carbon sink potential - Mid - Reforest cropland (1000 tCO2e/y)	0	0	6,052
Carbon sink potential - Mid - Reforest pasture (1000 tCO2e/y)	0	0	4,472
Carbon sink potential - Mid - Restore productivity (1000 tCO2e/y)	0	0	2,887
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)	0	0	78.3

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	253
Land impacted for carbon sink potential - High - Extend rotation length (1000 hectares)	0	0	4,338
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)	0	0	292
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	286
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)	0	0	533
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)	0	0	236
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)	0	0	1,431
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)	0	0	7,449
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)	0	0	39.1
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)	0	0	238
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)	0	0	1,662
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)	0	0	146
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	151
Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares)	0	0	267
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)	0	0	40.9
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)	0	0	866
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)	0	0	3,409
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)	0	0	58.7
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)	0	0	246
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)	0	0	3,000
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)	0	0	220
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	218
Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares)	0	0	400
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)	0	0	296
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)	0	0	1,744
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)	0	0	6,183

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

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal (million 2019$)	0	291	0.21	0.201	0.164	0.11	0.003
Monetary damages from air pollution - Natural Gas (million 2019$)	0	96.3	57.6	18.4	10.9	5.54	4.32
Monetary damages from air pollution - Transportation (million 2019$)	0	1,518	1,442	1,116	659	315	138
Premature deaths from air pollution - Coal (deaths)	0	32.6	0.024	0.023	0.018	0.012	0
Premature deaths from air pollution - Natural Gas (deaths)	0	10.9	6.5	2.07	1.23	0.626	0.488
Premature deaths from air pollution - Transportation (deaths)	0	171	162	126	74.2	35.4	15.6

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	4.14	4.85	0	0	0	0
Sales of cooking units - Electric Resistance (%)	58.9	67.6	94.5	99.7	100	100	100
Sales of cooking units - Gas (%)	41.1	32.4	5.54	0.279	0	0	0
Sales of space heating units - Electric Heat Pump (%)	3.41	7.97	30.9	76.7	90.3	91.9	91.7
Sales of space heating units - Electric Resistance (%)	9.83	13.9	11.3	5.52	3.76	3.59	3.79
Sales of space heating units - Fossil (%)	8.97	15.5	11.4	5.34	3.47	3.15	3.18
Sales of space heating units - Gas (%)	77.8	62.6	46.3	12.4	2.5	1.41	1.31
Sales of water heating units - Electric Heat Pump (%)	0	0.704	9.95	31.7	37.9	38.6	38.6
Sales of water heating units - Electric Resistance (%)	20.7	35.3	41.3	56	60.8	61.3	61.3
Sales of water heating units - Gas Furnace (%)	79.2	64	48.7	12.3	1.29	0.072	0
Sales of water heating units - Other (%)	0.018	0.021	0.021	0.021	0.02	0.02	0.02

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	1,035	2,659	4,300	6,517	7,089	6,761
Public EV charging plugs - DC Fast (1000 units)	0.168	0	1.92	0	8.36	0	13.5
Public EV charging plugs - L2 (1000 units)	0.739	0	46.2	0	201	0	325
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 (%)	1.59	1.85	1.27	0.408	0.075	0.013	0
Vehicle sales - Light-duty - EV (%)	3.78	14.8	45.8	81.6	96.3	99.3	100
Vehicle sales - Light-duty - gasoline (%)	90.1	78.5	49.5	16.8	3.32	0.591	0
Vehicle sales - Light-duty - hybrid (%)	4.29	4.45	3.17	1.18	0.287	0.062	0
Vehicle sales - Light-duty - hydrogen FC (%)	0.111	0.342	0.206	0.064	0.013	0.002	0
Vehicle sales - Light-duty - other (%)	0.103	0.1	0.065	0.023	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 37: *E+RE- scenario - PILLAR 1: Efficiency/Electrification - Overview*

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Commercial (PJ)	221	216	207	194	179	168	160
Final energy use - Industry (PJ)	391	405	406	401	400	399	401
Final energy use - Residential (PJ)	296	280	265	236	202	173	153
Final energy use - Transportation (PJ)	552	519	460	389	325	285	269

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	15,866	17,271	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 (%)	1.8	6.82	26.5	71.8	85.3	86.8	86.9
Sales of space heating units - Electric Resistance (%)	3.09	5.73	8.18	11.9	12.6	12.6	12.6
Sales of space heating units - Fossil (%)	4.77	2.09	0.407	0.017	0	0	0
Sales of space heating units - Gas Furnace (%)	90.3	85.4	64.9	16.3	2.07	0.546	0.457
Sales of water heating units - Electric Heat Pump (%)	0.491	1.66	12.6	38.5	46.3	47.1	47.2
Sales of water heating units - Electric Resistance (%)	4.33	7.76	18.5	43.6	51.2	52.1	52.2
Sales of water heating units - Gas Furnace (%)	94.1	89.6	68.2	17.2	1.81	0.101	0
Sales of water heating units - Other (%)	1.03	0.934	0.727	0.678	0.674	0.676	0.676

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	3.87	3.99	7.91	8.48	7.13	7.47

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	4.96	8.01	5.14	7.11	10.2	0.152
Capital invested - Wind - Constrained (billion $2018)	0	0.597	1.29	2.44	3.11	3.72	0.108

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

Item	2020	2025	2030	2035	2040	2045	2050
Solar - Base land use assumptions (GWh)	558	0	0	0	0	0	0
Solar - Constrained land use assumptions (GWh)	558	0	0	0	0	0	0
Wind - Base land use assumptions (GWh)	20,531	12,188	21,442	14,569	20,769	31,172	479
Wind - Constrained land use assumptions (GWh)	20,531	1,436	3,365	6,582	8,672	10,879	324

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

Item	2020	2025	2050
Carbon sink potential - Aggressive deployment - Corn-ethanol to energy grasses (1000 tCO2e/y)	0	0	-2,423
Carbon sink potential - Aggressive deployment - Cropland measures (1000 tCO2e/y)	0	0	-13,821
Carbon sink potential - Aggressive deployment - Permanent conservation cover (1000 tCO2e/y)	0	0	-414
Carbon sink potential - Aggressive deployment - Total (1000 tCO2e/y)	0	0	-16,658
Carbon sink potential - Moderate deployment - Corn-ethanol to energy grasses (1000 tCO2e/y)	0	0	-2,423

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	-7,283
Carbon sink potential - Moderate deployment - Permanent conservation cover (1000 tCO2e/y)	0	0	-207
Carbon sink potential - Moderate deployment - Total (1000 tCO2e/y)	0	0	-9,914
Land impacted for carbon sink - Aggressive deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	1,097
Land impacted for carbon sink - Aggressive deployment - Cropland measures (1000 hectares)	0	0	6,974
Land impacted for carbon sink - Aggressive deployment - Permanent conservation cover (1000 hectares)	0	0	753
Land impacted for carbon sink - Aggressive deployment - Total (1000 hectares)	0	0	8,824
Land impacted for carbon sink - Moderate deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	1,097
Land impacted for carbon sink - Moderate deployment - Cropland measures (1000 hectares)	0	0	3,675
Land impacted for carbon sink - Moderate deployment - Permanent conservation cover (1000 hectares)	0	0	376
Land impacted for carbon sink - Moderate deployment - Total (1000 hectares)	0	0	5,149

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	479
Carbon sink potential - High - All (not counting overlap) (1000 tCO2e/y)	0	0	40,029
Carbon sink potential - High - Avoid deforestation (1000 tCO2e/y)	0	0	1,871
Carbon sink potential - High - Extend rotation length (1000 tCO2e/y)	0	0	8,507
Carbon sink potential - High - Improve plantations (1000 tCO2e/y)	0	0	793
Carbon sink potential - High - Increase retention of HWP (1000 tCO2e/y)	0	0	4,667
Carbon sink potential - High - Increase trees outside forests (1000 tCO2e/y)	0	0	3,012
Carbon sink potential - High - Reforest cropland (1000 tCO2e/y)	0	0	8,069
Carbon sink potential - High - Reforest pasture (1000 tCO2e/y)	0	0	8,313
Carbon sink potential - High - Restore productivity (1000 tCO2e/y)	0	0	4,318
Carbon sink potential - Low - Accelerate regeneration (1000 tCO2e/y)	0	0	240
Carbon sink potential - Low - All (not counting overlap) (1000 tCO2e/y)	0	0	12,952
Carbon sink potential - Low - Avoid deforestation (1000 tCO2e/y)	0	0	312
Carbon sink potential - Low - Extend rotation length (1000 tCO2e/y)	0	0	3,267
Carbon sink potential - Low - Improve plantations (1000 tCO2e/y)	0	0	404
Carbon sink potential - Low - Increase retention of HWP (1000 tCO2e/y)	0	0	1,556

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	1,054
Carbon sink potential - Low - Reforest cropland (1000 tCO2e/y)	0	0	4,034
Carbon sink potential - Low - Reforest pasture (1000 tCO2e/y)	0	0	630
Carbon sink potential - Low - Restore productivity (1000 tCO2e/y)	0	0	1,455
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO2e/y)	0	0	359
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO2e/y)	0	0	26,484
Carbon sink potential - Mid - Avoid deforestation (1000 tCO2e/y)	0	0	1,091
Carbon sink potential - Mid - Extend rotation length (1000 tCO2e/y)	0	0	5,887
Carbon sink potential - Mid - Improve plantations (1000 tCO2e/y)	0	0	591
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO2e/y)	0	0	3,112
Carbon sink potential - Mid - Increase trees outside forests (1000 tCO2e/y)	0	0	2,033
Carbon sink potential - Mid - Reforest cropland (1000 tCO2e/y)	0	0	6,052
Carbon sink potential - Mid - Reforest pasture (1000 tCO2e/y)	0	0	4,472
Carbon sink potential - Mid - Restore productivity (1000 tCO2e/y)	0	0	2,887
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)	0	0	78.3
Land impacted for carbon sink potential - High - Avoid deforestation (over 30 years) (1000 hectares)	0	0	253
Land impacted for carbon sink potential - High - Extend rotation length (1000 hectares)	0	0	4,338
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)	0	0	292
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	286
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)	0	0	533
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)	0	0	236
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)	0	0	1,431
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)	0	0	7,449
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)	0	0	39.1
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)	0	0	238
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)	0	0	1,662
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)	0	0	146
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	151

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	267
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)	0	0	40.9
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)	0	0	866
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)	0	0	3,409
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)	0	0	58.7
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)	0	0	246
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)	0	0	3,000
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)	0	0	220
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	218
Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares)	0	0	400
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)	0	0	296
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)	0	0	1,744
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)	0	0	6,183

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

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal (million 2019$)	0	291	0.21	0.201	0.164	0.11	0.003
Monetary damages from air pollution - Natural Gas (million 2019$)	0	109	68.4	85	57.8	28.1	10.9
Monetary damages from air pollution - Transportation (million 2019$)	0	1,518	1,442	1,116	659	315	138
Premature deaths from air pollution - Coal (deaths)	0	32.6	0.024	0.023	0.018	0.012	0
Premature deaths from air pollution - Natural Gas (deaths)	0	12.3	7.72	9.61	6.53	3.17	1.23
Premature deaths from air pollution - Transportation (deaths)	0	171	162	126	74.2	35.4	15.6

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	4.12	4.74	0	0	0	0
Sales of cooking units - Electric Resistance (%)	58.7	59.8	63.6	73.5	87.4	95.9	98.9
Sales of cooking units - Gas (%)	41.3	40.2	36.4	26.5	12.6	4.07	1.1
Sales of space heating units - Electric Heat Pump (%)	3.41	6.07	7.47	11.9	22.3	35.6	44
Sales of space heating units - Electric Resistance (%)	9.83	14.1	13.8	13.3	12.1	10.4	9.55
Sales of space heating units - Fossil (%)	8.97	16.1	15.9	15.1	13.3	11.3	10.2
Sales of space heating units - Gas (%)	77.8	63.8	62.8	59.6	52.3	42.7	36.3
Sales of water heating units - Electric Heat Pump (%)	0	0.188	0.757	2.61	7.15	13.2	17.1
Sales of water heating units - Electric Resistance (%)	20.7	35	35.3	36.5	39.6	43.7	46.5

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 (%)	79.2	64.8	63.9	60.9	53.3	43.1	36.4
Sales of water heating units - Other (%)	0.018	0.021	0.021	0.021	0.021	0.021	0.02

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	168	352	1,190	3,738	5,448
Public EV charging plugs - DC Fast (1000 units)	0.168	0	0.604	0	3.11	0	8.65
Public EV charging plugs - L2 (1000 units)	0.739	0	14.5	0	74.8	0	208
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 (%)	1.6	2.01	2.06	1.64	1.06	0.542	0.232
Vehicle sales - Light-duty - EV (%)	1.84	4.58	11.6	25.5	48	71.8	87.5
Vehicle sales - Light-duty - gasoline (%)	91.9	87.7	79.9	67.1	46.6	25.1	11.1
Vehicle sales - Light-duty - hybrid (%)	4.45	5.26	5.92	5.41	4.07	2.42	1.17
Vehicle sales - Light-duty - hydrogen FC (%)	0.113	0.381	0.328	0.252	0.179	0.1	0.046
Vehicle sales - Light-duty - other (%)	0.105	0.108	0.098	0.086	0.062	0.034	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)	221	216	210	204	198	192	187
Final energy use - Industry (PJ)	391	406	408	408	409	409	410
Final energy use - Residential (PJ)	296	280	269	259	249	237	223
Final energy use - Transportation (PJ)	552	523	479	445	418	387	350

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	15,866	17,291	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 (%)	1.8	5.6	6.81	10.6	19.8	32.1	40.2
Sales of space heating units - Electric Resistance (%)	3.09	5.44	5.57	6.02	6.98	8.07	8.69
Sales of space heating units - Fossil (%)	4.77	2.45	2.43	2.18	1.78	1.47	1.36
Sales of space heating units - Gas Furnace (%)	90.3	86.5	85.2	81.2	71.4	58.3	49.7
Sales of water heating units - Electric Heat Pump (%)	0.491	1.03	1.71	3.92	9.33	16.6	21.3
Sales of water heating units - Electric Resistance (%)	4.33	7.15	7.85	9.96	15.2	22.3	26.9
Sales of water heating units - Gas Furnace (%)	94.1	90.8	89.5	85.2	74.6	60.3	50.9
Sales of water heating units - Other (%)	1.03	0.978	0.967	0.931	0.876	0.845	0.834

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	3.06	3.08	4.07	4.2	6.25	6.61

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	0.046	0.387	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	88.1	849	849	849	849	849
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	31.8	191	951	2,401	3,337	8,444
Conversion capital investment - Cumulative 5-yr (million $2018)	0	50.2	432	8,095	15,433	9,966	67,223
Number of facilities - Allam power w ccu (quantity)	0	0	0	0	0	0	0
Number of facilities - Beccs hydrogen (quantity)	0	0	0	9	30	42	42
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	47
Number of facilities - Pyrolysis ccu (quantity)	0	0	0	0	0	0	18
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	10.4	30.2	43	55.1
Annual - BECCS (MMT)	0	0	0	10.4	30.2	43	55.1
Annual - Cement and lime (MMT)	0	0	0	0	0	0	0
Annual - NGCC (MMT)	0	0	0	0	0	0	0
Cumulative - All (MMT)	0	0	0	10.4	40.6	83.6	139
Cumulative - BECCS (MMT)	0	0	0	10.4	40.6	83.6	139
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	385	1,087	1,282	1,789
Cumulative investment - All (million $2018)	0	0	0	715	1,223	1,916	2,313
Cumulative investment - Spur (million $2018)	0	0	0	250	759	1,452	1,848
Cumulative investment - Trunk (million $2018)	0	0	0	464	464	464	464
Spur (km)	0	0	0	297	999	1,194	1,701
Trunk (km)	0	0	0	88.1	88.1	88.1	88.1

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	-2,914
Carbon sink potential - Aggressive deployment - Cropland measures (1000 tCO2e/y)	0	0	-12,952
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	-386
Carbon sink potential - Aggressive deployment - Total (1000 tCO2e/y)	0	0	-16,252
Carbon sink potential - Moderate deployment - Corn-ethanol to energy grasses (1000 tCO2e/y)	0	0	-2,914
Carbon sink potential - Moderate deployment - Cropland measures (1000 tCO2e/y)	0	0	-6,825
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	-193
Carbon sink potential - Moderate deployment - Total (1000 tCO2e/y)	0	0	-9,932
Land impacted for carbon sink - Aggressive deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	1,589
Land impacted for carbon sink - Aggressive deployment - Cropland measures (1000 hectares)	0	0	16,087
Land impacted for carbon sink - Aggressive deployment - Cropland to woody energy crops (1000 hectares)	0	0	29.2
Land impacted for carbon sink - Aggressive deployment - Pasture to energy crops (1000 hectares)	0	0	137
Land impacted for carbon sink - Aggressive deployment - Permanent conservation cover (1000 hectares)	0	0	702
Land impacted for carbon sink - Aggressive deployment - Total (1000 hectares)	0	0	18,543
Land impacted for carbon sink - Moderate deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	1,589
Land impacted for carbon sink - Moderate deployment - Cropland measures (1000 hectares)	0	0	3,433
Land impacted for carbon sink - Moderate deployment - Cropland to woody energy crops (1000 hectares)	0	0	29.2
Land impacted for carbon sink - Moderate deployment - Pasture to energy crops (1000 hectares)	0	0	137
Land impacted for carbon sink - Moderate deployment - Permanent conservation cover (1000 hectares)	0	0	351
Land impacted for carbon sink - Moderate deployment - Total (1000 hectares)	0	0	5,538

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	479
Carbon sink potential - High - All (not counting overlap) (1000 tCO2e/y)	0	0	40,029
Carbon sink potential - High - Avoid deforestation (1000 tCO2e/y)	0	0	1,871
Carbon sink potential - High - Extend rotation length (1000 tCO2e/y)	0	0	8,507
Carbon sink potential - High - Improve plantations (1000 tCO2e/y)	0	0	793
Carbon sink potential - High - Increase retention of HWP (1000 tCO2e/y)	0	0	4,667
Carbon sink potential - High - Increase trees outside forests (1000 tCO2e/y)	0	0	3,012
Carbon sink potential - High - Reforest cropland (1000 tCO2e/y)	0	0	8,069
Carbon sink potential - High - Reforest pasture (1000 tCO2e/y)	0	0	8,313
Carbon sink potential - High - Restore productivity (1000 tCO2e/y)	0	0	4,318
Carbon sink potential - Low - Accelerate regeneration (1000 tCO2e/y)	0	0	240
Carbon sink potential - Low - All (not counting overlap) (1000 tCO2e/y)	0	0	12,952
Carbon sink potential - Low - Avoid deforestation (1000 tCO2e/y)	0	0	312
Carbon sink potential - Low - Extend rotation length (1000 tCO2e/y)	0	0	3,267
Carbon sink potential - Low - Improve plantations (1000 tCO2e/y)	0	0	404
Carbon sink potential - Low - Increase retention of HWP (1000 tCO2e/y)	0	0	1,556
Carbon sink potential - Low - Increase trees outside forests (1000 tCO2e/y)	0	0	1,054
Carbon sink potential - Low - Reforest cropland (1000 tCO2e/y)	0	0	4,034
Carbon sink potential - Low - Reforest pasture (1000 tCO2e/y)	0	0	630
Carbon sink potential - Low - Restore productivity (1000 tCO2e/y)	0	0	1,455
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO2e/y)	0	0	359
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO2e/y)	0	0	26,484
Carbon sink potential - Mid - Avoid deforestation (1000 tCO2e/y)	0	0	1,091
Carbon sink potential - Mid - Extend rotation length (1000 tCO2e/y)	0	0	5,887
Carbon sink potential - Mid - Improve plantations (1000 tCO2e/y)	0	0	591
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO2e/y)	0	0	3,112
Carbon sink potential - Mid - Increase trees outside forests (1000 tCO2e/y)	0	0	2,033
Carbon sink potential - Mid - Reforest cropland (1000 tCO2e/y)	0	0	6,052
Carbon sink potential - Mid - Reforest pasture (1000 tCO2e/y)	0	0	4,472
Carbon sink potential - Mid - Restore productivity (1000 tCO2e/y)	0	0	2,887
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)	0	0	78.3

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	253
Land impacted for carbon sink potential - High - Extend rotation length (1000 hectares)	0	0	4,338
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)	0	0	292
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	286
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)	0	0	533
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)	0	0	236
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)	0	0	1,431
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)	0	0	7,449
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)	0	0	39.1
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)	0	0	238
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)	0	0	1,662
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)	0	0	146
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	151
Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares)	0	0	267
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)	0	0	40.9
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)	0	0	866
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)	0	0	3,409
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)	0	0	58.7
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)	0	0	246
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)	0	0	3,000
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)	0	0	220
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	218
Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares)	0	0	400
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)	0	0	296
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)	0	0	1,744
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)	0	0	6,183

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	4.02	4.15	0	0	0	0
Sales of cooking units - Electric Resistance (%)	58.3	58.3	58.3	58.3	58.3	58.3	58.3
Sales of cooking units - Gas (%)	41.7	41.7	41.7	41.7	41.7	41.7	41.7
Sales of space heating units - Electric Heat Pump (%)	2.72	9.25	9.56	10	10.4	10.8	11.4
Sales of space heating units - Electric Resistance (%)	9.92	13.6	13.4	13.3	13.2	12.7	12.4
Sales of space heating units - Fossil (%)	9.2	15	14.2	13.5	13.2	13	13.1
Sales of space heating units - Gas (%)	78.2	62.1	62.9	63.2	63.2	63.4	63.2
Sales of water heating units - Electric Heat Pump (%)	0	0	0	0	0	0	0
Sales of water heating units - Electric Resistance (%)	20.7	34.9	34.8	34.8	34.8	34.8	34.7
Sales of water heating units - Gas Furnace (%)	79.2	65.1	65.2	65.2	65.2	65.2	65.2
Sales of water heating units - Other (%)	0.018	0.021	0.021	0.021	0.021	0.021	0.021

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 (%)	1.59	2	2.19	2.04	1.84	1.71	1.63
Vehicle sales - Light-duty - EV (%)	3.43	5.43	6.19	7.61	9.28	10.8	11.9
Vehicle sales - Light-duty - gasoline (%)	90.5	86.9	84.8	83	81	79	77.5
Vehicle sales - Light-duty - hybrid (%)	4.31	5.16	6.32	6.89	7.47	8.07	8.55
Vehicle sales - Light-duty - hydrogen FC (%)	0.111	0.378	0.348	0.31	0.307	0.308	0.319
Vehicle sales - Light-duty - other (%)	0.104	0.108	0.104	0.105	0.104	0.103	0.106
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)	221	221	221	218	216	217	223
Final energy use - Industry (PJ)	391	416	428	441	457	472	491
Final energy use - Residential (PJ)	296	281	273	268	265	264	263
Final energy use - Transportation (PJ)	552	526	489	468	472	488	508

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	15,688	16,188	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 (%)	1.8	12.1	41.6	67.7	72.9	73.7	73.7
Sales of space heating units - Electric Resistance (%)	3.09	6.45	11.5	19.7	24.9	25.8	25.8
Sales of space heating units - Fossil (%)	4.77	2.37	1.87	0.846	0.129	0.011	0
Sales of space heating units - Gas Furnace (%)	90.3	79.1	45.1	11.8	1.99	0.575	0.459
Sales of water heating units - Electric Heat Pump (%)	0.491	0.81	0.809	0.808	0.806	0.803	0.802

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 (%)	4.33	6.94	6.97	6.94	6.93	6.95	6.95
Sales of water heating units - Gas Furnace (%)	94.1	91.3	91.2	91.3	91.3	91.3	91.3
Sales of water heating units - Other (%)	1.03	0.982	0.983	0.981	0.978	0.982	0.983

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	3.78	3.89	5.19	5.44	4.77	4.91

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

Item	2020	2025	2030	2050
Business-as-usual carbon sink - Natural uptake (Mt CO2e/y)	-33.3	0	-15.2	-13.5
Business-as-usual carbon sink - Retained in Hardwood Products (Mt CO2e/y)	-1.27	0	-2.28	-2.37
Business-as-usual carbon sink - Total (Mt CO2e/y)	-34.5	0	-17.4	-15.9
Carbon sink potential - High - Accelerate regeneration (1000 tCO2e/y)	0	0	0	479
Carbon sink potential - High - All (not counting overlap) (1000 tCO2e/y)	0	0	0	40,029
Carbon sink potential - High - Avoid deforestation (1000 tCO2e/y)	0	0	0	1,871
Carbon sink potential - High - Extend rotation length (1000 tCO2e/y)	0	0	0	8,507
Carbon sink potential - High - Improve plantations (1000 tCO2e/y)	0	0	0	793
Carbon sink potential - High - Increase retention of HWP (1000 tCO2e/y)	0	0	0	4,667
Carbon sink potential - High - Increase trees outside forests (1000 tCO2e/y)	0	0	0	3,012
Carbon sink potential - High - Reforest cropland (1000 tCO2e/y)	0	0	0	8,069
Carbon sink potential - High - Reforest pasture (1000 tCO2e/y)	0	0	0	8,313
Carbon sink potential - High - Restore productivity (1000 tCO2e/y)	0	0	0	4,318
Carbon sink potential - Low - Accelerate regeneration (1000 tCO2e/y)	0	0	0	240
Carbon sink potential - Low - All (not counting overlap) (1000 tCO2e/y)	0	0	0	12,952
Carbon sink potential - Low - Avoid deforestation (1000 tCO2e/y)	0	0	0	312
Carbon sink potential - Low - Extend rotation length (1000 tCO2e/y)	0	0	0	3,267
Carbon sink potential - Low - Improve plantations (1000 tCO2e/y)	0	0	0	404
Carbon sink potential - Low - Increase retention of HWP (1000 tCO2e/y)	0	0	0	1,556
Carbon sink potential - Low - Increase trees outside forests (1000 tCO2e/y)	0	0	0	1,054
Carbon sink potential - Low - Reforest cropland (1000 tCO2e/y)	0	0	0	4,034
Carbon sink potential - Low - Reforest pasture (1000 tCO2e/y)	0	0	0	630
Carbon sink potential - Low - Restore productivity (1000 tCO2e/y)	0	0	0	1,455
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO2e/y)	0	0	0	359
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO2e/y)	0	0	0	26,484

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	1,091
Carbon sink potential - Mid - Extend rotation length (1000 tCO2e/y)	0	0	0	5,887
Carbon sink potential - Mid - Improve plantations (1000 tCO2e/y)	0	0	0	591
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO2e/y)	0	0	0	3,112
Carbon sink potential - Mid - Increase trees outside forests (1000 tCO2e/y)	0	0	0	2,033
Carbon sink potential - Mid - Reforest cropland (1000 tCO2e/y)	0	0	0	6,052
Carbon sink potential - Mid - Reforest pasture (1000 tCO2e/y)	0	0	0	4,472
Carbon sink potential - Mid - Restore productivity (1000 tCO2e/y)	0	0	0	2,887
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)	0	0	0	78.3
Land impacted for carbon sink potential - High - Avoid deforestation (over 30 years) (1000 hectares)	0	0	0	253
Land impacted for carbon sink potential - High - Extend rotation length (1000 hectares)	0	0	0	4,338
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)	0	0	0	292
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	286
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)	0	0	0	533
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)	0	0	0	236
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)	0	0	0	1,431
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)	0	0	0	7,449
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)	0	0	0	39.1
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)	0	0	0	238
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)	0	0	0	1,662
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)	0	0	0	146
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	151
Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares)	0	0	0	267
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)	0	0	0	40.9
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)	0	0	0	866
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)	0	0	0	3,409
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)	0	0	0	58.7
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)	0	0	0	246

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	3,000
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)	0	0	0	220
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	218
Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares)	0	0	0	400
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)	0	0	0	296
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)	0	0	0	1,744
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)	0	0	0	6,183

Table 64: *REF scenario - IMPACTS - Health*

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal (million 2019$)	0	798	446	269	216	191	185
Monetary damages from air pollution - Natural Gas (million 2019$)	0	140	154	179	112	88.5	77.8
Monetary damages from air pollution - Transportation (million 2019$)	0	1,543	1,609	1,680	1,760	1,841	1,924
Premature deaths from air pollution - Coal (deaths)	0	89.5	50	30.2	24.2	21.4	20.8
Premature deaths from air pollution - Natural Gas (deaths)	0	15.8	17.4	20.2	12.7	9.99	8.79
Premature deaths from air pollution - Transportation (deaths)	0	174	181	189	198	207	216