Net-Zero America - kentucky 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	3.38	3.59	0	0	0	0
Sales of cooking units - Electric Resistance (%)	76.9	81.8	96.9	99.8	100	100	100
Sales of cooking units - Gas (%)	23.1	18.2	3.11	0.157	0	0	0
Sales of space heating units - Electric Heat Pump (%)	26.6	42.5	77.8	85.8	86.2	86.1	86.1
Sales of space heating units - Electric Resistance (%)	26.5	25.4	10.6	7.34	7.19	7.29	7.32
Sales of space heating units - Fossil (%)	9.65	11.3	5.2	3.78	3.67	3.61	3.61
Sales of space heating units - Gas (%)	37.2	20.8	6.32	3.1	2.98	2.95	2.94
Sales of water heating units - Electric Heat Pump (%)	0	8.47	44.9	53	53.3	53.4	53.4
Sales of water heating units - Electric Resistance (%)	62.5	70	49.2	44.5	44.3	44.3	44.3
Sales of water heating units - Gas Furnace (%)	34.2	19.2	3.59	0.151	0	0	0
Sales of water heating units - Other (%)	3.3	2.39	2.36	2.36	2.36	2.37	2.38

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	840	2,147	3,490	5,282	5,754	5,483
Public EV charging plugs - DC Fast (1000 units)	0.06	0	1.72	0	7.66	0	12.4
Public EV charging plugs - L2 (1000 units)	0.251	0	41.4	0	184	0	298
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 (%)	1.56	1.82	1.26	0.403	0.075	0.013	0
Vehicle sales - Light-duty - EV (%)	3.9	15.1	46.4	81.8	96.3	99.3	100
Vehicle sales - Light-duty - gasoline (%)	89.9	78.1	48.9	16.6	3.3	0.59	0
Vehicle sales - Light-duty - hybrid (%)	4.4	4.53	3.21	1.19	0.29	0.063	0
Vehicle sales - Light-duty - hydrogen FC (%)	0.11	0.34	0.203	0.063	0.013	0.002	0
Vehicle sales - Light-duty - other (%)	0.102	0.098	0.064	0.022	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)	119	118	113	105	99.3	96.6	97
Final energy use - Industry (PJ)	382	396	409	403	409	414	415
Final energy use - Residential (PJ)	184	171	156	137	121	111	106
Final energy use - Transportation (PJ)	426	391	344	288	236	205	193

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	12,650	14,338	0	0	0	0
Sales of cooking units - Electric Resistance (%)	43.5	55.3	83.4	88.9	89.2	89.2	89.1
Sales of cooking units - Gas (%)	56.5	44.7	16.6	11.1	10.8	10.8	10.9
Sales of space heating units - Electric Heat Pump (%)	5.4	31	77.5	91	92.2	92.3	92.3
Sales of space heating units - Electric Resistance (%)	3.11	4.17	4.51	5.9	6.19	6.19	6.21
Sales of space heating units - Fossil (%)	15.1	4.35	0.819	0.034	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 (%)	76.4	60.5	17.1	3.03	1.58	1.53	1.52
Sales of water heating units - Electric Heat Pump (%)	0.117	10.6	55.7	65.7	66.2	66.2	66.2
Sales of water heating units - Electric Resistance (%)	4.29	9.87	28	32.1	32.3	32.2	32.3
Sales of water heating units - Gas Furnace (%)	94.4	77.9	14.7	0.621	0	0	0
Sales of water heating units - Other (%)	1.17	1.57	1.57	1.57	1.57	1.56	1.55

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	3.26	3.36	4.91	5.18	4.05	4.16

Table 6: *E+ scenario - PILLAR 2: Clean Electricity - Generating capacity*

Item	2020	2025	2030	2035	2040	2045	2050
Capital invested - Biomass power plant (billion $2018)	0	0	0	0	0	0	0
Capital invested - Biomass w/ccu allam power plant (billion $2018)	0	0	0	0	0	0	0
Capital invested - Biomass w/ccu power plant (billion $2018)	0	0	5.14	0	0	5.51	0
Capital invested - Solar PV - Base (billion $2018)	0	0	0	0	0	0	0.071
Capital invested - Solar PV - Constrained (billion $2018)	0	0.091	0	0	0	0.132	0.08
Capital invested - Wind - Constrained (billion $2018)	0	0	0.098	0.431	0.052	0	0

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

Item	2020	2025	2030	2035	2040	2045	2050
Biomass power plant (GWh)	0	0	0	0	0	0	0
Biomass w/ccu allam power plant (GWh)	0	0	0	0	0	0	0
Biomass w/ccu power plant (GWh)	0	0	5,771	5,771	5,771	11,950	11,950
Solar - Base land use assumptions (GWh)	145	0	0	0	0	0	139
Solar - Constrained land use assumptions (GWh)	145	0	0	0	0	0	0
Wind - Constrained land use assumptions (GWh)	0	0	217	838	91	0	0

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

Item	2020	2025	2030	2035	2040	2045	2050
Biomass purchases (million $2018/year)	0	0	227	552	552	902	902
Conversion capital investment - Cumulative 5-yr (million $2018)	0	0	4,717	5,838	0	6,983	0
Number of facilities - Allam power w ccu (quantity)	0	0	0	0	0	0	0
Number of facilities - Beccs hydrogen (quantity)	0	0	0	6	6	8	8
Number of facilities - Diesel (quantity)	0	0	0	0	0	0	0
Number of facilities - Diesel ccu (quantity)	0	0	0	0	0	0	0
Number of facilities - Power (quantity)	0	0	0	0	0	0	0
Number of facilities - Power ccu (quantity)	0	0	4	4	4	9	9
Number of facilities - Pyrolysis (quantity)	0	0	0	0	0	0	0
Number of facilities - Pyrolysis ccu (quantity)	0	0	0	0	0	1	1
Number of facilities - Sng (quantity)	0	0	0	0	0	0	0
Number of facilities - Sng ccu (quantity)	0	0	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	5.71	20.1	22.8	35.3	34.1
Annual - BECCS (MMT)	0	0	5.71	13.2	13	21.4	21.4

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

Item	2020	2025	2030	2035	2040	2045	2050
Annual - Cement and lime (MMT)	0	0	0	0	3.32	3.42	3.53
Annual - NGCC (MMT)	0	0	0	6.95	6.44	10.4	9.12
Cumulative - All (MMT)	0	0	5.71	25.9	48.6	83.9	118
Cumulative - BECCS (MMT)	0	0	5.71	18.9	31.9	53.4	74.8
Cumulative - Cement and lime (MMT)	0	0	0	0	3.32	6.74	10.3
Cumulative - NGCC (MMT)	0	0	0	6.95	13.4	23.8	33

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

Item	2020	2025	2030	2035	2040	2045	2050
CO2 storage (MMT)	0	0	1.1	1.76	3.61	5.16	6.52
Injection wells (wells)	0	0	1	4	7	12	15
Resource characterization, appraisal, permitting costs (million $2020)	0	45.8	128	165	165	165	165
Wells and facilities construction costs (million $2020)	0	0	30.5	119	212	354	439

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

Item	2020	2025	2030	2035	2040	2045	2050
All (km)	0	0	505	1,390	1,455	2,534	2,836
Cumulative investment - All (million $2018)	0	0	1,724	2,883	2,920	3,762	4,000
Cumulative investment - Spur (million $2018)	0	0	284	929	966	1,808	2,046
Cumulative investment - Trunk (million $2018)	0	0	1,440	1,954	1,954	1,954	1,954
Spur (km)	0	0	230	1,031	1,097	2,176	2,477
Trunk (km)	0	0	275	359	359	359	359

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	-432
Carbon sink potential - Aggressive deployment - Cropland measures (1000 tCO2e/y)	0	0	-4,963
Carbon sink potential - Aggressive deployment - Permanent conservation cover (1000 tCO2e/y)	0	0	-136
Carbon sink potential - Aggressive deployment - Total (1000 tCO2e/y)	0	0	-5,532
Carbon sink potential - Moderate deployment - Corn-ethanol to energy grasses (1000 tCO2e/y)	0	0	-432
Carbon sink potential - Moderate deployment - Cropland measures (1000 tCO2e/y)	0	0	-2,618
Carbon sink potential - Moderate deployment - Permanent conservation cover (1000 tCO2e/y)	0	0	-67.9
Carbon sink potential - Moderate deployment - Total (1000 tCO2e/y)	0	0	-3,118
Land impacted for carbon sink - Aggressive deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	188
Land impacted for carbon sink - Aggressive deployment - Cropland measures (1000 hectares)	0	0	2,250
Land impacted for carbon sink - Aggressive deployment - Permanent conservation cover (1000 hectares)	0	0	247
Land impacted for carbon sink - Aggressive deployment - Total (1000 hectares)	0	0	2,685
Land impacted for carbon sink - Moderate deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	188
Land impacted for carbon sink - Moderate deployment - Cropland measures (1000 hectares)	0	0	1,187

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

Item	2020	2025	2050
Land impacted for carbon sink - Moderate deployment - Permanent conservation cover (1000 hectares)	0	0	124
Land impacted for carbon sink - Moderate deployment - Total (1000 hectares)	0	0	1,498

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

Item	2020	2025	2050
Carbon sink potential - High - Accelerate regeneration (1000 tCO2e/y)	0	0	96.7
Carbon sink potential - High - All (not counting overlap) (1000 tCO2e/y)	0	0	27,796
Carbon sink potential - High - Avoid deforestation (1000 tCO2e/y)	0	0	1,537
Carbon sink potential - High - Extend rotation length (1000 tCO2e/y)	0	0	5,669
Carbon sink potential - High - Improve plantations (1000 tCO2e/y)	0	0	48.1
Carbon sink potential - High - Increase retention of HWP (1000 tCO2e/y)	0	0	4,665
Carbon sink potential - High - Increase trees outside forests (1000 tCO2e/y)	0	0	965
Carbon sink potential - High - Reforest cropland (1000 tCO2e/y)	0	0	1,409
Carbon sink potential - High - Reforest pasture (1000 tCO2e/y)	0	0	10,207
Carbon sink potential - High - Restore productivity (1000 tCO2e/y)	0	0	3,200
Carbon sink potential - Low - Accelerate regeneration (1000 tCO2e/y)	0	0	48.5
Carbon sink potential - Low - All (not counting overlap) (1000 tCO2e/y)	0	0	6,956
Carbon sink potential - Low - Avoid deforestation (1000 tCO2e/y)	0	0	256
Carbon sink potential - Low - Extend rotation length (1000 tCO2e/y)	0	0	2,177
Carbon sink potential - Low - Improve plantations (1000 tCO2e/y)	0	0	24.5
Carbon sink potential - Low - Increase retention of HWP (1000 tCO2e/y)	0	0	1,555
Carbon sink potential - Low - Increase trees outside forests (1000 tCO2e/y)	0	0	338
Carbon sink potential - Low - Reforest cropland (1000 tCO2e/y)	0	0	704
Carbon sink potential - Low - Reforest pasture (1000 tCO2e/y)	0	0	773
Carbon sink potential - Low - Restore productivity (1000 tCO2e/y)	0	0	1,079
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO2e/y)	0	0	72.6
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO2e/y)	0	0	17,376
Carbon sink potential - Mid - Avoid deforestation (1000 tCO2e/y)	0	0	897
Carbon sink potential - Mid - Extend rotation length (1000 tCO2e/y)	0	0	3,923
Carbon sink potential - Mid - Improve plantations (1000 tCO2e/y)	0	0	35.9
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO2e/y)	0	0	3,110
Carbon sink potential - Mid - Increase trees outside forests (1000 tCO2e/y)	0	0	651

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

Item	2020	2025	2050
Carbon sink potential - Mid - Reforest cropland (1000 tCO2e/y)	0	0	1,057
Carbon sink potential - Mid - Reforest pasture (1000 tCO2e/y)	0	0	5,490
Carbon sink potential - Mid - Restore productivity (1000 tCO2e/y)	0	0	2,139
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)	0	0	15.8
Land impacted for carbon sink potential - High - Avoid deforestation (over 30 years) (1000 hectares)	0	0	208
Land impacted for carbon sink potential - High - Extend rotation length (1000 hectares)	0	0	2,891
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)	0	0	17.7
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	91.7
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)	0	0	93.2
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)	0	0	290
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)	0	0	1,061
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)	0	0	4,668
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)	0	0	7.91
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)	0	0	195
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)	0	0	1,107
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)	0	0	8.86
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	48.3
Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares)	0	0	46.6
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)	0	0	50.3
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)	0	0	642
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)	0	0	2,107
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)	0	0	11.9
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)	0	0	202
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)	0	0	1,999
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)	0	0	13.3
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	70
Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares)	0	0	69.9

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

Item	2020	2025	2050
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)	0	0	363
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)	0	0	1,293
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)	0	0	4,022

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

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal (million 2019$)	0	766	2.45	2.43	2.28	1.74	0.169
Monetary damages from air pollution - Natural Gas (million 2019$)	0	166	129	71.3	56.6	24.6	8.82
Monetary damages from air pollution - Transportation (million 2019$)	0	1,223	1,135	858	493	225	90.1
Premature deaths from air pollution - Coal (deaths)	0	85.9	0.275	0.273	0.256	0.195	0.019
Premature deaths from air pollution - Natural Gas (deaths)	0	18.7	14.5	8.05	6.39	2.78	0.997
Premature deaths from air pollution - Transportation (deaths)	0	138	128	96.5	55.5	25.3	10.1

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

Item	2020	2025	2030	2035	2040	2045	2050
By economic sector - Agriculture (jobs)	92	96.7	299	1,155	982	1,266	1,043
By economic sector - Construction (jobs)	4,307	3,515	4,016	4,488	3,984	3,689	3,953
By economic sector - Manufacturing (jobs)	4,082	6,895	8,210	10,972	10,457	8,644	10,810
By economic sector - Mining (jobs)	6,505	3,343	2,045	1,485	1,026	741	535
By economic sector - Other (jobs)	266	192	198	249	252	245	305
By economic sector - Pipeline (jobs)	390	384	485	428	317	312	353
By economic sector - Professional (jobs)	3,282	2,162	1,906	2,831	2,559	2,950	2,893
By economic sector - Trade (jobs)	3,666	2,011	1,576	1,563	1,364	1,319	1,276
By economic sector - Utilities (jobs)	7,015	5,255	5,483	6,059	5,536	4,636	4,648
By education level - All sectors - Associates degree or some college (jobs)	9,018	7,408	7,599	9,006	8,212	7,226	7,950
By education level - All sectors - Bachelors degree (jobs)	6,024	4,990	4,941	5,868	5,290	4,789	5,164
By education level - All sectors - Doctoral degree (jobs)	185	139	128	162	144	149	151
By education level - All sectors - High school diploma or less (jobs)	12,961	10,191	10,458	12,880	11,654	10,535	11,394
By education level - All sectors - Masters or professional degree (jobs)	1,416	1,128	1,092	1,314	1,177	1,102	1,156
By resource sector - Biomass (jobs)	275	295	796	3,253	2,933	4,620	4,463
By resource sector - CO2 (jobs)	0	24.2	1,338	1,452	1,106	1,664	2,392
By resource sector - Coal (jobs)	9,681	3,153	589	505	432	384	339
By resource sector - Grid (jobs)	8,090	5,665	6,646	8,440	7,292	6,211	6,045
By resource sector - Natural Gas (jobs)	4,405	4,926	4,400	3,428	3,561	2,066	1,464
By resource sector - Nuclear (jobs)	0	0	0	0	0	0	0
By resource sector - Oil (jobs)	5,230	4,580	3,754	2,855	2,011	1,414	933
By resource sector - Solar (jobs)	1,416	2,727	3,196	4,630	4,869	4,415	6,347
By resource sector - Wind (jobs)	506	2,484	3,499	4,667	4,273	3,026	3,833
Median wages - Annual - All ($2019 per job)	54,492	54,997	55,154	55,014	55,539	56,203	56,450
On-Site or In-Plant Training - Total jobs - 1 to 4 years (jobs)	4,725	3,827	3,908	4,608	4,177	3,679	4,012
On-Site or In-Plant Training - Total jobs - 4 to 10 years (jobs)	1,826	1,415	1,435	1,626	1,462	1,306	1,382
On-Site or In-Plant Training - Total jobs - None (jobs)	4,496	3,777	3,876	4,748	4,311	3,904	4,248
On-Site or In-Plant Training - Total jobs - Over 10 years (jobs)	225	191	200	236	216	191	209

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

Item	2020	2025	2030	2035	2040	2045	2050
On-Site or In-Plant Training - Total jobs - Up to 1 year (jobs)	18,333	14,645	14,798	18,012	16,312	14,721	15,965
On-the-Job Training - All sectors - 1 to 4 years (jobs)	6,004	4,882	4,989	5,848	5,304	4,658	5,080
On-the-Job Training - All sectors - 4 to 10 years (jobs)	1,760	1,345	1,370	1,552	1,397	1,246	1,317
On-the-Job Training - All sectors - None (jobs)	1,529	1,241	1,246	1,496	1,352	1,237	1,345
On-the-Job Training - All sectors - Over 10 years (jobs)	247	233	247	296	271	236	270
On-the-Job Training - All sectors - Up to 1 year (jobs)	20,064	16,154	16,366	20,038	18,153	16,423	17,804
Related work experience - All sectors - 1 to 4 years (jobs)	10,963	8,676	8,710	10,438	9,429	8,449	9,108
Related work experience - All sectors - 4 to 10 years (jobs)	6,688	5,489	5,568	6,575	5,960	5,299	5,768
Related work experience - All sectors - None (jobs)	4,150	3,382	3,477	4,217	3,821	3,452	3,720
Related work experience - All sectors - Over 10 years (jobs)	1,789	1,540	1,575	1,873	1,704	1,497	1,660
Related work experience - All sectors - Up to 1 year (jobs)	6,013	4,768	4,887	6,126	5,562	5,103	5,559
Wage income - All (million $2019)	1,613	1,312	1,336	1,608	1,471	1,338	1,457

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

Item	2020	2025	2030	2035	2040	2045	2050
Natural gas consumption - Annual (tcf)	259	263	222	178	134	84.2	58.4
Natural gas consumption - Cumulative (tcf)	0	0	0	0	0	0	5,358
Natural gas production - Annual (tcf)	86.8	96.2	91	79.2	67	53.1	41.3
Oil consumption - Annual (million bbls)	93.4	88.2	77.2	61.2	46.1	34.1	24.3
Oil consumption - Cumulative (million bbls)	0	0	0	0	0	0	1,887
Oil production - Annual (million bbls)	2.71	2.93	2.94	2.94	2.33	1.89	1.26

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	3.35	3.47	0	0	0	0
Sales of cooking units - Electric Resistance (%)	76.8	77.4	79.5	85.1	92.9	97.7	99.4
Sales of cooking units - Gas (%)	23.2	22.6	20.5	14.9	7.09	2.29	0.616
Sales of space heating units - Electric Heat Pump (%)	26.6	35.6	39.7	51.4	69.2	80.7	84.7
Sales of space heating units - Electric Resistance (%)	26.5	28.2	26.4	21.5	14.1	9.46	7.83
Sales of space heating units - Fossil (%)	9.65	12.5	11.9	9.77	6.6	4.55	3.88
Sales of space heating units - Gas (%)	37.2	23.6	22	17.4	10.1	5.25	3.56
Sales of water heating units - Electric Heat Pump (%)	0	1.46	5.6	17.5	35.8	47.8	51.9
Sales of water heating units - Electric Resistance (%)	62.5	74	71.8	64.8	54.3	47.5	45.1
Sales of water heating units - Gas Furnace (%)	34.2	22.2	20.3	15.3	7.52	2.39	0.624
Sales of water heating units - Other (%)	3.3	2.39	2.37	2.38	2.39	2.38	2.38

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	135	286	962	3,037	4,422
Public EV charging plugs - DC Fast (1000 units)	0.06	0	0.518	0	2.83	0	7.94
Public EV charging plugs - L2 (1000 units)	0.251	0	12.5	0	68	0	191
Vehicle sales - Heavy-duty - diesel (%)	97.4	96	91.3	79.8	58.2	32.1	13.7
Vehicle sales - Heavy-duty - EV (%)	0.498	1.45	4.11	10.8	23.6	39.5	51
Vehicle sales - Heavy-duty - gasoline (%)	0.228	0.236	0.239	0.225	0.179	0.109	0.051

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

Item	2020	2025	2030	2035	2040	2045	2050
Vehicle sales - Heavy-duty - hybrid (%)	0.083	0.094	0.104	0.107	0.092	0.06	0.03
Vehicle sales - Heavy-duty - hydrogen FC (%)	0.332	0.969	2.74	7.17	15.7	26.3	34
Vehicle sales - Heavy-duty - other (%)	1.5	1.28	1.46	1.95	2.25	1.96	1.14
Vehicle sales - Light-duty - diesel (%)	1.57	1.98	2.06	1.64	1.05	0.538	0.231
Vehicle sales - Light-duty - EV (%)	1.88	4.66	11.8	25.8	48.3	72	87.5
Vehicle sales - Light-duty - gasoline (%)	91.8	87.5	79.7	66.7	46.3	24.9	11
Vehicle sales - Light-duty - hybrid (%)	4.56	5.37	6.03	5.49	4.12	2.44	1.18
Vehicle sales - Light-duty - hydrogen FC (%)	0.113	0.38	0.326	0.249	0.177	0.098	0.046
Vehicle sales - Light-duty - other (%)	0.103	0.107	0.097	0.085	0.061	0.034	0.015
Vehicle sales - Medium-duty - diesel (%)	64.8	62.2	57.7	49.4	35.6	19.6	8.37
Vehicle sales - Medium-duty - EV (%)	0.664	1.94	5.49	14.3	31.4	52.6	68
Vehicle sales - Medium-duty - gasoline (%)	33.8	34.7	34.7	31.9	24.4	14.2	6.33
Vehicle sales - Medium-duty - hybrid (%)	0.363	0.418	0.464	0.478	0.414	0.275	0.141
Vehicle sales - Medium-duty - hydrogen FC (%)	0.166	0.485	1.37	3.58	7.86	13.2	17
Vehicle sales - Medium-duty - other (%)	0.253	0.266	0.279	0.286	0.258	0.184	0.102

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

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Commercial (PJ)	119	119	117	114	110	106	103
Final energy use - Industry (PJ)	382	396	410	408	416	420	420
Final energy use - Residential (PJ)	184	172	163	153	142	129	118
Final energy use - Transportation (PJ)	427	394	360	333	312	287	259

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	12,642	14,325	0	0	0	0
Sales of cooking units - Electric Resistance (%)	43.5	47.1	51.3	61.6	76.1	85	88
Sales of cooking units - Gas (%)	56.5	52.9	48.7	38.4	23.9	15	12
Sales of space heating units - Electric Heat Pump (%)	5.4	22.1	27.3	42.8	66.9	83.6	89.9
Sales of space heating units - Electric Resistance (%)	3.11	4.17	4.24	4.4	4.84	5.52	5.99
Sales of space heating units - Fossil (%)	15.1	5.03	4.61	3.36	1.65	0.539	0.139
Sales of space heating units - Gas Furnace (%)	76.4	68.7	63.8	49.5	26.6	10.3	3.94
Sales of water heating units - Electric Heat Pump (%)	0.117	1.95	7.08	21.8	44.5	59.3	64.4
Sales of water heating units - Electric Resistance (%)	4.29	6.36	8.3	14.3	23.5	29.4	31.5
Sales of water heating units - Gas Furnace (%)	94.4	90.1	83.1	62.2	30.5	9.74	2.54
Sales of water heating units - Other (%)	1.17	1.57	1.57	1.57	1.57	1.56	1.55

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	2.71	2.75	3.26	3.36	4.25	4.44

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	-432
Carbon sink potential - Aggressive deployment - Cropland measures (1000 tCO2e/y)	0	0	-4,963
Carbon sink potential - Aggressive deployment - Permanent conservation cover (1000 tCO2e/y)	0	0	-136
Carbon sink potential - Aggressive deployment - Total (1000 tCO2e/y)	0	0	-5,532
Carbon sink potential - Moderate deployment - Corn-ethanol to energy grasses (1000 tCO2e/y)	0	0	-432

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

Item	2020	2025	2050
Carbon sink potential - Moderate deployment - Cropland measures (1000 tCO2e/y)	0	0	-2,618
Carbon sink potential - Moderate deployment - Permanent conservation cover (1000 tCO2e/y)	0	0	-67.9
Carbon sink potential - Moderate deployment - Total (1000 tCO2e/y)	0	0	-3,118
Land impacted for carbon sink - Aggressive deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	188
Land impacted for carbon sink - Aggressive deployment - Cropland measures (1000 hectares)	0	0	2,250
Land impacted for carbon sink - Aggressive deployment - Permanent conservation cover (1000 hectares)	0	0	247
Land impacted for carbon sink - Aggressive deployment - Total (1000 hectares)	0	0	2,685
Land impacted for carbon sink - Moderate deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	188
Land impacted for carbon sink - Moderate deployment - Cropland measures (1000 hectares)	0	0	1,187
Land impacted for carbon sink - Moderate deployment - Permanent conservation cover (1000 hectares)	0	0	124
Land impacted for carbon sink - Moderate deployment - Total (1000 hectares)	0	0	1,498

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

Item	2020	2025	2050
Carbon sink potential - High - Accelerate regeneration (1000 tCO2e/y)	0	0	96.7
Carbon sink potential - High - All (not counting overlap) (1000 tCO2e/y)	0	0	27,796
Carbon sink potential - High - Avoid deforestation (1000 tCO2e/y)	0	0	1,537
Carbon sink potential - High - Extend rotation length (1000 tCO2e/y)	0	0	5,669
Carbon sink potential - High - Improve plantations (1000 tCO2e/y)	0	0	48.1
Carbon sink potential - High - Increase retention of HWP (1000 tCO2e/y)	0	0	4,665
Carbon sink potential - High - Increase trees outside forests (1000 tCO2e/y)	0	0	965
Carbon sink potential - High - Reforest cropland (1000 tCO2e/y)	0	0	1,409
Carbon sink potential - High - Reforest pasture (1000 tCO2e/y)	0	0	10,207
Carbon sink potential - High - Restore productivity (1000 tCO2e/y)	0	0	3,200
Carbon sink potential - Low - Accelerate regeneration (1000 tCO2e/y)	0	0	48.5
Carbon sink potential - Low - All (not counting overlap) (1000 tCO2e/y)	0	0	6,956
Carbon sink potential - Low - Avoid deforestation (1000 tCO2e/y)	0	0	256
Carbon sink potential - Low - Extend rotation length (1000 tCO2e/y)	0	0	2,177
Carbon sink potential - Low - Improve plantations (1000 tCO2e/y)	0	0	24.5
Carbon sink potential - Low - Increase retention of HWP (1000 tCO2e/y)	0	0	1,555

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

Item	2020	2025	2050
Carbon sink potential - Low - Increase trees outside forests (1000 tCO2e/y)	0	0	338
Carbon sink potential - Low - Reforest cropland (1000 tCO2e/y)	0	0	704
Carbon sink potential - Low - Reforest pasture (1000 tCO2e/y)	0	0	773
Carbon sink potential - Low - Restore productivity (1000 tCO2e/y)	0	0	1,079
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO2e/y)	0	0	72.6
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO2e/y)	0	0	17,376
Carbon sink potential - Mid - Avoid deforestation (1000 tCO2e/y)	0	0	897
Carbon sink potential - Mid - Extend rotation length (1000 tCO2e/y)	0	0	3,923
Carbon sink potential - Mid - Improve plantations (1000 tCO2e/y)	0	0	35.9
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO2e/y)	0	0	3,110
Carbon sink potential - Mid - Increase trees outside forests (1000 tCO2e/y)	0	0	651
Carbon sink potential - Mid - Reforest cropland (1000 tCO2e/y)	0	0	1,057
Carbon sink potential - Mid - Reforest pasture (1000 tCO2e/y)	0	0	5,490
Carbon sink potential - Mid - Restore productivity (1000 tCO2e/y)	0	0	2,139
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)	0	0	15.8
Land impacted for carbon sink potential - High - Avoid deforestation (over 30 years) (1000 hectares)	0	0	208
Land impacted for carbon sink potential - High - Extend rotation length (1000 hectares)	0	0	2,891
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)	0	0	17.7
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	91.7
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)	0	0	93.2
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)	0	0	290
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)	0	0	1,061
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)	0	0	4,668
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)	0	0	7.91
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)	0	0	195
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)	0	0	1,107
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)	0	0	8.86
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	48.3

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

Item	2020	2025	2050
Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares)	0	0	46.6
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)	0	0	50.3
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)	0	0	642
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)	0	0	2,107
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)	0	0	11.9
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)	0	0	202
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)	0	0	1,999
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)	0	0	13.3
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	70
Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares)	0	0	69.9
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)	0	0	363
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)	0	0	1,293
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)	0	0	4,022

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

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal (million 2019$)	0	766	2.45	2.43	2.28	1.74	0.169
Monetary damages from air pollution - Natural Gas (million 2019$)	0	142	85.6	32.8	14	4.84	2.76
Monetary damages from air pollution - Transportation (million 2019$)	0	1,243	1,249	1,211	1,086	860	589
Premature deaths from air pollution - Coal (deaths)	0	85.9	0.275	0.273	0.256	0.195	0.019
Premature deaths from air pollution - Natural Gas (deaths)	0	16.1	9.67	3.71	1.59	0.547	0.312
Premature deaths from air pollution - Transportation (deaths)	0	140	141	136	122	96.8	66.2

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	3.38	3.59	0	0	0	0
Sales of cooking units - Electric Resistance (%)	76.9	81.8	96.9	99.8	100	100	100
Sales of cooking units - Gas (%)	23.1	18.2	3.11	0.157	0	0	0
Sales of space heating units - Electric Heat Pump (%)	26.6	42.5	77.8	85.8	86.2	86.1	86.1
Sales of space heating units - Electric Resistance (%)	26.5	25.4	10.6	7.34	7.19	7.29	7.32
Sales of space heating units - Fossil (%)	9.65	11.3	5.2	3.78	3.67	3.61	3.61
Sales of space heating units - Gas (%)	37.2	20.8	6.32	3.1	2.98	2.95	2.94
Sales of water heating units - Electric Heat Pump (%)	0	8.47	44.9	53	53.3	53.4	53.4
Sales of water heating units - Electric Resistance (%)	62.5	70	49.2	44.5	44.3	44.3	44.3

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

Item	2020	2025	2030	2035	2040	2045	2050
Sales of water heating units - Gas Furnace (%)	34.2	19.2	3.59	0.151	0	0	0
Sales of water heating units - Other (%)	3.3	2.39	2.36	2.36	2.36	2.37	2.38

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	840	2,147	3,490	5,282	5,754	5,483
Public EV charging plugs - DC Fast (1000 units)	0.06	0	1.72	0	7.66	0	12.4
Public EV charging plugs - L2 (1000 units)	0.251	0	41.4	0	184	0	298
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 (%)	1.56	1.82	1.26	0.403	0.075	0.013	0
Vehicle sales - Light-duty - EV (%)	3.9	15.1	46.4	81.8	96.3	99.3	100
Vehicle sales - Light-duty - gasoline (%)	89.9	78.1	48.9	16.6	3.3	0.59	0
Vehicle sales - Light-duty - hybrid (%)	4.4	4.53	3.21	1.19	0.29	0.063	0
Vehicle sales - Light-duty - hydrogen FC (%)	0.11	0.34	0.203	0.063	0.013	0.002	0
Vehicle sales - Light-duty - other (%)	0.102	0.098	0.064	0.022	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)	119	118	113	105	99.3	96.6	97
Final energy use - Industry (PJ)	382	396	409	403	409	414	415
Final energy use - Residential (PJ)	184	171	156	137	121	111	106
Final energy use - Transportation (PJ)	426	391	344	288	236	205	193

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	12,650	14,338	0	0	0	0
Sales of cooking units - Electric Resistance (%)	43.5	55.3	83.4	88.9	89.2	89.2	89.1
Sales of cooking units - Gas (%)	56.5	44.7	16.6	11.1	10.8	10.8	10.9
Sales of space heating units - Electric Heat Pump (%)	5.4	31	77.5	91	92.2	92.3	92.3
Sales of space heating units - Electric Resistance (%)	3.11	4.17	4.51	5.9	6.19	6.19	6.21
Sales of space heating units - Fossil (%)	15.1	4.35	0.819	0.034	0	0	0
Sales of space heating units - Gas Furnace (%)	76.4	60.5	17.1	3.03	1.58	1.53	1.52
Sales of water heating units - Electric Heat Pump (%)	0.117	10.6	55.7	65.7	66.2	66.2	66.2
Sales of water heating units - Electric Resistance (%)	4.29	9.87	28	32.1	32.3	32.2	32.3
Sales of water heating units - Gas Furnace (%)	94.4	77.9	14.7	0.621	0	0	0
Sales of water heating units - Other (%)	1.17	1.57	1.57	1.57	1.57	1.56	1.55

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	3.26	3.36	4.91	5.18	4.05	4.16

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	0.519	5.27
Capital invested - Wind - Base (billion $2018)	0	0	0	0	0.302	0.116	0.175

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

Item	2020	2025	2030	2035	2040	2045	2050
Solar - Base land use assumptions (GWh)	145	0	0	0	0	930	10,365
Solar - Constrained land use assumptions (GWh)	145	0	0	0	0	1,294	10,440
Wind - Base land use assumptions (GWh)	0	0	0	0	623	237	450
Wind - Constrained land use assumptions (GWh)	0	0	217	929	0	0	0

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	-432
Carbon sink potential - Aggressive deployment - Cropland measures (1000 tCO2e/y)	0	0	-4,963
Carbon sink potential - Aggressive deployment - Permanent conservation cover (1000 tCO2e/y)	0	0	-136
Carbon sink potential - Aggressive deployment - Total (1000 tCO2e/y)	0	0	-5,532
Carbon sink potential - Moderate deployment - Corn-ethanol to energy grasses (1000 tCO2e/y)	0	0	-432
Carbon sink potential - Moderate deployment - Cropland measures (1000 tCO2e/y)	0	0	-2,618
Carbon sink potential - Moderate deployment - Permanent conservation cover (1000 tCO2e/y)	0	0	-67.9
Carbon sink potential - Moderate deployment - Total (1000 tCO2e/y)	0	0	-3,118
Land impacted for carbon sink - Aggressive deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	188
Land impacted for carbon sink - Aggressive deployment - Cropland measures (1000 hectares)	0	0	2,250
Land impacted for carbon sink - Aggressive deployment - Permanent conservation cover (1000 hectares)	0	0	247
Land impacted for carbon sink - Aggressive deployment - Total (1000 hectares)	0	0	2,685
Land impacted for carbon sink - Moderate deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	188
Land impacted for carbon sink - Moderate deployment - Cropland measures (1000 hectares)	0	0	1,187
Land impacted for carbon sink - Moderate deployment - Permanent conservation cover (1000 hectares)	0	0	124
Land impacted for carbon sink - Moderate deployment - Total (1000 hectares)	0	0	1,498

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	96.7
Carbon sink potential - High - All (not counting overlap) (1000 tCO2e/y)	0	0	27,796
Carbon sink potential - High - Avoid deforestation (1000 tCO2e/y)	0	0	1,537

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

Item	2020	2025	2050
Carbon sink potential - High - Extend rotation length (1000 tCO2e/y)	0	0	5,669
Carbon sink potential - High - Improve plantations (1000 tCO2e/y)	0	0	48.1
Carbon sink potential - High - Increase retention of HWP (1000 tCO2e/y)	0	0	4,665
Carbon sink potential - High - Increase trees outside forests (1000 tCO2e/y)	0	0	965
Carbon sink potential - High - Reforest cropland (1000 tCO2e/y)	0	0	1,409
Carbon sink potential - High - Reforest pasture (1000 tCO2e/y)	0	0	10,207
Carbon sink potential - High - Restore productivity (1000 tCO2e/y)	0	0	3,200
Carbon sink potential - Low - Accelerate regeneration (1000 tCO2e/y)	0	0	48.5
Carbon sink potential - Low - All (not counting overlap) (1000 tCO2e/y)	0	0	6,956
Carbon sink potential - Low - Avoid deforestation (1000 tCO2e/y)	0	0	256
Carbon sink potential - Low - Extend rotation length (1000 tCO2e/y)	0	0	2,177
Carbon sink potential - Low - Improve plantations (1000 tCO2e/y)	0	0	24.5
Carbon sink potential - Low - Increase retention of HWP (1000 tCO2e/y)	0	0	1,555
Carbon sink potential - Low - Increase trees outside forests (1000 tCO2e/y)	0	0	338
Carbon sink potential - Low - Reforest cropland (1000 tCO2e/y)	0	0	704
Carbon sink potential - Low - Reforest pasture (1000 tCO2e/y)	0	0	773
Carbon sink potential - Low - Restore productivity (1000 tCO2e/y)	0	0	1,079
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO2e/y)	0	0	72.6
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO2e/y)	0	0	17,376
Carbon sink potential - Mid - Avoid deforestation (1000 tCO2e/y)	0	0	897
Carbon sink potential - Mid - Extend rotation length (1000 tCO2e/y)	0	0	3,923
Carbon sink potential - Mid - Improve plantations (1000 tCO2e/y)	0	0	35.9
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO2e/y)	0	0	3,110
Carbon sink potential - Mid - Increase trees outside forests (1000 tCO2e/y)	0	0	651
Carbon sink potential - Mid - Reforest cropland (1000 tCO2e/y)	0	0	1,057
Carbon sink potential - Mid - Reforest pasture (1000 tCO2e/y)	0	0	5,490
Carbon sink potential - Mid - Restore productivity (1000 tCO2e/y)	0	0	2,139
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)	0	0	15.8
Land impacted for carbon sink potential - High - Avoid deforestation (over 30 years) (1000 hectares)	0	0	208
Land impacted for carbon sink potential - High - Extend rotation length (1000 hectares)	0	0	2,891
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)	0	0	17.7

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

Item	2020	2025	2050
Land impacted for carbon sink potential - High - Increase retention of HWP (1000 hectares)	0	0	0
Land impacted for carbon sink potential - High - Increase trees outside forests (1000 hectares)	0	0	91.7
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)	0	0	93.2
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)	0	0	290
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)	0	0	1,061
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)	0	0	4,668
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)	0	0	7.91
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)	0	0	195
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)	0	0	1,107
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)	0	0	8.86
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	48.3
Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares)	0	0	46.6
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)	0	0	50.3
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)	0	0	642
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)	0	0	2,107
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)	0	0	11.9
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)	0	0	202
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)	0	0	1,999
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)	0	0	13.3
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	70
Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares)	0	0	69.9
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)	0	0	363
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)	0	0	1,293
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)	0	0	4,022

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

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal (million 2019$)	0	766	2.45	2.43	2.28	1.74	0.169
Monetary damages from air pollution - Natural Gas (million 2019$)	0	138	98.7	54.5	33.5	10.3	3.24
Monetary damages from air pollution - Transportation (million 2019$)	0	1,223	1,135	858	493	225	90.1

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

Item	2020	2025	2030	2035	2040	2045	2050
Premature deaths from air pollution - Coal (deaths)	0	85.9	0.275	0.273	0.256	0.195	0.019
Premature deaths from air pollution - Natural Gas (deaths)	0	15.6	11.1	6.16	3.78	1.16	0.366
Premature deaths from air pollution - Transportation (deaths)	0	138	128	96.5	55.5	25.3	10.1

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	3.38	3.59	0	0	0	0
Sales of cooking units - Electric Resistance (%)	76.9	81.8	96.9	99.8	100	100	100
Sales of cooking units - Gas (%)	23.1	18.2	3.11	0.157	0	0	0
Sales of space heating units - Electric Heat Pump (%)	26.6	42.5	77.8	85.8	86.2	86.1	86.1
Sales of space heating units - Electric Resistance (%)	26.5	25.4	10.6	7.34	7.19	7.29	7.32
Sales of space heating units - Fossil (%)	9.65	11.3	5.2	3.78	3.67	3.61	3.61
Sales of space heating units - Gas (%)	37.2	20.8	6.32	3.1	2.98	2.95	2.94
Sales of water heating units - Electric Heat Pump (%)	0	8.47	44.9	53	53.3	53.4	53.4
Sales of water heating units - Electric Resistance (%)	62.5	70	49.2	44.5	44.3	44.3	44.3
Sales of water heating units - Gas Furnace (%)	34.2	19.2	3.59	0.151	0	0	0
Sales of water heating units - Other (%)	3.3	2.39	2.36	2.36	2.36	2.37	2.38

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	840	2,147	3,490	5,282	5,754	5,483
Public EV charging plugs - DC Fast (1000 units)	0.06	0	1.72	0	7.66	0	12.4
Public EV charging plugs - L2 (1000 units)	0.251	0	41.4	0	184	0	298
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 (%)	1.56	1.82	1.26	0.403	0.075	0.013	0
Vehicle sales - Light-duty - EV (%)	3.9	15.1	46.4	81.8	96.3	99.3	100
Vehicle sales - Light-duty - gasoline (%)	89.9	78.1	48.9	16.6	3.3	0.59	0
Vehicle sales - Light-duty - hybrid (%)	4.4	4.53	3.21	1.19	0.29	0.063	0
Vehicle sales - Light-duty - hydrogen FC (%)	0.11	0.34	0.203	0.063	0.013	0.002	0
Vehicle sales - Light-duty - other (%)	0.102	0.098	0.064	0.022	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)	119	118	113	105	99.3	96.6	97
Final energy use - Industry (PJ)	382	396	409	403	409	414	415
Final energy use - Residential (PJ)	184	171	156	137	121	111	106
Final energy use - Transportation (PJ)	426	391	344	288	236	205	193

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	12,650	14,338	0	0	0	0
Sales of cooking units - Electric Resistance (%)	43.5	55.3	83.4	88.9	89.2	89.2	89.1
Sales of cooking units - Gas (%)	56.5	44.7	16.6	11.1	10.8	10.8	10.9
Sales of space heating units - Electric Heat Pump (%)	5.4	31	77.5	91	92.2	92.3	92.3
Sales of space heating units - Electric Resistance (%)	3.11	4.17	4.51	5.9	6.19	6.19	6.21
Sales of space heating units - Fossil (%)	15.1	4.35	0.819	0.034	0	0	0
Sales of space heating units - Gas Furnace (%)	76.4	60.5	17.1	3.03	1.58	1.53	1.52
Sales of water heating units - Electric Heat Pump (%)	0.117	10.6	55.7	65.7	66.2	66.2	66.2
Sales of water heating units - Electric Resistance (%)	4.29	9.87	28	32.1	32.3	32.2	32.3
Sales of water heating units - Gas Furnace (%)	94.4	77.9	14.7	0.621	0	0	0
Sales of water heating units - Other (%)	1.17	1.57	1.57	1.57	1.57	1.56	1.55

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	3.26	3.36	4.91	5.18	4.05	4.16

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

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

Item	2020	2025
Solar - Base land use assumptions (GWh)	145	0
Solar - Constrained land use assumptions (GWh)	145	0

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

Item	2020	2025	2050
Carbon sink potential - Aggressive deployment - Corn-ethanol to energy grasses (1000 tCO2e/y)	0	0	-432
Carbon sink potential - Aggressive deployment - Cropland measures (1000 tCO2e/y)	0	0	-4,963
Carbon sink potential - Aggressive deployment - Permanent conservation cover (1000 tCO2e/y)	0	0	-136
Carbon sink potential - Aggressive deployment - Total (1000 tCO2e/y)	0	0	-5,532
Carbon sink potential - Moderate deployment - Corn-ethanol to energy grasses (1000 tCO2e/y)	0	0	-432
Carbon sink potential - Moderate deployment - Cropland measures (1000 tCO2e/y)	0	0	-2,618
Carbon sink potential - Moderate deployment - Permanent conservation cover (1000 tCO2e/y)	0	0	-67.9
Carbon sink potential - Moderate deployment - Total (1000 tCO2e/y)	0	0	-3,118
Land impacted for carbon sink - Aggressive deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	188
Land impacted for carbon sink - Aggressive deployment - Cropland measures (1000 hectares)	0	0	2,250

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

Item	2020	2025	2050
Land impacted for carbon sink - Aggressive deployment - Permanent conservation cover (1000 hectares)	0	0	247
Land impacted for carbon sink - Aggressive deployment - Total (1000 hectares)	0	0	2,685
Land impacted for carbon sink - Moderate deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	188
Land impacted for carbon sink - Moderate deployment - Cropland measures (1000 hectares)	0	0	1,187
Land impacted for carbon sink - Moderate deployment - Permanent conservation cover (1000 hectares)	0	0	124
Land impacted for carbon sink - Moderate deployment - Total (1000 hectares)	0	0	1,498

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	96.7
Carbon sink potential - High - All (not counting overlap) (1000 tCO2e/y)	0	0	27,796
Carbon sink potential - High - Avoid deforestation (1000 tCO2e/y)	0	0	1,537
Carbon sink potential - High - Extend rotation length (1000 tCO2e/y)	0	0	5,669
Carbon sink potential - High - Improve plantations (1000 tCO2e/y)	0	0	48.1
Carbon sink potential - High - Increase retention of HWP (1000 tCO2e/y)	0	0	4,665
Carbon sink potential - High - Increase trees outside forests (1000 tCO2e/y)	0	0	965
Carbon sink potential - High - Reforest cropland (1000 tCO2e/y)	0	0	1,409
Carbon sink potential - High - Reforest pasture (1000 tCO2e/y)	0	0	10,207
Carbon sink potential - High - Restore productivity (1000 tCO2e/y)	0	0	3,200
Carbon sink potential - Low - Accelerate regeneration (1000 tCO2e/y)	0	0	48.5
Carbon sink potential - Low - All (not counting overlap) (1000 tCO2e/y)	0	0	6,956
Carbon sink potential - Low - Avoid deforestation (1000 tCO2e/y)	0	0	256
Carbon sink potential - Low - Extend rotation length (1000 tCO2e/y)	0	0	2,177
Carbon sink potential - Low - Improve plantations (1000 tCO2e/y)	0	0	24.5
Carbon sink potential - Low - Increase retention of HWP (1000 tCO2e/y)	0	0	1,555
Carbon sink potential - Low - Increase trees outside forests (1000 tCO2e/y)	0	0	338
Carbon sink potential - Low - Reforest cropland (1000 tCO2e/y)	0	0	704
Carbon sink potential - Low - Reforest pasture (1000 tCO2e/y)	0	0	773
Carbon sink potential - Low - Restore productivity (1000 tCO2e/y)	0	0	1,079
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO2e/y)	0	0	72.6
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO2e/y)	0	0	17,376

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

Item	2020	2025	2050
Carbon sink potential - Mid - Avoid deforestation (1000 tCO2e/y)	0	0	897
Carbon sink potential - Mid - Extend rotation length (1000 tCO2e/y)	0	0	3,923
Carbon sink potential - Mid - Improve plantations (1000 tCO2e/y)	0	0	35.9
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO2e/y)	0	0	3,110
Carbon sink potential - Mid - Increase trees outside forests (1000 tCO2e/y)	0	0	651
Carbon sink potential - Mid - Reforest cropland (1000 tCO2e/y)	0	0	1,057
Carbon sink potential - Mid - Reforest pasture (1000 tCO2e/y)	0	0	5,490
Carbon sink potential - Mid - Restore productivity (1000 tCO2e/y)	0	0	2,139
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)	0	0	15.8
Land impacted for carbon sink potential - High - Avoid deforestation (over 30 years) (1000 hectares)	0	0	208
Land impacted for carbon sink potential - High - Extend rotation length (1000 hectares)	0	0	2,891
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)	0	0	17.7
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	91.7
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)	0	0	93.2
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)	0	0	290
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)	0	0	1,061
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)	0	0	4,668
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)	0	0	7.91
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)	0	0	195
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)	0	0	1,107
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)	0	0	8.86
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	48.3
Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares)	0	0	46.6
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)	0	0	50.3
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)	0	0	642
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)	0	0	2,107
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)	0	0	11.9
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)	0	0	202

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

Item	2020	2025	2050
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)	0	0	1,999
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)	0	0	13.3
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	70
Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares)	0	0	69.9
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)	0	0	363
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)	0	0	1,293
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)	0	0	4,022

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

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal (million 2019$)	0	766	2.45	2.43	2.28	1.74	0.169
Monetary damages from air pollution - Natural Gas (million 2019$)	0	139	91.6	117	86.8	29.1	8.95
Monetary damages from air pollution - Transportation (million 2019$)	0	1,223	1,135	858	493	225	90.1
Premature deaths from air pollution - Coal (deaths)	0	85.9	0.275	0.273	0.256	0.195	0.019
Premature deaths from air pollution - Natural Gas (deaths)	0	15.7	10.3	13.2	9.81	3.29	1.01
Premature deaths from air pollution - Transportation (deaths)	0	138	128	96.5	55.5	25.3	10.1

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	3.35	3.47	0	0	0	0
Sales of cooking units - Electric Resistance (%)	76.8	77.4	79.5	85.1	92.9	97.7	99.4
Sales of cooking units - Gas (%)	23.2	22.6	20.5	14.9	7.09	2.29	0.616
Sales of space heating units - Electric Heat Pump (%)	26.6	35.6	39.7	51.4	69.2	80.7	84.7
Sales of space heating units - Electric Resistance (%)	26.5	28.2	26.4	21.5	14.1	9.46	7.83
Sales of space heating units - Fossil (%)	9.65	12.5	11.9	9.77	6.6	4.55	3.88
Sales of space heating units - Gas (%)	37.2	23.6	22	17.4	10.1	5.25	3.56
Sales of water heating units - Electric Heat Pump (%)	0	1.46	5.6	17.5	35.8	47.8	51.9
Sales of water heating units - Electric Resistance (%)	62.5	74	71.8	64.8	54.3	47.5	45.1
Sales of water heating units - Gas Furnace (%)	34.2	22.2	20.3	15.3	7.52	2.39	0.624
Sales of water heating units - Other (%)	3.3	2.39	2.37	2.38	2.39	2.38	2.38

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	135	286	962	3,037	4,422
Public EV charging plugs - DC Fast (1000 units)	0.06	0	0.518	0	2.83	0	7.94
Public EV charging plugs - L2 (1000 units)	0.251	0	12.5	0	68	0	191
Vehicle sales - Heavy-duty - diesel (%)	97.4	96	91.3	79.8	58.2	32.1	13.7
Vehicle sales - Heavy-duty - EV (%)	0.498	1.45	4.11	10.8	23.6	39.5	51
Vehicle sales - Heavy-duty - gasoline (%)	0.228	0.236	0.239	0.225	0.179	0.109	0.051

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

Item	2020	2025	2030	2035	2040	2045	2050
Vehicle sales - Heavy-duty - hybrid (%)	0.083	0.094	0.104	0.107	0.092	0.06	0.03
Vehicle sales - Heavy-duty - hydrogen FC (%)	0.332	0.969	2.74	7.17	15.7	26.3	34
Vehicle sales - Heavy-duty - other (%)	1.5	1.28	1.46	1.95	2.25	1.96	1.14
Vehicle sales - Light-duty - diesel (%)	1.57	1.98	2.06	1.64	1.05	0.538	0.231
Vehicle sales - Light-duty - EV (%)	1.88	4.66	11.8	25.8	48.3	72	87.5
Vehicle sales - Light-duty - gasoline (%)	91.8	87.5	79.7	66.7	46.3	24.9	11
Vehicle sales - Light-duty - hybrid (%)	4.56	5.37	6.03	5.49	4.12	2.44	1.18
Vehicle sales - Light-duty - hydrogen FC (%)	0.113	0.38	0.326	0.249	0.177	0.098	0.046
Vehicle sales - Light-duty - other (%)	0.103	0.107	0.097	0.085	0.061	0.034	0.015
Vehicle sales - Medium-duty - diesel (%)	64.8	62.2	57.7	49.4	35.6	19.6	8.37
Vehicle sales - Medium-duty - EV (%)	0.664	1.94	5.49	14.3	31.4	52.6	68
Vehicle sales - Medium-duty - gasoline (%)	33.8	34.7	34.7	31.9	24.4	14.2	6.33
Vehicle sales - Medium-duty - hybrid (%)	0.363	0.418	0.464	0.478	0.414	0.275	0.141
Vehicle sales - Medium-duty - hydrogen FC (%)	0.166	0.485	1.37	3.58	7.86	13.2	17
Vehicle sales - Medium-duty - other (%)	0.253	0.266	0.279	0.286	0.258	0.184	0.102

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

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Commercial (PJ)	119	119	117	114	110	106	103
Final energy use - Industry (PJ)	382	396	410	408	416	420	420
Final energy use - Residential (PJ)	184	172	163	153	142	129	118
Final energy use - Transportation (PJ)	427	394	360	333	312	287	259

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	12,642	14,325	0	0	0	0
Sales of cooking units - Electric Resistance (%)	43.5	47.1	51.3	61.6	76.1	85	88
Sales of cooking units - Gas (%)	56.5	52.9	48.7	38.4	23.9	15	12
Sales of space heating units - Electric Heat Pump (%)	5.4	22.1	27.3	42.8	66.9	83.6	89.9
Sales of space heating units - Electric Resistance (%)	3.11	4.17	4.24	4.4	4.84	5.52	5.99
Sales of space heating units - Fossil (%)	15.1	5.03	4.61	3.36	1.65	0.539	0.139
Sales of space heating units - Gas Furnace (%)	76.4	68.7	63.8	49.5	26.6	10.3	3.94
Sales of water heating units - Electric Heat Pump (%)	0.117	1.95	7.08	21.8	44.5	59.3	64.4
Sales of water heating units - Electric Resistance (%)	4.29	6.36	8.3	14.3	23.5	29.4	31.5
Sales of water heating units - Gas Furnace (%)	94.4	90.1	83.1	62.2	30.5	9.74	2.54
Sales of water heating units - Other (%)	1.17	1.57	1.57	1.57	1.57	1.56	1.55

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	2.71	2.75	3.26	3.36	4.25	4.44

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

Item	2020	2025	2030	2035	2040	2045	2050
Capital invested - Biomass power plant (billion $2018)	0	0	0	0	0	0	0
Capital invested - Biomass w/ccu allam power plant (billion $2018)	0	0	0	0	0	0.018	0
Capital invested - Biomass w/ccu power plant (billion $2018)	0	0	31.9	0	7.92	5.72	0

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

Item	2020	2025	2030	2035	2040	2045	2050
Biomass power plant (GWh)	0	0	0	0	0	0	0
Biomass w/ccu allam power plant (GWh)	0	0	0	0	0	18	18
Biomass w/ccu power plant (GWh)	0	0	35,757	35,757	44,647	51,069	51,069

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

Item	2020	2025	2030	2035	2040	2045	2050
Biomass purchases (million $2018/year)	0	0	2,298	2,298	2,870	3,689	3,789
Conversion capital investment - Cumulative 5-yr (million $2018)	0	0	29,223	0	7,265	9,733	1,101
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	5	6
Number of facilities - Diesel (quantity)	0	0	0	0	0	0	0
Number of facilities - Diesel ccu (quantity)	0	0	0	0	0	1	1
Number of facilities - Power (quantity)	0	0	0	0	0	0	0
Number of facilities - Power ccu (quantity)	0	0	29	29	36	40	40
Number of facilities - Pyrolysis (quantity)	0	0	0	0	0	0	0
Number of facilities - Pyrolysis ccu (quantity)	0	0	0	0	0	0	0
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 53: *E-B+ scenario - PILLAR 4: CCUS - CO2 capture*

Item	2020	2025	2030	2035	2040	2045	2050
Annual - All (MMT)	0	0	35.4	35.4	47.5	59.7	61.2
Annual - BECCS (MMT)	0	0	35.4	35.4	44.2	56.3	57.5
Annual - Cement and lime (MMT)	0	0	0	0	3.32	3.42	3.53
Annual - NGCC (MMT)	0	0	0	0	0	0	0.14
Cumulative - All (MMT)	0	0	35.4	70.8	118	178	239
Cumulative - BECCS (MMT)	0	0	35.4	70.8	115	171	229
Cumulative - Cement and lime (MMT)	0	0	0	0	3.32	6.74	10.3
Cumulative - NGCC (MMT)	0	0	0	0	0	0	0.14

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

Item	2020	2025	2030	2035	2040	2045	2050
CO2 storage (MMT)	0	0	1.85	6.42	13.1	17.7	18.4
Injection wells (wells)	0	0	3	12	21	35	44
Resource characterization, appraisal, permitting costs (million $2020)	0	45.8	201	311	311	311	311
Wells and facilities construction costs (million $2020)	0	0	91.4	356	635	1,062	1,318

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

Item	2020	2025	2030	2035	2040	2045	2050
All (km)	0	0	1,500	1,584	1,637	2,764	3,373
Cumulative investment - All (million $2018)	0	0	3,203	3,800	4,513	5,600	6,265
Cumulative investment - Spur (million $2018)	0	0	1,678	1,677	1,686	2,774	3,438
Cumulative investment - Trunk (million $2018)	0	0	1,525	2,123	2,827	2,827	2,827
Spur (km)	0	0	1,225	1,225	1,195	2,322	2,931
Trunk (km)	0	0	275	359	442	442	442

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	-971
Carbon sink potential - Aggressive deployment - Cropland measures (1000 tCO2e/y)	0	0	-4,584
Carbon sink potential - Aggressive deployment - Cropland to woody energy crops (1000 tCO2e/y)	0	0	0

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

Item	2020	2025	2050
Carbon sink potential - Aggressive deployment - Pasture to energy crops (1000 tCO2e/y)	0	0	0
Carbon sink potential - Aggressive deployment - Permanent conservation cover (1000 tCO2e/y)	0	0	-124
Carbon sink potential - Aggressive deployment - Total (1000 tCO2e/y)	0	0	-5,680
Carbon sink potential - Moderate deployment - Corn-ethanol to energy grasses (1000 tCO2e/y)	0	0	-971
Carbon sink potential - Moderate deployment - Cropland measures (1000 tCO2e/y)	0	0	-2,418
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	-62.1
Carbon sink potential - Moderate deployment - Total (1000 tCO2e/y)	0	0	-3,451
Land impacted for carbon sink - Aggressive deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	395
Land impacted for carbon sink - Aggressive deployment - Cropland measures (1000 hectares)	0	0	5,086
Land impacted for carbon sink - Aggressive deployment - Cropland to woody energy crops (1000 hectares)	0	0	92.2
Land impacted for carbon sink - Aggressive deployment - Pasture to energy crops (1000 hectares)	0	0	432
Land impacted for carbon sink - Aggressive deployment - Permanent conservation cover (1000 hectares)	0	0	226
Land impacted for carbon sink - Aggressive deployment - Total (1000 hectares)	0	0	6,231
Land impacted for carbon sink - Moderate deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	395
Land impacted for carbon sink - Moderate deployment - Cropland measures (1000 hectares)	0	0	1,086
Land impacted for carbon sink - Moderate deployment - Cropland to woody energy crops (1000 hectares)	0	0	92.2
Land impacted for carbon sink - Moderate deployment - Pasture to energy crops (1000 hectares)	0	0	432
Land impacted for carbon sink - Moderate deployment - Permanent conservation cover (1000 hectares)	0	0	113
Land impacted for carbon sink - Moderate deployment - Total (1000 hectares)	0	0	2,118

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	96.7
Carbon sink potential - High - All (not counting overlap) (1000 tCO2e/y)	0	0	27,796
Carbon sink potential - High - Avoid deforestation (1000 tCO2e/y)	0	0	1,537
Carbon sink potential - High - Extend rotation length (1000 tCO2e/y)	0	0	5,669

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

Item	2020	2025	2050
Carbon sink potential - High - Improve plantations (1000 tCO2e/y)	0	0	48.1
Carbon sink potential - High - Increase retention of HWP (1000 tCO2e/y)	0	0	4,665
Carbon sink potential - High - Increase trees outside forests (1000 tCO2e/y)	0	0	965
Carbon sink potential - High - Reforest cropland (1000 tCO2e/y)	0	0	1,409
Carbon sink potential - High - Reforest pasture (1000 tCO2e/y)	0	0	10,207
Carbon sink potential - High - Restore productivity (1000 tCO2e/y)	0	0	3,200
Carbon sink potential - Low - Accelerate regeneration (1000 tCO2e/y)	0	0	48.5
Carbon sink potential - Low - All (not counting overlap) (1000 tCO2e/y)	0	0	6,956
Carbon sink potential - Low - Avoid deforestation (1000 tCO2e/y)	0	0	256
Carbon sink potential - Low - Extend rotation length (1000 tCO2e/y)	0	0	2,177
Carbon sink potential - Low - Improve plantations (1000 tCO2e/y)	0	0	24.5
Carbon sink potential - Low - Increase retention of HWP (1000 tCO2e/y)	0	0	1,555
Carbon sink potential - Low - Increase trees outside forests (1000 tCO2e/y)	0	0	338
Carbon sink potential - Low - Reforest cropland (1000 tCO2e/y)	0	0	704
Carbon sink potential - Low - Reforest pasture (1000 tCO2e/y)	0	0	773
Carbon sink potential - Low - Restore productivity (1000 tCO2e/y)	0	0	1,079
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO2e/y)	0	0	72.6
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO2e/y)	0	0	17,376
Carbon sink potential - Mid - Avoid deforestation (1000 tCO2e/y)	0	0	897
Carbon sink potential - Mid - Extend rotation length (1000 tCO2e/y)	0	0	3,923
Carbon sink potential - Mid - Improve plantations (1000 tCO2e/y)	0	0	35.9
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO2e/y)	0	0	3,110
Carbon sink potential - Mid - Increase trees outside forests (1000 tCO2e/y)	0	0	651
Carbon sink potential - Mid - Reforest cropland (1000 tCO2e/y)	0	0	1,057
Carbon sink potential - Mid - Reforest pasture (1000 tCO2e/y)	0	0	5,490
Carbon sink potential - Mid - Restore productivity (1000 tCO2e/y)	0	0	2,139
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)	0	0	15.8
Land impacted for carbon sink potential - High - Avoid deforestation (over 30 years) (1000 hectares)	0	0	208
Land impacted for carbon sink potential - High - Extend rotation length (1000 hectares)	0	0	2,891
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)	0	0	17.7
Land impacted for carbon sink potential - High - Increase retention of HWP (1000 hectares)	0	0	0

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

Item	2020	2025	2050
Land impacted for carbon sink potential - High - Increase trees outside forests (1000 hectares)	0	0	91.7
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)	0	0	93.2
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)	0	0	290
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)	0	0	1,061
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)	0	0	4,668
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)	0	0	7.91
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)	0	0	195
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)	0	0	1,107
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)	0	0	8.86
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	48.3
Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares)	0	0	46.6
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)	0	0	50.3
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)	0	0	642
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)	0	0	2,107
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)	0	0	11.9
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)	0	0	202
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)	0	0	1,999
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)	0	0	13.3
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	70
Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares)	0	0	69.9
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)	0	0	363
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)	0	0	1,293
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)	0	0	4,022

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	3.33	3.22	0	0	0	0
Sales of cooking units - Electric Resistance (%)	76.6	76.6	76.6	76.6	76.6	76.6	76.6
Sales of cooking units - Gas (%)	23.4	23.4	23.4	23.4	23.4	23.4	23.4
Sales of space heating units - Electric Heat Pump (%)	24.6	48.5	49.4	50.7	51.9	53.4	55.7
Sales of space heating units - Electric Resistance (%)	27.3	23.3	22.9	22.2	21.3	19.9	17.6

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

Item	2020	2025	2030	2035	2040	2045	2050
Sales of space heating units - Fossil (%)	9.89	9.17	7.81	7.09	6.94	6.85	6.89
Sales of space heating units - Gas (%)	38.3	19	19.9	20	19.9	19.9	19.8
Sales of water heating units - Electric Heat Pump (%)	0	0	0	0	0	0	0
Sales of water heating units - Electric Resistance (%)	62.5	74.8	75	74.8	74.6	74.6	74.6
Sales of water heating units - Gas Furnace (%)	34.2	22.8	22.6	22.8	23	23	23
Sales of water heating units - Other (%)	3.3	2.39	2.37	2.39	2.4	2.4	2.41

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 (%)	1.56	1.97	2.19	2.03	1.83	1.71	1.62
Vehicle sales - Light-duty - EV (%)	3.54	5.57	6.35	7.81	9.51	11	12.2
Vehicle sales - Light-duty - gasoline (%)	90.3	86.7	84.6	82.7	80.7	78.7	77.2
Vehicle sales - Light-duty - hybrid (%)	4.42	5.26	6.45	7.01	7.58	8.17	8.62
Vehicle sales - Light-duty - hydrogen FC (%)	0.111	0.377	0.346	0.308	0.305	0.305	0.316
Vehicle sales - Light-duty - other (%)	0.102	0.106	0.103	0.103	0.103	0.101	0.104
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)	119	120	121	120	120	122	127
Final energy use - Industry (PJ)	382	406	427	438	455	470	488
Final energy use - Residential (PJ)	184	172	165	159	157	156	157
Final energy use - Transportation (PJ)	426	395	363	345	346	357	372

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	12,419	12,935	0	0	0	0
Sales of cooking units - Electric Resistance (%)	43.5	45.6	45.9	45.7	46	45.9	45.7
Sales of cooking units - Gas (%)	56.5	54.4	54.1	54.3	54	54.1	54.3
Sales of space heating units - Electric Heat Pump (%)	5.4	26.5	53.4	75.5	79.2	79.6	79.6
Sales of space heating units - Electric Resistance (%)	3.11	5.03	9.13	15	18.3	18.8	18.9
Sales of space heating units - Fossil (%)	15.1	4.63	2.27	0.341	0.034	0	0
Sales of space heating units - Gas Furnace (%)	76.4	63.9	35.2	9.15	2.46	1.58	1.52
Sales of water heating units - Electric Heat Pump (%)	0.117	0.149	0.144	0.146	0.145	0.143	0.145
Sales of water heating units - Electric Resistance (%)	4.29	5.63	5.49	5.57	5.54	5.49	5.54
Sales of water heating units - Gas Furnace (%)	94.4	92.6	92.8	92.7	92.7	92.8	92.8
Sales of water heating units - Other (%)	1.17	1.57	1.57	1.57	1.57	1.56	1.55

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	3.28	3.39	4.37	4.58	4.26	4.41

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

Item	2020	2025	2030	2050
Business-as-usual carbon sink - Natural uptake (Mt CO2e/y)	-13.6	0	-9.57	-7.76
Business-as-usual carbon sink - Retained in Hardwood Products (Mt CO2e/y)	-1.27	0	-2.12	-2.23
Business-as-usual carbon sink - Total (Mt CO2e/y)	-14.9	0	-11.7	-9.99
Carbon sink potential - High - Accelerate regeneration (1000 tCO2e/y)	0	0	0	96.7
Carbon sink potential - High - All (not counting overlap) (1000 tCO2e/y)	0	0	0	27,796
Carbon sink potential - High - Avoid deforestation (1000 tCO2e/y)	0	0	0	1,537
Carbon sink potential - High - Extend rotation length (1000 tCO2e/y)	0	0	0	5,669
Carbon sink potential - High - Improve plantations (1000 tCO2e/y)	0	0	0	48.1
Carbon sink potential - High - Increase retention of HWP (1000 tCO2e/y)	0	0	0	4,665
Carbon sink potential - High - Increase trees outside forests (1000 tCO2e/y)	0	0	0	965
Carbon sink potential - High - Reforest cropland (1000 tCO2e/y)	0	0	0	1,409
Carbon sink potential - High - Reforest pasture (1000 tCO2e/y)	0	0	0	10,207
Carbon sink potential - High - Restore productivity (1000 tCO2e/y)	0	0	0	3,200
Carbon sink potential - Low - Accelerate regeneration (1000 tCO2e/y)	0	0	0	48.5
Carbon sink potential - Low - All (not counting overlap) (1000 tCO2e/y)	0	0	0	6,956
Carbon sink potential - Low - Avoid deforestation (1000 tCO2e/y)	0	0	0	256
Carbon sink potential - Low - Extend rotation length (1000 tCO2e/y)	0	0	0	2,177
Carbon sink potential - Low - Improve plantations (1000 tCO2e/y)	0	0	0	24.5
Carbon sink potential - Low - Increase retention of HWP (1000 tCO2e/y)	0	0	0	1,555
Carbon sink potential - Low - Increase trees outside forests (1000 tCO2e/y)	0	0	0	338
Carbon sink potential - Low - Reforest cropland (1000 tCO2e/y)	0	0	0	704
Carbon sink potential - Low - Reforest pasture (1000 tCO2e/y)	0	0	0	773
Carbon sink potential - Low - Restore productivity (1000 tCO2e/y)	0	0	0	1,079
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO2e/y)	0	0	0	72.6
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO2e/y)	0	0	0	17,376
Carbon sink potential - Mid - Avoid deforestation (1000 tCO2e/y)	0	0	0	897
Carbon sink potential - Mid - Extend rotation length (1000 tCO2e/y)	0	0	0	3,923
Carbon sink potential - Mid - Improve plantations (1000 tCO2e/y)	0	0	0	35.9
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO2e/y)	0	0	0	3,110

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

Item	2020	2025	2030	2050
Carbon sink potential - Mid - Increase trees outside forests (1000 tCO2e/y)	0	0	0	651
Carbon sink potential - Mid - Reforest cropland (1000 tCO2e/y)	0	0	0	1,057
Carbon sink potential - Mid - Reforest pasture (1000 tCO2e/y)	0	0	0	5,490
Carbon sink potential - Mid - Restore productivity (1000 tCO2e/y)	0	0	0	2,139
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)	0	0	0	15.8
Land impacted for carbon sink potential - High - Avoid deforestation (over 30 years) (1000 hectares)	0	0	0	208
Land impacted for carbon sink potential - High - Extend rotation length (1000 hectares)	0	0	0	2,891
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)	0	0	0	17.7
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	91.7
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)	0	0	0	93.2
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)	0	0	0	290
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)	0	0	0	1,061
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)	0	0	0	4,668
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)	0	0	0	7.91
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)	0	0	0	195
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)	0	0	0	1,107
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)	0	0	0	8.86
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	48.3
Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares)	0	0	0	46.6
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)	0	0	0	50.3
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)	0	0	0	642
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)	0	0	0	2,107
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)	0	0	0	11.9
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)	0	0	0	202
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)	0	0	0	1,999
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)	0	0	0	13.3
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	70

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

Item	2020	2025	2030	2050
Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares)	0	0	0	69.9
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)	0	0	0	363
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)	0	0	0	1,293
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)	0	0	0	4,022

Table 64: *REF scenario - IMPACTS - Health*

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal (million 2019$)	0	1,982	1,418	1,196	1,075	1,032	1,011
Monetary damages from air pollution - Natural Gas (million 2019$)	0	134	176	193	250	199	173
Monetary damages from air pollution - Transportation (million 2019$)	0	1,243	1,267	1,291	1,321	1,351	1,382
Premature deaths from air pollution - Coal (deaths)	0	222	159	134	121	116	113
Premature deaths from air pollution - Natural Gas (deaths)	0	15.2	19.9	21.8	28.2	22.5	19.5
Premature deaths from air pollution - Transportation (deaths)	0	140	142	145	149	152	155