Net-Zero America - illinois 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	10.8	14.4	0	0	0	0
Sales of cooking units - Electric Resistance (%)	50.8	61.3	93.4	99.7	100	100	100
Sales of cooking units - Gas (%)	49.2	38.7	6.63	0.334	0	0	0
Sales of space heating units - Electric Heat Pump (%)	3.5	10.7	39.6	85.8	93.9	94.4	94.2
Sales of space heating units - Electric Resistance (%)	12.7	18.4	13.8	6.17	4.76	4.69	4.9
Sales of space heating units - Fossil (%)	2.45	4.48	3.17	1.07	0.718	0.695	0.671
Sales of space heating units - Gas (%)	81.4	66.5	43.4	6.93	0.605	0.212	0.217
Sales of water heating units - Electric Heat Pump (%)	0	1.85	15.9	37.3	41	41.2	41.2
Sales of water heating units - Electric Resistance (%)	22.7	38.5	43.9	56.3	58.6	58.7	58.6
Sales of water heating units - Gas Furnace (%)	77.3	59.6	40	6.28	0.367	0	0
Sales of water heating units - Other (%)	0.046	0.112	0.113	0.113	0.111	0.111	0.112

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	2,022	5,214	8,399	12,743	13,847	13,214
Public EV charging plugs - DC Fast (1000 units)	0.299	0	3.24	0	13.9	0	22.4
Public EV charging plugs - L2 (1000 units)	1.41	0	78	0	334	0	539
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 (%)	1.4	1.68	1.2	0.382	0.072	0.013	0
Vehicle sales - Light-duty - EV (%)	4.42	16.7	48.8	82.7	96.4	99.3	100
Vehicle sales - Light-duty - gasoline (%)	89.1	76.3	46.4	15.6	3.17	0.586	0
Vehicle sales - Light-duty - hybrid (%)	4.91	4.9	3.38	1.24	0.304	0.067	0
Vehicle sales - Light-duty - hydrogen FC (%)	0.11	0.331	0.191	0.059	0.012	0.002	0
Vehicle sales - Light-duty - other (%)	0.095	0.091	0.058	0.02	0.004	0.001	0
Vehicle sales - Medium-duty - diesel (%)	64.7	59.7	42.3	14.4	2.59	0.384	0
Vehicle sales - Medium-duty - EV (%)	0.784	5.07	25.3	60.8	76.5	79.5	80
Vehicle sales - Medium-duty - gasoline (%)	33.7	33.3	25.5	9.32	1.77	0.277	0
Vehicle sales - Medium-duty - hybrid (%)	0.363	0.402	0.341	0.14	0.03	0.005	0
Vehicle sales - Medium-duty - hydrogen FC (%)	0.196	1.27	6.33	15.2	19.1	19.9	20
Vehicle sales - Medium-duty - other (%)	0.253	0.255	0.205	0.083	0.019	0.004	0

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

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Commercial (PJ)	441	434	415	383	346	319	305
Final energy use - Industry (PJ)	634	660	671	671	678	686	694
Final energy use - Residential (PJ)	591	551	512	443	367	307	269
Final energy use - Transportation (PJ)	1,043	977	873	748	634	562	530

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	40,927	44,680	0	0	0	0
Sales of cooking units - Electric Resistance (%)	41	54.2	82.9	88.6	88.9	88.9	88.9
Sales of cooking units - Gas (%)	59	45.8	17.1	11.4	11.1	11.1	11.1
Sales of space heating units - Electric Heat Pump (%)	0.751	8.27	35.3	81	89	89.5	89.5
Sales of space heating units - Electric Resistance (%)	2.86	3.5	5.34	9.38	10.1	10.2	10.2
Sales of space heating units - Fossil (%)	0	2.07	0.402	0.017	0	0	0

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

Item	2020	2025	2030	2035	2040	2045	2050
Sales of space heating units - Gas Furnace (%)	96.4	86.2	59	9.63	0.906	0.363	0.363
Sales of water heating units - Electric Heat Pump (%)	0.271	2.48	19.4	46.1	50.7	51	51
Sales of water heating units - Electric Resistance (%)	2.65	4.62	18.3	44	48.5	48.8	48.8
Sales of water heating units - Gas Furnace (%)	96.9	92.7	62.2	9.74	0.572	0	0
Sales of water heating units - Other (%)	0.154	0.185	0.186	0.187	0.186	0.187	0.187

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	6.63	6.83	11.6	12.4	12.3	13

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	0
Capital invested - Biomass w/ccu power plant (billion $2018)	0	0	0.199	0	0	0	0
Capital invested - Solar PV - Base (billion $2018)	0	2.64	1.73	5.31	8.41	4.98	2.34
Capital invested - Solar PV - Constrained (billion $2018)	0	1.16	2.5	7.75	8.56	5.43	1.47
Capital invested - Wind - Base (billion $2018)	0	10.1	29	25.6	30.1	28	30.8
Capital invested - Wind - Constrained (billion $2018)	0	3.55	6.59	4.41	2.68	0.201	66

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	24.2	24.2	24.2	24.2
Biomass w/ccu power plant (GWh)	0	0	224	224	224	224	224
Solar - Base land use assumptions (GWh)	650	3,663	2,607	8,856	14,766	8,959	4,440
Solar - Constrained land use assumptions (GWh)	770	1,890	4,260	8,627	12,881	11,258	2,947
Wind - Base land use assumptions (GWh)	22,788	22,093	70,431	65,330	79,992	77,614	88,212
Wind - Constrained land use assumptions (GWh)	23,175	7,399	15,480	10,759	6,967	407	178,172

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

Item	2020	2025	2030	2035	2040	2045	2050
Biomass purchases (million $2018/year)	0	0	11.3	2,030	3,353	3,754	3,754
Conversion capital investment - Cumulative 5-yr (million $2018)	0	0	183	29,262	19,141	5,818	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	33	56	63	63
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	2	2	2	2	2
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	2	2	2	2	2

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

Item	2020	2025	2030	2035	2040	2045	2050
Annual - All (MMT)	0	0	0.24	41.5	66.8	74.1	74.8
Annual - BECCS (MMT)	0	0	0.22	37.8	62.4	69.9	69.9
Annual - Cement and lime (MMT)	0	0	0	3.35	3.32	3.42	3.53
Annual - NGCC (MMT)	0	0	0.02	0.38	1.08	0.81	1.38
Cumulative - All (MMT)	0	0	0.24	41.8	109	183	257
Cumulative - BECCS (MMT)	0	0	0.22	38	100	170	240
Cumulative - Cement and lime (MMT)	0	0	0	3.35	6.67	10.1	13.6
Cumulative - NGCC (MMT)	0	0	0.02	0.4	1.48	2.29	3.67

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

Item	2020	2025	2030	2035	2040	2045	2050
CO2 storage (MMT)	0	0	1.1	3.52	7.23	11.2	14.9
Injection wells (wells)	0	0	2	9	15	26	32
Resource characterization, appraisal, permitting costs (million $2020)	0	100	281	361	361	361	361
Wells and facilities construction costs (million $2020)	0	0	66.8	260	464	776	963

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

Item	2020	2025	2030	2035	2040	2045	2050
All (km)	0	0	1,464	3,167	4,446	5,778	6,621
Cumulative investment - All (million $2018)	0	0	6,204	9,975	10,943	12,504	13,165
Cumulative investment - Spur (million $2018)	0	0	304	1,825	2,792	4,354	5,015
Cumulative investment - Trunk (million $2018)	0	0	5,900	8,150	8,150	8,150	8,150
Spur (km)	0	0	507	1,842	3,122	4,454	5,297
Trunk (km)	0	0	958	1,324	1,324	1,324	1,324

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	-3,836
Carbon sink potential - Aggressive deployment - Cropland measures (1000 tCO2e/y)	0	0	-17,544
Carbon sink potential - Aggressive deployment - Permanent conservation cover (1000 tCO2e/y)	0	0	-428
Carbon sink potential - Aggressive deployment - Total (1000 tCO2e/y)	0	0	-21,808
Carbon sink potential - Moderate deployment - Corn-ethanol to energy grasses (1000 tCO2e/y)	0	0	-3,836
Carbon sink potential - Moderate deployment - Cropland measures (1000 tCO2e/y)	0	0	-9,245
Carbon sink potential - Moderate deployment - Permanent conservation cover (1000 tCO2e/y)	0	0	-214
Carbon sink potential - Moderate deployment - Total (1000 tCO2e/y)	0	0	-13,295
Land impacted for carbon sink - Aggressive deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	1,734
Land impacted for carbon sink - Aggressive deployment - Cropland measures (1000 hectares)	0	0	7,209
Land impacted for carbon sink - Aggressive deployment - Permanent conservation cover (1000 hectares)	0	0	779
Land impacted for carbon sink - Aggressive deployment - Total (1000 hectares)	0	0	9,721
Land impacted for carbon sink - Moderate deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	1,734

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

Item	2020	2025	2050
Land impacted for carbon sink - Moderate deployment - Cropland measures (1000 hectares)	0	0	3,799
Land impacted for carbon sink - Moderate deployment - Permanent conservation cover (1000 hectares)	0	0	389
Land impacted for carbon sink - Moderate deployment - Total (1000 hectares)	0	0	5,922

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

Item	2020	2025	2050
Carbon sink potential - High - Accelerate regeneration (1000 tCO2e/y)	0	0	95.6
Carbon sink potential - High - All (not counting overlap) (1000 tCO2e/y)	0	0	21,662
Carbon sink potential - High - Avoid deforestation (1000 tCO2e/y)	0	0	2,692
Carbon sink potential - High - Extend rotation length (1000 tCO2e/y)	0	0	2,426
Carbon sink potential - High - Improve plantations (1000 tCO2e/y)	0	0	108
Carbon sink potential - High - Increase retention of HWP (1000 tCO2e/y)	0	0	1,364
Carbon sink potential - High - Increase trees outside forests (1000 tCO2e/y)	0	0	3,477
Carbon sink potential - High - Reforest cropland (1000 tCO2e/y)	0	0	5,430
Carbon sink potential - High - Reforest pasture (1000 tCO2e/y)	0	0	4,831
Carbon sink potential - High - Restore productivity (1000 tCO2e/y)	0	0	1,239
Carbon sink potential - Low - Accelerate regeneration (1000 tCO2e/y)	0	0	47.9
Carbon sink potential - Low - All (not counting overlap) (1000 tCO2e/y)	0	0	6,654
Carbon sink potential - Low - Avoid deforestation (1000 tCO2e/y)	0	0	449
Carbon sink potential - Low - Extend rotation length (1000 tCO2e/y)	0	0	932
Carbon sink potential - Low - Improve plantations (1000 tCO2e/y)	0	0	55.1
Carbon sink potential - Low - Increase retention of HWP (1000 tCO2e/y)	0	0	455
Carbon sink potential - Low - Increase trees outside forests (1000 tCO2e/y)	0	0	1,217
Carbon sink potential - Low - Reforest cropland (1000 tCO2e/y)	0	0	2,715
Carbon sink potential - Low - Reforest pasture (1000 tCO2e/y)	0	0	366
Carbon sink potential - Low - Restore productivity (1000 tCO2e/y)	0	0	418
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO2e/y)	0	0	71.7
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO2e/y)	0	0	14,157
Carbon sink potential - Mid - Avoid deforestation (1000 tCO2e/y)	0	0	1,570
Carbon sink potential - Mid - Extend rotation length (1000 tCO2e/y)	0	0	1,679
Carbon sink potential - Mid - Improve plantations (1000 tCO2e/y)	0	0	80.8
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO2e/y)	0	0	909

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	2,347
Carbon sink potential - Mid - Reforest cropland (1000 tCO2e/y)	0	0	4,073
Carbon sink potential - Mid - Reforest pasture (1000 tCO2e/y)	0	0	2,599
Carbon sink potential - Mid - Restore productivity (1000 tCO2e/y)	0	0	828
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)	0	0	15.6
Land impacted for carbon sink potential - High - Avoid deforestation (over 30 years) (1000 hectares)	0	0	364
Land impacted for carbon sink potential - High - Extend rotation length (1000 hectares)	0	0	1,237
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)	0	0	39.9
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	330
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)	0	0	359
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)	0	0	137
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)	0	0	411
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)	0	0	2,894
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)	0	0	7.82
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)	0	0	342
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)	0	0	474
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)	0	0	20
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	174
Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares)	0	0	180
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)	0	0	23.8
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)	0	0	248
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)	0	0	1,469
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)	0	0	11.7
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)	0	0	353
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)	0	0	855
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)	0	0	30
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	252

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	269
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)	0	0	172
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)	0	0	500
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)	0	0	2,444

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

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal (million 2019$)	0	967	0.82	0.798	0.692	0.487	0.034
Monetary damages from air pollution - Natural Gas (million 2019$)	0	406	285	214	182	104	45
Monetary damages from air pollution - Transportation (million 2019$)	0	4,899	4,586	3,504	2,047	963	413
Premature deaths from air pollution - Coal (deaths)	0	109	0.092	0.089	0.078	0.055	0.004
Premature deaths from air pollution - Natural Gas (deaths)	0	45.8	32.2	24.1	20.6	11.8	5.09
Premature deaths from air pollution - Transportation (deaths)	0	551	516	394	230	108	46.5

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

Item	2020	2025	2030	2035	2040	2045	2050
By economic sector - Agriculture (jobs)	2,965	2,969	3,009	6,027	6,096	4,421	3,486
By economic sector - Construction (jobs)	12,370	17,402	25,542	34,708	42,720	45,856	51,094
By economic sector - Manufacturing (jobs)	11,251	19,745	23,393	31,660	31,381	26,513	32,791
By economic sector - Mining (jobs)	11,564	7,211	4,726	3,490	2,423	1,769	1,288
By economic sector - Other (jobs)	737	1,357	1,979	3,434	5,038	5,493	6,239
By economic sector - Pipeline (jobs)	1,070	1,058	1,601	1,066	632	556	657
By economic sector - Professional (jobs)	8,626	10,710	15,142	24,613	32,319	36,422	40,856
By economic sector - Trade (jobs)	8,227	8,059	9,493	12,933	16,399	18,501	21,341
By economic sector - Utilities (jobs)	20,127	21,944	26,956	32,994	38,326	40,915	46,284
By education level - All sectors - Associates degree or some college (jobs)	22,609	27,319	34,622	46,468	54,488	56,651	64,674
By education level - All sectors - Bachelors degree (jobs)	15,947	18,781	23,004	30,907	36,166	37,734	42,706
By education level - All sectors - Doctoral degree (jobs)	526	621	798	1,160	1,442	1,570	1,749
By education level - All sectors - High school diploma or less (jobs)	34,002	39,240	47,835	64,703	74,038	74,717	83,892
By education level - All sectors - Masters or professional degree (jobs)	3,853	4,493	5,582	7,687	9,200	9,776	11,014
By resource sector - Biomass (jobs)	7,202	7,011	6,882	15,395	17,314	16,261	15,366
By resource sector - CO2 (jobs)	0	53.1	5,823	3,018	974	1,978	3,799
By resource sector - Coal (jobs)	11,281	4,620	1,584	1,162	1,004	900	796
By resource sector - Grid (jobs)	20,170	24,329	31,296	49,021	61,863	71,240	83,397
By resource sector - Natural Gas (jobs)	10,580	10,687	8,662	7,320	7,749	4,221	3,147
By resource sector - Nuclear (jobs)	6,369	6,266	5,516	3,870	2,680	1,368	0
By resource sector - Oil (jobs)	13,013	11,530	9,557	7,423	5,282	3,774	2,521
By resource sector - Solar (jobs)	3,308	9,777	10,623	18,308	23,642	20,303	23,475
By resource sector - Wind (jobs)	5,014	16,180	31,897	45,408	54,826	60,402	71,532
Median wages - Annual - All ($2019 per job)	64,497	64,977	66,411	67,018	68,533	70,362	71,320
On-Site or In-Plant Training - Total jobs - 1 to 4 years (jobs)	11,921	14,200	17,888	23,892	27,925	28,977	32,936
On-Site or In-Plant Training - Total jobs - 4 to 10 years (jobs)	4,645	5,518	7,215	9,578	11,448	12,172	13,775
On-Site or In-Plant Training - Total jobs - None (jobs)	12,029	14,546	18,152	24,767	28,922	29,763	33,601

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)	591	732	953	1,277	1,501	1,573	1,799
On-Site or In-Plant Training - Total jobs - Up to 1 year (jobs)	47,751	55,458	67,632	91,410	105,538	107,963	121,924
On-the-Job Training - All sectors - 1 to 4 years (jobs)	15,116	18,106	22,978	30,637	35,933	37,435	42,598
On-the-Job Training - All sectors - 4 to 10 years (jobs)	4,422	5,281	6,999	9,347	11,254	12,014	13,607
On-the-Job Training - All sectors - None (jobs)	4,184	4,926	6,033	8,107	9,440	9,734	10,961
On-the-Job Training - All sectors - Over 10 years (jobs)	681	879	1,109	1,459	1,659	1,669	1,899
On-the-Job Training - All sectors - Up to 1 year (jobs)	52,534	61,261	74,721	101,374	117,048	119,594	134,970
Related work experience - All sectors - 1 to 4 years (jobs)	27,689	32,202	39,725	53,657	62,656	64,815	73,283
Related work experience - All sectors - 4 to 10 years (jobs)	17,121	20,469	25,716	34,424	40,324	42,009	47,740
Related work experience - All sectors - None (jobs)	11,045	13,011	16,120	21,780	25,262	25,904	29,229
Related work experience - All sectors - Over 10 years (jobs)	4,670	5,658	7,001	9,294	10,723	11,039	12,597
Related work experience - All sectors - Up to 1 year (jobs)	16,412	19,114	23,279	31,769	36,369	36,680	41,185
Wage income - All (million $2019)	4,962	5,878	7,428	10,115	12,017	12,698	14,553

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

Item	2020	2025	2030	2035	2040	2045	2050
Natural gas consumption - Annual (tcf)	846	858	723	580	437	275	191
Natural gas consumption - Cumulative (tcf)	0	0	0	0	0	0	17,474
Natural gas production - Annual (tcf)	2.62	2.9	2.75	2.39	2.02	1.6	1.25
Oil consumption - Annual (million bbls)	215	204	179	143	108	81.3	59.6
Oil consumption - Cumulative (million bbls)	0	0	0	0	0	0	4,405
Oil production - Annual (million bbls)	10.1	10.9	10.9	10.9	8.66	7.04	4.69

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	10.7	14.3	0	0	0	0
Sales of cooking units - Electric Resistance (%)	50.6	51.9	56.4	68.3	84.9	95.1	98.7
Sales of cooking units - Gas (%)	49.4	48.1	43.6	31.7	15.1	4.87	1.31
Sales of space heating units - Electric Heat Pump (%)	3.5	8.23	11.6	22.2	45.5	72.3	87.2
Sales of space heating units - Electric Resistance (%)	12.7	18.7	18.1	16.4	12.5	8.16	5.9
Sales of space heating units - Fossil (%)	2.45	4.6	4.47	3.97	2.93	1.72	1.01
Sales of space heating units - Gas (%)	81.4	68.5	65.9	57.4	39	17.8	5.87
Sales of water heating units - Electric Heat Pump (%)	0	0.582	2.2	7.34	18.4	30.9	37.9
Sales of water heating units - Electric Resistance (%)	22.7	38.3	38.8	40.9	46.2	52.8	56.7
Sales of water heating units - Gas Furnace (%)	77.3	61	58.9	51.7	35.3	16.1	5.22
Sales of water heating units - Other (%)	0.046	0.112	0.113	0.113	0.113	0.113	0.112

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	333	687	2,331	7,297	10,644
Public EV charging plugs - DC Fast (1000 units)	0.299	0	1.05	0	5.19	0	14.3
Public EV charging plugs - L2 (1000 units)	1.41	0	25.2	0	125	0	345
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 (%)	1.41	1.85	2.03	1.61	1.02	0.519	0.223
Vehicle sales - Light-duty - EV (%)	2.06	5.07	12.6	27.1	49.7	72.9	87.9
Vehicle sales - Light-duty - gasoline (%)	91.2	86.7	78.4	65.1	44.7	23.9	10.6
Vehicle sales - Light-duty - hybrid (%)	5.1	5.88	6.55	5.89	4.34	2.52	1.21
Vehicle sales - Light-duty - hydrogen FC (%)	0.112	0.376	0.317	0.239	0.168	0.092	0.043
Vehicle sales - Light-duty - other (%)	0.096	0.1	0.09	0.078	0.056	0.03	0.014
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)	441	434	424	414	399	379	356
Final energy use - Industry (PJ)	634	660	674	680	693	701	708
Final energy use - Residential (PJ)	591	552	524	495	458	408	352
Final energy use - Transportation (PJ)	1,044	984	908	847	798	740	672

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	40,922	44,666	0	0	0	0
Sales of cooking units - Electric Resistance (%)	41	45.8	49.8	60.5	75.4	84.5	87.7
Sales of cooking units - Gas (%)	59	54.2	50.2	39.5	24.6	15.5	12.3
Sales of space heating units - Electric Heat Pump (%)	0.751	6.2	9.31	19.3	41.6	67.6	82.4
Sales of space heating units - Electric Resistance (%)	2.86	3.43	3.64	4.33	6.04	8.25	9.53
Sales of space heating units - Fossil (%)	0	2.4	2.27	1.73	0.88	0.287	0.075
Sales of space heating units - Gas Furnace (%)	96.4	88	84.8	74.6	51.5	23.8	7.97
Sales of water heating units - Electric Heat Pump (%)	0.271	1.04	2.99	9.2	22.7	38.2	46.9
Sales of water heating units - Electric Resistance (%)	2.65	3.78	5.32	10.5	22.3	36.6	44.8
Sales of water heating units - Gas Furnace (%)	96.9	95	91.5	80.1	54.8	25	8.1
Sales of water heating units - Other (%)	0.154	0.185	0.186	0.187	0.186	0.187	0.187

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	5.41	5.46	7.27	7.54	10.4	11

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	-3,836
Carbon sink potential - Aggressive deployment - Cropland measures (1000 tCO2e/y)	0	0	-17,544
Carbon sink potential - Aggressive deployment - Permanent conservation cover (1000 tCO2e/y)	0	0	-428
Carbon sink potential - Aggressive deployment - Total (1000 tCO2e/y)	0	0	-21,808

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	-3,836
Carbon sink potential - Moderate deployment - Cropland measures (1000 tCO2e/y)	0	0	-9,245
Carbon sink potential - Moderate deployment - Permanent conservation cover (1000 tCO2e/y)	0	0	-214
Carbon sink potential - Moderate deployment - Total (1000 tCO2e/y)	0	0	-13,295
Land impacted for carbon sink - Aggressive deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	1,734
Land impacted for carbon sink - Aggressive deployment - Cropland measures (1000 hectares)	0	0	7,209
Land impacted for carbon sink - Aggressive deployment - Permanent conservation cover (1000 hectares)	0	0	779
Land impacted for carbon sink - Aggressive deployment - Total (1000 hectares)	0	0	9,721
Land impacted for carbon sink - Moderate deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	1,734
Land impacted for carbon sink - Moderate deployment - Cropland measures (1000 hectares)	0	0	3,799
Land impacted for carbon sink - Moderate deployment - Permanent conservation cover (1000 hectares)	0	0	389
Land impacted for carbon sink - Moderate deployment - Total (1000 hectares)	0	0	5,922

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

Item	2020	2025	2050
Carbon sink potential - High - Accelerate regeneration (1000 tCO2e/y)	0	0	95.6
Carbon sink potential - High - All (not counting overlap) (1000 tCO2e/y)	0	0	21,662
Carbon sink potential - High - Avoid deforestation (1000 tCO2e/y)	0	0	2,692
Carbon sink potential - High - Extend rotation length (1000 tCO2e/y)	0	0	2,426
Carbon sink potential - High - Improve plantations (1000 tCO2e/y)	0	0	108
Carbon sink potential - High - Increase retention of HWP (1000 tCO2e/y)	0	0	1,364
Carbon sink potential - High - Increase trees outside forests (1000 tCO2e/y)	0	0	3,477
Carbon sink potential - High - Reforest cropland (1000 tCO2e/y)	0	0	5,430
Carbon sink potential - High - Reforest pasture (1000 tCO2e/y)	0	0	4,831
Carbon sink potential - High - Restore productivity (1000 tCO2e/y)	0	0	1,239
Carbon sink potential - Low - Accelerate regeneration (1000 tCO2e/y)	0	0	47.9
Carbon sink potential - Low - All (not counting overlap) (1000 tCO2e/y)	0	0	6,654
Carbon sink potential - Low - Avoid deforestation (1000 tCO2e/y)	0	0	449
Carbon sink potential - Low - Extend rotation length (1000 tCO2e/y)	0	0	932
Carbon sink potential - Low - Improve plantations (1000 tCO2e/y)	0	0	55.1

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	455
Carbon sink potential - Low - Increase trees outside forests (1000 tCO2e/y)	0	0	1,217
Carbon sink potential - Low - Reforest cropland (1000 tCO2e/y)	0	0	2,715
Carbon sink potential - Low - Reforest pasture (1000 tCO2e/y)	0	0	366
Carbon sink potential - Low - Restore productivity (1000 tCO2e/y)	0	0	418
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO2e/y)	0	0	71.7
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO2e/y)	0	0	14,157
Carbon sink potential - Mid - Avoid deforestation (1000 tCO2e/y)	0	0	1,570
Carbon sink potential - Mid - Extend rotation length (1000 tCO2e/y)	0	0	1,679
Carbon sink potential - Mid - Improve plantations (1000 tCO2e/y)	0	0	80.8
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO2e/y)	0	0	909
Carbon sink potential - Mid - Increase trees outside forests (1000 tCO2e/y)	0	0	2,347
Carbon sink potential - Mid - Reforest cropland (1000 tCO2e/y)	0	0	4,073
Carbon sink potential - Mid - Reforest pasture (1000 tCO2e/y)	0	0	2,599
Carbon sink potential - Mid - Restore productivity (1000 tCO2e/y)	0	0	828
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)	0	0	15.6
Land impacted for carbon sink potential - High - Avoid deforestation (over 30 years) (1000 hectares)	0	0	364
Land impacted for carbon sink potential - High - Extend rotation length (1000 hectares)	0	0	1,237
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)	0	0	39.9
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	330
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)	0	0	359
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)	0	0	137
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)	0	0	411
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)	0	0	2,894
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)	0	0	7.82
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)	0	0	342
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)	0	0	474
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)	0	0	20
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	174
Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares)	0	0	180
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)	0	0	23.8
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)	0	0	248
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)	0	0	1,469
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)	0	0	11.7
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)	0	0	353
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)	0	0	855
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)	0	0	30
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	252
Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares)	0	0	269
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)	0	0	172
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)	0	0	500
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)	0	0	2,444

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

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal (million 2019$)	0	967	0.82	0.798	0.692	0.487	0.034
Monetary damages from air pollution - Natural Gas (million 2019$)	0	440	300	127	55.5	18.5	13.4
Monetary damages from air pollution - Transportation (million 2019$)	0	4,985	5,062	4,958	4,497	3,605	2,497
Premature deaths from air pollution - Coal (deaths)	0	109	0.092	0.089	0.078	0.055	0.004
Premature deaths from air pollution - Natural Gas (deaths)	0	49.7	33.9	14.4	6.27	2.09	1.52
Premature deaths from air pollution - Transportation (deaths)	0	561	569	558	506	405	281

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	10.8	14.4	0	0	0	0
Sales of cooking units - Electric Resistance (%)	50.8	61.3	93.4	99.7	100	100	100
Sales of cooking units - Gas (%)	49.2	38.7	6.63	0.334	0	0	0
Sales of space heating units - Electric Heat Pump (%)	3.5	10.7	39.6	85.8	93.9	94.4	94.2
Sales of space heating units - Electric Resistance (%)	12.7	18.4	13.8	6.17	4.76	4.69	4.9
Sales of space heating units - Fossil (%)	2.45	4.48	3.17	1.07	0.718	0.695	0.671
Sales of space heating units - Gas (%)	81.4	66.5	43.4	6.93	0.605	0.212	0.217
Sales of water heating units - Electric Heat Pump (%)	0	1.85	15.9	37.3	41	41.2	41.2

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 (%)	22.7	38.5	43.9	56.3	58.6	58.7	58.6
Sales of water heating units - Gas Furnace (%)	77.3	59.6	40	6.28	0.367	0	0
Sales of water heating units - Other (%)	0.046	0.112	0.113	0.113	0.111	0.111	0.112

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	2,022	5,214	8,399	12,743	13,847	13,214
Public EV charging plugs - DC Fast (1000 units)	0.299	0	3.24	0	13.9	0	22.4
Public EV charging plugs - L2 (1000 units)	1.41	0	78	0	334	0	539
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 (%)	1.4	1.68	1.2	0.382	0.072	0.013	0
Vehicle sales - Light-duty - EV (%)	4.42	16.7	48.8	82.7	96.4	99.3	100
Vehicle sales - Light-duty - gasoline (%)	89.1	76.3	46.4	15.6	3.17	0.586	0
Vehicle sales - Light-duty - hybrid (%)	4.91	4.9	3.38	1.24	0.304	0.067	0
Vehicle sales - Light-duty - hydrogen FC (%)	0.11	0.331	0.191	0.059	0.012	0.002	0
Vehicle sales - Light-duty - other (%)	0.095	0.091	0.058	0.02	0.004	0.001	0
Vehicle sales - Medium-duty - diesel (%)	64.7	59.7	42.3	14.4	2.59	0.384	0
Vehicle sales - Medium-duty - EV (%)	0.784	5.07	25.3	60.8	76.5	79.5	80
Vehicle sales - Medium-duty - gasoline (%)	33.7	33.3	25.5	9.32	1.77	0.277	0
Vehicle sales - Medium-duty - hybrid (%)	0.363	0.402	0.341	0.14	0.03	0.005	0
Vehicle sales - Medium-duty - hydrogen FC (%)	0.196	1.27	6.33	15.2	19.1	19.9	20
Vehicle sales - Medium-duty - other (%)	0.253	0.255	0.205	0.083	0.019	0.004	0

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

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Commercial (PJ)	441	434	415	383	346	319	305
Final energy use - Industry (PJ)	634	660	671	671	678	686	694
Final energy use - Residential (PJ)	591	551	512	443	367	307	269
Final energy use - Transportation (PJ)	1,043	977	873	748	634	562	530

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	40,927	44,680	0	0	0	0
Sales of cooking units - Electric Resistance (%)	41	54.2	82.9	88.6	88.9	88.9	88.9
Sales of cooking units - Gas (%)	59	45.8	17.1	11.4	11.1	11.1	11.1
Sales of space heating units - Electric Heat Pump (%)	0.751	8.27	35.3	81	89	89.5	89.5
Sales of space heating units - Electric Resistance (%)	2.86	3.5	5.34	9.38	10.1	10.2	10.2
Sales of space heating units - Fossil (%)	0	2.07	0.402	0.017	0	0	0
Sales of space heating units - Gas Furnace (%)	96.4	86.2	59	9.63	0.906	0.363	0.363
Sales of water heating units - Electric Heat Pump (%)	0.271	2.48	19.4	46.1	50.7	51	51
Sales of water heating units - Electric Resistance (%)	2.65	4.62	18.3	44	48.5	48.8	48.8
Sales of water heating units - Gas Furnace (%)	96.9	92.7	62.2	9.74	0.572	0	0
Sales of water heating units - Other (%)	0.154	0.185	0.186	0.187	0.186	0.187	0.187

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	6.63	6.83	11.6	12.4	12.3	13

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	1.93	6.22	10.7	7.78	9.39	13.6
Capital invested - Wind - Base (billion $2018)	0	10.5	29.9	38.8	42.7	38.7	18.6

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

Item	2020	2025	2030	2035	2040	2045	2050
Solar - Base land use assumptions (GWh)	650	2,685	9,605	17,415	13,767	17,465	26,717
Solar - Constrained land use assumptions (GWh)	650	3,869	8,165	17,245	13,051	17,936	29,931
Wind - Base land use assumptions (GWh)	22,788	22,969	72,467	98,809	112,813	104,504	50,957
Wind - Constrained land use assumptions (GWh)	23,175	7,399	15,587	17,489	537	99.8	380,451

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	-3,836
Carbon sink potential - Aggressive deployment - Cropland measures (1000 tCO2e/y)	0	0	-17,544
Carbon sink potential - Aggressive deployment - Permanent conservation cover (1000 tCO2e/y)	0	0	-428
Carbon sink potential - Aggressive deployment - Total (1000 tCO2e/y)	0	0	-21,808
Carbon sink potential - Moderate deployment - Corn-ethanol to energy grasses (1000 tCO2e/y)	0	0	-3,836
Carbon sink potential - Moderate deployment - Cropland measures (1000 tCO2e/y)	0	0	-9,245
Carbon sink potential - Moderate deployment - Permanent conservation cover (1000 tCO2e/y)	0	0	-214
Carbon sink potential - Moderate deployment - Total (1000 tCO2e/y)	0	0	-13,295
Land impacted for carbon sink - Aggressive deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	1,734
Land impacted for carbon sink - Aggressive deployment - Cropland measures (1000 hectares)	0	0	7,209
Land impacted for carbon sink - Aggressive deployment - Permanent conservation cover (1000 hectares)	0	0	779
Land impacted for carbon sink - Aggressive deployment - Total (1000 hectares)	0	0	9,721
Land impacted for carbon sink - Moderate deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	1,734
Land impacted for carbon sink - Moderate deployment - Cropland measures (1000 hectares)	0	0	3,799
Land impacted for carbon sink - Moderate deployment - Permanent conservation cover (1000 hectares)	0	0	389
Land impacted for carbon sink - Moderate deployment - Total (1000 hectares)	0	0	5,922

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	95.6
Carbon sink potential - High - All (not counting overlap) (1000 tCO2e/y)	0	0	21,662
Carbon sink potential - High - Avoid deforestation (1000 tCO2e/y)	0	0	2,692
Carbon sink potential - High - Extend rotation length (1000 tCO2e/y)	0	0	2,426
Carbon sink potential - High - Improve plantations (1000 tCO2e/y)	0	0	108
Carbon sink potential - High - Increase retention of HWP (1000 tCO2e/y)	0	0	1,364
Carbon sink potential - High - Increase trees outside forests (1000 tCO2e/y)	0	0	3,477
Carbon sink potential - High - Reforest cropland (1000 tCO2e/y)	0	0	5,430
Carbon sink potential - High - Reforest pasture (1000 tCO2e/y)	0	0	4,831
Carbon sink potential - High - Restore productivity (1000 tCO2e/y)	0	0	1,239
Carbon sink potential - Low - Accelerate regeneration (1000 tCO2e/y)	0	0	47.9
Carbon sink potential - Low - All (not counting overlap) (1000 tCO2e/y)	0	0	6,654
Carbon sink potential - Low - Avoid deforestation (1000 tCO2e/y)	0	0	449
Carbon sink potential - Low - Extend rotation length (1000 tCO2e/y)	0	0	932
Carbon sink potential - Low - Improve plantations (1000 tCO2e/y)	0	0	55.1
Carbon sink potential - Low - Increase retention of HWP (1000 tCO2e/y)	0	0	455
Carbon sink potential - Low - Increase trees outside forests (1000 tCO2e/y)	0	0	1,217
Carbon sink potential - Low - Reforest cropland (1000 tCO2e/y)	0	0	2,715
Carbon sink potential - Low - Reforest pasture (1000 tCO2e/y)	0	0	366
Carbon sink potential - Low - Restore productivity (1000 tCO2e/y)	0	0	418
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO2e/y)	0	0	71.7
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO2e/y)	0	0	14,157
Carbon sink potential - Mid - Avoid deforestation (1000 tCO2e/y)	0	0	1,570
Carbon sink potential - Mid - Extend rotation length (1000 tCO2e/y)	0	0	1,679
Carbon sink potential - Mid - Improve plantations (1000 tCO2e/y)	0	0	80.8
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO2e/y)	0	0	909
Carbon sink potential - Mid - Increase trees outside forests (1000 tCO2e/y)	0	0	2,347
Carbon sink potential - Mid - Reforest cropland (1000 tCO2e/y)	0	0	4,073
Carbon sink potential - Mid - Reforest pasture (1000 tCO2e/y)	0	0	2,599
Carbon sink potential - Mid - Restore productivity (1000 tCO2e/y)	0	0	828
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)	0	0	15.6

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	364
Land impacted for carbon sink potential - High - Extend rotation length (1000 hectares)	0	0	1,237
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)	0	0	39.9
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	330
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)	0	0	359
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)	0	0	137
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)	0	0	411
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)	0	0	2,894
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)	0	0	7.82
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)	0	0	342
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)	0	0	474
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)	0	0	20
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	174
Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares)	0	0	180
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)	0	0	23.8
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)	0	0	248
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)	0	0	1,469
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)	0	0	11.7
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)	0	0	353
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)	0	0	855
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)	0	0	30
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	252
Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares)	0	0	269
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)	0	0	172
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)	0	0	500
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)	0	0	2,444

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

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal (million 2019$)	0	967	0.82	0.798	0.692	0.487	0.034
Monetary damages from air pollution - Natural Gas (million 2019$)	0	432	286	165	110	39.2	10.8
Monetary damages from air pollution - Transportation (million 2019$)	0	4,899	4,586	3,504	2,047	963	413
Premature deaths from air pollution - Coal (deaths)	0	109	0.092	0.089	0.078	0.055	0.004
Premature deaths from air pollution - Natural Gas (deaths)	0	48.7	32.3	18.6	12.5	4.43	1.22
Premature deaths from air pollution - Transportation (deaths)	0	551	516	394	230	108	46.5

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	10.8	14.4	0	0	0	0
Sales of cooking units - Electric Resistance (%)	50.8	61.3	93.4	99.7	100	100	100
Sales of cooking units - Gas (%)	49.2	38.7	6.63	0.334	0	0	0
Sales of space heating units - Electric Heat Pump (%)	3.5	10.7	39.6	85.8	93.9	94.4	94.2
Sales of space heating units - Electric Resistance (%)	12.7	18.4	13.8	6.17	4.76	4.69	4.9
Sales of space heating units - Fossil (%)	2.45	4.48	3.17	1.07	0.718	0.695	0.671
Sales of space heating units - Gas (%)	81.4	66.5	43.4	6.93	0.605	0.212	0.217
Sales of water heating units - Electric Heat Pump (%)	0	1.85	15.9	37.3	41	41.2	41.2
Sales of water heating units - Electric Resistance (%)	22.7	38.5	43.9	56.3	58.6	58.7	58.6
Sales of water heating units - Gas Furnace (%)	77.3	59.6	40	6.28	0.367	0	0
Sales of water heating units - Other (%)	0.046	0.112	0.113	0.113	0.111	0.111	0.112

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	2,022	5,214	8,399	12,743	13,847	13,214
Public EV charging plugs - DC Fast (1000 units)	0.299	0	3.24	0	13.9	0	22.4
Public EV charging plugs - L2 (1000 units)	1.41	0	78	0	334	0	539
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 (%)	1.4	1.68	1.2	0.382	0.072	0.013	0
Vehicle sales - Light-duty - EV (%)	4.42	16.7	48.8	82.7	96.4	99.3	100
Vehicle sales - Light-duty - gasoline (%)	89.1	76.3	46.4	15.6	3.17	0.586	0
Vehicle sales - Light-duty - hybrid (%)	4.91	4.9	3.38	1.24	0.304	0.067	0
Vehicle sales - Light-duty - hydrogen FC (%)	0.11	0.331	0.191	0.059	0.012	0.002	0
Vehicle sales - Light-duty - other (%)	0.095	0.091	0.058	0.02	0.004	0.001	0
Vehicle sales - Medium-duty - diesel (%)	64.7	59.7	42.3	14.4	2.59	0.384	0
Vehicle sales - Medium-duty - EV (%)	0.784	5.07	25.3	60.8	76.5	79.5	80
Vehicle sales - Medium-duty - gasoline (%)	33.7	33.3	25.5	9.32	1.77	0.277	0
Vehicle sales - Medium-duty - hybrid (%)	0.363	0.402	0.341	0.14	0.03	0.005	0
Vehicle sales - Medium-duty - hydrogen FC (%)	0.196	1.27	6.33	15.2	19.1	19.9	20
Vehicle sales - Medium-duty - other (%)	0.253	0.255	0.205	0.083	0.019	0.004	0

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

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Commercial (PJ)	441	434	415	383	346	319	305
Final energy use - Industry (PJ)	634	660	671	671	678	686	694
Final energy use - Residential (PJ)	591	551	512	443	367	307	269
Final energy use - Transportation (PJ)	1,043	977	873	748	634	562	530

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	40,927	44,680	0	0	0	0
Sales of cooking units - Electric Resistance (%)	41	54.2	82.9	88.6	88.9	88.9	88.9
Sales of cooking units - Gas (%)	59	45.8	17.1	11.4	11.1	11.1	11.1
Sales of space heating units - Electric Heat Pump (%)	0.751	8.27	35.3	81	89	89.5	89.5
Sales of space heating units - Electric Resistance (%)	2.86	3.5	5.34	9.38	10.1	10.2	10.2
Sales of space heating units - Fossil (%)	0	2.07	0.402	0.017	0	0	0
Sales of space heating units - Gas Furnace (%)	96.4	86.2	59	9.63	0.906	0.363	0.363
Sales of water heating units - Electric Heat Pump (%)	0.271	2.48	19.4	46.1	50.7	51	51
Sales of water heating units - Electric Resistance (%)	2.65	4.62	18.3	44	48.5	48.8	48.8
Sales of water heating units - Gas Furnace (%)	96.9	92.7	62.2	9.74	0.572	0	0
Sales of water heating units - Other (%)	0.154	0.185	0.186	0.187	0.186	0.187	0.187

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	6.63	6.83	11.6	12.4	12.3	13

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	2.75	6.89	3.69	4.13	1.86	0
Capital invested - Solar PV - Constrained (billion $2018)	0	2.5	5.3	4.21	4.26	1.14	0
Capital invested - Wind - Base (billion $2018)	0	7.65	9.8	0	7.4	12.2	24
Capital invested - Wind - Constrained (billion $2018)	0	3.22	3.5	0.04	1.89	2.27	4.57

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

Item	2020	2025	2030	2035	2040	2045	2050
Solar - Base land use assumptions (GWh)	650	3,834	10,723	6,208	7,362	3,470	0
Solar - Constrained land use assumptions (GWh)	650	3,470	8,244	7,050	7,618	2,139	0
Wind - Base land use assumptions (GWh)	22,788	16,823	24,209	0	19,958	34,467	71,885
Wind - Constrained land use assumptions (GWh)	22,788	6,911	8,515	107	4,977	6,191	12,646

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	-3,836
Carbon sink potential - Aggressive deployment - Cropland measures (1000 tCO2e/y)	0	0	-17,544
Carbon sink potential - Aggressive deployment - Permanent conservation cover (1000 tCO2e/y)	0	0	-428
Carbon sink potential - Aggressive deployment - Total (1000 tCO2e/y)	0	0	-21,808
Carbon sink potential - Moderate deployment - Corn-ethanol to energy grasses (1000 tCO2e/y)	0	0	-3,836

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	-9,245
Carbon sink potential - Moderate deployment - Permanent conservation cover (1000 tCO2e/y)	0	0	-214
Carbon sink potential - Moderate deployment - Total (1000 tCO2e/y)	0	0	-13,295
Land impacted for carbon sink - Aggressive deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	1,734
Land impacted for carbon sink - Aggressive deployment - Cropland measures (1000 hectares)	0	0	7,209
Land impacted for carbon sink - Aggressive deployment - Permanent conservation cover (1000 hectares)	0	0	779
Land impacted for carbon sink - Aggressive deployment - Total (1000 hectares)	0	0	9,721
Land impacted for carbon sink - Moderate deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	1,734
Land impacted for carbon sink - Moderate deployment - Cropland measures (1000 hectares)	0	0	3,799
Land impacted for carbon sink - Moderate deployment - Permanent conservation cover (1000 hectares)	0	0	389
Land impacted for carbon sink - Moderate deployment - Total (1000 hectares)	0	0	5,922

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	95.6
Carbon sink potential - High - All (not counting overlap) (1000 tCO2e/y)	0	0	21,662
Carbon sink potential - High - Avoid deforestation (1000 tCO2e/y)	0	0	2,692
Carbon sink potential - High - Extend rotation length (1000 tCO2e/y)	0	0	2,426
Carbon sink potential - High - Improve plantations (1000 tCO2e/y)	0	0	108
Carbon sink potential - High - Increase retention of HWP (1000 tCO2e/y)	0	0	1,364
Carbon sink potential - High - Increase trees outside forests (1000 tCO2e/y)	0	0	3,477
Carbon sink potential - High - Reforest cropland (1000 tCO2e/y)	0	0	5,430
Carbon sink potential - High - Reforest pasture (1000 tCO2e/y)	0	0	4,831
Carbon sink potential - High - Restore productivity (1000 tCO2e/y)	0	0	1,239
Carbon sink potential - Low - Accelerate regeneration (1000 tCO2e/y)	0	0	47.9
Carbon sink potential - Low - All (not counting overlap) (1000 tCO2e/y)	0	0	6,654
Carbon sink potential - Low - Avoid deforestation (1000 tCO2e/y)	0	0	449
Carbon sink potential - Low - Extend rotation length (1000 tCO2e/y)	0	0	932
Carbon sink potential - Low - Improve plantations (1000 tCO2e/y)	0	0	55.1
Carbon sink potential - Low - Increase retention of HWP (1000 tCO2e/y)	0	0	455

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	1,217
Carbon sink potential - Low - Reforest cropland (1000 tCO2e/y)	0	0	2,715
Carbon sink potential - Low - Reforest pasture (1000 tCO2e/y)	0	0	366
Carbon sink potential - Low - Restore productivity (1000 tCO2e/y)	0	0	418
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO2e/y)	0	0	71.7
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO2e/y)	0	0	14,157
Carbon sink potential - Mid - Avoid deforestation (1000 tCO2e/y)	0	0	1,570
Carbon sink potential - Mid - Extend rotation length (1000 tCO2e/y)	0	0	1,679
Carbon sink potential - Mid - Improve plantations (1000 tCO2e/y)	0	0	80.8
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO2e/y)	0	0	909
Carbon sink potential - Mid - Increase trees outside forests (1000 tCO2e/y)	0	0	2,347
Carbon sink potential - Mid - Reforest cropland (1000 tCO2e/y)	0	0	4,073
Carbon sink potential - Mid - Reforest pasture (1000 tCO2e/y)	0	0	2,599
Carbon sink potential - Mid - Restore productivity (1000 tCO2e/y)	0	0	828
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)	0	0	15.6
Land impacted for carbon sink potential - High - Avoid deforestation (over 30 years) (1000 hectares)	0	0	364
Land impacted for carbon sink potential - High - Extend rotation length (1000 hectares)	0	0	1,237
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)	0	0	39.9
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	330
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)	0	0	359
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)	0	0	137
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)	0	0	411
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)	0	0	2,894
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)	0	0	7.82
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)	0	0	342
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)	0	0	474
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)	0	0	20
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	174

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	180
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)	0	0	23.8
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)	0	0	248
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)	0	0	1,469
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)	0	0	11.7
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)	0	0	353
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)	0	0	855
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)	0	0	30
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	252
Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares)	0	0	269
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)	0	0	172
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)	0	0	500
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)	0	0	2,444

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

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal (million 2019$)	0	967	0.82	0.798	0.692	0.487	0.034
Monetary damages from air pollution - Natural Gas (million 2019$)	0	368	198	317	227	91	29.4
Monetary damages from air pollution - Transportation (million 2019$)	0	4,899	4,586	3,504	2,047	963	413
Premature deaths from air pollution - Coal (deaths)	0	109	0.092	0.089	0.078	0.055	0.004
Premature deaths from air pollution - Natural Gas (deaths)	0	41.6	22.4	35.8	25.6	10.3	3.32
Premature deaths from air pollution - Transportation (deaths)	0	551	516	394	230	108	46.5

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	10.7	14.3	0	0	0	0
Sales of cooking units - Electric Resistance (%)	50.6	51.9	56.4	68.3	84.9	95.1	98.7
Sales of cooking units - Gas (%)	49.4	48.1	43.6	31.7	15.1	4.87	1.31
Sales of space heating units - Electric Heat Pump (%)	3.5	8.23	11.6	22.2	45.5	72.3	87.2
Sales of space heating units - Electric Resistance (%)	12.7	18.7	18.1	16.4	12.5	8.16	5.9
Sales of space heating units - Fossil (%)	2.45	4.6	4.47	3.97	2.93	1.72	1.01
Sales of space heating units - Gas (%)	81.4	68.5	65.9	57.4	39	17.8	5.87
Sales of water heating units - Electric Heat Pump (%)	0	0.582	2.2	7.34	18.4	30.9	37.9
Sales of water heating units - Electric Resistance (%)	22.7	38.3	38.8	40.9	46.2	52.8	56.7

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 (%)	77.3	61	58.9	51.7	35.3	16.1	5.22
Sales of water heating units - Other (%)	0.046	0.112	0.113	0.113	0.113	0.113	0.112

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	333	687	2,331	7,297	10,644
Public EV charging plugs - DC Fast (1000 units)	0.299	0	1.05	0	5.19	0	14.3
Public EV charging plugs - L2 (1000 units)	1.41	0	25.2	0	125	0	345
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 (%)	1.41	1.85	2.03	1.61	1.02	0.519	0.223
Vehicle sales - Light-duty - EV (%)	2.06	5.07	12.6	27.1	49.7	72.9	87.9
Vehicle sales - Light-duty - gasoline (%)	91.2	86.7	78.4	65.1	44.7	23.9	10.6
Vehicle sales - Light-duty - hybrid (%)	5.1	5.88	6.55	5.89	4.34	2.52	1.21
Vehicle sales - Light-duty - hydrogen FC (%)	0.112	0.376	0.317	0.239	0.168	0.092	0.043
Vehicle sales - Light-duty - other (%)	0.096	0.1	0.09	0.078	0.056	0.03	0.014
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)	441	434	424	414	399	379	356
Final energy use - Industry (PJ)	634	660	674	680	693	701	708
Final energy use - Residential (PJ)	591	552	524	495	458	408	352
Final energy use - Transportation (PJ)	1,044	984	908	847	798	740	672

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	40,922	44,666	0	0	0	0
Sales of cooking units - Electric Resistance (%)	41	45.8	49.8	60.5	75.4	84.5	87.7
Sales of cooking units - Gas (%)	59	54.2	50.2	39.5	24.6	15.5	12.3
Sales of space heating units - Electric Heat Pump (%)	0.751	6.2	9.31	19.3	41.6	67.6	82.4
Sales of space heating units - Electric Resistance (%)	2.86	3.43	3.64	4.33	6.04	8.25	9.53
Sales of space heating units - Fossil (%)	0	2.4	2.27	1.73	0.88	0.287	0.075
Sales of space heating units - Gas Furnace (%)	96.4	88	84.8	74.6	51.5	23.8	7.97
Sales of water heating units - Electric Heat Pump (%)	0.271	1.04	2.99	9.2	22.7	38.2	46.9
Sales of water heating units - Electric Resistance (%)	2.65	3.78	5.32	10.5	22.3	36.6	44.8
Sales of water heating units - Gas Furnace (%)	96.9	95	91.5	80.1	54.8	25	8.1
Sales of water heating units - Other (%)	0.154	0.185	0.186	0.187	0.186	0.187	0.187

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	5.41	5.46	7.27	7.54	10.4	11

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	0.075	0	0	0
Capital invested - Biomass w/ccu power plant (billion $2018)	0	0	1.9	1.4	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	74.6	74.6	74.6	74.6
Biomass w/ccu power plant (GWh)	0	0	2,136	3,710	3,710	3,710	3,710

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	151	6,164	10,720	10,720	10,720
Conversion capital investment - Cumulative 5-yr (million $2018)	0	0	1,746	60,802	45,876	0	0
Number of facilities - Allam power w ccu (quantity)	0	0	0	2	2	2	2
Number of facilities - Beccs hydrogen (quantity)	0	0	0	70	124	124	124
Number of facilities - Diesel (quantity)	0	0	0	0	0	0	0
Number of facilities - Diesel ccu (quantity)	0	0	0	2	2	2	2
Number of facilities - Power (quantity)	0	0	0	0	0	0	0
Number of facilities - Power ccu (quantity)	0	0	2	4	4	4	4
Number of facilities - Pyrolysis (quantity)	0	0	0	0	0	0	0
Number of facilities - Pyrolysis ccu (quantity)	0	0	0	2	2	2	2
Number of facilities - Sng (quantity)	0	0	0	0	0	0	0
Number of facilities - Sng ccu (quantity)	0	0	2	2	2	2	2

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

Item	2020	2025	2030	2035	2040	2045	2050
Annual - All (MMT)	0	0	2.13	83.5	142	142	143
Annual - BECCS (MMT)	0	0	2.12	80	139	139	139
Annual - Cement and lime (MMT)	0	0	0	3.35	3.32	3.42	3.53
Annual - NGCC (MMT)	0	0	0.01	0.09	0.11	0.08	0.03
Cumulative - All (MMT)	0	0	2.13	85.6	228	371	513
Cumulative - BECCS (MMT)	0	0	2.12	82.2	221	360	499
Cumulative - Cement and lime (MMT)	0	0	0	3.35	6.67	10.1	13.6
Cumulative - NGCC (MMT)	0	0	0.01	0.1	0.21	0.29	0.32

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

Item	2020	2025	2030	2035	2040	2045	2050
CO2 storage (MMT)	0	0	2.77	13.9	27.3	38.4	40.1
Injection wells (wells)	0	0	7	26	46	78	96
Resource characterization, appraisal, permitting costs (million $2020)	0	100	441	682	682	682	682
Wells and facilities construction costs (million $2020)	0	0	200	781	1,392	2,327	2,890

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

Item	2020	2025	2030	2035	2040	2045	2050
All (km)	0	0	1,311	5,604	8,760	8,881	8,894
Cumulative investment - All (million $2018)	0	0	6,509	13,041	20,368	21,553	21,678
Cumulative investment - Spur (million $2018)	0	0	240	4,152	6,968	8,152	8,277
Cumulative investment - Trunk (million $2018)	0	0	6,269	8,888	13,401	13,401	13,401
Spur (km)	0	0	354	4,280	6,716	6,837	6,849
Trunk (km)	0	0	958	1,324	2,045	2,045	2,045

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	-4,993
Carbon sink potential - Aggressive deployment - Cropland measures (1000 tCO2e/y)	0	0	-15,905
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	-387
Carbon sink potential - Aggressive deployment - Total (1000 tCO2e/y)	0	0	-21,285
Carbon sink potential - Moderate deployment - Corn-ethanol to energy grasses (1000 tCO2e/y)	0	0	-4,993
Carbon sink potential - Moderate deployment - Cropland measures (1000 tCO2e/y)	0	0	-8,380
Carbon sink potential - Moderate deployment - Cropland to woody energy crops (1000 tCO2e/y)	0	0	0
Carbon sink potential - Moderate deployment - Pasture to energy crops (1000 tCO2e/y)	0	0	0
Carbon sink potential - Moderate deployment - Permanent conservation cover (1000 tCO2e/y)	0	0	-193
Carbon sink potential - Moderate deployment - Total (1000 tCO2e/y)	0	0	-13,567
Land impacted for carbon sink - Aggressive deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	2,460
Land impacted for carbon sink - Aggressive deployment - Cropland measures (1000 hectares)	0	0	16,127
Land impacted for carbon sink - Aggressive deployment - Cropland to woody energy crops (1000 hectares)	0	0	822
Land impacted for carbon sink - Aggressive deployment - Pasture to energy crops (1000 hectares)	0	0	113
Land impacted for carbon sink - Aggressive deployment - Permanent conservation cover (1000 hectares)	0	0	703
Land impacted for carbon sink - Aggressive deployment - Total (1000 hectares)	0	0	20,227
Land impacted for carbon sink - Moderate deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	2,460
Land impacted for carbon sink - Moderate deployment - Cropland measures (1000 hectares)	0	0	3,442
Land impacted for carbon sink - Moderate deployment - Cropland to woody energy crops (1000 hectares)	0	0	822
Land impacted for carbon sink - Moderate deployment - Pasture to energy crops (1000 hectares)	0	0	113
Land impacted for carbon sink - Moderate deployment - Permanent conservation cover (1000 hectares)	0	0	352
Land impacted for carbon sink - Moderate deployment - Total (1000 hectares)	0	0	7,189

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	95.6
Carbon sink potential - High - All (not counting overlap) (1000 tCO2e/y)	0	0	21,662
Carbon sink potential - High - Avoid deforestation (1000 tCO2e/y)	0	0	2,692
Carbon sink potential - High - Extend rotation length (1000 tCO2e/y)	0	0	2,426
Carbon sink potential - High - Improve plantations (1000 tCO2e/y)	0	0	108
Carbon sink potential - High - Increase retention of HWP (1000 tCO2e/y)	0	0	1,364
Carbon sink potential - High - Increase trees outside forests (1000 tCO2e/y)	0	0	3,477
Carbon sink potential - High - Reforest cropland (1000 tCO2e/y)	0	0	5,430
Carbon sink potential - High - Reforest pasture (1000 tCO2e/y)	0	0	4,831
Carbon sink potential - High - Restore productivity (1000 tCO2e/y)	0	0	1,239
Carbon sink potential - Low - Accelerate regeneration (1000 tCO2e/y)	0	0	47.9
Carbon sink potential - Low - All (not counting overlap) (1000 tCO2e/y)	0	0	6,654
Carbon sink potential - Low - Avoid deforestation (1000 tCO2e/y)	0	0	449
Carbon sink potential - Low - Extend rotation length (1000 tCO2e/y)	0	0	932
Carbon sink potential - Low - Improve plantations (1000 tCO2e/y)	0	0	55.1
Carbon sink potential - Low - Increase retention of HWP (1000 tCO2e/y)	0	0	455
Carbon sink potential - Low - Increase trees outside forests (1000 tCO2e/y)	0	0	1,217
Carbon sink potential - Low - Reforest cropland (1000 tCO2e/y)	0	0	2,715
Carbon sink potential - Low - Reforest pasture (1000 tCO2e/y)	0	0	366
Carbon sink potential - Low - Restore productivity (1000 tCO2e/y)	0	0	418
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO2e/y)	0	0	71.7
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO2e/y)	0	0	14,157
Carbon sink potential - Mid - Avoid deforestation (1000 tCO2e/y)	0	0	1,570
Carbon sink potential - Mid - Extend rotation length (1000 tCO2e/y)	0	0	1,679
Carbon sink potential - Mid - Improve plantations (1000 tCO2e/y)	0	0	80.8
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO2e/y)	0	0	909
Carbon sink potential - Mid - Increase trees outside forests (1000 tCO2e/y)	0	0	2,347
Carbon sink potential - Mid - Reforest cropland (1000 tCO2e/y)	0	0	4,073
Carbon sink potential - Mid - Reforest pasture (1000 tCO2e/y)	0	0	2,599
Carbon sink potential - Mid - Restore productivity (1000 tCO2e/y)	0	0	828
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)	0	0	15.6

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	364
Land impacted for carbon sink potential - High - Extend rotation length (1000 hectares)	0	0	1,237
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)	0	0	39.9
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	330
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)	0	0	359
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)	0	0	137
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)	0	0	411
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)	0	0	2,894
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)	0	0	7.82
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)	0	0	342
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)	0	0	474
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)	0	0	20
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	174
Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares)	0	0	180
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)	0	0	23.8
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)	0	0	248
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)	0	0	1,469
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)	0	0	11.7
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)	0	0	353
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)	0	0	855
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)	0	0	30
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	252
Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares)	0	0	269
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)	0	0	172
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)	0	0	500
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)	0	0	2,444

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	10.3	11.1	0	0	0	0
Sales of cooking units - Electric Resistance (%)	50.2	50.2	50.2	50.2	50.2	50.2	50.2
Sales of cooking units - Gas (%)	49.8	49.8	49.8	49.8	49.8	49.8	49.8
Sales of space heating units - Electric Heat Pump (%)	2.39	12.9	13.5	14.3	15	15.6	16.5
Sales of space heating units - Electric Resistance (%)	12.9	17.8	17.6	17.4	16.8	16	15.2
Sales of space heating units - Fossil (%)	2.6	4.13	4.15	4.15	4.16	4.19	4.17
Sales of space heating units - Gas (%)	82.1	65.2	64.8	64.2	64.1	64.2	64
Sales of water heating units - Electric Heat Pump (%)	0	0	0	0	0	0	0
Sales of water heating units - Electric Resistance (%)	22.7	38.1	37.9	37.8	37.8	37.7	37.7
Sales of water heating units - Gas Furnace (%)	77.3	61.8	62	62.1	62.1	62.2	62.2
Sales of water heating units - Other (%)	0.046	0.112	0.113	0.113	0.113	0.114	0.114

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 (%)	1.4	1.84	2.16	2.01	1.81	1.68	1.6
Vehicle sales - Light-duty - EV (%)	4.06	6.24	7.06	8.71	10.6	12.1	13.3
Vehicle sales - Light-duty - gasoline (%)	89.4	85.7	83.3	81.3	79.2	77.2	75.7
Vehicle sales - Light-duty - hybrid (%)	4.93	5.75	7	7.56	8.09	8.59	8.95
Vehicle sales - Light-duty - hydrogen FC (%)	0.11	0.371	0.337	0.297	0.293	0.293	0.303
Vehicle sales - Light-duty - other (%)	0.095	0.099	0.095	0.096	0.095	0.094	0.096
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)	441	441	437	426	415	414	426
Final energy use - Industry (PJ)	634	673	695	715	742	766	795
Final energy use - Residential (PJ)	591	553	532	516	507	501	496
Final energy use - Transportation (PJ)	1,044	993	935	904	914	947	988

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	40,483	41,990	0	0	0	0
Sales of cooking units - Electric Resistance (%)	41	44.2	44.3	44.3	44.3	44.4	44.5
Sales of cooking units - Gas (%)	59	55.8	55.7	55.7	55.7	55.6	55.5
Sales of space heating units - Electric Heat Pump (%)	0.751	12.5	44.7	71.1	75.5	75.9	75.9
Sales of space heating units - Electric Resistance (%)	2.86	4.31	8.93	17.1	22.7	23.6	23.7
Sales of space heating units - Fossil (%)	0	2.21	1.15	0.205	0.023	0	0
Sales of space heating units - Gas Furnace (%)	96.4	81	45.2	11.6	1.78	0.443	0.362
Sales of water heating units - Electric Heat Pump (%)	0.271	0.342	0.346	0.345	0.34	0.342	0.342

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 (%)	2.65	3.2	3.17	3.18	3.17	3.15	3.16
Sales of water heating units - Gas Furnace (%)	96.9	96.3	96.3	96.3	96.3	96.3	96.3
Sales of water heating units - Other (%)	0.154	0.185	0.186	0.187	0.186	0.187	0.187

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	5.74	5.83	7.97	8.31	10.3	10.9

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

Item	2020	2025	2030	2050
Business-as-usual carbon sink - Natural uptake (Mt CO2e/y)	-11.1	0	-4.33	-3.87
Business-as-usual carbon sink - Retained in Hardwood Products (Mt CO2e/y)	-0.371	0	-0.667	-0.694
Business-as-usual carbon sink - Total (Mt CO2e/y)	-11.5	0	-5	-4.57
Carbon sink potential - High - Accelerate regeneration (1000 tCO2e/y)	0	0	0	95.6
Carbon sink potential - High - All (not counting overlap) (1000 tCO2e/y)	0	0	0	21,662
Carbon sink potential - High - Avoid deforestation (1000 tCO2e/y)	0	0	0	2,692
Carbon sink potential - High - Extend rotation length (1000 tCO2e/y)	0	0	0	2,426
Carbon sink potential - High - Improve plantations (1000 tCO2e/y)	0	0	0	108
Carbon sink potential - High - Increase retention of HWP (1000 tCO2e/y)	0	0	0	1,364
Carbon sink potential - High - Increase trees outside forests (1000 tCO2e/y)	0	0	0	3,477
Carbon sink potential - High - Reforest cropland (1000 tCO2e/y)	0	0	0	5,430
Carbon sink potential - High - Reforest pasture (1000 tCO2e/y)	0	0	0	4,831
Carbon sink potential - High - Restore productivity (1000 tCO2e/y)	0	0	0	1,239
Carbon sink potential - Low - Accelerate regeneration (1000 tCO2e/y)	0	0	0	47.9
Carbon sink potential - Low - All (not counting overlap) (1000 tCO2e/y)	0	0	0	6,654
Carbon sink potential - Low - Avoid deforestation (1000 tCO2e/y)	0	0	0	449
Carbon sink potential - Low - Extend rotation length (1000 tCO2e/y)	0	0	0	932
Carbon sink potential - Low - Improve plantations (1000 tCO2e/y)	0	0	0	55.1
Carbon sink potential - Low - Increase retention of HWP (1000 tCO2e/y)	0	0	0	455
Carbon sink potential - Low - Increase trees outside forests (1000 tCO2e/y)	0	0	0	1,217
Carbon sink potential - Low - Reforest cropland (1000 tCO2e/y)	0	0	0	2,715
Carbon sink potential - Low - Reforest pasture (1000 tCO2e/y)	0	0	0	366
Carbon sink potential - Low - Restore productivity (1000 tCO2e/y)	0	0	0	418
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO2e/y)	0	0	0	71.7
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO2e/y)	0	0	0	14,157

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

Item	2020	2025	2030	2050
Carbon sink potential - Mid - Avoid deforestation (1000 tCO2e/y)	0	0	0	1,570
Carbon sink potential - Mid - Extend rotation length (1000 tCO2e/y)	0	0	0	1,679
Carbon sink potential - Mid - Improve plantations (1000 tCO2e/y)	0	0	0	80.8
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO2e/y)	0	0	0	909
Carbon sink potential - Mid - Increase trees outside forests (1000 tCO2e/y)	0	0	0	2,347
Carbon sink potential - Mid - Reforest cropland (1000 tCO2e/y)	0	0	0	4,073
Carbon sink potential - Mid - Reforest pasture (1000 tCO2e/y)	0	0	0	2,599
Carbon sink potential - Mid - Restore productivity (1000 tCO2e/y)	0	0	0	828
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)	0	0	0	15.6
Land impacted for carbon sink potential - High - Avoid deforestation (over 30 years) (1000 hectares)	0	0	0	364
Land impacted for carbon sink potential - High - Extend rotation length (1000 hectares)	0	0	0	1,237
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)	0	0	0	39.9
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	330
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)	0	0	0	359
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)	0	0	0	137
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)	0	0	0	411
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)	0	0	0	2,894
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)	0	0	0	7.82
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)	0	0	0	342
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)	0	0	0	474
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)	0	0	0	20
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	174
Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares)	0	0	0	180
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)	0	0	0	23.8
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)	0	0	0	248
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)	0	0	0	1,469
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)	0	0	0	11.7
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)	0	0	0	353

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	855
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)	0	0	0	30
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	252
Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares)	0	0	0	269
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)	0	0	0	172
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)	0	0	0	500
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)	0	0	0	2,444

Table 64: *REF scenario - IMPACTS - Health*

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal (million 2019$)	0	3,848	2,388	1,664	1,343	1,220	1,201
Monetary damages from air pollution - Natural Gas (million 2019$)	0	410	476	592	593	630	563
Monetary damages from air pollution - Transportation (million 2019$)	0	4,980	5,129	5,287	5,472	5,655	5,836
Premature deaths from air pollution - Coal (deaths)	0	432	268	187	151	137	135
Premature deaths from air pollution - Natural Gas (deaths)	0	46.3	53.8	66.9	67	71.1	63.5
Premature deaths from air pollution - Transportation (deaths)	0	560	577	595	615	636	656