Net-Zero America - iowa state report

Larson et al. 2020

February 2021

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

Notes

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

List of Tables

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

Item	2020	2025	2030	2035	2040	2045	2050
Residential HVAC investment in 2020s vs. REF - Cumulative 5-yr (billion $2018)	0	2.73	3.43	0	0	0	0
Sales of cooking units - Electric Resistance (%)	62.2	70.3	94.9	99.7	100	100	100
Sales of cooking units - Gas (%)	37.8	29.7	5.08	0.256	0	0	0
Sales of space heating units - Electric Heat Pump (%)	4.32	9.3	34.2	83.1	91.9	92.5	92.3
Sales of space heating units - Electric Resistance (%)	10.7	14.9	11.7	5.07	3.86	3.82	4.03
Sales of space heating units - Fossil (%)	10.9	17.4	12.6	4.14	2.53	2.35	2.41
Sales of space heating units - Gas (%)	74.1	58.4	41.4	7.68	1.69	1.31	1.28
Sales of water heating units - Electric Heat Pump (%)	0	0.81	11.1	33.7	37.7	37.9	37.9
Sales of water heating units - Electric Resistance (%)	25.3	40.6	46.5	59.5	61.9	62.1	62
Sales of water heating units - Gas Furnace (%)	74.7	58.5	42.4	6.78	0.4	0	0
Sales of water heating units - Other (%)	0.023	0.026	0.026	0.026	0.025	0.025	0.025

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	710	1,814	2,950	4,464	4,863	4,634
Public EV charging plugs - DC Fast (1000 units)	0.103	0	1.41	0	6.29	0	10.2
Public EV charging plugs - L2 (1000 units)	0.26	0	34	0	151	0	245
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 (%)	1.71	1.95	1.32	0.425	0.077	0.013	0
Vehicle sales - Light-duty - EV (%)	3.38	13.6	43.9	80.8	96.2	99.3	100
Vehicle sales - Light-duty - gasoline (%)	90.8	79.9	51.4	17.5	3.42	0.594	0
Vehicle sales - Light-duty - hybrid (%)	3.9	4.16	3.03	1.15	0.275	0.059	0
Vehicle sales - Light-duty - hydrogen FC (%)	0.111	0.349	0.216	0.068	0.013	0.002	0
Vehicle sales - Light-duty - other (%)	0.109	0.105	0.07	0.025	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)	119	116	111	104	96.2	90.2	86.6
Final energy use - Industry (PJ)	698	727	740	738	743	749	755
Final energy use - Residential (PJ)	158	149	141	125	107	92.3	82.5
Final energy use - Transportation (PJ)	288	269	235	195	158	136	127

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	9,055	9,857	0	0	0	0
Sales of cooking units - Electric Resistance (%)	44.8	57.1	84	89.3	89.6	89.6	89.6
Sales of cooking units - Gas (%)	55.2	42.9	16	10.7	10.4	10.4	10.4
Sales of space heating units - Electric Heat Pump (%)	2.46	7.62	30.1	77.9	86.5	87	87
Sales of space heating units - Electric Resistance (%)	4.11	5.76	8.25	11.9	12.5	12.5	12.5
Sales of space heating units - Fossil (%)	2.55	1.96	0.38	0.016	0	0	0

Table 4: *E+ scenario - PILLAR 1: Efficiency/Electrification - Commercial (continued)*

Item	2020	2025	2030	2035	2040	2045	2050
Sales of space heating units - Gas Furnace (%)	90.9	84.7	61.3	10.2	1.03	0.455	0.455
Sales of water heating units - Electric Heat Pump (%)	0.634	1.83	14.5	42	47	47.3	47.3
Sales of water heating units - Electric Resistance (%)	5.5	7.95	20.3	47	51.7	52	52
Sales of water heating units - Gas Furnace (%)	93	89.3	64.5	10.3	0.611	0	0
Sales of water heating units - Other (%)	0.862	0.936	0.728	0.68	0.676	0.678	0.678

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

Item	2020	2025	2030	2035	2040	2045	2050
Electricity distribution capital invested - Cumulative 5-yr (billion $2018)	0	3.02	3.15	5.47	5.86	5.07	5.32

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	0.005	0.145	0	0	0	0
Capital invested - Biomass w/ccu allam power plant (billion $2018)	0	0	0	0	0	0	0
Capital invested - Biomass w/ccu power plant (billion $2018)	0	0	0	0	0	0	0
Capital invested - Solar PV - Base (billion $2018)	0	0.206	3.13	1.6	4.19	3.71	12.2
Capital invested - Solar PV - Constrained (billion $2018)	0	1.52	5.68	4.23	7.07	2.88	9.72
Capital invested - Wind - Base (billion $2018)	0	5.86	8.69	23.4	24.2	37	53
Capital invested - Wind - Constrained (billion $2018)	0	13.8	10.4	16.5	14.7	6.29	1.17

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

Item	2020	2025	2030	2035	2040	2045	2050
Biomass power plant (GWh)	0	9.49	295	295	295	295	295
Biomass w/ccu allam power plant (GWh)	0	0	0	0	0	0	0
Biomass w/ccu power plant (GWh)	0	0	0	0	0	0	0
Solar - Base land use assumptions (GWh)	195	291	4,933	2,733	7,556	7,066	24,404
Solar - Constrained land use assumptions (GWh)	182	1,362	7,347	4,646	4,661	8,647	28,077
Wind - Base land use assumptions (GWh)	41,883	13,833	22,486	64,078	68,670	109,324	162,150
Wind - Constrained land use assumptions (GWh)	41,883	19,958	30,273	45,756	40,311	18,222	4,577

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

Item	2020	2025	2030	2035	2040	2045	2050
Biomass purchases (million $2018/year)	0	131	247	249	249	1,542	3,892
Conversion capital investment - Cumulative 5-yr (million $2018)	0	5.45	162	25.9	0.269	17,934	48,036
Number of facilities - Allam power w ccu (quantity)	0	0	0	0	0	0	0
Number of facilities - Beccs hydrogen (quantity)	0	0	0	0	0	19	31
Number of facilities - Diesel (quantity)	0	0	0	1	1	2	2
Number of facilities - Diesel ccu (quantity)	0	0	0	0	0	0	0
Number of facilities - Power (quantity)	0	1	1	1	1	1	1
Number of facilities - Power ccu (quantity)	0	0	0	0	0	0	0
Number of facilities - Pyrolysis (quantity)	0	0	0	1	1	2	2
Number of facilities - Pyrolysis ccu (quantity)	0	0	0	0	0	0	28
Number of facilities - Sng (quantity)	0	1	1	1	1	2	2
Number of facilities - Sng ccu (quantity)	0	0	0	0	0	0	0

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

Item	2020	2025	2030	2035	2040	2045	2050
Annual - All (MMT)	0	0	3.25	3.35	3.32	26.5	58
Annual - BECCS (MMT)	0	0	0	0	0	23	54.5
Annual - Cement and lime (MMT)	0	0	3.24	3.35	3.32	3.42	3.53
Annual - NGCC (MMT)	0	0	0.01	0	0	0	0
Cumulative - All (MMT)	0	0	3.25	6.6	9.92	36.4	94.4
Cumulative - BECCS (MMT)	0	0	0	0	0	23	77.5
Cumulative - Cement and lime (MMT)	0	0	3.24	6.59	9.91	13.3	16.9
Cumulative - NGCC (MMT)	0	0	0.01	0.01	0.01	0.01	0.01

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

Item	2020	2025	2030	2035	2040	2045	2050
CO2 storage (MMT)	0	0	0	0	0	0	0
Injection wells (wells)	0	0	0	0	0	0	0
Resource characterization, appraisal, permitting costs (million $2020)	0	0	0.01	0.01	0.01	0.01	0.01
Wells and facilities construction costs (million $2020)	0	0	0	0.01	0.01	0.02	0.02

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

Item	2020	2025	2030	2035	2040	2045	2050
All (km)	0	0	664	957	887	1,982	4,263
Cumulative investment - All (million $2018)	0	0	4,192	5,208	5,173	6,364	8,539
Cumulative investment - Spur (million $2018)	0	0	39.1	157	122	1,313	3,488
Cumulative investment - Trunk (million $2018)	0	0	4,153	5,051	5,051	5,051	5,051
Spur (km)	0	0	47	167	96.9	1,192	3,474
Trunk (km)	0	0	617	790	790	790	790

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	-4,209
Carbon sink potential - Aggressive deployment - Cropland measures (1000 tCO2e/y)	0	0	-14,138
Carbon sink potential - Aggressive deployment - Permanent conservation cover (1000 tCO2e/y)	0	0	-472
Carbon sink potential - Aggressive deployment - Total (1000 tCO2e/y)	0	0	-18,820
Carbon sink potential - Moderate deployment - Corn-ethanol to energy grasses (1000 tCO2e/y)	0	0	-4,209
Carbon sink potential - Moderate deployment - Cropland measures (1000 tCO2e/y)	0	0	-7,458
Carbon sink potential - Moderate deployment - Permanent conservation cover (1000 tCO2e/y)	0	0	-236
Carbon sink potential - Moderate deployment - Total (1000 tCO2e/y)	0	0	-11,904
Land impacted for carbon sink - Aggressive deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	2,095
Land impacted for carbon sink - Aggressive deployment - Cropland measures (1000 hectares)	0	0	7,797
Land impacted for carbon sink - Aggressive deployment - Permanent conservation cover (1000 hectares)	0	0	859
Land impacted for carbon sink - Aggressive deployment - Total (1000 hectares)	0	0	10,751
Land impacted for carbon sink - Moderate deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	2,095

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	4,113
Land impacted for carbon sink - Moderate deployment - Permanent conservation cover (1000 hectares)	0	0	429
Land impacted for carbon sink - Moderate deployment - Total (1000 hectares)	0	0	6,638

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

Item	2020	2025	2050
Carbon sink potential - High - Accelerate regeneration (1000 tCO2e/y)	0	0	131
Carbon sink potential - High - All (not counting overlap) (1000 tCO2e/y)	0	0	25,467
Carbon sink potential - High - Avoid deforestation (1000 tCO2e/y)	0	0	1,534
Carbon sink potential - High - Extend rotation length (1000 tCO2e/y)	0	0	1,092
Carbon sink potential - High - Improve plantations (1000 tCO2e/y)	0	0	39.8
Carbon sink potential - High - Increase retention of HWP (1000 tCO2e/y)	0	0	732
Carbon sink potential - High - Increase trees outside forests (1000 tCO2e/y)	0	0	3,556
Carbon sink potential - High - Reforest cropland (1000 tCO2e/y)	0	0	10,483
Carbon sink potential - High - Reforest pasture (1000 tCO2e/y)	0	0	7,074
Carbon sink potential - High - Restore productivity (1000 tCO2e/y)	0	0	824
Carbon sink potential - Low - Accelerate regeneration (1000 tCO2e/y)	0	0	65.8
Carbon sink potential - Low - All (not counting overlap) (1000 tCO2e/y)	0	0	8,305
Carbon sink potential - Low - Avoid deforestation (1000 tCO2e/y)	0	0	256
Carbon sink potential - Low - Extend rotation length (1000 tCO2e/y)	0	0	420
Carbon sink potential - Low - Improve plantations (1000 tCO2e/y)	0	0	20.3
Carbon sink potential - Low - Increase retention of HWP (1000 tCO2e/y)	0	0	244
Carbon sink potential - Low - Increase trees outside forests (1000 tCO2e/y)	0	0	1,245
Carbon sink potential - Low - Reforest cropland (1000 tCO2e/y)	0	0	5,241
Carbon sink potential - Low - Reforest pasture (1000 tCO2e/y)	0	0	536
Carbon sink potential - Low - Restore productivity (1000 tCO2e/y)	0	0	278
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO2e/y)	0	0	98.5
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO2e/y)	0	0	16,885
Carbon sink potential - Mid - Avoid deforestation (1000 tCO2e/y)	0	0	895
Carbon sink potential - Mid - Extend rotation length (1000 tCO2e/y)	0	0	756
Carbon sink potential - Mid - Improve plantations (1000 tCO2e/y)	0	0	29.7
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO2e/y)	0	0	488

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

Item	2020	2025	2050
Carbon sink potential - Mid - Increase trees outside forests (1000 tCO2e/y)	0	0	2,400
Carbon sink potential - Mid - Reforest cropland (1000 tCO2e/y)	0	0	7,862
Carbon sink potential - Mid - Reforest pasture (1000 tCO2e/y)	0	0	3,805
Carbon sink potential - Mid - Restore productivity (1000 tCO2e/y)	0	0	551
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)	0	0	21.5
Land impacted for carbon sink potential - High - Avoid deforestation (over 30 years) (1000 hectares)	0	0	208
Land impacted for carbon sink potential - High - Extend rotation length (1000 hectares)	0	0	557
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)	0	0	14.7
Land impacted for carbon sink potential - High - Increase retention of HWP (1000 hectares)	0	0	0
Land impacted for carbon sink potential - High - Increase trees outside forests (1000 hectares)	0	0	338
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)	0	0	693
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)	0	0	201
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)	0	0	273
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)	0	0	2,306
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)	0	0	10.7
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)	0	0	195
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)	0	0	213
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)	0	0	7.34
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	178
Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares)	0	0	347
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)	0	0	34.8
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)	0	0	165
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)	0	0	1,151
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)	0	0	16.1
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)	0	0	201
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)	0	0	385
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)	0	0	11
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	258

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	520
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)	0	0	252
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)	0	0	333
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)	0	0	1,976

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

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal (million 2019$)	0	289	0.218	0.209	0.173	0.115	0.003
Monetary damages from air pollution - Natural Gas (million 2019$)	0	98.9	55.2	25.7	17.7	11.4	5.49
Monetary damages from air pollution - Transportation (million 2019$)	0	349	321	241	137	62.1	24.5
Premature deaths from air pollution - Coal (deaths)	0	32.4	0.025	0.023	0.019	0.013	0
Premature deaths from air pollution - Natural Gas (deaths)	0	11.2	6.23	2.9	2	1.29	0.62
Premature deaths from air pollution - Transportation (deaths)	0	39.2	36.1	27.1	15.5	6.99	2.75

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

Item	2020	2025	2030	2035	2040	2045	2050
By economic sector - Agriculture (jobs)	6,918	6,919	7,067	7,049	3,937	2,193	3,480
By economic sector - Construction (jobs)	9,137	11,440	16,019	20,793	27,027	36,103	56,878
By economic sector - Manufacturing (jobs)	7,388	10,064	11,218	13,662	12,171	10,801	15,718
By economic sector - Mining (jobs)	2,370	1,793	1,250	880	600	399	273
By economic sector - Other (jobs)	735	948	1,518	2,117	3,231	4,392	8,198
By economic sector - Pipeline (jobs)	417	418	869	411	239	206	316
By economic sector - Professional (jobs)	6,365	7,857	9,624	14,553	18,985	27,778	44,883
By economic sector - Trade (jobs)	6,254	6,346	6,829	8,852	10,696	14,511	23,876
By economic sector - Utilities (jobs)	8,872	9,974	12,746	16,840	21,337	30,273	47,298
By education level - All sectors - Associates degree or some college (jobs)	13,112	15,576	19,439	25,251	30,501	40,249	63,815
By education level - All sectors - Bachelors degree (jobs)	9,084	10,547	12,609	16,591	19,855	26,536	42,160
By education level - All sectors - Doctoral degree (jobs)	328	388	468	658	826	1,164	1,870
By education level - All sectors - High school diploma or less (jobs)	23,678	26,619	31,470	38,405	41,866	51,647	81,806
By education level - All sectors - Masters or professional degree (jobs)	2,253	2,628	3,155	4,252	5,174	7,058	11,269
By resource sector - Biomass (jobs)	16,701	16,205	16,154	15,911	9,407	8,321	15,993
By resource sector - CO2 (jobs)	0	0	4,129	939	52.6	326	1,578
By resource sector - Coal (jobs)	2,446	1,406	317	0	0	0	0
By resource sector - Grid (jobs)	12,217	15,007	17,367	28,428	38,098	54,804	87,225
By resource sector - Natural Gas (jobs)	3,793	3,506	3,071	2,722	2,297	2,336	2,017
By resource sector - Nuclear (jobs)	205	0	0	0	0	0	0
By resource sector - Oil (jobs)	4,116	3,740	3,174	2,517	1,961	1,552	1,239
By resource sector - Solar (jobs)	2,167	3,175	6,544	6,748	10,259	10,167	23,668
By resource sector - Wind (jobs)	6,809	12,720	16,386	27,892	36,146	49,148	69,200
Median wages - Annual - All ($2019 per job)	54,358	55,379	56,490	58,047	59,984	61,881	62,771
On-Site or In-Plant Training - Total jobs - 1 to 4 years (jobs)	6,857	8,095	10,087	13,024	15,661	20,617	32,614
On-Site or In-Plant Training - Total jobs - 4 to 10 years (jobs)	2,760	3,256	4,179	5,420	6,728	9,069	14,342
On-Site or In-Plant Training - Total jobs - None (jobs)	7,645	8,882	10,746	13,766	16,034	20,848	33,129

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)	404	474	588	748	879	1,141	1,803
On-Site or In-Plant Training - Total jobs - Up to 1 year (jobs)	30,789	35,051	41,541	52,201	58,919	74,979	119,033
On-the-Job Training - All sectors - 1 to 4 years (jobs)	8,479	10,101	12,721	16,554	20,176	26,786	42,340
On-the-Job Training - All sectors - 4 to 10 years (jobs)	2,608	3,105	4,048	5,287	6,653	9,024	14,284
On-the-Job Training - All sectors - None (jobs)	2,768	3,134	3,716	4,680	5,357	6,863	10,964
On-the-Job Training - All sectors - Over 10 years (jobs)	417	504	625	789	915	1,146	1,796
On-the-Job Training - All sectors - Up to 1 year (jobs)	34,183	38,914	46,030	57,849	65,121	82,835	131,537
Related work experience - All sectors - 1 to 4 years (jobs)	16,171	18,734	22,747	29,309	34,649	45,565	72,353
Related work experience - All sectors - 4 to 10 years (jobs)	9,873	11,629	14,347	18,675	22,508	29,854	47,258
Related work experience - All sectors - None (jobs)	7,557	8,561	10,233	12,710	14,321	18,205	28,946
Related work experience - All sectors - Over 10 years (jobs)	2,625	3,118	3,804	4,946	5,870	7,665	12,097
Related work experience - All sectors - Up to 1 year (jobs)	12,230	13,716	16,010	19,519	20,874	25,365	40,267
Wage income - All (million $2019)	2,634	3,088	3,793	4,944	5,892	7,838	12,614

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

Item	2020	2025	2030	2035	2040	2045	2050
Natural gas consumption - Annual (tcf)	338	343	289	232	175	110	76.2
Natural gas consumption - Cumulative (tcf)	0	0	0	0	0	0	6,984
Natural gas production - Annual (tcf)	0	0	0	0	0	0	0
Oil consumption - Annual (million bbls)	84.4	84.1	77.8	66.8	56.1	47.5	40.4
Oil consumption - Cumulative (million bbls)	0	0	0	0	0	0	2,036
Oil production - Annual (million bbls)	0	0	0	0	0	0	0

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

Item	2020	2025	2030	2035	2040	2045	2050
Residential HVAC investment in 2020s vs. REF - Cumulative 5-yr (billion $2018)	0	2.72	3.37	0	0	0	0
Sales of cooking units - Electric Resistance (%)	62.1	63.1	66.6	75.7	88.4	96.3	99
Sales of cooking units - Gas (%)	37.9	36.9	33.4	24.3	11.6	3.74	1.01
Sales of space heating units - Electric Heat Pump (%)	4.32	7.79	10.3	18.6	37.9	61.5	75.1
Sales of space heating units - Electric Resistance (%)	10.7	15	14.6	13.6	11.1	7.88	6.19
Sales of space heating units - Fossil (%)	10.9	17.8	17.4	15.8	12.1	7.79	5.49
Sales of space heating units - Gas (%)	74.1	59.4	57.7	52.1	39	22.8	13.2
Sales of water heating units - Electric Heat Pump (%)	0	0.379	1.42	4.88	13.3	23.9	30.1
Sales of water heating units - Electric Resistance (%)	25.3	40.4	40.9	42.9	47.7	53.9	57.5
Sales of water heating units - Gas Furnace (%)	74.7	59.2	57.6	52.2	39	22.2	12.3
Sales of water heating units - Other (%)	0.023	0.026	0.026	0.026	0.026	0.025	0.025

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	114	242	813	2,567	3,737
Public EV charging plugs - DC Fast (1000 units)	0.103	0	0.425	0	2.32	0	6.52
Public EV charging plugs - L2 (1000 units)	0.26	0	10.2	0	55.9	0	157
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 (%)	1.72	2.11	2.09	1.67	1.08	0.558	0.238
Vehicle sales - Light-duty - EV (%)	1.7	4.27	11	24.5	46.8	71	87.2
Vehicle sales - Light-duty - gasoline (%)	92.3	88.3	81	68.4	47.9	25.9	11.4
Vehicle sales - Light-duty - hybrid (%)	4.03	4.87	5.52	5.1	3.9	2.35	1.15
Vehicle sales - Light-duty - hydrogen FC (%)	0.113	0.385	0.335	0.26	0.187	0.104	0.048
Vehicle sales - Light-duty - other (%)	0.11	0.113	0.104	0.091	0.066	0.037	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)	119	116	113	110	106	102	97.9
Final energy use - Industry (PJ)	698	728	742	746	756	762	767
Final energy use - Residential (PJ)	158	150	143	137	130	120	108
Final energy use - Transportation (PJ)	289	271	246	226	211	194	173

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	9,055	9,867	0	0	0	0
Sales of cooking units - Electric Resistance (%)	44.8	49.3	53.1	63	76.9	85.5	88.5
Sales of cooking units - Gas (%)	55.2	50.7	46.9	37	23.1	14.5	11.5
Sales of space heating units - Electric Heat Pump (%)	2.46	6.56	8.85	16.3	34.3	56.8	70
Sales of space heating units - Electric Resistance (%)	4.11	5.51	5.75	6.55	8.23	10.1	11.1
Sales of space heating units - Fossil (%)	2.55	2.28	2.17	1.72	1.01	0.534	0.37
Sales of space heating units - Gas Furnace (%)	90.9	85.6	83.2	75.4	56.5	32.5	18.5
Sales of water heating units - Electric Heat Pump (%)	0.634	1.28	2.56	6.82	17.1	30.1	37.7
Sales of water heating units - Electric Resistance (%)	5.5	7.41	8.68	12.8	22.8	35.4	42.8
Sales of water heating units - Gas Furnace (%)	93	90.3	87.8	79.5	59.3	33.8	18.7
Sales of water heating units - Other (%)	0.862	0.976	0.957	0.895	0.802	0.745	0.724

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	2.47	2.54	3.3	3.45	4.74	5.02

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	-4,209
Carbon sink potential - Aggressive deployment - Cropland measures (1000 tCO2e/y)	0	0	-14,138
Carbon sink potential - Aggressive deployment - Permanent conservation cover (1000 tCO2e/y)	0	0	-472
Carbon sink potential - Aggressive deployment - Total (1000 tCO2e/y)	0	0	-18,820

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	-4,209
Carbon sink potential - Moderate deployment - Cropland measures (1000 tCO2e/y)	0	0	-7,458
Carbon sink potential - Moderate deployment - Permanent conservation cover (1000 tCO2e/y)	0	0	-236
Carbon sink potential - Moderate deployment - Total (1000 tCO2e/y)	0	0	-11,904
Land impacted for carbon sink - Aggressive deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	2,095
Land impacted for carbon sink - Aggressive deployment - Cropland measures (1000 hectares)	0	0	7,797
Land impacted for carbon sink - Aggressive deployment - Permanent conservation cover (1000 hectares)	0	0	859
Land impacted for carbon sink - Aggressive deployment - Total (1000 hectares)	0	0	10,751
Land impacted for carbon sink - Moderate deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	2,095
Land impacted for carbon sink - Moderate deployment - Cropland measures (1000 hectares)	0	0	4,113
Land impacted for carbon sink - Moderate deployment - Permanent conservation cover (1000 hectares)	0	0	429
Land impacted for carbon sink - Moderate deployment - Total (1000 hectares)	0	0	6,638

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

Item	2020	2025	2050
Carbon sink potential - High - Accelerate regeneration (1000 tCO2e/y)	0	0	131
Carbon sink potential - High - All (not counting overlap) (1000 tCO2e/y)	0	0	25,467
Carbon sink potential - High - Avoid deforestation (1000 tCO2e/y)	0	0	1,534
Carbon sink potential - High - Extend rotation length (1000 tCO2e/y)	0	0	1,092
Carbon sink potential - High - Improve plantations (1000 tCO2e/y)	0	0	39.8
Carbon sink potential - High - Increase retention of HWP (1000 tCO2e/y)	0	0	732
Carbon sink potential - High - Increase trees outside forests (1000 tCO2e/y)	0	0	3,556
Carbon sink potential - High - Reforest cropland (1000 tCO2e/y)	0	0	10,483
Carbon sink potential - High - Reforest pasture (1000 tCO2e/y)	0	0	7,074
Carbon sink potential - High - Restore productivity (1000 tCO2e/y)	0	0	824
Carbon sink potential - Low - Accelerate regeneration (1000 tCO2e/y)	0	0	65.8
Carbon sink potential - Low - All (not counting overlap) (1000 tCO2e/y)	0	0	8,305
Carbon sink potential - Low - Avoid deforestation (1000 tCO2e/y)	0	0	256
Carbon sink potential - Low - Extend rotation length (1000 tCO2e/y)	0	0	420
Carbon sink potential - Low - Improve plantations (1000 tCO2e/y)	0	0	20.3

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	244
Carbon sink potential - Low - Increase trees outside forests (1000 tCO2e/y)	0	0	1,245
Carbon sink potential - Low - Reforest cropland (1000 tCO2e/y)	0	0	5,241
Carbon sink potential - Low - Reforest pasture (1000 tCO2e/y)	0	0	536
Carbon sink potential - Low - Restore productivity (1000 tCO2e/y)	0	0	278
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO2e/y)	0	0	98.5
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO2e/y)	0	0	16,885
Carbon sink potential - Mid - Avoid deforestation (1000 tCO2e/y)	0	0	895
Carbon sink potential - Mid - Extend rotation length (1000 tCO2e/y)	0	0	756
Carbon sink potential - Mid - Improve plantations (1000 tCO2e/y)	0	0	29.7
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO2e/y)	0	0	488
Carbon sink potential - Mid - Increase trees outside forests (1000 tCO2e/y)	0	0	2,400
Carbon sink potential - Mid - Reforest cropland (1000 tCO2e/y)	0	0	7,862
Carbon sink potential - Mid - Reforest pasture (1000 tCO2e/y)	0	0	3,805
Carbon sink potential - Mid - Restore productivity (1000 tCO2e/y)	0	0	551
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)	0	0	21.5
Land impacted for carbon sink potential - High - Avoid deforestation (over 30 years) (1000 hectares)	0	0	208
Land impacted for carbon sink potential - High - Extend rotation length (1000 hectares)	0	0	557
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)	0	0	14.7
Land impacted for carbon sink potential - High - Increase retention of HWP (1000 hectares)	0	0	0
Land impacted for carbon sink potential - High - Increase trees outside forests (1000 hectares)	0	0	338
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)	0	0	693
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)	0	0	201
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)	0	0	273
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)	0	0	2,306
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)	0	0	10.7
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)	0	0	195
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)	0	0	213
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)	0	0	7.34
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	178
Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares)	0	0	347
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)	0	0	34.8
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)	0	0	165
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)	0	0	1,151
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)	0	0	16.1
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)	0	0	201
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)	0	0	385
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)	0	0	11
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	258
Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares)	0	0	520
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)	0	0	252
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)	0	0	333
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)	0	0	1,976

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

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal (million 2019$)	0	289	0.218	0.209	0.173	0.115	0.003
Monetary damages from air pollution - Natural Gas (million 2019$)	0	98.5	47.8	19.4	8.97	3.61	2.91
Monetary damages from air pollution - Transportation (million 2019$)	0	354	352	339	303	239	163
Premature deaths from air pollution - Coal (deaths)	0	32.4	0.025	0.023	0.019	0.013	0
Premature deaths from air pollution - Natural Gas (deaths)	0	11.1	5.39	2.19	1.01	0.408	0.329
Premature deaths from air pollution - Transportation (deaths)	0	39.8	39.6	38.1	34	26.9	18.3

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	2.73	3.43	0	0	0	0
Sales of cooking units - Electric Resistance (%)	62.2	70.3	94.9	99.7	100	100	100
Sales of cooking units - Gas (%)	37.8	29.7	5.08	0.256	0	0	0
Sales of space heating units - Electric Heat Pump (%)	4.32	9.3	34.2	83.1	91.9	92.5	92.3
Sales of space heating units - Electric Resistance (%)	10.7	14.9	11.7	5.07	3.86	3.82	4.03
Sales of space heating units - Fossil (%)	10.9	17.4	12.6	4.14	2.53	2.35	2.41
Sales of space heating units - Gas (%)	74.1	58.4	41.4	7.68	1.69	1.31	1.28
Sales of water heating units - Electric Heat Pump (%)	0	0.81	11.1	33.7	37.7	37.9	37.9

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 (%)	25.3	40.6	46.5	59.5	61.9	62.1	62
Sales of water heating units - Gas Furnace (%)	74.7	58.5	42.4	6.78	0.4	0	0
Sales of water heating units - Other (%)	0.023	0.026	0.026	0.026	0.025	0.025	0.025

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	710	1,814	2,950	4,464	4,863	4,634
Public EV charging plugs - DC Fast (1000 units)	0.103	0	1.41	0	6.29	0	10.2
Public EV charging plugs - L2 (1000 units)	0.26	0	34	0	151	0	245
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 (%)	1.71	1.95	1.32	0.425	0.077	0.013	0
Vehicle sales - Light-duty - EV (%)	3.38	13.6	43.9	80.8	96.2	99.3	100
Vehicle sales - Light-duty - gasoline (%)	90.8	79.9	51.4	17.5	3.42	0.594	0
Vehicle sales - Light-duty - hybrid (%)	3.9	4.16	3.03	1.15	0.275	0.059	0
Vehicle sales - Light-duty - hydrogen FC (%)	0.111	0.349	0.216	0.068	0.013	0.002	0
Vehicle sales - Light-duty - other (%)	0.109	0.105	0.07	0.025	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)	119	116	111	104	96.2	90.2	86.6
Final energy use - Industry (PJ)	698	727	740	738	743	749	755
Final energy use - Residential (PJ)	158	149	141	125	107	92.3	82.5
Final energy use - Transportation (PJ)	288	269	235	195	158	136	127

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	9,055	9,857	0	0	0	0
Sales of cooking units - Electric Resistance (%)	44.8	57.1	84	89.3	89.6	89.6	89.6
Sales of cooking units - Gas (%)	55.2	42.9	16	10.7	10.4	10.4	10.4
Sales of space heating units - Electric Heat Pump (%)	2.46	7.62	30.1	77.9	86.5	87	87
Sales of space heating units - Electric Resistance (%)	4.11	5.76	8.25	11.9	12.5	12.5	12.5
Sales of space heating units - Fossil (%)	2.55	1.96	0.38	0.016	0	0	0
Sales of space heating units - Gas Furnace (%)	90.9	84.7	61.3	10.2	1.03	0.455	0.455
Sales of water heating units - Electric Heat Pump (%)	0.634	1.83	14.5	42	47	47.3	47.3
Sales of water heating units - Electric Resistance (%)	5.5	7.95	20.3	47	51.7	52	52
Sales of water heating units - Gas Furnace (%)	93	89.3	64.5	10.3	0.611	0	0
Sales of water heating units - Other (%)	0.862	0.936	0.728	0.68	0.676	0.678	0.678

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

Item	2020	2025	2030	2035	2040	2045	2050
Electricity distribution capital invested - Cumulative 5-yr (billion $2018)	0	3.02	3.15	5.47	5.86	5.07	5.32

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	12.5	9.1	12.2	7.82	10.9
Capital invested - Wind - Base (billion $2018)	0	7.4	11	28.2	51	72.5	59.1

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

Item	2020	2025	2030	2035	2040	2045	2050
Solar - Base land use assumptions (GWh)	195	0	19,582	15,262	21,685	14,725	21,758
Solar - Constrained land use assumptions (GWh)	195	0	11,891	18,623	22,375	22,038	37,077
Wind - Base land use assumptions (GWh)	41,883	17,449	28,231	76,923	143,311	208,935	172,779
Wind - Constrained land use assumptions (GWh)	41,883	24,748	32,502	63,422	33,204	5,052	194,159

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	-4,209
Carbon sink potential - Aggressive deployment - Cropland measures (1000 tCO2e/y)	0	0	-14,138
Carbon sink potential - Aggressive deployment - Permanent conservation cover (1000 tCO2e/y)	0	0	-472
Carbon sink potential - Aggressive deployment - Total (1000 tCO2e/y)	0	0	-18,820
Carbon sink potential - Moderate deployment - Corn-ethanol to energy grasses (1000 tCO2e/y)	0	0	-4,209
Carbon sink potential - Moderate deployment - Cropland measures (1000 tCO2e/y)	0	0	-7,458
Carbon sink potential - Moderate deployment - Permanent conservation cover (1000 tCO2e/y)	0	0	-236
Carbon sink potential - Moderate deployment - Total (1000 tCO2e/y)	0	0	-11,904
Land impacted for carbon sink - Aggressive deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	2,095
Land impacted for carbon sink - Aggressive deployment - Cropland measures (1000 hectares)	0	0	7,797
Land impacted for carbon sink - Aggressive deployment - Permanent conservation cover (1000 hectares)	0	0	859
Land impacted for carbon sink - Aggressive deployment - Total (1000 hectares)	0	0	10,751
Land impacted for carbon sink - Moderate deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	2,095
Land impacted for carbon sink - Moderate deployment - Cropland measures (1000 hectares)	0	0	4,113
Land impacted for carbon sink - Moderate deployment - Permanent conservation cover (1000 hectares)	0	0	429
Land impacted for carbon sink - Moderate deployment - Total (1000 hectares)	0	0	6,638

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	131
Carbon sink potential - High - All (not counting overlap) (1000 tCO2e/y)	0	0	25,467
Carbon sink potential - High - Avoid deforestation (1000 tCO2e/y)	0	0	1,534
Carbon sink potential - High - Extend rotation length (1000 tCO2e/y)	0	0	1,092
Carbon sink potential - High - Improve plantations (1000 tCO2e/y)	0	0	39.8
Carbon sink potential - High - Increase retention of HWP (1000 tCO2e/y)	0	0	732
Carbon sink potential - High - Increase trees outside forests (1000 tCO2e/y)	0	0	3,556
Carbon sink potential - High - Reforest cropland (1000 tCO2e/y)	0	0	10,483
Carbon sink potential - High - Reforest pasture (1000 tCO2e/y)	0	0	7,074
Carbon sink potential - High - Restore productivity (1000 tCO2e/y)	0	0	824
Carbon sink potential - Low - Accelerate regeneration (1000 tCO2e/y)	0	0	65.8
Carbon sink potential - Low - All (not counting overlap) (1000 tCO2e/y)	0	0	8,305
Carbon sink potential - Low - Avoid deforestation (1000 tCO2e/y)	0	0	256
Carbon sink potential - Low - Extend rotation length (1000 tCO2e/y)	0	0	420
Carbon sink potential - Low - Improve plantations (1000 tCO2e/y)	0	0	20.3
Carbon sink potential - Low - Increase retention of HWP (1000 tCO2e/y)	0	0	244
Carbon sink potential - Low - Increase trees outside forests (1000 tCO2e/y)	0	0	1,245
Carbon sink potential - Low - Reforest cropland (1000 tCO2e/y)	0	0	5,241
Carbon sink potential - Low - Reforest pasture (1000 tCO2e/y)	0	0	536
Carbon sink potential - Low - Restore productivity (1000 tCO2e/y)	0	0	278
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO2e/y)	0	0	98.5
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO2e/y)	0	0	16,885
Carbon sink potential - Mid - Avoid deforestation (1000 tCO2e/y)	0	0	895
Carbon sink potential - Mid - Extend rotation length (1000 tCO2e/y)	0	0	756
Carbon sink potential - Mid - Improve plantations (1000 tCO2e/y)	0	0	29.7
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO2e/y)	0	0	488
Carbon sink potential - Mid - Increase trees outside forests (1000 tCO2e/y)	0	0	2,400
Carbon sink potential - Mid - Reforest cropland (1000 tCO2e/y)	0	0	7,862
Carbon sink potential - Mid - Reforest pasture (1000 tCO2e/y)	0	0	3,805
Carbon sink potential - Mid - Restore productivity (1000 tCO2e/y)	0	0	551
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)	0	0	21.5

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	208
Land impacted for carbon sink potential - High - Extend rotation length (1000 hectares)	0	0	557
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)	0	0	14.7
Land impacted for carbon sink potential - High - Increase retention of HWP (1000 hectares)	0	0	0
Land impacted for carbon sink potential - High - Increase trees outside forests (1000 hectares)	0	0	338
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)	0	0	693
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)	0	0	201
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)	0	0	273
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)	0	0	2,306
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)	0	0	10.7
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)	0	0	195
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)	0	0	213
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)	0	0	7.34
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	178
Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares)	0	0	347
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)	0	0	34.8
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)	0	0	165
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)	0	0	1,151
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)	0	0	16.1
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)	0	0	201
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)	0	0	385
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)	0	0	11
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	258
Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares)	0	0	520
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)	0	0	252
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)	0	0	333
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)	0	0	1,976

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

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal (million 2019$)	0	289	0.218	0.209	0.173	0.115	0.003
Monetary damages from air pollution - Natural Gas (million 2019$)	0	92.3	50.1	16.1	9.87	4.31	2.69
Monetary damages from air pollution - Transportation (million 2019$)	0	349	321	241	137	62.1	24.5
Premature deaths from air pollution - Coal (deaths)	0	32.4	0.025	0.023	0.019	0.013	0
Premature deaths from air pollution - Natural Gas (deaths)	0	10.4	5.65	1.82	1.11	0.487	0.303
Premature deaths from air pollution - Transportation (deaths)	0	39.2	36.1	27.1	15.5	6.99	2.75

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	2.73	3.43	0	0	0	0
Sales of cooking units - Electric Resistance (%)	62.2	70.3	94.9	99.7	100	100	100
Sales of cooking units - Gas (%)	37.8	29.7	5.08	0.256	0	0	0
Sales of space heating units - Electric Heat Pump (%)	4.32	9.3	34.2	83.1	91.9	92.5	92.3
Sales of space heating units - Electric Resistance (%)	10.7	14.9	11.7	5.07	3.86	3.82	4.03
Sales of space heating units - Fossil (%)	10.9	17.4	12.6	4.14	2.53	2.35	2.41
Sales of space heating units - Gas (%)	74.1	58.4	41.4	7.68	1.69	1.31	1.28
Sales of water heating units - Electric Heat Pump (%)	0	0.81	11.1	33.7	37.7	37.9	37.9
Sales of water heating units - Electric Resistance (%)	25.3	40.6	46.5	59.5	61.9	62.1	62
Sales of water heating units - Gas Furnace (%)	74.7	58.5	42.4	6.78	0.4	0	0
Sales of water heating units - Other (%)	0.023	0.026	0.026	0.026	0.025	0.025	0.025

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	710	1,814	2,950	4,464	4,863	4,634
Public EV charging plugs - DC Fast (1000 units)	0.103	0	1.41	0	6.29	0	10.2
Public EV charging plugs - L2 (1000 units)	0.26	0	34	0	151	0	245
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 (%)	1.71	1.95	1.32	0.425	0.077	0.013	0
Vehicle sales - Light-duty - EV (%)	3.38	13.6	43.9	80.8	96.2	99.3	100
Vehicle sales - Light-duty - gasoline (%)	90.8	79.9	51.4	17.5	3.42	0.594	0
Vehicle sales - Light-duty - hybrid (%)	3.9	4.16	3.03	1.15	0.275	0.059	0
Vehicle sales - Light-duty - hydrogen FC (%)	0.111	0.349	0.216	0.068	0.013	0.002	0
Vehicle sales - Light-duty - other (%)	0.109	0.105	0.07	0.025	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)	119	116	111	104	96.2	90.2	86.6
Final energy use - Industry (PJ)	698	727	740	738	743	749	755
Final energy use - Residential (PJ)	158	149	141	125	107	92.3	82.5
Final energy use - Transportation (PJ)	288	269	235	195	158	136	127

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	9,055	9,857	0	0	0	0
Sales of cooking units - Electric Resistance (%)	44.8	57.1	84	89.3	89.6	89.6	89.6
Sales of cooking units - Gas (%)	55.2	42.9	16	10.7	10.4	10.4	10.4
Sales of space heating units - Electric Heat Pump (%)	2.46	7.62	30.1	77.9	86.5	87	87
Sales of space heating units - Electric Resistance (%)	4.11	5.76	8.25	11.9	12.5	12.5	12.5
Sales of space heating units - Fossil (%)	2.55	1.96	0.38	0.016	0	0	0
Sales of space heating units - Gas Furnace (%)	90.9	84.7	61.3	10.2	1.03	0.455	0.455
Sales of water heating units - Electric Heat Pump (%)	0.634	1.83	14.5	42	47	47.3	47.3
Sales of water heating units - Electric Resistance (%)	5.5	7.95	20.3	47	51.7	52	52
Sales of water heating units - Gas Furnace (%)	93	89.3	64.5	10.3	0.611	0	0
Sales of water heating units - Other (%)	0.862	0.936	0.728	0.68	0.676	0.678	0.678

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

Item	2020	2025	2030	2035	2040	2045	2050
Electricity distribution capital invested - Cumulative 5-yr (billion $2018)	0	3.02	3.15	5.47	5.86	5.07	5.32

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	1.6	1.92	2.46	1.34	1.03	0
Capital invested - Solar PV - Constrained (billion $2018)	0	3.27	1.61	1.91	1.19	0.971	0
Capital invested - Wind - Base (billion $2018)	0	0.916	6.86	6.44	11.9	15.7	0.297
Capital invested - Wind - Constrained (billion $2018)	0	3.08	8.43	8.58	8.09	7.9	7.74

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

Item	2020	2025	2030	2035	2040	2045	2050
Solar - Base land use assumptions (GWh)	195	2,243	3,025	4,165	2,400	1,938	0
Solar - Constrained land use assumptions (GWh)	1,214	4,591	2,511	3,250	2,130	1,828	0
Wind - Base land use assumptions (GWh)	41,883	2,158	17,872	17,833	34,383	47,370	923
Wind - Constrained land use assumptions (GWh)	41,883	7,164	21,335	22,932	22,335	22,489	22,992

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	-4,209
Carbon sink potential - Aggressive deployment - Cropland measures (1000 tCO2e/y)	0	0	-14,138
Carbon sink potential - Aggressive deployment - Permanent conservation cover (1000 tCO2e/y)	0	0	-472
Carbon sink potential - Aggressive deployment - Total (1000 tCO2e/y)	0	0	-18,820
Carbon sink potential - Moderate deployment - Corn-ethanol to energy grasses (1000 tCO2e/y)	0	0	-4,209

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

Item	2020	2025	2050
Carbon sink potential - Moderate deployment - Cropland measures (1000 tCO2e/y)	0	0	-7,458
Carbon sink potential - Moderate deployment - Permanent conservation cover (1000 tCO2e/y)	0	0	-236
Carbon sink potential - Moderate deployment - Total (1000 tCO2e/y)	0	0	-11,904
Land impacted for carbon sink - Aggressive deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	2,095
Land impacted for carbon sink - Aggressive deployment - Cropland measures (1000 hectares)	0	0	7,797
Land impacted for carbon sink - Aggressive deployment - Permanent conservation cover (1000 hectares)	0	0	859
Land impacted for carbon sink - Aggressive deployment - Total (1000 hectares)	0	0	10,751
Land impacted for carbon sink - Moderate deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	2,095
Land impacted for carbon sink - Moderate deployment - Cropland measures (1000 hectares)	0	0	4,113
Land impacted for carbon sink - Moderate deployment - Permanent conservation cover (1000 hectares)	0	0	429
Land impacted for carbon sink - Moderate deployment - Total (1000 hectares)	0	0	6,638

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	131
Carbon sink potential - High - All (not counting overlap) (1000 tCO2e/y)	0	0	25,467
Carbon sink potential - High - Avoid deforestation (1000 tCO2e/y)	0	0	1,534
Carbon sink potential - High - Extend rotation length (1000 tCO2e/y)	0	0	1,092
Carbon sink potential - High - Improve plantations (1000 tCO2e/y)	0	0	39.8
Carbon sink potential - High - Increase retention of HWP (1000 tCO2e/y)	0	0	732
Carbon sink potential - High - Increase trees outside forests (1000 tCO2e/y)	0	0	3,556
Carbon sink potential - High - Reforest cropland (1000 tCO2e/y)	0	0	10,483
Carbon sink potential - High - Reforest pasture (1000 tCO2e/y)	0	0	7,074
Carbon sink potential - High - Restore productivity (1000 tCO2e/y)	0	0	824
Carbon sink potential - Low - Accelerate regeneration (1000 tCO2e/y)	0	0	65.8
Carbon sink potential - Low - All (not counting overlap) (1000 tCO2e/y)	0	0	8,305
Carbon sink potential - Low - Avoid deforestation (1000 tCO2e/y)	0	0	256
Carbon sink potential - Low - Extend rotation length (1000 tCO2e/y)	0	0	420
Carbon sink potential - Low - Improve plantations (1000 tCO2e/y)	0	0	20.3
Carbon sink potential - Low - Increase retention of HWP (1000 tCO2e/y)	0	0	244

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

Item	2020	2025	2050
Carbon sink potential - Low - Increase trees outside forests (1000 tCO2e/y)	0	0	1,245
Carbon sink potential - Low - Reforest cropland (1000 tCO2e/y)	0	0	5,241
Carbon sink potential - Low - Reforest pasture (1000 tCO2e/y)	0	0	536
Carbon sink potential - Low - Restore productivity (1000 tCO2e/y)	0	0	278
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO2e/y)	0	0	98.5
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO2e/y)	0	0	16,885
Carbon sink potential - Mid - Avoid deforestation (1000 tCO2e/y)	0	0	895
Carbon sink potential - Mid - Extend rotation length (1000 tCO2e/y)	0	0	756
Carbon sink potential - Mid - Improve plantations (1000 tCO2e/y)	0	0	29.7
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO2e/y)	0	0	488
Carbon sink potential - Mid - Increase trees outside forests (1000 tCO2e/y)	0	0	2,400
Carbon sink potential - Mid - Reforest cropland (1000 tCO2e/y)	0	0	7,862
Carbon sink potential - Mid - Reforest pasture (1000 tCO2e/y)	0	0	3,805
Carbon sink potential - Mid - Restore productivity (1000 tCO2e/y)	0	0	551
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)	0	0	21.5
Land impacted for carbon sink potential - High - Avoid deforestation (over 30 years) (1000 hectares)	0	0	208
Land impacted for carbon sink potential - High - Extend rotation length (1000 hectares)	0	0	557
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)	0	0	14.7
Land impacted for carbon sink potential - High - Increase retention of HWP (1000 hectares)	0	0	0
Land impacted for carbon sink potential - High - Increase trees outside forests (1000 hectares)	0	0	338
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)	0	0	693
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)	0	0	201
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)	0	0	273
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)	0	0	2,306
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)	0	0	10.7
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)	0	0	195
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)	0	0	213
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)	0	0	7.34
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	178

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	347
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)	0	0	34.8
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)	0	0	165
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)	0	0	1,151
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)	0	0	16.1
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)	0	0	201
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)	0	0	385
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)	0	0	11
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	258
Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares)	0	0	520
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)	0	0	252
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)	0	0	333
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)	0	0	1,976

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

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal (million 2019$)	0	289	0.218	0.209	0.173	0.115	0.003
Monetary damages from air pollution - Natural Gas (million 2019$)	0	104	49.6	53.7	37	15	6.9
Monetary damages from air pollution - Transportation (million 2019$)	0	349	321	241	137	62.1	24.5
Premature deaths from air pollution - Coal (deaths)	0	32.4	0.025	0.023	0.019	0.013	0
Premature deaths from air pollution - Natural Gas (deaths)	0	11.7	5.61	6.06	4.18	1.7	0.78
Premature deaths from air pollution - Transportation (deaths)	0	39.2	36.1	27.1	15.5	6.99	2.75

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

Item	2020	2025	2030	2035	2040	2045	2050
Residential HVAC investment in 2020s vs. REF - Cumulative 5-yr (billion $2018)	0	2.72	3.37	0	0	0	0
Sales of cooking units - Electric Resistance (%)	62.1	63.1	66.6	75.7	88.4	96.3	99
Sales of cooking units - Gas (%)	37.9	36.9	33.4	24.3	11.6	3.74	1.01
Sales of space heating units - Electric Heat Pump (%)	4.32	7.79	10.3	18.6	37.9	61.5	75.1
Sales of space heating units - Electric Resistance (%)	10.7	15	14.6	13.6	11.1	7.88	6.19
Sales of space heating units - Fossil (%)	10.9	17.8	17.4	15.8	12.1	7.79	5.49
Sales of space heating units - Gas (%)	74.1	59.4	57.7	52.1	39	22.8	13.2
Sales of water heating units - Electric Heat Pump (%)	0	0.379	1.42	4.88	13.3	23.9	30.1
Sales of water heating units - Electric Resistance (%)	25.3	40.4	40.9	42.9	47.7	53.9	57.5

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

Item	2020	2025	2030	2035	2040	2045	2050
Sales of water heating units - Gas Furnace (%)	74.7	59.2	57.6	52.2	39	22.2	12.3
Sales of water heating units - Other (%)	0.023	0.026	0.026	0.026	0.026	0.025	0.025

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	114	242	813	2,567	3,737
Public EV charging plugs - DC Fast (1000 units)	0.103	0	0.425	0	2.32	0	6.52
Public EV charging plugs - L2 (1000 units)	0.26	0	10.2	0	55.9	0	157
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 (%)	1.72	2.11	2.09	1.67	1.08	0.558	0.238
Vehicle sales - Light-duty - EV (%)	1.7	4.27	11	24.5	46.8	71	87.2
Vehicle sales - Light-duty - gasoline (%)	92.3	88.3	81	68.4	47.9	25.9	11.4
Vehicle sales - Light-duty - hybrid (%)	4.03	4.87	5.52	5.1	3.9	2.35	1.15
Vehicle sales - Light-duty - hydrogen FC (%)	0.113	0.385	0.335	0.26	0.187	0.104	0.048
Vehicle sales - Light-duty - other (%)	0.11	0.113	0.104	0.091	0.066	0.037	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)	119	116	113	110	106	102	97.9
Final energy use - Industry (PJ)	698	728	742	746	756	762	767
Final energy use - Residential (PJ)	158	150	143	137	130	120	108
Final energy use - Transportation (PJ)	289	271	246	226	211	194	173

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	9,055	9,867	0	0	0	0
Sales of cooking units - Electric Resistance (%)	44.8	49.3	53.1	63	76.9	85.5	88.5
Sales of cooking units - Gas (%)	55.2	50.7	46.9	37	23.1	14.5	11.5
Sales of space heating units - Electric Heat Pump (%)	2.46	6.56	8.85	16.3	34.3	56.8	70
Sales of space heating units - Electric Resistance (%)	4.11	5.51	5.75	6.55	8.23	10.1	11.1
Sales of space heating units - Fossil (%)	2.55	2.28	2.17	1.72	1.01	0.534	0.37
Sales of space heating units - Gas Furnace (%)	90.9	85.6	83.2	75.4	56.5	32.5	18.5
Sales of water heating units - Electric Heat Pump (%)	0.634	1.28	2.56	6.82	17.1	30.1	37.7
Sales of water heating units - Electric Resistance (%)	5.5	7.41	8.68	12.8	22.8	35.4	42.8
Sales of water heating units - Gas Furnace (%)	93	90.3	87.8	79.5	59.3	33.8	18.7
Sales of water heating units - Other (%)	0.862	0.976	0.957	0.895	0.802	0.745	0.724

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	2.47	2.54	3.3	3.45	4.74	5.02

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	0.005	0.13	0	0	0	0
Capital invested - Biomass w/ccu allam power plant (billion $2018)	0	0	0	0	0.012	0	0
Capital invested - Biomass w/ccu power plant (billion $2018)	0	0	0	0	8.02	0.797	0

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

Item	2020	2025	2030	2035	2040	2045	2050
Biomass power plant (GWh)	0	9.52	264	264	264	264	264
Biomass w/ccu allam power plant (GWh)	0	0	0	0	11.5	11.5	11.5
Biomass w/ccu power plant (GWh)	0	0	0	0	9,003	9,897	9,897

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

Item	2020	2025	2030	2035	2040	2045	2050
Biomass purchases (million $2018/year)	0	311	335	337	3,172	4,260	8,697
Conversion capital investment - Cumulative 5-yr (million $2018)	0	5.5	145	27.7	29,846	11,171	70,993
Number of facilities - Allam power w ccu (quantity)	0	0	0	0	1	1	1
Number of facilities - Beccs hydrogen (quantity)	0	0	0	0	25	39	49
Number of facilities - Diesel (quantity)	0	0	0	1	2	2	2
Number of facilities - Diesel ccu (quantity)	0	0	0	0	1	1	1
Number of facilities - Power (quantity)	0	1	1	1	1	1	1
Number of facilities - Power ccu (quantity)	0	0	0	0	7	8	8
Number of facilities - Pyrolysis (quantity)	0	0	0	1	2	2	2
Number of facilities - Pyrolysis ccu (quantity)	0	0	0	0	0	1	44
Number of facilities - Sng (quantity)	0	1	1	1	1	1	1
Number of facilities - Sng ccu (quantity)	0	0	0	0	0	0	0

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

Item	2020	2025	2030	2035	2040	2045	2050
Annual - All (MMT)	0	0	3.24	3.35	41.1	55.5	96.1
Annual - BECCS (MMT)	0	0	0	0	37.8	52.1	92.6
Annual - Cement and lime (MMT)	0	0	3.24	3.35	3.32	3.42	3.53
Annual - NGCC (MMT)	0	0	0.01	0	0	0	0
Cumulative - All (MMT)	0	0	3.24	6.59	47.7	103	199
Cumulative - BECCS (MMT)	0	0	0	0	37.8	89.9	182
Cumulative - Cement and lime (MMT)	0	0	3.24	6.59	9.91	13.3	16.9
Cumulative - NGCC (MMT)	0	0	0.01	0.01	0.01	0.01	0.01

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

Item	2020	2025	2030	2035	2040	2045	2050
CO2 storage (MMT)	0	0	0	0	0	0	0
Injection wells (wells)	0	0	0	0	0	0	0
Resource characterization, appraisal, permitting costs (million $2020)	0	0	0.01	0.02	0.02	0.02	0.02
Wells and facilities construction costs (million $2020)	0	0	0	0.02	0.03	0.06	0.07

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

Item	2020	2025	2030	2035	2040	2045	2050
All (km)	0	0	664	887	2,807	4,289	6,153
Cumulative investment - All (million $2018)	0	0	4,269	5,411	10,382	11,657	13,724
Cumulative investment - Spur (million $2018)	0	0	39.1	191	1,957	3,232	5,299
Cumulative investment - Trunk (million $2018)	0	0	4,230	5,220	8,425	8,425	8,425
Spur (km)	0	0	47	96.9	1,400	2,882	4,746
Trunk (km)	0	0	617	790	1,407	1,407	1,407

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	-5,657
Carbon sink potential - Aggressive deployment - Cropland measures (1000 tCO2e/y)	0	0	-12,929
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	-431
Carbon sink potential - Aggressive deployment - Total (1000 tCO2e/y)	0	0	-19,017
Carbon sink potential - Moderate deployment - Corn-ethanol to energy grasses (1000 tCO2e/y)	0	0	-5,657
Carbon sink potential - Moderate deployment - Cropland measures (1000 tCO2e/y)	0	0	-6,820
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	-215
Carbon sink potential - Moderate deployment - Total (1000 tCO2e/y)	0	0	-12,692
Land impacted for carbon sink - Aggressive deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	2,826
Land impacted for carbon sink - Aggressive deployment - Cropland measures (1000 hectares)	0	0	17,578
Land impacted for carbon sink - Aggressive deployment - Cropland to woody energy crops (1000 hectares)	0	0	436
Land impacted for carbon sink - Aggressive deployment - Pasture to energy crops (1000 hectares)	0	0	259
Land impacted for carbon sink - Aggressive deployment - Permanent conservation cover (1000 hectares)	0	0	784
Land impacted for carbon sink - Aggressive deployment - Total (1000 hectares)	0	0	21,883
Land impacted for carbon sink - Moderate deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	2,826
Land impacted for carbon sink - Moderate deployment - Cropland measures (1000 hectares)	0	0	3,755
Land impacted for carbon sink - Moderate deployment - Cropland to woody energy crops (1000 hectares)	0	0	436
Land impacted for carbon sink - Moderate deployment - Pasture to energy crops (1000 hectares)	0	0	259
Land impacted for carbon sink - Moderate deployment - Permanent conservation cover (1000 hectares)	0	0	392
Land impacted for carbon sink - Moderate deployment - Total (1000 hectares)	0	0	7,668

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	131
Carbon sink potential - High - All (not counting overlap) (1000 tCO2e/y)	0	0	25,467
Carbon sink potential - High - Avoid deforestation (1000 tCO2e/y)	0	0	1,534
Carbon sink potential - High - Extend rotation length (1000 tCO2e/y)	0	0	1,092
Carbon sink potential - High - Improve plantations (1000 tCO2e/y)	0	0	39.8
Carbon sink potential - High - Increase retention of HWP (1000 tCO2e/y)	0	0	732
Carbon sink potential - High - Increase trees outside forests (1000 tCO2e/y)	0	0	3,556
Carbon sink potential - High - Reforest cropland (1000 tCO2e/y)	0	0	10,483
Carbon sink potential - High - Reforest pasture (1000 tCO2e/y)	0	0	7,074
Carbon sink potential - High - Restore productivity (1000 tCO2e/y)	0	0	824
Carbon sink potential - Low - Accelerate regeneration (1000 tCO2e/y)	0	0	65.8
Carbon sink potential - Low - All (not counting overlap) (1000 tCO2e/y)	0	0	8,305
Carbon sink potential - Low - Avoid deforestation (1000 tCO2e/y)	0	0	256
Carbon sink potential - Low - Extend rotation length (1000 tCO2e/y)	0	0	420
Carbon sink potential - Low - Improve plantations (1000 tCO2e/y)	0	0	20.3
Carbon sink potential - Low - Increase retention of HWP (1000 tCO2e/y)	0	0	244
Carbon sink potential - Low - Increase trees outside forests (1000 tCO2e/y)	0	0	1,245
Carbon sink potential - Low - Reforest cropland (1000 tCO2e/y)	0	0	5,241
Carbon sink potential - Low - Reforest pasture (1000 tCO2e/y)	0	0	536
Carbon sink potential - Low - Restore productivity (1000 tCO2e/y)	0	0	278
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO2e/y)	0	0	98.5
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO2e/y)	0	0	16,885
Carbon sink potential - Mid - Avoid deforestation (1000 tCO2e/y)	0	0	895
Carbon sink potential - Mid - Extend rotation length (1000 tCO2e/y)	0	0	756
Carbon sink potential - Mid - Improve plantations (1000 tCO2e/y)	0	0	29.7
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO2e/y)	0	0	488
Carbon sink potential - Mid - Increase trees outside forests (1000 tCO2e/y)	0	0	2,400
Carbon sink potential - Mid - Reforest cropland (1000 tCO2e/y)	0	0	7,862
Carbon sink potential - Mid - Reforest pasture (1000 tCO2e/y)	0	0	3,805
Carbon sink potential - Mid - Restore productivity (1000 tCO2e/y)	0	0	551
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)	0	0	21.5

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	208
Land impacted for carbon sink potential - High - Extend rotation length (1000 hectares)	0	0	557
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)	0	0	14.7
Land impacted for carbon sink potential - High - Increase retention of HWP (1000 hectares)	0	0	0
Land impacted for carbon sink potential - High - Increase trees outside forests (1000 hectares)	0	0	338
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)	0	0	693
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)	0	0	201
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)	0	0	273
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)	0	0	2,306
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)	0	0	10.7
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)	0	0	195
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)	0	0	213
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)	0	0	7.34
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	178
Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares)	0	0	347
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)	0	0	34.8
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)	0	0	165
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)	0	0	1,151
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)	0	0	16.1
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)	0	0	201
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)	0	0	385
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)	0	0	11
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	258
Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares)	0	0	520
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)	0	0	252
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)	0	0	333
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)	0	0	1,976

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

Item	2020	2025	2030	2035	2040	2045	2050
Residential HVAC investment in 2020s vs. REF - Cumulative 5-yr (billion $2018)	0	2.62	2.76	0	0	0	0
Sales of cooking units - Electric Resistance (%)	61.8	61.8	61.8	61.8	61.8	61.8	61.8
Sales of cooking units - Gas (%)	38.2	38.2	38.2	38.2	38.2	38.2	38.2
Sales of space heating units - Electric Heat Pump (%)	3.44	11.4	11.7	12.3	12.7	13.2	13.9
Sales of space heating units - Electric Resistance (%)	10.9	14.5	14.3	14.1	13.9	13.4	12.8
Sales of space heating units - Fossil (%)	11.1	16.5	16.1	15.8	15.5	15.4	15.5
Sales of space heating units - Gas (%)	74.6	57.6	57.9	57.8	57.8	58	57.7
Sales of water heating units - Electric Heat Pump (%)	0	0	0	0	0	0	0
Sales of water heating units - Electric Resistance (%)	25.3	40.2	40.1	40	40	40	40
Sales of water heating units - Gas Furnace (%)	74.7	59.8	59.9	59.9	59.9	60	60
Sales of water heating units - Other (%)	0.023	0.026	0.026	0.026	0.026	0.026	0.026

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 (%)	1.71	2.1	2.21	2.06	1.86	1.73	1.65
Vehicle sales - Light-duty - EV (%)	3.03	4.92	5.63	6.88	8.43	9.87	11
Vehicle sales - Light-duty - gasoline (%)	91.1	87.7	85.8	84.2	82.2	80.3	78.6
Vehicle sales - Light-duty - hybrid (%)	3.92	4.79	5.88	6.46	7.07	7.72	8.28
Vehicle sales - Light-duty - hydrogen FC (%)	0.112	0.382	0.355	0.318	0.317	0.318	0.329
Vehicle sales - Light-duty - other (%)	0.109	0.113	0.11	0.111	0.11	0.109	0.112
Vehicle sales - Medium-duty - diesel (%)	65.2	63.5	61.6	59.6	58	56.5	55.2
Vehicle sales - Medium-duty - EV (%)	0.027	0.105	0.329	0.671	0.895	0.973	0.993
Vehicle sales - Medium-duty - gasoline (%)	34	35.5	37	38.5	39.7	40.8	41.7
Vehicle sales - Medium-duty - hybrid (%)	0.365	0.427	0.496	0.577	0.674	0.793	0.929
Vehicle sales - Medium-duty - hydrogen FC (%)	0.175	0.208	0.242	0.285	0.339	0.409	0.487
Vehicle sales - Medium-duty - other (%)	0.255	0.271	0.298	0.345	0.42	0.528	0.671

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

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Commercial (PJ)	119	119	119	117	116	116	120
Final energy use - Industry (PJ)	698	736	756	769	790	805	826
Final energy use - Residential (PJ)	158	150	146	144	143	143	143
Final energy use - Transportation (PJ)	289	271	248	234	233	240	249

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

Item	2020	2025	2030	2035	2040	2045	2050
Commercial HVAC investment in 2020s - Cumulative 5-yr (million $2018)	0	8,949	9,212	0	0	0	0
Sales of cooking units - Electric Resistance (%)	44.8	47.8	47.9	47.8	47.9	47.9	48
Sales of cooking units - Gas (%)	55.2	52.2	52.1	52.2	52.1	52.1	52
Sales of space heating units - Electric Heat Pump (%)	2.46	13	44.6	70.4	74.7	75.1	75.2
Sales of space heating units - Electric Resistance (%)	4.11	6.34	10.8	18.4	23.5	24.3	24.4
Sales of space heating units - Fossil (%)	2.55	2.22	1.72	0.767	0.114	0.009	0
Sales of space heating units - Gas Furnace (%)	90.9	78.4	43	10.4	1.69	0.519	0.457
Sales of water heating units - Electric Heat Pump (%)	0.634	0.814	0.811	0.811	0.809	0.805	0.804

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

Item	2020	2025	2030	2035	2040	2045	2050
Sales of water heating units - Electric Resistance (%)	5.5	6.96	6.98	6.96	6.96	6.97	6.97
Sales of water heating units - Gas Furnace (%)	93	91.2	91.2	91.2	91.3	91.2	91.2
Sales of water heating units - Other (%)	0.862	0.984	0.985	0.982	0.981	0.985	0.986

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

Item	2020	2025	2030	2035	2040	2045	2050
Electricity distribution capital invested - Cumulative 5-yr (billion $2018)	0	2.55	2.62	2.79	2.88	2.99	3.08

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

Item	2020	2025	2030	2050
Business-as-usual carbon sink - Natural uptake (Mt CO2e/y)	3.55	0	-2.54	-2.27
Business-as-usual carbon sink - Retained in Hardwood Products (Mt CO2e/y)	-0.199	0	-0.358	-0.373
Business-as-usual carbon sink - Total (Mt CO2e/y)	3.35	0	-2.9	-2.65
Carbon sink potential - High - Accelerate regeneration (1000 tCO2e/y)	0	0	0	131
Carbon sink potential - High - All (not counting overlap) (1000 tCO2e/y)	0	0	0	25,467
Carbon sink potential - High - Avoid deforestation (1000 tCO2e/y)	0	0	0	1,534
Carbon sink potential - High - Extend rotation length (1000 tCO2e/y)	0	0	0	1,092
Carbon sink potential - High - Improve plantations (1000 tCO2e/y)	0	0	0	39.8
Carbon sink potential - High - Increase retention of HWP (1000 tCO2e/y)	0	0	0	732
Carbon sink potential - High - Increase trees outside forests (1000 tCO2e/y)	0	0	0	3,556
Carbon sink potential - High - Reforest cropland (1000 tCO2e/y)	0	0	0	10,483
Carbon sink potential - High - Reforest pasture (1000 tCO2e/y)	0	0	0	7,074
Carbon sink potential - High - Restore productivity (1000 tCO2e/y)	0	0	0	824
Carbon sink potential - Low - Accelerate regeneration (1000 tCO2e/y)	0	0	0	65.8
Carbon sink potential - Low - All (not counting overlap) (1000 tCO2e/y)	0	0	0	8,305
Carbon sink potential - Low - Avoid deforestation (1000 tCO2e/y)	0	0	0	256
Carbon sink potential - Low - Extend rotation length (1000 tCO2e/y)	0	0	0	420
Carbon sink potential - Low - Improve plantations (1000 tCO2e/y)	0	0	0	20.3
Carbon sink potential - Low - Increase retention of HWP (1000 tCO2e/y)	0	0	0	244
Carbon sink potential - Low - Increase trees outside forests (1000 tCO2e/y)	0	0	0	1,245
Carbon sink potential - Low - Reforest cropland (1000 tCO2e/y)	0	0	0	5,241
Carbon sink potential - Low - Reforest pasture (1000 tCO2e/y)	0	0	0	536
Carbon sink potential - Low - Restore productivity (1000 tCO2e/y)	0	0	0	278
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO2e/y)	0	0	0	98.5
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO2e/y)	0	0	0	16,885

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	895
Carbon sink potential - Mid - Extend rotation length (1000 tCO2e/y)	0	0	0	756
Carbon sink potential - Mid - Improve plantations (1000 tCO2e/y)	0	0	0	29.7
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO2e/y)	0	0	0	488
Carbon sink potential - Mid - Increase trees outside forests (1000 tCO2e/y)	0	0	0	2,400
Carbon sink potential - Mid - Reforest cropland (1000 tCO2e/y)	0	0	0	7,862
Carbon sink potential - Mid - Reforest pasture (1000 tCO2e/y)	0	0	0	3,805
Carbon sink potential - Mid - Restore productivity (1000 tCO2e/y)	0	0	0	551
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)	0	0	0	21.5
Land impacted for carbon sink potential - High - Avoid deforestation (over 30 years) (1000 hectares)	0	0	0	208
Land impacted for carbon sink potential - High - Extend rotation length (1000 hectares)	0	0	0	557
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)	0	0	0	14.7
Land impacted for carbon sink potential - High - Increase retention of HWP (1000 hectares)	0	0	0	0
Land impacted for carbon sink potential - High - Increase trees outside forests (1000 hectares)	0	0	0	338
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)	0	0	0	693
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)	0	0	0	201
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)	0	0	0	273
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)	0	0	0	2,306
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)	0	0	0	10.7
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)	0	0	0	195
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)	0	0	0	213
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)	0	0	0	7.34
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	178
Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares)	0	0	0	347
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)	0	0	0	34.8
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)	0	0	0	165
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)	0	0	0	1,151
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)	0	0	0	16.1
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)	0	0	0	201

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	385
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)	0	0	0	11
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	258
Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares)	0	0	0	520
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)	0	0	0	252
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)	0	0	0	333
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)	0	0	0	1,976

Table 64: *REF scenario - IMPACTS - Health*

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal (million 2019$)	0	895	502	304	245	215	209
Monetary damages from air pollution - Natural Gas (million 2019$)	0	115	98.7	109	70.5	61.2	56.5
Monetary damages from air pollution - Transportation (million 2019$)	0	354	357	362	368	375	382
Premature deaths from air pollution - Coal (deaths)	0	100	56.3	34.1	27.5	24.1	23.4
Premature deaths from air pollution - Natural Gas (deaths)	0	13	11.1	12.3	7.97	6.91	6.38
Premature deaths from air pollution - Transportation (deaths)	0	39.8	40.2	40.7	41.4	42.2	43