Net-Zero America - north dakota 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	0.514	0.598	0	0	0	0
Sales of cooking units - Electric Resistance (%)	80.2	84.4	97.3	99.9	100	100	100
Sales of cooking units - Gas (%)	19.8	15.6	2.66	0.134	0	0	0
Sales of space heating units - Electric Heat Pump (%)	8.4	12.9	25.9	58.5	84	88	87.9
Sales of space heating units - Electric Resistance (%)	28.4	34.1	30.9	19.4	10.1	8.76	8.9
Sales of space heating units - Fossil (%)	13.7	18.3	14.3	8.01	3.29	2.43	2.5
Sales of space heating units - Gas (%)	49.5	34.6	28.9	14.1	2.65	0.854	0.684
Sales of water heating units - Electric Heat Pump (%)	0	0.203	3.49	14.3	21.9	23	23.1
Sales of water heating units - Electric Resistance (%)	52.4	66.9	67.7	71.6	76.1	76.8	76.8
Sales of water heating units - Gas Furnace (%)	47.6	32.8	28.8	14	2.01	0.152	0
Sales of water heating units - Other (%)	0.036	0.035	0.035	0.035	0.035	0.035	0.035

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	173	442	719	1,088	1,186	1,130
Public EV charging plugs - DC Fast (1000 units)	0.024	0	0.353	0	1.57	0	2.54
Public EV charging plugs - L2 (1000 units)	0.043	0	8.49	0	37.8	0	61.2
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 (%)	1.96	2.17	1.42	0.461	0.082	0.013	0
Vehicle sales - Light-duty - EV (%)	2.56	11.1	39.9	79.2	96	99.3	100
Vehicle sales - Light-duty - gasoline (%)	92.2	82.7	55.6	19.2	3.64	0.601	0
Vehicle sales - Light-duty - hybrid (%)	3.1	3.59	2.75	1.07	0.251	0.052	0
Vehicle sales - Light-duty - hydrogen FC (%)	0.113	0.363	0.237	0.075	0.015	0.002	0
Vehicle sales - Light-duty - other (%)	0.12	0.116	0.081	0.029	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)	25.2	24.8	24	22.9	21.6	20.3	19.5
Final energy use - Industry (PJ)	124	130	131	130	129	129	130
Final energy use - Residential (PJ)	38.3	36.3	34.5	31.9	28.4	25	22.3
Final energy use - Transportation (PJ)	104	97.6	88.2	76.6	66	59.6	57.2

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	2,165	2,361	0	0	0	0
Sales of cooking units - Electric Resistance (%)	44.8	57.1	84	89.3	89.6	89.6	89.6
Sales of cooking units - Gas (%)	55.2	42.9	16	10.7	10.4	10.4	10.4
Sales of space heating units - Electric Heat Pump (%)	6.09	4.46	15.5	53	81.8	86.3	86.7
Sales of space heating units - Electric Resistance (%)	9.99	5.81	8.04	12	12.9	12.9	12.9
Sales of space heating units - Fossil (%)	9.8	2.42	0.475	0.02	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 (%)	74.1	87.3	76	35	5.3	0.843	0.483
Sales of water heating units - Electric Heat Pump (%)	1.62	1.17	6.88	27.5	44	46.5	46.7
Sales of water heating units - Electric Resistance (%)	13.6	7.49	13.1	33.4	49.8	52.4	52.6
Sales of water heating units - Gas Furnace (%)	82.1	90.4	79.3	38.4	5.51	0.416	0
Sales of water heating units - Other (%)	2.67	0.964	0.742	0.696	0.692	0.695	0.695

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	0.777	0.801	1.5	1.61	1.57	1.66

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	0.024	0	0.007	0
Capital invested - Biomass w/ccu power plant (billion $2018)	0	0	0.081	0	0	0.013	0
Capital invested - Wind - Base (billion $2018)	0	0	0	0.287	0.603	3.22	9.02
Capital invested - Wind - Constrained (billion $2018)	0	0.092	1.88	4.94	9.39	26.8	72.8

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	23.9	23.9	30.8	30.8
Biomass w/ccu power plant (GWh)	0	0	90.7	90.7	90.7	105	105
Wind - Base land use assumptions (GWh)	19,216	0	0	808	1,778	10,268	30,035
Wind - Constrained land use assumptions (GWh)	19,216	0	2,953	13,544	23,229	78,296	215,679

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

Item	2020	2025	2030	2035	2040	2045	2050
Biomass purchases (million $2018/year)	0	0	4.97	410	529	609	1,023
Conversion capital investment - Cumulative 5-yr (million $2018)	0	0	74.4	5,477	1,614	1,086	5,582
Number of facilities - Allam power w ccu (quantity)	0	0	0	1	1	2	2
Number of facilities - Beccs hydrogen (quantity)	0	0	0	7	10	13	17
Number of facilities - Diesel (quantity)	0	0	0	0	0	0	0
Number of facilities - Diesel ccu (quantity)	0	0	0	1	2	3	3
Number of facilities - Power (quantity)	0	0	0	0	0	0	0
Number of facilities - Power ccu (quantity)	0	0	1	1	1	2	2
Number of facilities - Pyrolysis (quantity)	0	0	0	0	0	0	0
Number of facilities - Pyrolysis ccu (quantity)	0	0	0	1	2	3	3
Number of facilities - Sng (quantity)	0	0	0	0	0	0	0
Number of facilities - Sng ccu (quantity)	0	0	1	1	1	2	2

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

Item	2020	2025	2030	2035	2040	2045	2050
Annual - All (MMT)	0	0	0.09	7.12	9.17	10.5	17.7
Annual - BECCS (MMT)	0	0	0.09	7.08	9.15	10.5	17.7
Annual - Cement and lime (MMT)	0	0	0	0	0	0	0
Annual - NGCC (MMT)	0	0	0	0.03	0.03	0.02	0.01
Cumulative - All (MMT)	0	0	0.09	7.21	16.4	26.9	44.6

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

Item	2020	2025	2030	2035	2040	2045	2050
Cumulative - BECCS (MMT)	0	0	0.09	7.17	16.3	26.8	44.5
Cumulative - Cement and lime (MMT)	0	0	0	0	0	0	0
Cumulative - NGCC (MMT)	0	0	0	0.03	0.06	0.08	0.09

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

Item	2020	2025	2030	2035	2040	2045	2050
CO2 storage (MMT)	0	0	2.19	6.17	11.7	18.9	25.2
Injection wells (wells)	0	0	4	15	26	44	54
Resource characterization, appraisal, permitting costs (million $2020)	0	135	406	542	542	542	542
Wells and facilities construction costs (million $2020)	0	0	113	439	783	1,309	1,625

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

Item	2020	2025	2030	2035	2040	2045	2050
All (km)	0	0	554	2,251	2,490	3,079	4,487
Cumulative investment - All (million $2018)	0	0	416	2,905	3,053	3,385	4,468
Cumulative investment - Spur (million $2018)	0	0	217	1,178	1,327	1,659	2,742
Cumulative investment - Trunk (million $2018)	0	0	199	1,726	1,726	1,726	1,726
Spur (km)	0	0	416	1,805	2,044	2,633	4,042
Trunk (km)	0	0	138	446	446	446	446

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	-551
Carbon sink potential - Aggressive deployment - Cropland measures (1000 tCO2e/y)	0	0	-10,108
Carbon sink potential - Aggressive deployment - Permanent conservation cover (1000 tCO2e/y)	0	0	-660
Carbon sink potential - Aggressive deployment - Total (1000 tCO2e/y)	0	0	-11,319
Carbon sink potential - Moderate deployment - Corn-ethanol to energy grasses (1000 tCO2e/y)	0	0	-551
Carbon sink potential - Moderate deployment - Cropland measures (1000 tCO2e/y)	0	0	-5,330
Carbon sink potential - Moderate deployment - Permanent conservation cover (1000 tCO2e/y)	0	0	-330
Carbon sink potential - Moderate deployment - Total (1000 tCO2e/y)	0	0	-6,211
Land impacted for carbon sink - Aggressive deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	300
Land impacted for carbon sink - Aggressive deployment - Cropland measures (1000 hectares)	0	0	9,928
Land impacted for carbon sink - Aggressive deployment - Permanent conservation cover (1000 hectares)	0	0	1,092
Land impacted for carbon sink - Aggressive deployment - Total (1000 hectares)	0	0	11,320
Land impacted for carbon sink - Moderate deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	300
Land impacted for carbon sink - Moderate deployment - Cropland measures (1000 hectares)	0	0	5,237
Land impacted for carbon sink - Moderate deployment - Permanent conservation cover (1000 hectares)	0	0	546

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

Item	2020	2025	2050
Land impacted for carbon sink - Moderate deployment - Total (1000 hectares)	0	0	6,083

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

Item	2020	2025	2050
Carbon sink potential - High - Accelerate regeneration (1000 tCO2e/y)	0	0	38.5
Carbon sink potential - High - All (not counting overlap) (1000 tCO2e/y)	0	0	23,528
Carbon sink potential - High - Avoid deforestation (1000 tCO2e/y)	0	0	821
Carbon sink potential - High - Extend rotation length (1000 tCO2e/y)	0	0	414
Carbon sink potential - High - Improve plantations (1000 tCO2e/y)	0	0	20.6
Carbon sink potential - High - Increase retention of HWP (1000 tCO2e/y)	0	0	41.5
Carbon sink potential - High - Increase trees outside forests (1000 tCO2e/y)	0	0	3,342
Carbon sink potential - High - Reforest cropland (1000 tCO2e/y)	0	0	13,386
Carbon sink potential - High - Reforest pasture (1000 tCO2e/y)	0	0	5,274
Carbon sink potential - High - Restore productivity (1000 tCO2e/y)	0	0	191
Carbon sink potential - Low - Accelerate regeneration (1000 tCO2e/y)	0	0	19.3
Carbon sink potential - Low - All (not counting overlap) (1000 tCO2e/y)	0	0	8,666
Carbon sink potential - Low - Avoid deforestation (1000 tCO2e/y)	0	0	137
Carbon sink potential - Low - Extend rotation length (1000 tCO2e/y)	0	0	159
Carbon sink potential - Low - Improve plantations (1000 tCO2e/y)	0	0	10.5
Carbon sink potential - Low - Increase retention of HWP (1000 tCO2e/y)	0	0	13.8
Carbon sink potential - Low - Increase trees outside forests (1000 tCO2e/y)	0	0	1,170
Carbon sink potential - Low - Reforest cropland (1000 tCO2e/y)	0	0	6,693
Carbon sink potential - Low - Reforest pasture (1000 tCO2e/y)	0	0	400
Carbon sink potential - Low - Restore productivity (1000 tCO2e/y)	0	0	64.3
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO2e/y)	0	0	28.9
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO2e/y)	0	0	16,097
Carbon sink potential - Mid - Avoid deforestation (1000 tCO2e/y)	0	0	479
Carbon sink potential - Mid - Extend rotation length (1000 tCO2e/y)	0	0	286
Carbon sink potential - Mid - Improve plantations (1000 tCO2e/y)	0	0	15.4
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO2e/y)	0	0	27.6
Carbon sink potential - Mid - Increase trees outside forests (1000 tCO2e/y)	0	0	2,256
Carbon sink potential - Mid - Reforest cropland (1000 tCO2e/y)	0	0	10,039
Carbon sink potential - Mid - Reforest pasture (1000 tCO2e/y)	0	0	2,837

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

Item	2020	2025	2050
Carbon sink potential - Mid - Restore productivity (1000 tCO2e/y)	0	0	127
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)	0	0	6.3
Land impacted for carbon sink potential - High - Avoid deforestation (over 30 years) (1000 hectares)	0	0	111
Land impacted for carbon sink potential - High - Extend rotation length (1000 hectares)	0	0	211
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)	0	0	7.59
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	317
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)	0	0	885
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)	0	0	150
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)	0	0	63.2
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)	0	0	1,752
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)	0	0	3.15
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)	0	0	104
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)	0	0	80.8
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)	0	0	3.79
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	167
Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares)	0	0	443
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)	0	0	26
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)	0	0	38.2
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)	0	0	866
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)	0	0	4.72
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)	0	0	108
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)	0	0	146
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)	0	0	5.71
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	242
Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares)	0	0	664
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)	0	0	188
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)	0	0	77

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

Item	2020	2025	2050
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)	0	0	1,435

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

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal (million 2019$)	0	25.1	0.018	0.018	0.013	0.008	0
Monetary damages from air pollution - Natural Gas (million 2019$)	0	6.03	3.33	1.99	1.7	1.07	0.466
Monetary damages from air pollution - Transportation (million 2019$)	0	24.3	22.3	16.7	9.47	4.22	1.6
Premature deaths from air pollution - Coal (deaths)	0	2.82	0.002	0.002	0.001	0.001	0
Premature deaths from air pollution - Natural Gas (deaths)	0	0.681	0.376	0.225	0.192	0.121	0.053
Premature deaths from air pollution - Transportation (deaths)	0	2.73	2.51	1.88	1.06	0.474	0.179

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

Item	2020	2025	2030	2035	2040	2045	2050
By economic sector - Agriculture (jobs)	819	819	825	1,384	1,095	696	883
By economic sector - Construction (jobs)	8,009	8,513	7,968	9,267	7,706	8,666	11,179
By economic sector - Manufacturing (jobs)	7,533	10,549	11,439	13,536	12,081	9,891	11,265
By economic sector - Mining (jobs)	13,001	11,230	8,984	7,222	4,831	3,348	2,008
By economic sector - Other (jobs)	246	267	230	262	270	396	686
By economic sector - Pipeline (jobs)	1,375	1,477	1,486	1,775	1,313	1,210	1,181
By economic sector - Professional (jobs)	4,674	4,758	4,147	4,634	4,202	4,756	6,844
By economic sector - Trade (jobs)	9,668	8,804	7,514	6,824	5,155	4,501	4,598
By economic sector - Utilities (jobs)	3,658	3,426	2,545	4,160	3,639	5,794	9,514
By education level - All sectors - Associates degree or some college (jobs)	13,419	13,835	12,551	13,935	11,576	11,698	14,875
By education level - All sectors - Bachelors degree (jobs)	11,629	11,621	10,352	10,762	8,735	8,341	9,983
By education level - All sectors - Doctoral degree (jobs)	370	366	320	328	272	273	344
By education level - All sectors - High school diploma or less (jobs)	20,951	21,431	19,639	21,671	17,778	17,039	20,585
By education level - All sectors - Masters or professional degree (jobs)	2,614	2,590	2,276	2,366	1,932	1,907	2,371
By resource sector - Biomass (jobs)	1,980	1,923	1,882	3,450	3,008	2,575	3,902
By resource sector - CO2 (jobs)	0	72	432	3,217	1,824	3,002	5,307
By resource sector - Coal (jobs)	2,774	1,398	306	18.4	13.6	10.5	8.79
By resource sector - Grid (jobs)	4,197	3,938	2,787	4,099	4,717	8,046	13,277
By resource sector - Natural Gas (jobs)	6,791	6,390	5,139	3,906	2,818	2,150	1,561
By resource sector - Nuclear (jobs)	0	0	0	0	0	0	0
By resource sector - Oil (jobs)	29,165	28,669	26,333	24,126	17,859	13,626	8,672
By resource sector - Solar (jobs)	829	2,034	2,406	3,519	3,643	3,208	4,484
By resource sector - Wind (jobs)	3,249	5,420	5,854	6,728	6,411	6,640	10,946
Median wages - Annual - All ($2019 per job)	60,187	60,555	60,862	61,280	61,936	63,658	64,907
On-Site or In-Plant Training - Total jobs - 1 to 4 years (jobs)	7,239	7,418	6,719	7,403	6,108	6,136	7,689
On-Site or In-Plant Training - Total jobs - 4 to 10 years (jobs)	2,739	2,761	2,462	2,735	2,239	2,387	3,082
On-Site or In-Plant Training - Total jobs - None (jobs)	7,873	8,039	7,274	7,902	6,507	6,318	7,801
On-Site or In-Plant Training - Total jobs - Over 10 years (jobs)	323	339	311	356	297	311	408
On-Site or In-Plant Training - Total jobs - Up to 1 year (jobs)	30,810	31,286	28,372	30,667	25,141	24,105	29,178
On-the-Job Training - All sectors - 1 to 4 years (jobs)	9,014	9,249	8,361	9,249	7,644	7,771	9,842

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

Item	2020	2025	2030	2035	2040	2045	2050
On-the-Job Training - All sectors - 4 to 10 years (jobs)	2,446	2,470	2,197	2,489	2,051	2,247	2,972
On-the-Job Training - All sectors - None (jobs)	2,963	2,964	2,658	2,793	2,262	2,152	2,575
On-the-Job Training - All sectors - Over 10 years (jobs)	454	483	451	494	408	389	472
On-the-Job Training - All sectors - Up to 1 year (jobs)	34,107	34,677	31,471	34,038	27,928	26,698	32,297
Related work experience - All sectors - 1 to 4 years (jobs)	18,027	18,227	16,425	17,727	14,543	14,190	17,296
Related work experience - All sectors - 4 to 10 years (jobs)	11,048	11,239	10,123	10,964	9,012	8,946	11,109
Related work experience - All sectors - None (jobs)	6,949	7,088	6,441	7,073	5,797	5,666	6,961
Related work experience - All sectors - Over 10 years (jobs)	3,028	3,122	2,839	3,060	2,525	2,451	3,007
Related work experience - All sectors - Up to 1 year (jobs)	9,932	10,168	9,310	10,238	8,416	8,004	9,785
Wage income - All (million $2019)	2,948	3,018	2,747	3,007	2,496	2,499	3,126

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

Item	2020	2025	2030	2035	2040	2045	2050
Natural gas consumption - Annual (tcf)	96.6	98.1	82.7	66.3	49.9	31.4	21.8
Natural gas consumption - Cumulative (tcf)	0	0	0	0	0	0	1,997
Natural gas production - Annual (tcf)	623	690	653	568	481	381	296
Oil consumption - Annual (million bbls)	45.9	46	42.8	37.1	31.1	26.4	21.8
Oil consumption - Cumulative (million bbls)	0	0	0	0	0	0	1,120
Oil production - Annual (million bbls)	553	598	600	599	475	386	257

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	0.511	0.578	0	0	0	0
Sales of cooking units - Electric Resistance (%)	80.2	80.7	82.5	87.3	93.9	98	99.5
Sales of cooking units - Gas (%)	19.8	19.3	17.5	12.7	6.06	1.96	0.527
Sales of space heating units - Electric Heat Pump (%)	8.4	11.6	12.7	15.6	22.9	33.8	43
Sales of space heating units - Electric Resistance (%)	28.4	34.3	33.8	33	30.5	26.9	23.9
Sales of space heating units - Fossil (%)	13.7	19	18.9	18	16.1	13.6	12
Sales of space heating units - Gas (%)	49.5	35.1	34.6	33.4	30.5	25.7	21.2
Sales of water heating units - Electric Heat Pump (%)	0	0.054	0.328	1.13	3.24	6.62	9.51
Sales of water heating units - Electric Resistance (%)	52.4	66.9	67	67.1	67.8	69.2	70.5
Sales of water heating units - Gas Furnace (%)	47.6	33	32.6	31.8	29	24.2	19.9
Sales of water heating units - Other (%)	0.036	0.035	0.035	0.035	0.035	0.035	0.035

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	27.7	58.9	198	626	911
Public EV charging plugs - DC Fast (1000 units)	0.024	0	0.106	0	0.58	0	1.63
Public EV charging plugs - L2 (1000 units)	0.043	0	2.55	0	14	0	39.2
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 (%)	1.96	2.3	2.13	1.72	1.14	0.593	0.252

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

Item	2020	2025	2030	2035	2040	2045	2050
Vehicle sales - Light-duty - EV (%)	1.41	3.65	9.65	22.3	44.4	69.4	86.5
Vehicle sales - Light-duty - gasoline (%)	93.2	89.4	83.1	71.2	50.7	27.7	12.1
Vehicle sales - Light-duty - hybrid (%)	3.19	4.09	4.66	4.44	3.53	2.2	1.11
Vehicle sales - Light-duty - hydrogen FC (%)	0.114	0.392	0.35	0.276	0.203	0.115	0.053
Vehicle sales - Light-duty - other (%)	0.121	0.124	0.116	0.102	0.075	0.042	0.019
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)	25.2	24.8	24.2	23.7	23.1	22.6	22.2
Final energy use - Industry (PJ)	124	130	132	133	133	134	134
Final energy use - Residential (PJ)	38.3	36.3	34.8	33.5	32.4	31.2	29.7
Final energy use - Transportation (PJ)	104	98.2	91.1	85.7	81.6	76.8	71

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	2,165	2,363	0	0	0	0
Sales of cooking units - Electric Resistance (%)	44.8	49.3	53.1	63	76.9	85.5	88.5
Sales of cooking units - Gas (%)	55.2	50.7	46.9	37	23.1	14.5	11.5
Sales of space heating units - Electric Heat Pump (%)	6.09	3.87	4.9	7.61	14.7	26.5	37
Sales of space heating units - Electric Resistance (%)	9.99	5.53	5.63	6.05	7.05	8.18	8.82
Sales of space heating units - Fossil (%)	9.8	2.84	2.83	2.55	2.12	1.71	1.57
Sales of space heating units - Gas Furnace (%)	74.1	87.8	86.6	83.8	76.1	63.6	52.6
Sales of water heating units - Electric Heat Pump (%)	1.62	0.913	1.44	2.92	6.86	13.4	19.4
Sales of water heating units - Electric Resistance (%)	13.6	7.24	7.77	9.19	13.1	19.6	25.5
Sales of water heating units - Gas Furnace (%)	82.1	90.8	89.8	86.9	79.2	66.1	54.3
Sales of water heating units - Other (%)	2.67	1.01	0.99	0.955	0.899	0.868	0.856

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	0.635	0.643	0.813	0.84	1.28	1.36

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	-551
Carbon sink potential - Aggressive deployment - Cropland measures (1000 tCO2e/y)	0	0	-10,108
Carbon sink potential - Aggressive deployment - Permanent conservation cover (1000 tCO2e/y)	0	0	-660
Carbon sink potential - Aggressive deployment - Total (1000 tCO2e/y)	0	0	-11,319
Carbon sink potential - Moderate deployment - Corn-ethanol to energy grasses (1000 tCO2e/y)	0	0	-551
Carbon sink potential - Moderate deployment - Cropland measures (1000 tCO2e/y)	0	0	-5,330
Carbon sink potential - Moderate deployment - Permanent conservation cover (1000 tCO2e/y)	0	0	-330

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

Item	2020	2025	2050
Carbon sink potential - Moderate deployment - Total (1000 tCO2e/y)	0	0	-6,211
Land impacted for carbon sink - Aggressive deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	300
Land impacted for carbon sink - Aggressive deployment - Cropland measures (1000 hectares)	0	0	9,928
Land impacted for carbon sink - Aggressive deployment - Permanent conservation cover (1000 hectares)	0	0	1,092
Land impacted for carbon sink - Aggressive deployment - Total (1000 hectares)	0	0	11,320
Land impacted for carbon sink - Moderate deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	300
Land impacted for carbon sink - Moderate deployment - Cropland measures (1000 hectares)	0	0	5,237
Land impacted for carbon sink - Moderate deployment - Permanent conservation cover (1000 hectares)	0	0	546
Land impacted for carbon sink - Moderate deployment - Total (1000 hectares)	0	0	6,083

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

Item	2020	2025	2050
Carbon sink potential - High - Accelerate regeneration (1000 tCO2e/y)	0	0	38.5
Carbon sink potential - High - All (not counting overlap) (1000 tCO2e/y)	0	0	23,528
Carbon sink potential - High - Avoid deforestation (1000 tCO2e/y)	0	0	821
Carbon sink potential - High - Extend rotation length (1000 tCO2e/y)	0	0	414
Carbon sink potential - High - Improve plantations (1000 tCO2e/y)	0	0	20.6
Carbon sink potential - High - Increase retention of HWP (1000 tCO2e/y)	0	0	41.5
Carbon sink potential - High - Increase trees outside forests (1000 tCO2e/y)	0	0	3,342
Carbon sink potential - High - Reforest cropland (1000 tCO2e/y)	0	0	13,386
Carbon sink potential - High - Reforest pasture (1000 tCO2e/y)	0	0	5,274
Carbon sink potential - High - Restore productivity (1000 tCO2e/y)	0	0	191
Carbon sink potential - Low - Accelerate regeneration (1000 tCO2e/y)	0	0	19.3
Carbon sink potential - Low - All (not counting overlap) (1000 tCO2e/y)	0	0	8,666
Carbon sink potential - Low - Avoid deforestation (1000 tCO2e/y)	0	0	137
Carbon sink potential - Low - Extend rotation length (1000 tCO2e/y)	0	0	159
Carbon sink potential - Low - Improve plantations (1000 tCO2e/y)	0	0	10.5
Carbon sink potential - Low - Increase retention of HWP (1000 tCO2e/y)	0	0	13.8
Carbon sink potential - Low - Increase trees outside forests (1000 tCO2e/y)	0	0	1,170
Carbon sink potential - Low - Reforest cropland (1000 tCO2e/y)	0	0	6,693

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

Item	2020	2025	2050
Carbon sink potential - Low - Reforest pasture (1000 tCO2e/y)	0	0	400
Carbon sink potential - Low - Restore productivity (1000 tCO2e/y)	0	0	64.3
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO2e/y)	0	0	28.9
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO2e/y)	0	0	16,097
Carbon sink potential - Mid - Avoid deforestation (1000 tCO2e/y)	0	0	479
Carbon sink potential - Mid - Extend rotation length (1000 tCO2e/y)	0	0	286
Carbon sink potential - Mid - Improve plantations (1000 tCO2e/y)	0	0	15.4
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO2e/y)	0	0	27.6
Carbon sink potential - Mid - Increase trees outside forests (1000 tCO2e/y)	0	0	2,256
Carbon sink potential - Mid - Reforest cropland (1000 tCO2e/y)	0	0	10,039
Carbon sink potential - Mid - Reforest pasture (1000 tCO2e/y)	0	0	2,837
Carbon sink potential - Mid - Restore productivity (1000 tCO2e/y)	0	0	127
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)	0	0	6.3
Land impacted for carbon sink potential - High - Avoid deforestation (over 30 years) (1000 hectares)	0	0	111
Land impacted for carbon sink potential - High - Extend rotation length (1000 hectares)	0	0	211
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)	0	0	7.59
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	317
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)	0	0	885
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)	0	0	150
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)	0	0	63.2
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)	0	0	1,752
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)	0	0	3.15
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)	0	0	104
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)	0	0	80.8
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)	0	0	3.79
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	167
Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares)	0	0	443
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)	0	0	26

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

Item	2020	2025	2050
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)	0	0	38.2
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)	0	0	866
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)	0	0	4.72
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)	0	0	108
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)	0	0	146
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)	0	0	5.71
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	242
Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares)	0	0	664
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)	0	0	188
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)	0	0	77
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)	0	0	1,435

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

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal (million 2019$)	0	25.1	0.018	0.018	0.013	0.008	0
Monetary damages from air pollution - Natural Gas (million 2019$)	0	6.06	2.98	1.58	0.901	0.439	0.301
Monetary damages from air pollution - Transportation (million 2019$)	0	24.6	24.4	23.4	20.8	16.4	11.1
Premature deaths from air pollution - Coal (deaths)	0	2.82	0.002	0.002	0.001	0.001	0
Premature deaths from air pollution - Natural Gas (deaths)	0	0.684	0.337	0.178	0.102	0.05	0.034
Premature deaths from air pollution - Transportation (deaths)	0	2.77	2.75	2.63	2.34	1.84	1.25

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	0.514	0.598	0	0	0	0
Sales of cooking units - Electric Resistance (%)	80.2	84.4	97.3	99.9	100	100	100
Sales of cooking units - Gas (%)	19.8	15.6	2.66	0.134	0	0	0
Sales of space heating units - Electric Heat Pump (%)	8.4	12.9	25.9	58.5	84	88	87.9
Sales of space heating units - Electric Resistance (%)	28.4	34.1	30.9	19.4	10.1	8.76	8.9
Sales of space heating units - Fossil (%)	13.7	18.3	14.3	8.01	3.29	2.43	2.5
Sales of space heating units - Gas (%)	49.5	34.6	28.9	14.1	2.65	0.854	0.684
Sales of water heating units - Electric Heat Pump (%)	0	0.203	3.49	14.3	21.9	23	23.1
Sales of water heating units - Electric Resistance (%)	52.4	66.9	67.7	71.6	76.1	76.8	76.8
Sales of water heating units - Gas Furnace (%)	47.6	32.8	28.8	14	2.01	0.152	0
Sales of water heating units - Other (%)	0.036	0.035	0.035	0.035	0.035	0.035	0.035

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	173	442	719	1,088	1,186	1,130
Public EV charging plugs - DC Fast (1000 units)	0.024	0	0.353	0	1.57	0	2.54
Public EV charging plugs - L2 (1000 units)	0.043	0	8.49	0	37.8	0	61.2
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 (%)	1.96	2.17	1.42	0.461	0.082	0.013	0
Vehicle sales - Light-duty - EV (%)	2.56	11.1	39.9	79.2	96	99.3	100
Vehicle sales - Light-duty - gasoline (%)	92.2	82.7	55.6	19.2	3.64	0.601	0
Vehicle sales - Light-duty - hybrid (%)	3.1	3.59	2.75	1.07	0.251	0.052	0
Vehicle sales - Light-duty - hydrogen FC (%)	0.113	0.363	0.237	0.075	0.015	0.002	0
Vehicle sales - Light-duty - other (%)	0.12	0.116	0.081	0.029	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)	25.2	24.8	24	22.9	21.6	20.3	19.5
Final energy use - Industry (PJ)	124	130	131	130	129	129	130
Final energy use - Residential (PJ)	38.3	36.3	34.5	31.9	28.4	25	22.3
Final energy use - Transportation (PJ)	104	97.6	88.2	76.6	66	59.6	57.2

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	2,165	2,361	0	0	0	0
Sales of cooking units - Electric Resistance (%)	44.8	57.1	84	89.3	89.6	89.6	89.6
Sales of cooking units - Gas (%)	55.2	42.9	16	10.7	10.4	10.4	10.4
Sales of space heating units - Electric Heat Pump (%)	6.09	4.46	15.5	53	81.8	86.3	86.7
Sales of space heating units - Electric Resistance (%)	9.99	5.81	8.04	12	12.9	12.9	12.9
Sales of space heating units - Fossil (%)	9.8	2.42	0.475	0.02	0	0	0
Sales of space heating units - Gas Furnace (%)	74.1	87.3	76	35	5.3	0.843	0.483
Sales of water heating units - Electric Heat Pump (%)	1.62	1.17	6.88	27.5	44	46.5	46.7
Sales of water heating units - Electric Resistance (%)	13.6	7.49	13.1	33.4	49.8	52.4	52.6
Sales of water heating units - Gas Furnace (%)	82.1	90.4	79.3	38.4	5.51	0.416	0
Sales of water heating units - Other (%)	2.67	0.964	0.742	0.696	0.692	0.695	0.695

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	0.777	0.801	1.5	1.61	1.57	1.66

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

Item	2020	2025	2030	2035	2040	2045	2050
Capital invested - Wind - Base (billion $2018)	0	0	0	0.709	3.37	14.5	34.2

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

Item	2020	2025	2030	2035	2040	2045	2050
Wind - Base land use assumptions (GWh)	19,216	0	0	1,979	10,111	45,398	109,133
Wind - Constrained land use assumptions (GWh)	19,216	0	5,101	17,283	87,977	331,379	126,597

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	-551
Carbon sink potential - Aggressive deployment - Cropland measures (1000 tCO2e/y)	0	0	-10,108
Carbon sink potential - Aggressive deployment - Permanent conservation cover (1000 tCO2e/y)	0	0	-660
Carbon sink potential - Aggressive deployment - Total (1000 tCO2e/y)	0	0	-11,319
Carbon sink potential - Moderate deployment - Corn-ethanol to energy grasses (1000 tCO2e/y)	0	0	-551
Carbon sink potential - Moderate deployment - Cropland measures (1000 tCO2e/y)	0	0	-5,330
Carbon sink potential - Moderate deployment - Permanent conservation cover (1000 tCO2e/y)	0	0	-330
Carbon sink potential - Moderate deployment - Total (1000 tCO2e/y)	0	0	-6,211
Land impacted for carbon sink - Aggressive deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	300
Land impacted for carbon sink - Aggressive deployment - Cropland measures (1000 hectares)	0	0	9,928
Land impacted for carbon sink - Aggressive deployment - Permanent conservation cover (1000 hectares)	0	0	1,092
Land impacted for carbon sink - Aggressive deployment - Total (1000 hectares)	0	0	11,320
Land impacted for carbon sink - Moderate deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	300
Land impacted for carbon sink - Moderate deployment - Cropland measures (1000 hectares)	0	0	5,237
Land impacted for carbon sink - Moderate deployment - Permanent conservation cover (1000 hectares)	0	0	546
Land impacted for carbon sink - Moderate deployment - Total (1000 hectares)	0	0	6,083

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	38.5
Carbon sink potential - High - All (not counting overlap) (1000 tCO2e/y)	0	0	23,528
Carbon sink potential - High - Avoid deforestation (1000 tCO2e/y)	0	0	821
Carbon sink potential - High - Extend rotation length (1000 tCO2e/y)	0	0	414
Carbon sink potential - High - Improve plantations (1000 tCO2e/y)	0	0	20.6
Carbon sink potential - High - Increase retention of HWP (1000 tCO2e/y)	0	0	41.5
Carbon sink potential - High - Increase trees outside forests (1000 tCO2e/y)	0	0	3,342
Carbon sink potential - High - Reforest cropland (1000 tCO2e/y)	0	0	13,386

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

Item	2020	2025	2050
Carbon sink potential - High - Reforest pasture (1000 tCO2e/y)	0	0	5,274
Carbon sink potential - High - Restore productivity (1000 tCO2e/y)	0	0	191
Carbon sink potential - Low - Accelerate regeneration (1000 tCO2e/y)	0	0	19.3
Carbon sink potential - Low - All (not counting overlap) (1000 tCO2e/y)	0	0	8,666
Carbon sink potential - Low - Avoid deforestation (1000 tCO2e/y)	0	0	137
Carbon sink potential - Low - Extend rotation length (1000 tCO2e/y)	0	0	159
Carbon sink potential - Low - Improve plantations (1000 tCO2e/y)	0	0	10.5
Carbon sink potential - Low - Increase retention of HWP (1000 tCO2e/y)	0	0	13.8
Carbon sink potential - Low - Increase trees outside forests (1000 tCO2e/y)	0	0	1,170
Carbon sink potential - Low - Reforest cropland (1000 tCO2e/y)	0	0	6,693
Carbon sink potential - Low - Reforest pasture (1000 tCO2e/y)	0	0	400
Carbon sink potential - Low - Restore productivity (1000 tCO2e/y)	0	0	64.3
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO2e/y)	0	0	28.9
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO2e/y)	0	0	16,097
Carbon sink potential - Mid - Avoid deforestation (1000 tCO2e/y)	0	0	479
Carbon sink potential - Mid - Extend rotation length (1000 tCO2e/y)	0	0	286
Carbon sink potential - Mid - Improve plantations (1000 tCO2e/y)	0	0	15.4
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO2e/y)	0	0	27.6
Carbon sink potential - Mid - Increase trees outside forests (1000 tCO2e/y)	0	0	2,256
Carbon sink potential - Mid - Reforest cropland (1000 tCO2e/y)	0	0	10,039
Carbon sink potential - Mid - Reforest pasture (1000 tCO2e/y)	0	0	2,837
Carbon sink potential - Mid - Restore productivity (1000 tCO2e/y)	0	0	127
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)	0	0	6.3
Land impacted for carbon sink potential - High - Avoid deforestation (over 30 years) (1000 hectares)	0	0	111
Land impacted for carbon sink potential - High - Extend rotation length (1000 hectares)	0	0	211
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)	0	0	7.59
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	317
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)	0	0	885
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)	0	0	150
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)	0	0	63.2

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

Item	2020	2025	2050
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)	0	0	1,752
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)	0	0	3.15
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)	0	0	104
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)	0	0	80.8
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)	0	0	3.79
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	167
Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares)	0	0	443
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)	0	0	26
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)	0	0	38.2
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)	0	0	866
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)	0	0	4.72
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)	0	0	108
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)	0	0	146
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)	0	0	5.71
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	242
Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares)	0	0	664
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)	0	0	188
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)	0	0	77
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)	0	0	1,435

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

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal (million 2019$)	0	25.1	0.018	0.018	0.013	0.008	0
Monetary damages from air pollution - Natural Gas (million 2019$)	0	5.51	2.94	1.21	0.905	0.477	0.264
Monetary damages from air pollution - Transportation (million 2019$)	0	24.3	22.3	16.7	9.47	4.22	1.6
Premature deaths from air pollution - Coal (deaths)	0	2.82	0.002	0.002	0.001	0.001	0
Premature deaths from air pollution - Natural Gas (deaths)	0	0.623	0.332	0.136	0.102	0.054	0.03
Premature deaths from air pollution - Transportation (deaths)	0	2.73	2.51	1.88	1.06	0.474	0.179

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	0.514	0.598	0	0	0	0
Sales of cooking units - Electric Resistance (%)	80.2	84.4	97.3	99.9	100	100	100
Sales of cooking units - Gas (%)	19.8	15.6	2.66	0.134	0	0	0
Sales of space heating units - Electric Heat Pump (%)	8.4	12.9	25.9	58.5	84	88	87.9
Sales of space heating units - Electric Resistance (%)	28.4	34.1	30.9	19.4	10.1	8.76	8.9
Sales of space heating units - Fossil (%)	13.7	18.3	14.3	8.01	3.29	2.43	2.5
Sales of space heating units - Gas (%)	49.5	34.6	28.9	14.1	2.65	0.854	0.684
Sales of water heating units - Electric Heat Pump (%)	0	0.203	3.49	14.3	21.9	23	23.1
Sales of water heating units - Electric Resistance (%)	52.4	66.9	67.7	71.6	76.1	76.8	76.8
Sales of water heating units - Gas Furnace (%)	47.6	32.8	28.8	14	2.01	0.152	0
Sales of water heating units - Other (%)	0.036	0.035	0.035	0.035	0.035	0.035	0.035

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	173	442	719	1,088	1,186	1,130
Public EV charging plugs - DC Fast (1000 units)	0.024	0	0.353	0	1.57	0	2.54
Public EV charging plugs - L2 (1000 units)	0.043	0	8.49	0	37.8	0	61.2
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 (%)	1.96	2.17	1.42	0.461	0.082	0.013	0
Vehicle sales - Light-duty - EV (%)	2.56	11.1	39.9	79.2	96	99.3	100
Vehicle sales - Light-duty - gasoline (%)	92.2	82.7	55.6	19.2	3.64	0.601	0
Vehicle sales - Light-duty - hybrid (%)	3.1	3.59	2.75	1.07	0.251	0.052	0
Vehicle sales - Light-duty - hydrogen FC (%)	0.113	0.363	0.237	0.075	0.015	0.002	0
Vehicle sales - Light-duty - other (%)	0.12	0.116	0.081	0.029	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)	25.2	24.8	24	22.9	21.6	20.3	19.5
Final energy use - Industry (PJ)	124	130	131	130	129	129	130
Final energy use - Residential (PJ)	38.3	36.3	34.5	31.9	28.4	25	22.3
Final energy use - Transportation (PJ)	104	97.6	88.2	76.6	66	59.6	57.2

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	2,165	2,361	0	0	0	0
Sales of cooking units - Electric Resistance (%)	44.8	57.1	84	89.3	89.6	89.6	89.6
Sales of cooking units - Gas (%)	55.2	42.9	16	10.7	10.4	10.4	10.4
Sales of space heating units - Electric Heat Pump (%)	6.09	4.46	15.5	53	81.8	86.3	86.7
Sales of space heating units - Electric Resistance (%)	9.99	5.81	8.04	12	12.9	12.9	12.9
Sales of space heating units - Fossil (%)	9.8	2.42	0.475	0.02	0	0	0

Table 38: *E+RE- scenario - PILLAR 1: Efficiency/Electrification - Commercial (continued)*

Item	2020	2025	2030	2035	2040	2045	2050
Sales of space heating units - Gas Furnace (%)	74.1	87.3	76	35	5.3	0.843	0.483
Sales of water heating units - Electric Heat Pump (%)	1.62	1.17	6.88	27.5	44	46.5	46.7
Sales of water heating units - Electric Resistance (%)	13.6	7.49	13.1	33.4	49.8	52.4	52.6
Sales of water heating units - Gas Furnace (%)	82.1	90.4	79.3	38.4	5.51	0.416	0
Sales of water heating units - Other (%)	2.67	0.964	0.742	0.696	0.692	0.695	0.695

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	0.777	0.801	1.5	1.61	1.57	1.66

Table 40: *E+RE- scenario - PILLAR 2: Clean Electricity - Generating capacity*

Item	2020	2025	2030	2035	2040	2045	2050
Capital invested - Wind - Base (billion $2018)	0	0	0	0	0.232	0.325	0
Capital invested - Wind - Constrained (billion $2018)	0	0	0.248	1.04	2.61	3.33	0.033

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

Item	2020	2025	2030	2035	2040	2045	2050
Wind - Base land use assumptions (GWh)	19,216	0	0	0	679	1,013	0
Wind - Constrained land use assumptions (GWh)	19,216	0	659	2,950	7,822	10,362	106

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	-551
Carbon sink potential - Aggressive deployment - Cropland measures (1000 tCO2e/y)	0	0	-10,108
Carbon sink potential - Aggressive deployment - Permanent conservation cover (1000 tCO2e/y)	0	0	-660
Carbon sink potential - Aggressive deployment - Total (1000 tCO2e/y)	0	0	-11,319
Carbon sink potential - Moderate deployment - Corn-ethanol to energy grasses (1000 tCO2e/y)	0	0	-551
Carbon sink potential - Moderate deployment - Cropland measures (1000 tCO2e/y)	0	0	-5,330
Carbon sink potential - Moderate deployment - Permanent conservation cover (1000 tCO2e/y)	0	0	-330
Carbon sink potential - Moderate deployment - Total (1000 tCO2e/y)	0	0	-6,211
Land impacted for carbon sink - Aggressive deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	300
Land impacted for carbon sink - Aggressive deployment - Cropland measures (1000 hectares)	0	0	9,928
Land impacted for carbon sink - Aggressive deployment - Permanent conservation cover (1000 hectares)	0	0	1,092
Land impacted for carbon sink - Aggressive deployment - Total (1000 hectares)	0	0	11,320
Land impacted for carbon sink - Moderate deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	300
Land impacted for carbon sink - Moderate deployment - Cropland measures (1000 hectares)	0	0	5,237

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

Item	2020	2025	2050
Land impacted for carbon sink - Moderate deployment - Permanent conservation cover (1000 hectares)	0	0	546
Land impacted for carbon sink - Moderate deployment - Total (1000 hectares)	0	0	6,083

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	38.5
Carbon sink potential - High - All (not counting overlap) (1000 tCO2e/y)	0	0	23,528
Carbon sink potential - High - Avoid deforestation (1000 tCO2e/y)	0	0	821
Carbon sink potential - High - Extend rotation length (1000 tCO2e/y)	0	0	414
Carbon sink potential - High - Improve plantations (1000 tCO2e/y)	0	0	20.6
Carbon sink potential - High - Increase retention of HWP (1000 tCO2e/y)	0	0	41.5
Carbon sink potential - High - Increase trees outside forests (1000 tCO2e/y)	0	0	3,342
Carbon sink potential - High - Reforest cropland (1000 tCO2e/y)	0	0	13,386
Carbon sink potential - High - Reforest pasture (1000 tCO2e/y)	0	0	5,274
Carbon sink potential - High - Restore productivity (1000 tCO2e/y)	0	0	191
Carbon sink potential - Low - Accelerate regeneration (1000 tCO2e/y)	0	0	19.3
Carbon sink potential - Low - All (not counting overlap) (1000 tCO2e/y)	0	0	8,666
Carbon sink potential - Low - Avoid deforestation (1000 tCO2e/y)	0	0	137
Carbon sink potential - Low - Extend rotation length (1000 tCO2e/y)	0	0	159
Carbon sink potential - Low - Improve plantations (1000 tCO2e/y)	0	0	10.5
Carbon sink potential - Low - Increase retention of HWP (1000 tCO2e/y)	0	0	13.8
Carbon sink potential - Low - Increase trees outside forests (1000 tCO2e/y)	0	0	1,170
Carbon sink potential - Low - Reforest cropland (1000 tCO2e/y)	0	0	6,693
Carbon sink potential - Low - Reforest pasture (1000 tCO2e/y)	0	0	400
Carbon sink potential - Low - Restore productivity (1000 tCO2e/y)	0	0	64.3
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO2e/y)	0	0	28.9
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO2e/y)	0	0	16,097
Carbon sink potential - Mid - Avoid deforestation (1000 tCO2e/y)	0	0	479
Carbon sink potential - Mid - Extend rotation length (1000 tCO2e/y)	0	0	286
Carbon sink potential - Mid - Improve plantations (1000 tCO2e/y)	0	0	15.4
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO2e/y)	0	0	27.6
Carbon sink potential - Mid - Increase trees outside forests (1000 tCO2e/y)	0	0	2,256

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

Item	2020	2025	2050
Carbon sink potential - Mid - Reforest cropland (1000 tCO2e/y)	0	0	10,039
Carbon sink potential - Mid - Reforest pasture (1000 tCO2e/y)	0	0	2,837
Carbon sink potential - Mid - Restore productivity (1000 tCO2e/y)	0	0	127
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)	0	0	6.3
Land impacted for carbon sink potential - High - Avoid deforestation (over 30 years) (1000 hectares)	0	0	111
Land impacted for carbon sink potential - High - Extend rotation length (1000 hectares)	0	0	211
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)	0	0	7.59
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	317
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)	0	0	885
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)	0	0	150
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)	0	0	63.2
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)	0	0	1,752
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)	0	0	3.15
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)	0	0	104
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)	0	0	80.8
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)	0	0	3.79
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	167
Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares)	0	0	443
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)	0	0	26
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)	0	0	38.2
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)	0	0	866
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)	0	0	4.72
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)	0	0	108
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)	0	0	146
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)	0	0	5.71
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	242
Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares)	0	0	664

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

Item	2020	2025	2050
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)	0	0	188
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)	0	0	77
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)	0	0	1,435

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

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal (million 2019$)	0	25.1	0.018	0.018	0.013	0.008	0
Monetary damages from air pollution - Natural Gas (million 2019$)	0	6.1	3.38	3.33	3.08	1.42	0.481
Monetary damages from air pollution - Transportation (million 2019$)	0	24.3	22.3	16.7	9.47	4.22	1.6
Premature deaths from air pollution - Coal (deaths)	0	2.82	0.002	0.002	0.001	0.001	0
Premature deaths from air pollution - Natural Gas (deaths)	0	0.689	0.381	0.376	0.348	0.16	0.054
Premature deaths from air pollution - Transportation (deaths)	0	2.73	2.51	1.88	1.06	0.474	0.179

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	0.511	0.578	0	0	0	0
Sales of cooking units - Electric Resistance (%)	80.2	80.7	82.5	87.3	93.9	98	99.5
Sales of cooking units - Gas (%)	19.8	19.3	17.5	12.7	6.06	1.96	0.527
Sales of space heating units - Electric Heat Pump (%)	8.4	11.6	12.7	15.6	22.9	33.8	43
Sales of space heating units - Electric Resistance (%)	28.4	34.3	33.8	33	30.5	26.9	23.9
Sales of space heating units - Fossil (%)	13.7	19	18.9	18	16.1	13.6	12
Sales of space heating units - Gas (%)	49.5	35.1	34.6	33.4	30.5	25.7	21.2
Sales of water heating units - Electric Heat Pump (%)	0	0.054	0.328	1.13	3.24	6.62	9.51
Sales of water heating units - Electric Resistance (%)	52.4	66.9	67	67.1	67.8	69.2	70.5
Sales of water heating units - Gas Furnace (%)	47.6	33	32.6	31.8	29	24.2	19.9
Sales of water heating units - Other (%)	0.036	0.035	0.035	0.035	0.035	0.035	0.035

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	27.7	58.9	198	626	911
Public EV charging plugs - DC Fast (1000 units)	0.024	0	0.106	0	0.58	0	1.63
Public EV charging plugs - L2 (1000 units)	0.043	0	2.55	0	14	0	39.2
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 (%)	1.96	2.3	2.13	1.72	1.14	0.593	0.252
Vehicle sales - Light-duty - EV (%)	1.41	3.65	9.65	22.3	44.4	69.4	86.5
Vehicle sales - Light-duty - gasoline (%)	93.2	89.4	83.1	71.2	50.7	27.7	12.1
Vehicle sales - Light-duty - hybrid (%)	3.19	4.09	4.66	4.44	3.53	2.2	1.11
Vehicle sales - Light-duty - hydrogen FC (%)	0.114	0.392	0.35	0.276	0.203	0.115	0.053
Vehicle sales - Light-duty - other (%)	0.121	0.124	0.116	0.102	0.075	0.042	0.019
Vehicle sales - Medium-duty - diesel (%)	64.8	62.2	57.7	49.4	35.6	19.6	8.37

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

Item	2020	2025	2030	2035	2040	2045	2050
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)	25.2	24.8	24.2	23.7	23.1	22.6	22.2
Final energy use - Industry (PJ)	124	130	132	133	133	134	134
Final energy use - Residential (PJ)	38.3	36.3	34.8	33.5	32.4	31.2	29.7
Final energy use - Transportation (PJ)	104	98.2	91.1	85.7	81.6	76.8	71

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	2,165	2,363	0	0	0	0
Sales of cooking units - Electric Resistance (%)	44.8	49.3	53.1	63	76.9	85.5	88.5
Sales of cooking units - Gas (%)	55.2	50.7	46.9	37	23.1	14.5	11.5
Sales of space heating units - Electric Heat Pump (%)	6.09	3.87	4.9	7.61	14.7	26.5	37
Sales of space heating units - Electric Resistance (%)	9.99	5.53	5.63	6.05	7.05	8.18	8.82
Sales of space heating units - Fossil (%)	9.8	2.84	2.83	2.55	2.12	1.71	1.57
Sales of space heating units - Gas Furnace (%)	74.1	87.8	86.6	83.8	76.1	63.6	52.6
Sales of water heating units - Electric Heat Pump (%)	1.62	0.913	1.44	2.92	6.86	13.4	19.4
Sales of water heating units - Electric Resistance (%)	13.6	7.24	7.77	9.19	13.1	19.6	25.5
Sales of water heating units - Gas Furnace (%)	82.1	90.8	89.8	86.9	79.2	66.1	54.3
Sales of water heating units - Other (%)	2.67	1.01	0.99	0.955	0.899	0.868	0.856

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	0.635	0.643	0.813	0.84	1.28	1.36

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	0.025	0	0	0
Capital invested - Biomass w/ccu power plant (billion $2018)	0	0	0.093	0	0	0	0

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

Item	2020	2025	2030	2035	2040	2045	2050
Biomass power plant (GWh)	0	0	0	0	0	0	0
Biomass w/ccu allam power plant (GWh)	0	0	0	25.4	25.4	25.4	25.4
Biomass w/ccu power plant (GWh)	0	0	104	104	104	104	104

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	7.15	1,263	1,720	2,728	2,728

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

Item	2020	2025	2030	2035	2040	2045	2050
Conversion capital investment - Cumulative 5-yr (million $2018)	0	0	85.5	14,002	5,075	11,208	0
Number of facilities - Allam power w ccu (quantity)	0	0	0	1	1	1	1
Number of facilities - Beccs hydrogen (quantity)	0	0	0	15	19	32	32
Number of facilities - Diesel (quantity)	0	0	0	0	0	0	0
Number of facilities - Diesel ccu (quantity)	0	0	0	1	1	1	1
Number of facilities - Power (quantity)	0	0	0	0	0	0	0
Number of facilities - Power ccu (quantity)	0	0	1	1	1	1	1
Number of facilities - Pyrolysis (quantity)	0	0	0	0	0	0	0
Number of facilities - Pyrolysis ccu (quantity)	0	0	0	1	1	1	1
Number of facilities - Sng (quantity)	0	0	0	0	0	0	0
Number of facilities - Sng ccu (quantity)	0	0	1	1	1	1	1

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

Item	2020	2025	2030	2035	2040	2045	2050
Annual - All (MMT)	0	0	0.11	18.1	24.6	39	39
Annual - BECCS (MMT)	0	0	0.11	18	24.6	39	39
Annual - Cement and lime (MMT)	0	0	0	0	0	0	0
Annual - NGCC (MMT)	0	0	0	0.02	0.02	0.01	0.01
Cumulative - All (MMT)	0	0	0.11	18.2	42.8	81.8	121
Cumulative - BECCS (MMT)	0	0	0.11	18.1	42.7	81.7	121
Cumulative - Cement and lime (MMT)	0	0	0	0	0	0	0
Cumulative - NGCC (MMT)	0	0	0	0.02	0.04	0.05	0.06

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

Item	2020	2025	2030	2035	2040	2045	2050
CO2 storage (MMT)	0	0	4.62	20.3	40.4	56.1	58.5
Injection wells (wells)	0	0	10	38	68	113	141
Resource characterization, appraisal, permitting costs (million $2020)	0	135	623	975	975	975	975
Wells and facilities construction costs (million $2020)	0	0	293	1,142	2,035	3,403	4,225

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

Item	2020	2025	2030	2035	2040	2045	2050
All (km)	0	0	455	2,328	2,992	3,878	3,913
Cumulative investment - All (million $2018)	0	0	366	3,445	3,929	5,013	5,032
Cumulative investment - Spur (million $2018)	0	0	166	1,623	2,107	3,191	3,210
Cumulative investment - Trunk (million $2018)	0	0	199	1,822	1,822	1,822	1,822
Spur (km)	0	0	317	1,882	2,546	3,432	3,467
Trunk (km)	0	0	138	446	446	446	446

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	-1,265
Carbon sink potential - Aggressive deployment - Cropland measures (1000 tCO2e/y)	0	0	-9,446
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	-619
Carbon sink potential - Aggressive deployment - Total (1000 tCO2e/y)	0	0	-11,329
Carbon sink potential - Moderate deployment - Corn-ethanol to energy grasses (1000 tCO2e/y)	0	0	-1,265

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

Item	2020	2025	2050
Carbon sink potential - Moderate deployment - Cropland measures (1000 tCO2e/y)	0	0	-4,981
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	-309
Carbon sink potential - Moderate deployment - Total (1000 tCO2e/y)	0	0	-6,555
Land impacted for carbon sink - Aggressive deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	925
Land impacted for carbon sink - Aggressive deployment - Cropland measures (1000 hectares)	0	0	22,983
Land impacted for carbon sink - Aggressive deployment - Cropland to woody energy crops (1000 hectares)	0	0	63.5
Land impacted for carbon sink - Aggressive deployment - Pasture to energy crops (1000 hectares)	0	0	0
Land impacted for carbon sink - Aggressive deployment - Permanent conservation cover (1000 hectares)	0	0	1,024
Land impacted for carbon sink - Aggressive deployment - Total (1000 hectares)	0	0	24,995
Land impacted for carbon sink - Moderate deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	925
Land impacted for carbon sink - Moderate deployment - Cropland measures (1000 hectares)	0	0	4,910
Land impacted for carbon sink - Moderate deployment - Cropland to woody energy crops (1000 hectares)	0	0	63.5
Land impacted for carbon sink - Moderate deployment - Pasture to energy crops (1000 hectares)	0	0	0
Land impacted for carbon sink - Moderate deployment - Permanent conservation cover (1000 hectares)	0	0	512
Land impacted for carbon sink - Moderate deployment - Total (1000 hectares)	0	0	6,411

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	38.5
Carbon sink potential - High - All (not counting overlap) (1000 tCO2e/y)	0	0	23,528
Carbon sink potential - High - Avoid deforestation (1000 tCO2e/y)	0	0	821
Carbon sink potential - High - Extend rotation length (1000 tCO2e/y)	0	0	414
Carbon sink potential - High - Improve plantations (1000 tCO2e/y)	0	0	20.6
Carbon sink potential - High - Increase retention of HWP (1000 tCO2e/y)	0	0	41.5
Carbon sink potential - High - Increase trees outside forests (1000 tCO2e/y)	0	0	3,342
Carbon sink potential - High - Reforest cropland (1000 tCO2e/y)	0	0	13,386

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

Item	2020	2025	2050
Carbon sink potential - High - Reforest pasture (1000 tCO2e/y)	0	0	5,274
Carbon sink potential - High - Restore productivity (1000 tCO2e/y)	0	0	191
Carbon sink potential - Low - Accelerate regeneration (1000 tCO2e/y)	0	0	19.3
Carbon sink potential - Low - All (not counting overlap) (1000 tCO2e/y)	0	0	8,666
Carbon sink potential - Low - Avoid deforestation (1000 tCO2e/y)	0	0	137
Carbon sink potential - Low - Extend rotation length (1000 tCO2e/y)	0	0	159
Carbon sink potential - Low - Improve plantations (1000 tCO2e/y)	0	0	10.5
Carbon sink potential - Low - Increase retention of HWP (1000 tCO2e/y)	0	0	13.8
Carbon sink potential - Low - Increase trees outside forests (1000 tCO2e/y)	0	0	1,170
Carbon sink potential - Low - Reforest cropland (1000 tCO2e/y)	0	0	6,693
Carbon sink potential - Low - Reforest pasture (1000 tCO2e/y)	0	0	400
Carbon sink potential - Low - Restore productivity (1000 tCO2e/y)	0	0	64.3
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO2e/y)	0	0	28.9
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO2e/y)	0	0	16,097
Carbon sink potential - Mid - Avoid deforestation (1000 tCO2e/y)	0	0	479
Carbon sink potential - Mid - Extend rotation length (1000 tCO2e/y)	0	0	286
Carbon sink potential - Mid - Improve plantations (1000 tCO2e/y)	0	0	15.4
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO2e/y)	0	0	27.6
Carbon sink potential - Mid - Increase trees outside forests (1000 tCO2e/y)	0	0	2,256
Carbon sink potential - Mid - Reforest cropland (1000 tCO2e/y)	0	0	10,039
Carbon sink potential - Mid - Reforest pasture (1000 tCO2e/y)	0	0	2,837
Carbon sink potential - Mid - Restore productivity (1000 tCO2e/y)	0	0	127
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)	0	0	6.3
Land impacted for carbon sink potential - High - Avoid deforestation (over 30 years) (1000 hectares)	0	0	111
Land impacted for carbon sink potential - High - Extend rotation length (1000 hectares)	0	0	211
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)	0	0	7.59
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	317
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)	0	0	885
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)	0	0	150
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)	0	0	63.2

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

Item	2020	2025	2050
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)	0	0	1,752
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)	0	0	3.15
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)	0	0	104
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)	0	0	80.8
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)	0	0	3.79
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	167
Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares)	0	0	443
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)	0	0	26
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)	0	0	38.2
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)	0	0	866
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)	0	0	4.72
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)	0	0	108
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)	0	0	146
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)	0	0	5.71
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	242
Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares)	0	0	664
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)	0	0	188
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)	0	0	77
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)	0	0	1,435

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	0.501	0.505	0	0	0	0
Sales of cooking units - Electric Resistance (%)	80	80	80	80	80	80	80
Sales of cooking units - Gas (%)	20	20	20	20	20	20	20
Sales of space heating units - Electric Heat Pump (%)	8.16	12.8	12.9	13.2	13.6	14.2	14.8
Sales of space heating units - Electric Resistance (%)	28.5	33.8	33.6	33.4	32.8	32.4	31.9
Sales of space heating units - Fossil (%)	13.8	18.3	17.1	16.2	15.9	15.6	15.8
Sales of space heating units - Gas (%)	49.6	35.1	36.3	37.2	37.7	37.8	37.6
Sales of water heating units - Electric Heat Pump (%)	0	0	0	0	0	0	0
Sales of water heating units - Electric Resistance (%)	52.4	66.9	66.9	66.7	66.7	66.6	66.5
Sales of water heating units - Gas Furnace (%)	47.6	33.1	33.1	33.3	33.3	33.4	33.4
Sales of water heating units - Other (%)	0.036	0.035	0.035	0.035	0.035	0.035	0.035

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 (%)	1.96	2.31	2.26	2.09	1.9	1.78	1.69
Vehicle sales - Light-duty - EV (%)	2.22	3.88	4.45	5.36	6.61	7.88	8.97
Vehicle sales - Light-duty - gasoline (%)	92.5	89.3	87.8	86.5	84.8	82.9	81.2
Vehicle sales - Light-duty - hybrid (%)	3.11	4.04	4.96	5.55	6.2	6.95	7.69
Vehicle sales - Light-duty - hydrogen FC (%)	0.113	0.391	0.37	0.335	0.337	0.341	0.353
Vehicle sales - Light-duty - other (%)	0.12	0.124	0.122	0.123	0.124	0.123	0.127
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)	25.2	25.4	25.5	25.4	25.2	25.4	26
Final energy use - Industry (PJ)	124	133	138	143	148	154	160
Final energy use - Residential (PJ)	38.3	36.6	35.5	34.8	34.5	34.4	34.4
Final energy use - Transportation (PJ)	104	98.2	91.8	88.1	88.4	90.8	94

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	2,141	2,215	0	0	0	0
Sales of cooking units - Electric Resistance (%)	44.8	47.8	47.9	47.8	47.9	47.9	48
Sales of cooking units - Gas (%)	55.2	52.2	52.1	52.2	52.1	52.1	52
Sales of space heating units - Electric Heat Pump (%)	6.09	9.24	32.5	59.3	67.6	69.1	69.4
Sales of space heating units - Electric Resistance (%)	9.99	6.97	13.8	23.6	29.3	30.1	30.1
Sales of space heating units - Fossil (%)	9.8	2.76	2.28	1.06	0.17	0.016	0
Sales of space heating units - Gas Furnace (%)	74.1	81	51.4	16	2.93	0.762	0.485
Sales of water heating units - Electric Heat Pump (%)	1.62	0.827	0.827	0.829	0.828	0.824	0.82
Sales of water heating units - Electric Resistance (%)	13.6	7.16	7.17	7.13	7.14	7.14	7.13
Sales of water heating units - Gas Furnace (%)	82.1	91	91	91	91	91	91
Sales of water heating units - Other (%)	2.67	1.01	1.01	1.01	1	1.01	1.01

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	0.725	0.744	0.892	0.926	0.943	0.974

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

Item	2020	2025	2030	2050
Business-as-usual carbon sink - Natural uptake (Mt CO2e/y)	-1.19	0	0.158	0.045
Business-as-usual carbon sink - Retained in Hardwood Products (Mt CO2e/y)	-0.011	0	-0.023	-0.025
Business-as-usual carbon sink - Total (Mt CO2e/y)	-1.2	0	0.135	0.021
Carbon sink potential - High - Accelerate regeneration (1000 tCO2e/y)	0	0	0	38.5

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

Item	2020	2025	2030	2050
Carbon sink potential - High - All (not counting overlap) (1000 tCO2e/y)	0	0	0	23,528
Carbon sink potential - High - Avoid deforestation (1000 tCO2e/y)	0	0	0	821
Carbon sink potential - High - Extend rotation length (1000 tCO2e/y)	0	0	0	414
Carbon sink potential - High - Improve plantations (1000 tCO2e/y)	0	0	0	20.6
Carbon sink potential - High - Increase retention of HWP (1000 tCO2e/y)	0	0	0	41.5
Carbon sink potential - High - Increase trees outside forests (1000 tCO2e/y)	0	0	0	3,342
Carbon sink potential - High - Reforest cropland (1000 tCO2e/y)	0	0	0	13,386
Carbon sink potential - High - Reforest pasture (1000 tCO2e/y)	0	0	0	5,274
Carbon sink potential - High - Restore productivity (1000 tCO2e/y)	0	0	0	191
Carbon sink potential - Low - Accelerate regeneration (1000 tCO2e/y)	0	0	0	19.3
Carbon sink potential - Low - All (not counting overlap) (1000 tCO2e/y)	0	0	0	8,666
Carbon sink potential - Low - Avoid deforestation (1000 tCO2e/y)	0	0	0	137
Carbon sink potential - Low - Extend rotation length (1000 tCO2e/y)	0	0	0	159
Carbon sink potential - Low - Improve plantations (1000 tCO2e/y)	0	0	0	10.5
Carbon sink potential - Low - Increase retention of HWP (1000 tCO2e/y)	0	0	0	13.8
Carbon sink potential - Low - Increase trees outside forests (1000 tCO2e/y)	0	0	0	1,170
Carbon sink potential - Low - Reforest cropland (1000 tCO2e/y)	0	0	0	6,693
Carbon sink potential - Low - Reforest pasture (1000 tCO2e/y)	0	0	0	400
Carbon sink potential - Low - Restore productivity (1000 tCO2e/y)	0	0	0	64.3
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO2e/y)	0	0	0	28.9
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO2e/y)	0	0	0	16,097
Carbon sink potential - Mid - Avoid deforestation (1000 tCO2e/y)	0	0	0	479
Carbon sink potential - Mid - Extend rotation length (1000 tCO2e/y)	0	0	0	286
Carbon sink potential - Mid - Improve plantations (1000 tCO2e/y)	0	0	0	15.4
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO2e/y)	0	0	0	27.6
Carbon sink potential - Mid - Increase trees outside forests (1000 tCO2e/y)	0	0	0	2,256
Carbon sink potential - Mid - Reforest cropland (1000 tCO2e/y)	0	0	0	10,039
Carbon sink potential - Mid - Reforest pasture (1000 tCO2e/y)	0	0	0	2,837
Carbon sink potential - Mid - Restore productivity (1000 tCO2e/y)	0	0	0	127
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)	0	0	0	6.3
Land impacted for carbon sink potential - High - Avoid deforestation (over 30 years) (1000 hectares)	0	0	0	111

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

Item	2020	2025	2030	2050
Land impacted for carbon sink potential - High - Extend rotation length (1000 hectares)	0	0	0	211
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)	0	0	0	7.59
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	317
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)	0	0	0	885
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)	0	0	0	150
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)	0	0	0	63.2
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)	0	0	0	1,752
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)	0	0	0	3.15
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)	0	0	0	104
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)	0	0	0	80.8
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)	0	0	0	3.79
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	167
Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares)	0	0	0	443
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)	0	0	0	26
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)	0	0	0	38.2
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)	0	0	0	866
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)	0	0	0	4.72
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)	0	0	0	108
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)	0	0	0	146
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)	0	0	0	5.71
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	242
Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares)	0	0	0	664
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)	0	0	0	188
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)	0	0	0	77
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)	0	0	0	1,435

Table 64: *REF scenario - IMPACTS - Health*

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal (million 2019$)	0	77.9	35.8	21.9	17.2	15	14.3
Monetary damages from air pollution - Natural Gas (million 2019$)	0	6.77	6.13	6.34	4.48	3.82	3.17
Monetary damages from air pollution - Transportation (million 2019$)	0	24.6	24.8	25	25.3	25.7	26.1
Premature deaths from air pollution - Coal (deaths)	0	8.74	4.02	2.45	1.93	1.68	1.61
Premature deaths from air pollution - Natural Gas (deaths)	0	0.764	0.693	0.716	0.506	0.431	0.358
Premature deaths from air pollution - Transportation (deaths)	0	2.77	2.79	2.81	2.85	2.89	2.93