Net-Zero America - colorado 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	4.42	4.7	0	0	0	0
Sales of cooking units - Electric Resistance (%)	50.5	61	93.3	99.7	100	100	100
Sales of cooking units - Gas (%)	49.5	39	6.67	0.336	0	0	0
Sales of space heating units - Electric Heat Pump (%)	5.62	14.5	37.2	82.6	92	92.7	92.7
Sales of space heating units - Electric Resistance (%)	7.65	13.8	11	4.91	3.67	3.58	3.63
Sales of space heating units - Fossil (%)	3.24	5.67	4.53	2.12	1.56	1.5	1.52
Sales of space heating units - Gas (%)	83.5	66	47.3	10.4	2.8	2.21	2.19
Sales of water heating units - Electric Heat Pump (%)	0	0.93	12.1	36.4	41.4	41.7	41.8
Sales of water heating units - Electric Resistance (%)	13.2	25.9	34.2	52.7	56.7	57	57
Sales of water heating units - Gas Furnace (%)	85.7	72	52.4	9.64	0.728	0.02	0
Sales of water heating units - Other (%)	1.07	1.23	1.23	1.23	1.21	1.21	1.21

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	1,014	2,644	4,211	6,408	6,943	6,637
Public EV charging plugs - DC Fast (1000 units)	0.303	0	1.77	0	7.25	0	11.6
Public EV charging plugs - L2 (1000 units)	2.12	0	42.5	0	174	0	280
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 (%)	1.78	2.01	1.35	0.434	0.078	0.013	0
Vehicle sales - Light-duty - EV (%)	3.16	12.9	42.9	80.4	96.2	99.3	100
Vehicle sales - Light-duty - gasoline (%)	91.2	80.6	52.5	18	3.48	0.596	0
Vehicle sales - Light-duty - hybrid (%)	3.68	4.01	2.95	1.12	0.269	0.057	0
Vehicle sales - Light-duty - hydrogen FC (%)	0.112	0.353	0.221	0.07	0.014	0.002	0
Vehicle sales - Light-duty - other (%)	0.112	0.108	0.073	0.026	0.005	0.001	0
Vehicle sales - Medium-duty - diesel (%)	64.7	59.7	42.3	14.4	2.59	0.384	0
Vehicle sales - Medium-duty - EV (%)	0.784	5.07	25.3	60.8	76.5	79.5	80
Vehicle sales - Medium-duty - gasoline (%)	33.7	33.3	25.5	9.32	1.77	0.277	0
Vehicle sales - Medium-duty - hybrid (%)	0.363	0.402	0.341	0.14	0.03	0.005	0
Vehicle sales - Medium-duty - hydrogen FC (%)	0.196	1.27	6.33	15.2	19.1	19.9	20
Vehicle sales - Medium-duty - other (%)	0.253	0.255	0.205	0.083	0.019	0.004	0

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

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Commercial (PJ)	162	162	159	152	144	138	135
Final energy use - Industry (PJ)	171	180	187	200	221	233	246
Final energy use - Residential (PJ)	237	229	221	199	170	148	133
Final energy use - Transportation (PJ)	472	443	394	334	279	243	226

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	14,374	15,990	0	0	0	0
Sales of cooking units - Electric Resistance (%)	41.9	54.6	83	88.6	88.9	88.9	88.9
Sales of cooking units - Gas (%)	58.1	45.4	17	11.4	11.1	11.1	11.1
Sales of space heating units - Electric Heat Pump (%)	2.64	8.18	30.6	79.8	90	90.8	90.8
Sales of space heating units - Electric Resistance (%)	2.48	3.49	4.92	8.08	8.66	8.7	8.7
Sales of space heating units - Fossil (%)	0	0.208	0.04	0.002	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 (%)	94.9	88.1	64.4	12.2	1.37	0.522	0.498
Sales of water heating units - Electric Heat Pump (%)	0.022	1.12	14.3	42.9	48.9	49.4	49.4
Sales of water heating units - Electric Resistance (%)	1.1	2.5	15.4	43.8	49.7	50.2	50.2
Sales of water heating units - Gas Furnace (%)	98.6	96	69.9	12.9	0.972	0.027	0
Sales of water heating units - Other (%)	0.269	0.383	0.382	0.383	0.382	0.383	0.383

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	2.81	2.93	5.73	6.16	6.1	6.47

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	0	0	0	0	0
Capital invested - Biomass w/ccu allam power plant (billion $2018)	0	0	0	0	0	0.01	0
Capital invested - Biomass w/ccu power plant (billion $2018)	0	0	0	0	0	0.041	0.399
Capital invested - Solar PV - Base (billion $2018)	0	0.669	0.644	2.54	2.97	3.43	2.48
Capital invested - Solar PV - Constrained (billion $2018)	0	1.95	1.04	2.19	2.61	2.02	0.721
Capital invested - Wind - Base (billion $2018)	0	0.226	1.91	0.621	2.45	2.98	1.38
Capital invested - Wind - Constrained (billion $2018)	0	1.32	2.22	2.91	6.72	6.61	3.73

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	9.89	9.89
Biomass w/ccu power plant (GWh)	0	0	0	0	0	46.2	494
Solar - Base land use assumptions (GWh)	1,142	1,091	1,209	5,124	6,381	7,849	6,054
Solar - Constrained land use assumptions (GWh)	856	0	2,293	6,152	8,882	3,132	5,821
Wind - Base land use assumptions (GWh)	16,760	572	5,100	1,679	7,152	8,907	4,322
Wind - Constrained land use assumptions (GWh)	16,760	587	2,499	4,372	15,416	15,442	9,986

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

Item	2020	2025	2030	2035	2040	2045	2050
Biomass purchases (million $2018/year)	0	0	0	0	23.6	190	345
Conversion capital investment - Cumulative 5-yr (million $2018)	0	0	0	0	330	2,342	2,221
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	1	3	5
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	0	0	0	2	3
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	1	1

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

Item	2020	2025	2030	2035	2040	2045	2050
Annual - All (MMT)	0	0	0.02	3.38	3.77	6.87	9.81
Annual - BECCS (MMT)	0	0	0	0	0.42	3.41	6.22
Annual - Cement and lime (MMT)	0	0	0	3.35	3.32	3.42	3.53
Annual - NGCC (MMT)	0	0	0.02	0.02	0.03	0.03	0.05
Cumulative - All (MMT)	0	0	0.02	3.4	7.17	14	23.9
Cumulative - BECCS (MMT)	0	0	0	0	0.42	3.83	10.1
Cumulative - Cement and lime (MMT)	0	0	0	3.35	6.67	10.1	13.6
Cumulative - NGCC (MMT)	0	0	0.02	0.04	0.07	0.1	0.15

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

Item	2020	2025	2030	2035	2040	2045	2050
CO2 storage (MMT)	0	0	0	0.88	0.9	1.72	2.8
Injection wells (wells)	0	0	0	2	3	5	6
Resource characterization, appraisal, permitting costs (million $2020)	0	36	86.3	101	101	101	101
Wells and facilities construction costs (million $2020)	0	0	12	46.7	83.2	139	173

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

Item	2020	2025	2030	2035	2040	2045	2050
All (km)	0	0	256	556	861	1,099	2,219
Cumulative investment - All (million $2018)	0	0	1,225	1,484	1,687	1,902	2,649
Cumulative investment - Spur (million $2018)	0	0	0.3	259	463	677	1,424
Cumulative investment - Trunk (million $2018)	0	0	1,225	1,225	1,225	1,225	1,225
Spur (km)	0	0	0.5	301	605	843	1,963
Trunk (km)	0	0	255	255	255	255	255

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	-173
Carbon sink potential - Aggressive deployment - Cropland measures (1000 tCO2e/y)	0	0	-2,661
Carbon sink potential - Aggressive deployment - Permanent conservation cover (1000 tCO2e/y)	0	0	-214
Carbon sink potential - Aggressive deployment - Total (1000 tCO2e/y)	0	0	-3,048
Carbon sink potential - Moderate deployment - Corn-ethanol to energy grasses (1000 tCO2e/y)	0	0	-173
Carbon sink potential - Moderate deployment - Cropland measures (1000 tCO2e/y)	0	0	-1,384
Carbon sink potential - Moderate deployment - Permanent conservation cover (1000 tCO2e/y)	0	0	-107
Carbon sink potential - Moderate deployment - Total (1000 tCO2e/y)	0	0	-1,664
Land impacted for carbon sink - Aggressive deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	172
Land impacted for carbon sink - Aggressive deployment - Cropland measures (1000 hectares)	0	0	3,977
Land impacted for carbon sink - Aggressive deployment - Permanent conservation cover (1000 hectares)	0	0	329
Land impacted for carbon sink - Aggressive deployment - Total (1000 hectares)	0	0	4,478
Land impacted for carbon sink - Moderate deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	172

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	2,071
Land impacted for carbon sink - Moderate deployment - Permanent conservation cover (1000 hectares)	0	0	164
Land impacted for carbon sink - Moderate deployment - Total (1000 hectares)	0	0	2,407

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

Item	2020	2025	2050
Carbon sink potential - High - Accelerate regeneration (1000 tCO2e/y)	0	0	1,620
Carbon sink potential - High - All (not counting overlap) (1000 tCO2e/y)	0	0	48,148
Carbon sink potential - High - Avoid deforestation (1000 tCO2e/y)	0	0	1,559
Carbon sink potential - High - Extend rotation length (1000 tCO2e/y)	0	0	9,233
Carbon sink potential - High - Improve plantations (1000 tCO2e/y)	0	0	26.8
Carbon sink potential - High - Increase retention of HWP (1000 tCO2e/y)	0	0	174
Carbon sink potential - High - Increase trees outside forests (1000 tCO2e/y)	0	0	1,273
Carbon sink potential - High - Reforest cropland (1000 tCO2e/y)	0	0	24,902
Carbon sink potential - High - Reforest pasture (1000 tCO2e/y)	0	0	3,239
Carbon sink potential - High - Restore productivity (1000 tCO2e/y)	0	0	6,121
Carbon sink potential - Low - Accelerate regeneration (1000 tCO2e/y)	0	0	812
Carbon sink potential - Low - All (not counting overlap) (1000 tCO2e/y)	0	0	19,895
Carbon sink potential - Low - Avoid deforestation (1000 tCO2e/y)	0	0	260
Carbon sink potential - Low - Extend rotation length (1000 tCO2e/y)	0	0	3,547
Carbon sink potential - Low - Improve plantations (1000 tCO2e/y)	0	0	13.7
Carbon sink potential - Low - Increase retention of HWP (1000 tCO2e/y)	0	0	58.1
Carbon sink potential - Low - Increase trees outside forests (1000 tCO2e/y)	0	0	446
Carbon sink potential - Low - Reforest cropland (1000 tCO2e/y)	0	0	12,451
Carbon sink potential - Low - Reforest pasture (1000 tCO2e/y)	0	0	245
Carbon sink potential - Low - Restore productivity (1000 tCO2e/y)	0	0	2,063
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO2e/y)	0	0	1,216
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO2e/y)	0	0	34,021
Carbon sink potential - Mid - Avoid deforestation (1000 tCO2e/y)	0	0	909
Carbon sink potential - Mid - Extend rotation length (1000 tCO2e/y)	0	0	6,390
Carbon sink potential - Mid - Improve plantations (1000 tCO2e/y)	0	0	20
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO2e/y)	0	0	116

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	859
Carbon sink potential - Mid - Reforest cropland (1000 tCO2e/y)	0	0	18,676
Carbon sink potential - Mid - Reforest pasture (1000 tCO2e/y)	0	0	1,742
Carbon sink potential - Mid - Restore productivity (1000 tCO2e/y)	0	0	4,092
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)	0	0	265
Land impacted for carbon sink potential - High - Avoid deforestation (over 30 years) (1000 hectares)	0	0	211
Land impacted for carbon sink potential - High - Extend rotation length (1000 hectares)	0	0	4,708
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)	0	0	9.89
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	121
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)	0	0	1,646
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)	0	0	92
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)	0	0	2,029
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)	0	0	9,083
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)	0	0	133
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)	0	0	198
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)	0	0	1,804
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)	0	0	4.95
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	63.7
Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares)	0	0	823
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)	0	0	15.9
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)	0	0	1,228
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)	0	0	4,270
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)	0	0	199
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)	0	0	205
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)	0	0	3,256
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)	0	0	7.44
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	92.3

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

Item	2020	2025	2050
Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares)	0	0	1,235
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)	0	0	115
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)	0	0	2,472
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)	0	0	7,582

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

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal (million 2019$)	0	221	0.265	0.264	0.2	0.124	0.001
Monetary damages from air pollution - Natural Gas (million 2019$)	0	278	224	189	184	111	26.5
Monetary damages from air pollution - Transportation (million 2019$)	0	914	899	717	433	203	77.7
Premature deaths from air pollution - Coal (deaths)	0	24.8	0.03	0.03	0.022	0.014	0
Premature deaths from air pollution - Natural Gas (deaths)	0	31.4	25.4	21.3	20.8	12.6	2.99
Premature deaths from air pollution - Transportation (deaths)	0	103	101	80.7	48.7	22.8	8.74

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

Item	2020	2025	2030	2035	2040	2045	2050
By economic sector - Agriculture (jobs)	226	227	238	217	150	226	312
By economic sector - Construction (jobs)	12,365	11,496	11,816	13,596	15,058	16,387	17,444
By economic sector - Manufacturing (jobs)	12,772	12,947	16,996	19,901	17,693	15,315	15,730
By economic sector - Mining (jobs)	17,342	14,440	11,148	8,609	5,627	3,632	2,001
By economic sector - Other (jobs)	1,101	908	996	1,497	1,953	2,417	3,325
By economic sector - Pipeline (jobs)	1,253	1,289	1,273	1,048	827	631	478
By economic sector - Professional (jobs)	7,212	6,910	6,768	7,408	8,021	8,895	9,641
By economic sector - Trade (jobs)	8,160	7,383	6,697	6,720	6,405	6,459	6,735
By economic sector - Utilities (jobs)	7,546	7,757	8,117	9,529	11,820	13,543	13,159
By education level - All sectors - Associates degree or some college (jobs)	19,960	18,679	19,184	20,847	21,005	21,249	21,888
By education level - All sectors - Bachelors degree (jobs)	15,744	14,729	14,484	14,975	14,290	13,975	13,963
By education level - All sectors - Doctoral degree (jobs)	527	491	464	471	461	469	482
By education level - All sectors - High school diploma or less (jobs)	28,045	25,997	26,575	28,796	28,463	28,478	29,132
By education level - All sectors - Masters or professional degree (jobs)	3,702	3,461	3,342	3,437	3,335	3,333	3,359
By resource sector - Biomass (jobs)	561	553	552	488	376	833	1,367
By resource sector - CO2 (jobs)	0	18.7	861	190	326	524	982
By resource sector - Coal (jobs)	3,653	1,735	395	82.3	68.3	59.3	51.9
By resource sector - Grid (jobs)	6,671	8,248	9,262	14,112	18,554	22,996	22,700
By resource sector - Natural Gas (jobs)	15,690	14,315	12,133	9,627	8,311	5,968	4,045
By resource sector - Nuclear (jobs)	0	0	0.003	0.007	0.008	0.018	0.03
By resource sector - Oil (jobs)	26,301	25,199	22,582	20,059	14,539	10,815	6,718
By resource sector - Solar (jobs)	11,163	7,221	8,199	13,796	15,639	17,400	23,905
By resource sector - Wind (jobs)	3,938	6,068	10,065	10,172	9,741	8,906	9,055
Median wages - Annual - All ($2019 per job)	66,500	67,769	67,624	67,470	67,966	68,698	68,703
On-Site or In-Plant Training - Total jobs - 1 to 4 years (jobs)	10,677	9,981	10,136	10,912	10,911	10,988	11,200
On-Site or In-Plant Training - Total jobs - 4 to 10 years (jobs)	4,135	3,880	3,854	4,119	4,254	4,400	4,481
On-Site or In-Plant Training - Total jobs - None (jobs)	10,990	10,232	10,367	11,085	10,907	10,893	11,212

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)	495	473	492	542	560	576	592
On-Site or In-Plant Training - Total jobs - Up to 1 year (jobs)	41,680	38,792	39,199	41,868	40,922	40,646	41,339
On-the-Job Training - All sectors - 1 to 4 years (jobs)	13,588	12,708	12,898	13,881	13,945	14,086	14,368
On-the-Job Training - All sectors - 4 to 10 years (jobs)	3,820	3,575	3,568	3,862	4,069	4,269	4,394
On-the-Job Training - All sectors - None (jobs)	3,856	3,559	3,531	3,730	3,632	3,615	3,720
On-the-Job Training - All sectors - Over 10 years (jobs)	676	630	657	709	686	668	688
On-the-Job Training - All sectors - Up to 1 year (jobs)	46,036	42,884	43,394	46,344	45,221	44,865	45,654
Related work experience - All sectors - 1 to 4 years (jobs)	25,067	23,367	23,442	24,915	24,462	24,385	24,708
Related work experience - All sectors - 4 to 10 years (jobs)	15,816	14,810	14,920	15,877	15,693	15,688	15,915
Related work experience - All sectors - None (jobs)	9,448	8,844	8,982	9,663	9,621	9,689	9,925
Related work experience - All sectors - Over 10 years (jobs)	4,416	4,142	4,210	4,477	4,344	4,267	4,305
Related work experience - All sectors - Up to 1 year (jobs)	13,229	12,194	12,494	13,595	13,434	13,474	13,971
Wage income - All (million $2019)	4,521	4,294	4,331	4,624	4,592	4,638	4,729

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

Item	2020	2025	2030	2035	2040	2045	2050
Natural gas consumption - Annual (tcf)	372	377	318	255	192	121	83.7
Natural gas consumption - Cumulative (tcf)	0	0	0	0	0	0	7,678
Natural gas production - Annual (tcf)	1,859	2,061	1,948	1,697	1,435	1,138	884
Oil consumption - Annual (million bbls)	93.8	87.6	75.4	57.8	41.6	28.7	18.8
Oil consumption - Cumulative (million bbls)	0	0	0	0	0	0	1,793
Oil production - Annual (million bbls)	213	230	231	231	183	149	98.9

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	4.41	4.7	0	0	0	0
Sales of cooking units - Electric Resistance (%)	50.3	51.6	56.1	68.1	84.8	95.1	98.7
Sales of cooking units - Gas (%)	49.7	48.4	43.9	31.9	15.2	4.9	1.32
Sales of space heating units - Electric Heat Pump (%)	5.62	13.3	15.8	24.3	44	68.4	82.7
Sales of space heating units - Electric Resistance (%)	7.65	13.9	13.5	12.5	10.1	6.84	4.95
Sales of space heating units - Fossil (%)	3.24	5.74	5.68	5.1	3.9	2.66	2.01
Sales of space heating units - Gas (%)	83.5	67.1	65	58.1	42	22.1	10.3
Sales of water heating units - Electric Heat Pump (%)	0	0.46	1.74	5.96	16.1	28.9	36.5
Sales of water heating units - Electric Resistance (%)	13.2	25.6	26.5	29.7	37.4	47.1	52.9
Sales of water heating units - Gas Furnace (%)	85.7	72.7	70.5	63.1	45.3	22.7	9.32
Sales of water heating units - Other (%)	1.07	1.23	1.23	1.23	1.22	1.22	1.21

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	172	344	1,178	3,652	5,339
Public EV charging plugs - DC Fast (1000 units)	0.303	0	0.614	0	2.74	0	7.45
Public EV charging plugs - L2 (1000 units)	2.12	0	14.8	0	65.9	0	179
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 (%)	1.79	2.16	2.1	1.68	1.1	0.567	0.242
Vehicle sales - Light-duty - EV (%)	1.62	4.1	10.6	23.9	46.2	70.6	87
Vehicle sales - Light-duty - gasoline (%)	92.6	88.6	81.5	69.1	48.7	26.4	11.6
Vehicle sales - Light-duty - hybrid (%)	3.8	4.66	5.29	4.92	3.8	2.31	1.14
Vehicle sales - Light-duty - hydrogen FC (%)	0.113	0.387	0.339	0.264	0.191	0.107	0.05
Vehicle sales - Light-duty - other (%)	0.113	0.116	0.107	0.094	0.069	0.038	0.017
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)	162	162	161	160	158	155	151
Final energy use - Industry (PJ)	171	181	188	203	226	238	250
Final energy use - Residential (PJ)	237	229	225	220	212	196	175
Final energy use - Transportation (PJ)	472	446	410	379	355	326	292

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	14,373	15,986	0	0	0	0
Sales of cooking units - Electric Resistance (%)	41.9	46.2	50.2	60.8	75.4	84.6	87.8
Sales of cooking units - Gas (%)	58.1	53.8	49.8	39.2	24.6	15.4	12.2
Sales of space heating units - Electric Heat Pump (%)	2.64	7.26	9.83	18.3	38.7	64.6	80
Sales of space heating units - Electric Resistance (%)	2.48	3.43	3.58	4.11	5.42	7.07	8.03
Sales of space heating units - Fossil (%)	0	0.241	0.225	0.171	0.089	0.035	0.016
Sales of space heating units - Gas Furnace (%)	94.9	89.1	86.4	77.4	55.8	28.3	12
Sales of water heating units - Electric Heat Pump (%)	0.022	0.571	2.07	7.05	19	34.1	43.1
Sales of water heating units - Electric Resistance (%)	1.1	2	3.47	8.35	20.1	35.1	44
Sales of water heating units - Gas Furnace (%)	98.6	97	94.1	84.2	60.5	30.4	12.5
Sales of water heating units - Other (%)	0.269	0.383	0.382	0.383	0.382	0.383	0.383

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	2.32	2.38	3.28	3.43	5.13	5.47

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	-173
Carbon sink potential - Aggressive deployment - Cropland measures (1000 tCO2e/y)	0	0	-2,661
Carbon sink potential - Aggressive deployment - Permanent conservation cover (1000 tCO2e/y)	0	0	-214
Carbon sink potential - Aggressive deployment - Total (1000 tCO2e/y)	0	0	-3,048

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	-173
Carbon sink potential - Moderate deployment - Cropland measures (1000 tCO2e/y)	0	0	-1,384
Carbon sink potential - Moderate deployment - Permanent conservation cover (1000 tCO2e/y)	0	0	-107
Carbon sink potential - Moderate deployment - Total (1000 tCO2e/y)	0	0	-1,664
Land impacted for carbon sink - Aggressive deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	172
Land impacted for carbon sink - Aggressive deployment - Cropland measures (1000 hectares)	0	0	3,977
Land impacted for carbon sink - Aggressive deployment - Permanent conservation cover (1000 hectares)	0	0	329
Land impacted for carbon sink - Aggressive deployment - Total (1000 hectares)	0	0	4,478
Land impacted for carbon sink - Moderate deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	172
Land impacted for carbon sink - Moderate deployment - Cropland measures (1000 hectares)	0	0	2,071
Land impacted for carbon sink - Moderate deployment - Permanent conservation cover (1000 hectares)	0	0	164
Land impacted for carbon sink - Moderate deployment - Total (1000 hectares)	0	0	2,407

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

Item	2020	2025	2050
Carbon sink potential - High - Accelerate regeneration (1000 tCO2e/y)	0	0	1,620
Carbon sink potential - High - All (not counting overlap) (1000 tCO2e/y)	0	0	48,148
Carbon sink potential - High - Avoid deforestation (1000 tCO2e/y)	0	0	1,559
Carbon sink potential - High - Extend rotation length (1000 tCO2e/y)	0	0	9,233
Carbon sink potential - High - Improve plantations (1000 tCO2e/y)	0	0	26.8
Carbon sink potential - High - Increase retention of HWP (1000 tCO2e/y)	0	0	174
Carbon sink potential - High - Increase trees outside forests (1000 tCO2e/y)	0	0	1,273
Carbon sink potential - High - Reforest cropland (1000 tCO2e/y)	0	0	24,902
Carbon sink potential - High - Reforest pasture (1000 tCO2e/y)	0	0	3,239
Carbon sink potential - High - Restore productivity (1000 tCO2e/y)	0	0	6,121
Carbon sink potential - Low - Accelerate regeneration (1000 tCO2e/y)	0	0	812
Carbon sink potential - Low - All (not counting overlap) (1000 tCO2e/y)	0	0	19,895
Carbon sink potential - Low - Avoid deforestation (1000 tCO2e/y)	0	0	260
Carbon sink potential - Low - Extend rotation length (1000 tCO2e/y)	0	0	3,547
Carbon sink potential - Low - Improve plantations (1000 tCO2e/y)	0	0	13.7

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	58.1
Carbon sink potential - Low - Increase trees outside forests (1000 tCO2e/y)	0	0	446
Carbon sink potential - Low - Reforest cropland (1000 tCO2e/y)	0	0	12,451
Carbon sink potential - Low - Reforest pasture (1000 tCO2e/y)	0	0	245
Carbon sink potential - Low - Restore productivity (1000 tCO2e/y)	0	0	2,063
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO2e/y)	0	0	1,216
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO2e/y)	0	0	34,021
Carbon sink potential - Mid - Avoid deforestation (1000 tCO2e/y)	0	0	909
Carbon sink potential - Mid - Extend rotation length (1000 tCO2e/y)	0	0	6,390
Carbon sink potential - Mid - Improve plantations (1000 tCO2e/y)	0	0	20
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO2e/y)	0	0	116
Carbon sink potential - Mid - Increase trees outside forests (1000 tCO2e/y)	0	0	859
Carbon sink potential - Mid - Reforest cropland (1000 tCO2e/y)	0	0	18,676
Carbon sink potential - Mid - Reforest pasture (1000 tCO2e/y)	0	0	1,742
Carbon sink potential - Mid - Restore productivity (1000 tCO2e/y)	0	0	4,092
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)	0	0	265
Land impacted for carbon sink potential - High - Avoid deforestation (over 30 years) (1000 hectares)	0	0	211
Land impacted for carbon sink potential - High - Extend rotation length (1000 hectares)	0	0	4,708
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)	0	0	9.89
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	121
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)	0	0	1,646
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)	0	0	92
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)	0	0	2,029
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)	0	0	9,083
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)	0	0	133
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)	0	0	198
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)	0	0	1,804
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)	0	0	4.95
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	63.7
Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares)	0	0	823
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)	0	0	15.9
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)	0	0	1,228
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)	0	0	4,270
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)	0	0	199
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)	0	0	205
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)	0	0	3,256
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)	0	0	7.44
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	92.3
Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares)	0	0	1,235
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)	0	0	115
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)	0	0	2,472
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)	0	0	7,582

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

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal (million 2019$)	0	221	0.265	0.264	0.2	0.124	0.001
Monetary damages from air pollution - Natural Gas (million 2019$)	0	275	198	169	121	58.2	16.9
Monetary damages from air pollution - Transportation (million 2019$)	0	929	987	1,006	945	783	556
Premature deaths from air pollution - Coal (deaths)	0	24.8	0.03	0.03	0.022	0.014	0
Premature deaths from air pollution - Natural Gas (deaths)	0	31.1	22.4	19.1	13.7	6.58	1.91
Premature deaths from air pollution - Transportation (deaths)	0	104	111	113	106	88	62.5

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	4.42	4.7	0	0	0	0
Sales of cooking units - Electric Resistance (%)	50.5	61	93.3	99.7	100	100	100
Sales of cooking units - Gas (%)	49.5	39	6.67	0.336	0	0	0
Sales of space heating units - Electric Heat Pump (%)	5.62	14.5	37.2	82.6	92	92.7	92.7
Sales of space heating units - Electric Resistance (%)	7.65	13.8	11	4.91	3.67	3.58	3.63
Sales of space heating units - Fossil (%)	3.24	5.67	4.53	2.12	1.56	1.5	1.52
Sales of space heating units - Gas (%)	83.5	66	47.3	10.4	2.8	2.21	2.19
Sales of water heating units - Electric Heat Pump (%)	0	0.93	12.1	36.4	41.4	41.7	41.8

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 (%)	13.2	25.9	34.2	52.7	56.7	57	57
Sales of water heating units - Gas Furnace (%)	85.7	72	52.4	9.64	0.728	0.02	0
Sales of water heating units - Other (%)	1.07	1.23	1.23	1.23	1.21	1.21	1.21

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	1,014	2,644	4,211	6,408	6,943	6,637
Public EV charging plugs - DC Fast (1000 units)	0.303	0	1.77	0	7.25	0	11.6
Public EV charging plugs - L2 (1000 units)	2.12	0	42.5	0	174	0	280
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 (%)	1.78	2.01	1.35	0.434	0.078	0.013	0
Vehicle sales - Light-duty - EV (%)	3.16	12.9	42.9	80.4	96.2	99.3	100
Vehicle sales - Light-duty - gasoline (%)	91.2	80.6	52.5	18	3.48	0.596	0
Vehicle sales - Light-duty - hybrid (%)	3.68	4.01	2.95	1.12	0.269	0.057	0
Vehicle sales - Light-duty - hydrogen FC (%)	0.112	0.353	0.221	0.07	0.014	0.002	0
Vehicle sales - Light-duty - other (%)	0.112	0.108	0.073	0.026	0.005	0.001	0
Vehicle sales - Medium-duty - diesel (%)	64.7	59.7	42.3	14.4	2.59	0.384	0
Vehicle sales - Medium-duty - EV (%)	0.784	5.07	25.3	60.8	76.5	79.5	80
Vehicle sales - Medium-duty - gasoline (%)	33.7	33.3	25.5	9.32	1.77	0.277	0
Vehicle sales - Medium-duty - hybrid (%)	0.363	0.402	0.341	0.14	0.03	0.005	0
Vehicle sales - Medium-duty - hydrogen FC (%)	0.196	1.27	6.33	15.2	19.1	19.9	20
Vehicle sales - Medium-duty - other (%)	0.253	0.255	0.205	0.083	0.019	0.004	0

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

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Commercial (PJ)	162	162	159	152	144	138	135
Final energy use - Industry (PJ)	171	180	187	200	221	233	246
Final energy use - Residential (PJ)	237	229	221	199	170	148	133
Final energy use - Transportation (PJ)	472	443	394	334	279	243	226

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	14,374	15,990	0	0	0	0
Sales of cooking units - Electric Resistance (%)	41.9	54.6	83	88.6	88.9	88.9	88.9
Sales of cooking units - Gas (%)	58.1	45.4	17	11.4	11.1	11.1	11.1
Sales of space heating units - Electric Heat Pump (%)	2.64	8.18	30.6	79.8	90	90.8	90.8
Sales of space heating units - Electric Resistance (%)	2.48	3.49	4.92	8.08	8.66	8.7	8.7
Sales of space heating units - Fossil (%)	0	0.208	0.04	0.002	0	0	0
Sales of space heating units - Gas Furnace (%)	94.9	88.1	64.4	12.2	1.37	0.522	0.498
Sales of water heating units - Electric Heat Pump (%)	0.022	1.12	14.3	42.9	48.9	49.4	49.4
Sales of water heating units - Electric Resistance (%)	1.1	2.5	15.4	43.8	49.7	50.2	50.2
Sales of water heating units - Gas Furnace (%)	98.6	96	69.9	12.9	0.972	0.027	0
Sales of water heating units - Other (%)	0.269	0.383	0.382	0.383	0.382	0.383	0.383

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	2.81	2.93	5.73	6.16	6.1	6.47

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	2.45	2.57	4.26	7.7	35.7
Capital invested - Wind - Base (billion $2018)	0	0.715	1.61	2.18	6.64	8.39	38.4

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

Item	2020	2025	2030	2035	2040	2045	2050
Solar - Base land use assumptions (GWh)	1,142	0	4,510	5,224	9,077	17,551	85,919
Solar - Constrained land use assumptions (GWh)	1,142	1,743	6,552	2,471	7,600	13,494	90,049
Wind - Base land use assumptions (GWh)	16,760	1,766	4,273	6,042	18,802	24,359	111,347
Wind - Constrained land use assumptions (GWh)	16,760	706	2,976	14,054	35,526	48,314	152,249

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	-173
Carbon sink potential - Aggressive deployment - Cropland measures (1000 tCO2e/y)	0	0	-2,661
Carbon sink potential - Aggressive deployment - Permanent conservation cover (1000 tCO2e/y)	0	0	-214
Carbon sink potential - Aggressive deployment - Total (1000 tCO2e/y)	0	0	-3,048
Carbon sink potential - Moderate deployment - Corn-ethanol to energy grasses (1000 tCO2e/y)	0	0	-173
Carbon sink potential - Moderate deployment - Cropland measures (1000 tCO2e/y)	0	0	-1,384
Carbon sink potential - Moderate deployment - Permanent conservation cover (1000 tCO2e/y)	0	0	-107
Carbon sink potential - Moderate deployment - Total (1000 tCO2e/y)	0	0	-1,664
Land impacted for carbon sink - Aggressive deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	172
Land impacted for carbon sink - Aggressive deployment - Cropland measures (1000 hectares)	0	0	3,977
Land impacted for carbon sink - Aggressive deployment - Permanent conservation cover (1000 hectares)	0	0	329
Land impacted for carbon sink - Aggressive deployment - Total (1000 hectares)	0	0	4,478
Land impacted for carbon sink - Moderate deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	172
Land impacted for carbon sink - Moderate deployment - Cropland measures (1000 hectares)	0	0	2,071
Land impacted for carbon sink - Moderate deployment - Permanent conservation cover (1000 hectares)	0	0	164
Land impacted for carbon sink - Moderate deployment - Total (1000 hectares)	0	0	2,407

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	1,620
Carbon sink potential - High - All (not counting overlap) (1000 tCO2e/y)	0	0	48,148
Carbon sink potential - High - Avoid deforestation (1000 tCO2e/y)	0	0	1,559
Carbon sink potential - High - Extend rotation length (1000 tCO2e/y)	0	0	9,233
Carbon sink potential - High - Improve plantations (1000 tCO2e/y)	0	0	26.8
Carbon sink potential - High - Increase retention of HWP (1000 tCO2e/y)	0	0	174
Carbon sink potential - High - Increase trees outside forests (1000 tCO2e/y)	0	0	1,273
Carbon sink potential - High - Reforest cropland (1000 tCO2e/y)	0	0	24,902
Carbon sink potential - High - Reforest pasture (1000 tCO2e/y)	0	0	3,239
Carbon sink potential - High - Restore productivity (1000 tCO2e/y)	0	0	6,121
Carbon sink potential - Low - Accelerate regeneration (1000 tCO2e/y)	0	0	812
Carbon sink potential - Low - All (not counting overlap) (1000 tCO2e/y)	0	0	19,895
Carbon sink potential - Low - Avoid deforestation (1000 tCO2e/y)	0	0	260
Carbon sink potential - Low - Extend rotation length (1000 tCO2e/y)	0	0	3,547
Carbon sink potential - Low - Improve plantations (1000 tCO2e/y)	0	0	13.7
Carbon sink potential - Low - Increase retention of HWP (1000 tCO2e/y)	0	0	58.1
Carbon sink potential - Low - Increase trees outside forests (1000 tCO2e/y)	0	0	446
Carbon sink potential - Low - Reforest cropland (1000 tCO2e/y)	0	0	12,451
Carbon sink potential - Low - Reforest pasture (1000 tCO2e/y)	0	0	245
Carbon sink potential - Low - Restore productivity (1000 tCO2e/y)	0	0	2,063
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO2e/y)	0	0	1,216
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO2e/y)	0	0	34,021
Carbon sink potential - Mid - Avoid deforestation (1000 tCO2e/y)	0	0	909
Carbon sink potential - Mid - Extend rotation length (1000 tCO2e/y)	0	0	6,390
Carbon sink potential - Mid - Improve plantations (1000 tCO2e/y)	0	0	20
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO2e/y)	0	0	116
Carbon sink potential - Mid - Increase trees outside forests (1000 tCO2e/y)	0	0	859
Carbon sink potential - Mid - Reforest cropland (1000 tCO2e/y)	0	0	18,676
Carbon sink potential - Mid - Reforest pasture (1000 tCO2e/y)	0	0	1,742
Carbon sink potential - Mid - Restore productivity (1000 tCO2e/y)	0	0	4,092
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)	0	0	265

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	211
Land impacted for carbon sink potential - High - Extend rotation length (1000 hectares)	0	0	4,708
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)	0	0	9.89
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	121
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)	0	0	1,646
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)	0	0	92
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)	0	0	2,029
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)	0	0	9,083
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)	0	0	133
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)	0	0	198
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)	0	0	1,804
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)	0	0	4.95
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	63.7
Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares)	0	0	823
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)	0	0	15.9
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)	0	0	1,228
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)	0	0	4,270
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)	0	0	199
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)	0	0	205
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)	0	0	3,256
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)	0	0	7.44
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	92.3
Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares)	0	0	1,235
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)	0	0	115
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)	0	0	2,472
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)	0	0	7,582

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

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal (million 2019$)	0	221	0.265	0.264	0.2	0.124	0.001
Monetary damages from air pollution - Natural Gas (million 2019$)	0	251	170	108	96.8	46.8	13.5
Monetary damages from air pollution - Transportation (million 2019$)	0	914	899	717	433	203	77.7
Premature deaths from air pollution - Coal (deaths)	0	24.8	0.03	0.03	0.022	0.014	0
Premature deaths from air pollution - Natural Gas (deaths)	0	28.4	19.2	12.2	10.9	5.28	1.53
Premature deaths from air pollution - Transportation (deaths)	0	103	101	80.7	48.7	22.8	8.74

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	4.42	4.7	0	0	0	0
Sales of cooking units - Electric Resistance (%)	50.5	61	93.3	99.7	100	100	100
Sales of cooking units - Gas (%)	49.5	39	6.67	0.336	0	0	0
Sales of space heating units - Electric Heat Pump (%)	5.62	14.5	37.2	82.6	92	92.7	92.7
Sales of space heating units - Electric Resistance (%)	7.65	13.8	11	4.91	3.67	3.58	3.63
Sales of space heating units - Fossil (%)	3.24	5.67	4.53	2.12	1.56	1.5	1.52
Sales of space heating units - Gas (%)	83.5	66	47.3	10.4	2.8	2.21	2.19
Sales of water heating units - Electric Heat Pump (%)	0	0.93	12.1	36.4	41.4	41.7	41.8
Sales of water heating units - Electric Resistance (%)	13.2	25.9	34.2	52.7	56.7	57	57
Sales of water heating units - Gas Furnace (%)	85.7	72	52.4	9.64	0.728	0.02	0
Sales of water heating units - Other (%)	1.07	1.23	1.23	1.23	1.21	1.21	1.21

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	1,014	2,644	4,211	6,408	6,943	6,637
Public EV charging plugs - DC Fast (1000 units)	0.303	0	1.77	0	7.25	0	11.6
Public EV charging plugs - L2 (1000 units)	2.12	0	42.5	0	174	0	280
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 (%)	1.78	2.01	1.35	0.434	0.078	0.013	0
Vehicle sales - Light-duty - EV (%)	3.16	12.9	42.9	80.4	96.2	99.3	100
Vehicle sales - Light-duty - gasoline (%)	91.2	80.6	52.5	18	3.48	0.596	0
Vehicle sales - Light-duty - hybrid (%)	3.68	4.01	2.95	1.12	0.269	0.057	0
Vehicle sales - Light-duty - hydrogen FC (%)	0.112	0.353	0.221	0.07	0.014	0.002	0
Vehicle sales - Light-duty - other (%)	0.112	0.108	0.073	0.026	0.005	0.001	0
Vehicle sales - Medium-duty - diesel (%)	64.7	59.7	42.3	14.4	2.59	0.384	0
Vehicle sales - Medium-duty - EV (%)	0.784	5.07	25.3	60.8	76.5	79.5	80
Vehicle sales - Medium-duty - gasoline (%)	33.7	33.3	25.5	9.32	1.77	0.277	0
Vehicle sales - Medium-duty - hybrid (%)	0.363	0.402	0.341	0.14	0.03	0.005	0
Vehicle sales - Medium-duty - hydrogen FC (%)	0.196	1.27	6.33	15.2	19.1	19.9	20
Vehicle sales - Medium-duty - other (%)	0.253	0.255	0.205	0.083	0.019	0.004	0

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

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Commercial (PJ)	162	162	159	152	144	138	135
Final energy use - Industry (PJ)	171	180	187	200	221	233	246
Final energy use - Residential (PJ)	237	229	221	199	170	148	133
Final energy use - Transportation (PJ)	472	443	394	334	279	243	226

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	14,374	15,990	0	0	0	0
Sales of cooking units - Electric Resistance (%)	41.9	54.6	83	88.6	88.9	88.9	88.9
Sales of cooking units - Gas (%)	58.1	45.4	17	11.4	11.1	11.1	11.1
Sales of space heating units - Electric Heat Pump (%)	2.64	8.18	30.6	79.8	90	90.8	90.8
Sales of space heating units - Electric Resistance (%)	2.48	3.49	4.92	8.08	8.66	8.7	8.7
Sales of space heating units - Fossil (%)	0	0.208	0.04	0.002	0	0	0
Sales of space heating units - Gas Furnace (%)	94.9	88.1	64.4	12.2	1.37	0.522	0.498
Sales of water heating units - Electric Heat Pump (%)	0.022	1.12	14.3	42.9	48.9	49.4	49.4
Sales of water heating units - Electric Resistance (%)	1.1	2.5	15.4	43.8	49.7	50.2	50.2
Sales of water heating units - Gas Furnace (%)	98.6	96	69.9	12.9	0.972	0.027	0
Sales of water heating units - Other (%)	0.269	0.383	0.382	0.383	0.382	0.383	0.383

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	2.81	2.93	5.73	6.16	6.1	6.47

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	1.75	1.27	0.371	2.34	0.528	2.49
Capital invested - Solar PV - Constrained (billion $2018)	0	1.93	1.68	1.09	2.24	1.88	2.36
Capital invested - Wind - Base (billion $2018)	0	0.169	1.35	0.606	1.04	1.29	0.427
Capital invested - Wind - Constrained (billion $2018)	0	0.254	0.437	0.539	2.97	2.95	1.03

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

Item	2020	2025	2030	2035	2040	2045	2050
Solar - Base land use assumptions (GWh)	3,250	2,884	2,354	751	5,088	1,229	5,951
Solar - Constrained land use assumptions (GWh)	1,939	3,134	3,132	2,194	4,791	4,294	5,636
Wind - Base land use assumptions (GWh)	16,760	431	3,659	1,686	3,029	3,949	1,378
Wind - Constrained land use assumptions (GWh)	16,760	587	1,092	1,407	7,802	8,170	2,956

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	-173
Carbon sink potential - Aggressive deployment - Cropland measures (1000 tCO2e/y)	0	0	-2,661
Carbon sink potential - Aggressive deployment - Permanent conservation cover (1000 tCO2e/y)	0	0	-214
Carbon sink potential - Aggressive deployment - Total (1000 tCO2e/y)	0	0	-3,048
Carbon sink potential - Moderate deployment - Corn-ethanol to energy grasses (1000 tCO2e/y)	0	0	-173

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	-1,384
Carbon sink potential - Moderate deployment - Permanent conservation cover (1000 tCO2e/y)	0	0	-107
Carbon sink potential - Moderate deployment - Total (1000 tCO2e/y)	0	0	-1,664
Land impacted for carbon sink - Aggressive deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	172
Land impacted for carbon sink - Aggressive deployment - Cropland measures (1000 hectares)	0	0	3,977
Land impacted for carbon sink - Aggressive deployment - Permanent conservation cover (1000 hectares)	0	0	329
Land impacted for carbon sink - Aggressive deployment - Total (1000 hectares)	0	0	4,478
Land impacted for carbon sink - Moderate deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	172
Land impacted for carbon sink - Moderate deployment - Cropland measures (1000 hectares)	0	0	2,071
Land impacted for carbon sink - Moderate deployment - Permanent conservation cover (1000 hectares)	0	0	164
Land impacted for carbon sink - Moderate deployment - Total (1000 hectares)	0	0	2,407

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	1,620
Carbon sink potential - High - All (not counting overlap) (1000 tCO2e/y)	0	0	48,148
Carbon sink potential - High - Avoid deforestation (1000 tCO2e/y)	0	0	1,559
Carbon sink potential - High - Extend rotation length (1000 tCO2e/y)	0	0	9,233
Carbon sink potential - High - Improve plantations (1000 tCO2e/y)	0	0	26.8
Carbon sink potential - High - Increase retention of HWP (1000 tCO2e/y)	0	0	174
Carbon sink potential - High - Increase trees outside forests (1000 tCO2e/y)	0	0	1,273
Carbon sink potential - High - Reforest cropland (1000 tCO2e/y)	0	0	24,902
Carbon sink potential - High - Reforest pasture (1000 tCO2e/y)	0	0	3,239
Carbon sink potential - High - Restore productivity (1000 tCO2e/y)	0	0	6,121
Carbon sink potential - Low - Accelerate regeneration (1000 tCO2e/y)	0	0	812
Carbon sink potential - Low - All (not counting overlap) (1000 tCO2e/y)	0	0	19,895
Carbon sink potential - Low - Avoid deforestation (1000 tCO2e/y)	0	0	260
Carbon sink potential - Low - Extend rotation length (1000 tCO2e/y)	0	0	3,547
Carbon sink potential - Low - Improve plantations (1000 tCO2e/y)	0	0	13.7
Carbon sink potential - Low - Increase retention of HWP (1000 tCO2e/y)	0	0	58.1

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	446
Carbon sink potential - Low - Reforest cropland (1000 tCO2e/y)	0	0	12,451
Carbon sink potential - Low - Reforest pasture (1000 tCO2e/y)	0	0	245
Carbon sink potential - Low - Restore productivity (1000 tCO2e/y)	0	0	2,063
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO2e/y)	0	0	1,216
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO2e/y)	0	0	34,021
Carbon sink potential - Mid - Avoid deforestation (1000 tCO2e/y)	0	0	909
Carbon sink potential - Mid - Extend rotation length (1000 tCO2e/y)	0	0	6,390
Carbon sink potential - Mid - Improve plantations (1000 tCO2e/y)	0	0	20
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO2e/y)	0	0	116
Carbon sink potential - Mid - Increase trees outside forests (1000 tCO2e/y)	0	0	859
Carbon sink potential - Mid - Reforest cropland (1000 tCO2e/y)	0	0	18,676
Carbon sink potential - Mid - Reforest pasture (1000 tCO2e/y)	0	0	1,742
Carbon sink potential - Mid - Restore productivity (1000 tCO2e/y)	0	0	4,092
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)	0	0	265
Land impacted for carbon sink potential - High - Avoid deforestation (over 30 years) (1000 hectares)	0	0	211
Land impacted for carbon sink potential - High - Extend rotation length (1000 hectares)	0	0	4,708
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)	0	0	9.89
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	121
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)	0	0	1,646
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)	0	0	92
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)	0	0	2,029
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)	0	0	9,083
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)	0	0	133
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)	0	0	198
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)	0	0	1,804
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)	0	0	4.95
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	63.7

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	823
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)	0	0	15.9
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)	0	0	1,228
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)	0	0	4,270
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)	0	0	199
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)	0	0	205
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)	0	0	3,256
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)	0	0	7.44
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	92.3
Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares)	0	0	1,235
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)	0	0	115
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)	0	0	2,472
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)	0	0	7,582

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

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal (million 2019$)	0	221	0.265	0.264	0.2	0.124	0.001
Monetary damages from air pollution - Natural Gas (million 2019$)	0	267	186	193	368	169	19.3
Monetary damages from air pollution - Transportation (million 2019$)	0	914	899	717	433	203	77.7
Premature deaths from air pollution - Coal (deaths)	0	24.8	0.03	0.03	0.022	0.014	0
Premature deaths from air pollution - Natural Gas (deaths)	0	30.1	21	21.8	41.5	19	2.18
Premature deaths from air pollution - Transportation (deaths)	0	103	101	80.7	48.7	22.8	8.74

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	4.41	4.7	0	0	0	0
Sales of cooking units - Electric Resistance (%)	50.3	51.6	56.1	68.1	84.8	95.1	98.7
Sales of cooking units - Gas (%)	49.7	48.4	43.9	31.9	15.2	4.9	1.32
Sales of space heating units - Electric Heat Pump (%)	5.62	13.3	15.8	24.3	44	68.4	82.7
Sales of space heating units - Electric Resistance (%)	7.65	13.9	13.5	12.5	10.1	6.84	4.95
Sales of space heating units - Fossil (%)	3.24	5.74	5.68	5.1	3.9	2.66	2.01
Sales of space heating units - Gas (%)	83.5	67.1	65	58.1	42	22.1	10.3
Sales of water heating units - Electric Heat Pump (%)	0	0.46	1.74	5.96	16.1	28.9	36.5
Sales of water heating units - Electric Resistance (%)	13.2	25.6	26.5	29.7	37.4	47.1	52.9

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 (%)	85.7	72.7	70.5	63.1	45.3	22.7	9.32
Sales of water heating units - Other (%)	1.07	1.23	1.23	1.23	1.22	1.22	1.21

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	172	344	1,178	3,652	5,339
Public EV charging plugs - DC Fast (1000 units)	0.303	0	0.614	0	2.74	0	7.45
Public EV charging plugs - L2 (1000 units)	2.12	0	14.8	0	65.9	0	179
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 (%)	1.79	2.16	2.1	1.68	1.1	0.567	0.242
Vehicle sales - Light-duty - EV (%)	1.62	4.1	10.6	23.9	46.2	70.6	87
Vehicle sales - Light-duty - gasoline (%)	92.6	88.6	81.5	69.1	48.7	26.4	11.6
Vehicle sales - Light-duty - hybrid (%)	3.8	4.66	5.29	4.92	3.8	2.31	1.14
Vehicle sales - Light-duty - hydrogen FC (%)	0.113	0.387	0.339	0.264	0.191	0.107	0.05
Vehicle sales - Light-duty - other (%)	0.113	0.116	0.107	0.094	0.069	0.038	0.017
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)	162	162	161	160	158	155	151
Final energy use - Industry (PJ)	171	181	188	203	226	238	250
Final energy use - Residential (PJ)	237	229	225	220	212	196	175
Final energy use - Transportation (PJ)	472	446	410	379	355	326	292

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	14,373	15,986	0	0	0	0
Sales of cooking units - Electric Resistance (%)	41.9	46.2	50.2	60.8	75.4	84.6	87.8
Sales of cooking units - Gas (%)	58.1	53.8	49.8	39.2	24.6	15.4	12.2
Sales of space heating units - Electric Heat Pump (%)	2.64	7.26	9.83	18.3	38.7	64.6	80
Sales of space heating units - Electric Resistance (%)	2.48	3.43	3.58	4.11	5.42	7.07	8.03
Sales of space heating units - Fossil (%)	0	0.241	0.225	0.171	0.089	0.035	0.016
Sales of space heating units - Gas Furnace (%)	94.9	89.1	86.4	77.4	55.8	28.3	12
Sales of water heating units - Electric Heat Pump (%)	0.022	0.571	2.07	7.05	19	34.1	43.1
Sales of water heating units - Electric Resistance (%)	1.1	2	3.47	8.35	20.1	35.1	44
Sales of water heating units - Gas Furnace (%)	98.6	97	94.1	84.2	60.5	30.4	12.5
Sales of water heating units - Other (%)	0.269	0.383	0.382	0.383	0.382	0.383	0.383

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	2.32	2.38	3.28	3.43	5.13	5.47

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	0.009	0	0.042
Capital invested - Biomass w/ccu power plant (billion $2018)	0	0	0	0	0.139	0	0.584

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	9	9	51
Biomass w/ccu power plant (GWh)	0	0	0	0	156	156	812

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	0	0	117	458	500
Conversion capital investment - Cumulative 5-yr (million $2018)	0	0	0	0	1,360	3,889	588
Number of facilities - Allam power w ccu (quantity)	0	0	0	0	1	1	2
Number of facilities - Beccs hydrogen (quantity)	0	0	0	0	1	5	5
Number of facilities - Diesel (quantity)	0	0	0	0	0	0	0
Number of facilities - Diesel ccu (quantity)	0	0	0	0	1	1	1
Number of facilities - Power (quantity)	0	0	0	0	0	0	0
Number of facilities - Power ccu (quantity)	0	0	0	0	1	1	2
Number of facilities - Pyrolysis (quantity)	0	0	0	0	0	0	0
Number of facilities - Pyrolysis ccu (quantity)	0	0	0	0	1	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 53: *E-B+ scenario - PILLAR 4: CCUS - CO2 capture*

Item	2020	2025	2030	2035	2040	2045	2050
Annual - All (MMT)	0	0	0	3.38	5.08	10.2	11
Annual - BECCS (MMT)	0	0	0	0	1.72	6.72	7.4
Annual - Cement and lime (MMT)	0	0	0	3.35	3.32	3.42	3.53
Annual - NGCC (MMT)	0	0	0	0.03	0.04	0.04	0.04
Cumulative - All (MMT)	0	0	0	3.38	8.46	18.6	29.6
Cumulative - BECCS (MMT)	0	0	0	0	1.72	8.44	15.8
Cumulative - Cement and lime (MMT)	0	0	0	3.35	6.67	10.1	13.6
Cumulative - NGCC (MMT)	0	0	0	0.03	0.07	0.11	0.15

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

Item	2020	2025	2030	2035	2040	2045	2050
CO2 storage (MMT)	0	0	0	2.14	3.56	4.92	5.02
Injection wells (wells)	0	0	1	3	6	9	12
Resource characterization, appraisal, permitting costs (million $2020)	0	36	101	129	129	129	129
Wells and facilities construction costs (million $2020)	0	0	24	93.3	166	278	345

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

Item	2020	2025	2030	2035	2040	2045	2050
All (km)	0	0	256	696	1,003	1,698	2,129
Cumulative investment - All (million $2018)	0	0	1,225	1,699	2,013	2,575	2,836
Cumulative investment - Spur (million $2018)	0	0	0.299	360	674	1,236	1,497
Cumulative investment - Trunk (million $2018)	0	0	1,225	1,339	1,339	1,339	1,339
Spur (km)	0	0	0.5	441	747	1,442	1,874
Trunk (km)	0	0	255	255	255	255	255

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	-376
Carbon sink potential - Aggressive deployment - Cropland measures (1000 tCO2e/y)	0	0	-2,573
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	-205
Carbon sink potential - Aggressive deployment - Total (1000 tCO2e/y)	0	0	-3,153
Carbon sink potential - Moderate deployment - Corn-ethanol to energy grasses (1000 tCO2e/y)	0	0	-376
Carbon sink potential - Moderate deployment - Cropland measures (1000 tCO2e/y)	0	0	-1,338
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	-102
Carbon sink potential - Moderate deployment - Total (1000 tCO2e/y)	0	0	-1,815
Land impacted for carbon sink - Aggressive deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	313
Land impacted for carbon sink - Aggressive deployment - Cropland measures (1000 hectares)	0	0	9,486
Land impacted for carbon sink - Aggressive deployment - Cropland to woody energy crops (1000 hectares)	0	0	8.67
Land impacted for carbon sink - Aggressive deployment - Pasture to energy crops (1000 hectares)	0	0	0.404
Land impacted for carbon sink - Aggressive deployment - Permanent conservation cover (1000 hectares)	0	0	314
Land impacted for carbon sink - Aggressive deployment - Total (1000 hectares)	0	0	10,123
Land impacted for carbon sink - Moderate deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	313
Land impacted for carbon sink - Moderate deployment - Cropland measures (1000 hectares)	0	0	2,000
Land impacted for carbon sink - Moderate deployment - Cropland to woody energy crops (1000 hectares)	0	0	8.67
Land impacted for carbon sink - Moderate deployment - Pasture to energy crops (1000 hectares)	0	0	0.404
Land impacted for carbon sink - Moderate deployment - Permanent conservation cover (1000 hectares)	0	0	157
Land impacted for carbon sink - Moderate deployment - Total (1000 hectares)	0	0	2,479

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	1,620
Carbon sink potential - High - All (not counting overlap) (1000 tCO2e/y)	0	0	48,148
Carbon sink potential - High - Avoid deforestation (1000 tCO2e/y)	0	0	1,559
Carbon sink potential - High - Extend rotation length (1000 tCO2e/y)	0	0	9,233
Carbon sink potential - High - Improve plantations (1000 tCO2e/y)	0	0	26.8
Carbon sink potential - High - Increase retention of HWP (1000 tCO2e/y)	0	0	174
Carbon sink potential - High - Increase trees outside forests (1000 tCO2e/y)	0	0	1,273
Carbon sink potential - High - Reforest cropland (1000 tCO2e/y)	0	0	24,902
Carbon sink potential - High - Reforest pasture (1000 tCO2e/y)	0	0	3,239
Carbon sink potential - High - Restore productivity (1000 tCO2e/y)	0	0	6,121
Carbon sink potential - Low - Accelerate regeneration (1000 tCO2e/y)	0	0	812
Carbon sink potential - Low - All (not counting overlap) (1000 tCO2e/y)	0	0	19,895
Carbon sink potential - Low - Avoid deforestation (1000 tCO2e/y)	0	0	260
Carbon sink potential - Low - Extend rotation length (1000 tCO2e/y)	0	0	3,547
Carbon sink potential - Low - Improve plantations (1000 tCO2e/y)	0	0	13.7
Carbon sink potential - Low - Increase retention of HWP (1000 tCO2e/y)	0	0	58.1
Carbon sink potential - Low - Increase trees outside forests (1000 tCO2e/y)	0	0	446
Carbon sink potential - Low - Reforest cropland (1000 tCO2e/y)	0	0	12,451
Carbon sink potential - Low - Reforest pasture (1000 tCO2e/y)	0	0	245
Carbon sink potential - Low - Restore productivity (1000 tCO2e/y)	0	0	2,063
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO2e/y)	0	0	1,216
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO2e/y)	0	0	34,021
Carbon sink potential - Mid - Avoid deforestation (1000 tCO2e/y)	0	0	909
Carbon sink potential - Mid - Extend rotation length (1000 tCO2e/y)	0	0	6,390
Carbon sink potential - Mid - Improve plantations (1000 tCO2e/y)	0	0	20
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO2e/y)	0	0	116
Carbon sink potential - Mid - Increase trees outside forests (1000 tCO2e/y)	0	0	859
Carbon sink potential - Mid - Reforest cropland (1000 tCO2e/y)	0	0	18,676
Carbon sink potential - Mid - Reforest pasture (1000 tCO2e/y)	0	0	1,742
Carbon sink potential - Mid - Restore productivity (1000 tCO2e/y)	0	0	4,092
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)	0	0	265

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	211
Land impacted for carbon sink potential - High - Extend rotation length (1000 hectares)	0	0	4,708
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)	0	0	9.89
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	121
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)	0	0	1,646
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)	0	0	92
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)	0	0	2,029
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)	0	0	9,083
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)	0	0	133
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)	0	0	198
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)	0	0	1,804
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)	0	0	4.95
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	63.7
Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares)	0	0	823
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)	0	0	15.9
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)	0	0	1,228
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)	0	0	4,270
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)	0	0	199
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)	0	0	205
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)	0	0	3,256
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)	0	0	7.44
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	92.3
Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares)	0	0	1,235
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)	0	0	115
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)	0	0	2,472
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)	0	0	7,582

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	4.33	4.39	0	0	0	0
Sales of cooking units - Electric Resistance (%)	49.8	49.8	49.8	49.8	49.8	49.8	49.8
Sales of cooking units - Gas (%)	50.2	50.2	50.2	50.2	50.2	50.2	50.2
Sales of space heating units - Electric Heat Pump (%)	5.05	16.1	16.5	17	17.5	17.9	18.5
Sales of space heating units - Electric Resistance (%)	7.73	13.4	13.3	13.2	13.1	12.7	12.1
Sales of space heating units - Fossil (%)	3.28	5.42	5.49	5.36	5.12	5.04	5.13
Sales of space heating units - Gas (%)	83.9	65	64.8	64.4	64.3	64.4	64.2
Sales of water heating units - Electric Heat Pump (%)	0	0	0	0	0	0	0
Sales of water heating units - Electric Resistance (%)	13.2	25.2	25.3	25.3	25.4	25.4	25.4
Sales of water heating units - Gas Furnace (%)	85.7	73.5	73.5	73.5	73.4	73.4	73.4
Sales of water heating units - Other (%)	1.07	1.23	1.23	1.23	1.22	1.22	1.22

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 (%)	1.78	2.16	2.22	2.07	1.87	1.75	1.66
Vehicle sales - Light-duty - EV (%)	2.81	4.63	5.31	6.47	7.94	9.34	10.5
Vehicle sales - Light-duty - gasoline (%)	91.5	88.1	86.4	84.8	82.9	81	79.3
Vehicle sales - Light-duty - hybrid (%)	3.7	4.58	5.63	6.22	6.84	7.52	8.12
Vehicle sales - Light-duty - hydrogen FC (%)	0.112	0.385	0.359	0.323	0.322	0.324	0.336
Vehicle sales - Light-duty - other (%)	0.112	0.116	0.113	0.114	0.114	0.113	0.116
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)	162	165	169	170	172	177	185
Final energy use - Industry (PJ)	171	186	198	211	225	243	262
Final energy use - Residential (PJ)	237	231	230	232	235	240	244
Final energy use - Transportation (PJ)	472	451	423	407	409	422	438

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	14,192	14,841	0	0	0	0
Sales of cooking units - Electric Resistance (%)	41.9	44.7	44.7	44.6	44.4	44.5	44.6
Sales of cooking units - Gas (%)	58.1	55.3	55.3	55.4	55.6	55.5	55.4
Sales of space heating units - Electric Heat Pump (%)	2.64	13.8	46.2	73.2	77.9	78.5	78.5
Sales of space heating units - Electric Resistance (%)	2.48	4.35	8.94	16	20.3	21	21
Sales of space heating units - Fossil (%)	0	0.226	0.135	0.038	0.005	0	0
Sales of space heating units - Gas Furnace (%)	94.9	81.6	44.8	10.8	1.79	0.573	0.499
Sales of water heating units - Electric Heat Pump (%)	0.022	0.03	0.03	0.03	0.03	0.03	0.03

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 (%)	1.1	1.47	1.47	1.48	1.46	1.48	1.47
Sales of water heating units - Gas Furnace (%)	98.6	98.1	98.1	98.1	98.1	98.1	98.1
Sales of water heating units - Other (%)	0.269	0.383	0.382	0.383	0.382	0.383	0.383

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	2.52	2.6	3.5	3.68	4	4.2

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

Item	2020	2025	2030	2050
Business-as-usual carbon sink - Natural uptake (Mt CO2e/y)	6.25	0	4.02	1.15
Business-as-usual carbon sink - Retained in Hardwood Products (Mt CO2e/y)	-0.047	0	-0.099	-0.104
Business-as-usual carbon sink - Total (Mt CO2e/y)	6.2	0	3.93	1.05
Carbon sink potential - High - Accelerate regeneration (1000 tCO2e/y)	0	0	0	1,620
Carbon sink potential - High - All (not counting overlap) (1000 tCO2e/y)	0	0	0	48,148
Carbon sink potential - High - Avoid deforestation (1000 tCO2e/y)	0	0	0	1,559
Carbon sink potential - High - Extend rotation length (1000 tCO2e/y)	0	0	0	9,233
Carbon sink potential - High - Improve plantations (1000 tCO2e/y)	0	0	0	26.8
Carbon sink potential - High - Increase retention of HWP (1000 tCO2e/y)	0	0	0	174
Carbon sink potential - High - Increase trees outside forests (1000 tCO2e/y)	0	0	0	1,273
Carbon sink potential - High - Reforest cropland (1000 tCO2e/y)	0	0	0	24,902
Carbon sink potential - High - Reforest pasture (1000 tCO2e/y)	0	0	0	3,239
Carbon sink potential - High - Restore productivity (1000 tCO2e/y)	0	0	0	6,121
Carbon sink potential - Low - Accelerate regeneration (1000 tCO2e/y)	0	0	0	812
Carbon sink potential - Low - All (not counting overlap) (1000 tCO2e/y)	0	0	0	19,895
Carbon sink potential - Low - Avoid deforestation (1000 tCO2e/y)	0	0	0	260
Carbon sink potential - Low - Extend rotation length (1000 tCO2e/y)	0	0	0	3,547
Carbon sink potential - Low - Improve plantations (1000 tCO2e/y)	0	0	0	13.7
Carbon sink potential - Low - Increase retention of HWP (1000 tCO2e/y)	0	0	0	58.1
Carbon sink potential - Low - Increase trees outside forests (1000 tCO2e/y)	0	0	0	446
Carbon sink potential - Low - Reforest cropland (1000 tCO2e/y)	0	0	0	12,451
Carbon sink potential - Low - Reforest pasture (1000 tCO2e/y)	0	0	0	245
Carbon sink potential - Low - Restore productivity (1000 tCO2e/y)	0	0	0	2,063
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO2e/y)	0	0	0	1,216
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO2e/y)	0	0	0	34,021

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	909
Carbon sink potential - Mid - Extend rotation length (1000 tCO2e/y)	0	0	0	6,390
Carbon sink potential - Mid - Improve plantations (1000 tCO2e/y)	0	0	0	20
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO2e/y)	0	0	0	116
Carbon sink potential - Mid - Increase trees outside forests (1000 tCO2e/y)	0	0	0	859
Carbon sink potential - Mid - Reforest cropland (1000 tCO2e/y)	0	0	0	18,676
Carbon sink potential - Mid - Reforest pasture (1000 tCO2e/y)	0	0	0	1,742
Carbon sink potential - Mid - Restore productivity (1000 tCO2e/y)	0	0	0	4,092
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)	0	0	0	265
Land impacted for carbon sink potential - High - Avoid deforestation (over 30 years) (1000 hectares)	0	0	0	211
Land impacted for carbon sink potential - High - Extend rotation length (1000 hectares)	0	0	0	4,708
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)	0	0	0	9.89
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	121
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)	0	0	0	1,646
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)	0	0	0	92
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)	0	0	0	2,029
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)	0	0	0	9,083
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)	0	0	0	133
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)	0	0	0	198
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)	0	0	0	1,804
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)	0	0	0	4.95
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	63.7
Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares)	0	0	0	823
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)	0	0	0	15.9
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)	0	0	0	1,228
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)	0	0	0	4,270
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)	0	0	0	199
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)	0	0	0	205

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	3,256
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)	0	0	0	7.44
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	92.3
Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares)	0	0	0	1,235
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)	0	0	0	115
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)	0	0	0	2,472
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)	0	0	0	7,582

Table 64: *REF scenario - IMPACTS - Health*

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal (million 2019$)	0	507	247	140	110	96.1	92.3
Monetary damages from air pollution - Natural Gas (million 2019$)	0	298	312	303	226	187	73.9
Monetary damages from air pollution - Transportation (million 2019$)	0	927	999	1,069	1,143	1,217	1,293
Premature deaths from air pollution - Coal (deaths)	0	56.9	27.7	15.7	12.3	10.8	10.4
Premature deaths from air pollution - Natural Gas (deaths)	0	33.6	35.3	34.3	25.5	21.1	8.35
Premature deaths from air pollution - Transportation (deaths)	0	104	112	120	129	137	145