Net-Zero America - pennsylvania state report

Larson et al. 2020

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

Notes

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

List of Tables

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

Item	2020	2025	2030	2035	2040	2045	2050
Residential HVAC investment in 2020s vs. REF - Cumulative 5-yr (billion $2018)	0	10.8	12.5	0	0	0	0
Sales of cooking units - Electric Resistance (%)	55.4	64.9	94	99.7	100	100	100
Sales of cooking units - Gas (%)	44.6	35.1	6.01	0.303	0	0	0
Sales of space heating units - Electric Heat Pump (%)	8.42	19.7	58.8	85.6	89.5	89.7	89.7
Sales of space heating units - Electric Resistance (%)	9.49	11.8	7.94	3.83	3.14	3.17	3.29
Sales of space heating units - Fossil (%)	24.2	31.3	12.5	6.86	6.43	6.34	6.23
Sales of space heating units - Gas (%)	57.9	37.3	20.7	3.68	0.918	0.75	0.749
Sales of water heating units - Electric Heat Pump (%)	0	3.85	24.2	40.2	42.6	42.8	42.8
Sales of water heating units - Electric Resistance (%)	35.5	52.4	52.4	56.3	57.1	57.1	57.1
Sales of water heating units - Gas Furnace (%)	58.8	40.5	22.7	3.36	0.193	0	0
Sales of water heating units - Other (%)	5.73	3.25	0.692	0.122	0.097	0.097	0.098

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	2,057	5,276	8,545	12,946	14,088	13,433
Public EV charging plugs - DC Fast (1000 units)	0.267	0	3.52	0	15.4	0	24.9
Public EV charging plugs - L2 (1000 units)	1.32	0	84.6	0	370	0	599
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 (%)	1.43	1.71	1.21	0.386	0.073	0.013	0
Vehicle sales - Light-duty - EV (%)	4.31	16.4	48.3	82.5	96.4	99.3	100
Vehicle sales - Light-duty - gasoline (%)	89.2	76.6	46.9	15.8	3.2	0.587	0
Vehicle sales - Light-duty - hybrid (%)	4.8	4.82	3.34	1.23	0.301	0.066	0
Vehicle sales - Light-duty - hydrogen FC (%)	0.11	0.333	0.194	0.06	0.012	0.002	0
Vehicle sales - Light-duty - other (%)	0.096	0.092	0.059	0.021	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)	388	381	368	346	323	310	307
Final energy use - Industry (PJ)	791	783	767	757	724	706	669
Final energy use - Residential (PJ)	467	427	389	337	289	255	236
Final energy use - Transportation (PJ)	816	765	673	560	457	393	364

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	59,163	64,630	0	0	0	0
Sales of cooking units - Electric Resistance (%)	18.5	33.7	75.3	83.5	83.9	84	84
Sales of cooking units - Gas (%)	81.5	66.3	24.7	16.5	16.1	16	16
Sales of space heating units - Electric Heat Pump (%)	2.56	11.7	42	73.7	78.6	79.2	79.1
Sales of space heating units - Electric Resistance (%)	5.59	4.8	13.3	19	20.2	19.9	20
Sales of space heating units - Fossil (%)	19.4	14.8	2.91	0.126	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 (%)	72.4	68.7	41.8	7.14	1.21	0.873	0.87
Sales of water heating units - Electric Heat Pump (%)	0.624	4.78	29.6	52.2	55.8	56	56
Sales of water heating units - Electric Resistance (%)	3.49	4.26	19.8	40.2	43.6	43.8	43.8
Sales of water heating units - Gas Furnace (%)	94.2	89.8	50.2	7.42	0.426	0	0
Sales of water heating units - Other (%)	1.74	1.19	0.379	0.186	0.177	0.178	0.178

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	6.13	6.27	11.6	12.4	12.4	13.1

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

Item	2020	2025	2030	2035	2040	2045	2050
Capital invested - Biomass power plant (billion $2018)	0	0	0	0	0	0	0
Capital invested - Biomass w/ccu allam power plant (billion $2018)	0	0	0	0	0	0	0.031
Capital invested - Biomass w/ccu power plant (billion $2018)	0	0	0	0	0	0	0
Capital invested - Solar PV - Base (billion $2018)	0	1.23	2.29	11.7	18.8	27.7	33.5
Capital invested - Solar PV - Constrained (billion $2018)	0	0.076	2.55	12.2	15.2	34.6	27.8
Capital invested - Wind - Base (billion $2018)	0	0	0	0	0	0	0
Capital invested - Wind - Constrained (billion $2018)	0	0	0	15.8	85.7	0	0

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

Item	2020	2025	2030	2035	2040	2045	2050
Biomass power plant (GWh)	0	0	0	0	0	0	0
Biomass w/ccu allam power plant (GWh)	0	0	0	0	0	0	30.7
Biomass w/ccu power plant (GWh)	0	0	0	0	0	0	0
Solar - Base land use assumptions (GWh)	169	1,660	3,407	18,503	31,007	48,179	61,738
Solar - Constrained land use assumptions (GWh)	72.1	5,681	7,705	19,865	27,989	70,404	48,941
Wind - Base land use assumptions (GWh)	6,912	0	0	0	0	0	0
Wind - Constrained land use assumptions (GWh)	6,912	0	0	20,179	161,146	4,812	0

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

Item	2020	2025	2030	2035	2040	2045	2050
Biomass purchases (million $2018/year)	0	0	0	0	0	0	446
Conversion capital investment - Cumulative 5-yr (million $2018)	0	0	0	0	0	0	9,012
Number of facilities - Allam power w ccu (quantity)	0	0	0	0	0	0	1
Number of facilities - Beccs hydrogen (quantity)	0	0	0	0	0	0	9
Number of facilities - Diesel (quantity)	0	0	0	0	0	0	0
Number of facilities - Diesel ccu (quantity)	0	0	0	0	0	0	0
Number of facilities - Power (quantity)	0	0	0	0	0	0	0
Number of facilities - Power ccu (quantity)	0	0	0	0	0	0	0
Number of facilities - Pyrolysis (quantity)	0	0	0	0	0	0	0
Number of facilities - Pyrolysis ccu (quantity)	0	0	0	0	0	0	1
Number of facilities - Sng (quantity)	0	0	0	0	0	0	0
Number of facilities - Sng ccu (quantity)	0	0	0	0	0	0	0

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

Item	2020	2025	2030	2035	2040	2045	2050
Annual - All (MMT)	0	0	0	3.35	3.32	6.84	18.6
Annual - BECCS (MMT)	0	0	0	0	0	0	11.5
Annual - Cement and lime (MMT)	0	0	0	3.35	3.32	6.84	7.07
Annual - NGCC (MMT)	0	0	0	0	0	0	0
Cumulative - All (MMT)	0	0	0	3.35	6.67	13.5	32.1
Cumulative - BECCS (MMT)	0	0	0	0	0	0	11.5
Cumulative - Cement and lime (MMT)	0	0	0	3.35	6.67	13.5	20.6
Cumulative - NGCC (MMT)	0	0	0	0	0	0	0

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	0	0	0	0
Wells and facilities construction costs (million $2020)	0	0	0	0	0	0	0

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

Item	2020	2025	2030	2035	2040	2045	2050
All (km)	0	0	622	1,001	826	909	2,002
Cumulative investment - All (million $2018)	0	0	1,668	2,719	2,627	2,709	3,539
Cumulative investment - Spur (million $2018)	0	0	54.5	190	97.7	180	1,010
Cumulative investment - Trunk (million $2018)	0	0	1,614	2,529	2,529	2,529	2,529
Spur (km)	0	0	107	332	157	241	1,333
Trunk (km)	0	0	515	669	669	669	669

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	-304
Carbon sink potential - Aggressive deployment - Cropland measures (1000 tCO2e/y)	0	0	-2,059
Carbon sink potential - Aggressive deployment - Permanent conservation cover (1000 tCO2e/y)	0	0	-95.2
Carbon sink potential - Aggressive deployment - Total (1000 tCO2e/y)	0	0	-2,458
Carbon sink potential - Moderate deployment - Corn-ethanol to energy grasses (1000 tCO2e/y)	0	0	-304
Carbon sink potential - Moderate deployment - Cropland measures (1000 tCO2e/y)	0	0	-1,086
Carbon sink potential - Moderate deployment - Permanent conservation cover (1000 tCO2e/y)	0	0	-47.6
Carbon sink potential - Moderate deployment - Total (1000 tCO2e/y)	0	0	-1,437
Land impacted for carbon sink - Aggressive deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	139
Land impacted for carbon sink - Aggressive deployment - Cropland measures (1000 hectares)	0	0	1,571
Land impacted for carbon sink - Aggressive deployment - Permanent conservation cover (1000 hectares)	0	0	173
Land impacted for carbon sink - Aggressive deployment - Total (1000 hectares)	0	0	1,884
Land impacted for carbon sink - Moderate deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	139

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	829
Land impacted for carbon sink - Moderate deployment - Permanent conservation cover (1000 hectares)	0	0	86.6
Land impacted for carbon sink - Moderate deployment - Total (1000 hectares)	0	0	1,055

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

Item	2020	2025	2050
Carbon sink potential - High - Accelerate regeneration (1000 tCO2e/y)	0	0	291
Carbon sink potential - High - All (not counting overlap) (1000 tCO2e/y)	0	0	27,852
Carbon sink potential - High - Avoid deforestation (1000 tCO2e/y)	0	0	3,104
Carbon sink potential - High - Extend rotation length (1000 tCO2e/y)	0	0	8,777
Carbon sink potential - High - Improve plantations (1000 tCO2e/y)	0	0	440
Carbon sink potential - High - Increase retention of HWP (1000 tCO2e/y)	0	0	5,935
Carbon sink potential - High - Increase trees outside forests (1000 tCO2e/y)	0	0	1,121
Carbon sink potential - High - Reforest cropland (1000 tCO2e/y)	0	0	186
Carbon sink potential - High - Reforest pasture (1000 tCO2e/y)	0	0	4,122
Carbon sink potential - High - Restore productivity (1000 tCO2e/y)	0	0	3,875
Carbon sink potential - Low - Accelerate regeneration (1000 tCO2e/y)	0	0	146
Carbon sink potential - Low - All (not counting overlap) (1000 tCO2e/y)	0	0	8,341
Carbon sink potential - Low - Avoid deforestation (1000 tCO2e/y)	0	0	517
Carbon sink potential - Low - Extend rotation length (1000 tCO2e/y)	0	0	3,371
Carbon sink potential - Low - Improve plantations (1000 tCO2e/y)	0	0	224
Carbon sink potential - Low - Increase retention of HWP (1000 tCO2e/y)	0	0	1,978
Carbon sink potential - Low - Increase trees outside forests (1000 tCO2e/y)	0	0	392
Carbon sink potential - Low - Reforest cropland (1000 tCO2e/y)	0	0	93.2
Carbon sink potential - Low - Reforest pasture (1000 tCO2e/y)	0	0	312
Carbon sink potential - Low - Restore productivity (1000 tCO2e/y)	0	0	1,306
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO2e/y)	0	0	218
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO2e/y)	0	0	18,092
Carbon sink potential - Mid - Avoid deforestation (1000 tCO2e/y)	0	0	1,811
Carbon sink potential - Mid - Extend rotation length (1000 tCO2e/y)	0	0	6,074
Carbon sink potential - Mid - Improve plantations (1000 tCO2e/y)	0	0	328
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO2e/y)	0	0	3,957

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	757
Carbon sink potential - Mid - Reforest cropland (1000 tCO2e/y)	0	0	140
Carbon sink potential - Mid - Reforest pasture (1000 tCO2e/y)	0	0	2,217
Carbon sink potential - Mid - Restore productivity (1000 tCO2e/y)	0	0	2,591
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)	0	0	47.6
Land impacted for carbon sink potential - High - Avoid deforestation (over 30 years) (1000 hectares)	0	0	420
Land impacted for carbon sink potential - High - Extend rotation length (1000 hectares)	0	0	4,476
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)	0	0	162
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	107
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)	0	0	12.3
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)	0	0	117
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)	0	0	1,285
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)	0	0	6,626
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)	0	0	23.8
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)	0	0	395
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)	0	0	1,715
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)	0	0	81
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	56.1
Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares)	0	0	6.16
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)	0	0	20.3
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)	0	0	777
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)	0	0	3,074
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)	0	0	35.7
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)	0	0	407
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)	0	0	3,095
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)	0	0	122
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	81.3

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

Item	2020	2025	2050
Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares)	0	0	9.24
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)	0	0	147
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)	0	0	1,565
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)	0	0	5,463

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

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal (million 2019$)	0	2,390	1.63	1.62	1.48	1.01	0.081
Monetary damages from air pollution - Natural Gas (million 2019$)	0	614	453	294	268	170	67.9
Monetary damages from air pollution - Transportation (million 2019$)	0	4,170	3,868	2,927	1,689	768	300
Premature deaths from air pollution - Coal (deaths)	0	268	0.183	0.181	0.166	0.113	0.009
Premature deaths from air pollution - Natural Gas (deaths)	0	69.4	51.1	33.2	30.3	19.2	7.67
Premature deaths from air pollution - Transportation (deaths)	0	469	435	329	190	86.4	33.7

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

Item	2020	2025	2030	2035	2040	2045	2050
By economic sector - Agriculture (jobs)	350	375	568	326	211	97.7	632
By economic sector - Construction (jobs)	16,495	16,338	16,396	22,401	28,171	34,355	45,295
By economic sector - Manufacturing (jobs)	11,278	19,602	22,640	28,984	28,119	23,357	29,915
By economic sector - Mining (jobs)	18,558	13,345	9,256	6,636	4,454	2,850	1,740
By economic sector - Other (jobs)	856	840	1,025	2,668	4,597	6,936	10,799
By economic sector - Pipeline (jobs)	2,582	2,600	2,426	1,920	1,378	931	741
By economic sector - Professional (jobs)	8,958	7,981	7,156	9,193	11,823	14,796	20,938
By economic sector - Trade (jobs)	8,030	6,468	5,545	6,817	8,520	10,749	15,134
By economic sector - Utilities (jobs)	24,165	22,849	21,083	22,795	24,713	26,600	31,661
By education level - All sectors - Associates degree or some college (jobs)	28,200	28,277	27,133	32,433	36,054	39,103	50,749
By education level - All sectors - Bachelors degree (jobs)	19,339	19,136	17,876	20,440	22,007	23,331	30,187
By education level - All sectors - Doctoral degree (jobs)	619	573	512	590	672	768	1,034
By education level - All sectors - High school diploma or less (jobs)	38,473	37,948	36,483	43,620	48,135	51,879	67,564
By education level - All sectors - Masters or professional degree (jobs)	4,641	4,461	4,091	4,658	5,117	5,591	7,319
By resource sector - Biomass (jobs)	1,126	1,243	1,475	817	568	365	2,730
By resource sector - CO2 (jobs)	0	0	1,596	1,020	136	246	1,446
By resource sector - Coal (jobs)	11,979	5,457	2,203	1,748	1,519	1,367	1,211
By resource sector - Grid (jobs)	17,268	17,018	17,049	25,485	33,636	43,359	57,865
By resource sector - Natural Gas (jobs)	35,586	34,052	28,380	22,686	19,157	13,137	7,603
By resource sector - Nuclear (jobs)	4,890	4,428	3,817	3,179	1,814	636	0
By resource sector - Oil (jobs)	12,342	11,169	9,436	7,556	5,500	4,056	2,774
By resource sector - Solar (jobs)	5,813	9,472	12,101	26,280	37,790	48,918	72,736
By resource sector - Wind (jobs)	2,270	7,559	10,039	12,969	11,865	8,587	10,490
Median wages - Annual - All ($2019 per job)	61,909	62,196	62,443	62,390	63,104	64,136	64,668
On-Site or In-Plant Training - Total jobs - 1 to 4 years (jobs)	14,883	14,758	14,077	16,683	18,469	20,011	25,828
On-Site or In-Plant Training - Total jobs - 4 to 10 years (jobs)	6,075	5,839	5,485	6,450	7,325	8,213	10,550
On-Site or In-Plant Training - Total jobs - None (jobs)	14,300	14,411	13,811	16,423	18,119	19,532	25,569

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)	730	743	719	863	971	1,066	1,377
On-Site or In-Plant Training - Total jobs - Up to 1 year (jobs)	55,284	54,645	52,002	61,322	67,102	71,851	93,531
On-the-Job Training - All sectors - 1 to 4 years (jobs)	19,182	19,018	18,116	21,429	23,745	25,759	33,185
On-the-Job Training - All sectors - 4 to 10 years (jobs)	5,835	5,582	5,257	6,258	7,204	8,176	10,545
On-the-Job Training - All sectors - None (jobs)	4,828	4,761	4,505	5,356	5,945	6,494	8,561
On-the-Job Training - All sectors - Over 10 years (jobs)	839	894	880	1,065	1,157	1,211	1,566
On-the-Job Training - All sectors - Up to 1 year (jobs)	60,589	60,141	57,337	67,632	73,934	79,031	102,997
Related work experience - All sectors - 1 to 4 years (jobs)	33,543	32,879	31,090	36,443	40,009	43,099	55,874
Related work experience - All sectors - 4 to 10 years (jobs)	21,280	21,167	20,095	23,574	25,901	27,874	35,975
Related work experience - All sectors - None (jobs)	12,933	12,873	12,326	14,603	16,190	17,586	22,930
Related work experience - All sectors - Over 10 years (jobs)	5,771	5,876	5,616	6,574	7,083	7,435	9,555
Related work experience - All sectors - Up to 1 year (jobs)	17,747	17,602	16,968	20,547	22,802	24,678	32,520
Wage income - All (million $2019)	5,651	5,622	5,376	6,348	7,067	7,741	10,145

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

Item	2020	2025	2030	2035	2040	2045	2050
Natural gas consumption - Annual (tcf)	1,112	1,128	951	763	574	361	251
Natural gas consumption - Cumulative (tcf)	0	0	0	0	0	0	22,977
Natural gas production - Annual (tcf)	6,744	7,475	7,066	6,154	5,204	4,126	3,205
Oil consumption - Annual (million bbls)	188	181	162	132	104	81	62
Oil consumption - Cumulative (million bbls)	0	0	0	0	0	0	4,048
Oil production - Annual (million bbls)	7.76	8.39	8.42	8.41	6.66	5.42	3.6

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	10.8	13	0	0	0	0
Sales of cooking units - Electric Resistance (%)	55.2	56.3	60.5	71.3	86.3	95.6	98.8
Sales of cooking units - Gas (%)	44.8	43.7	39.5	28.7	13.7	4.42	1.19
Sales of space heating units - Electric Heat Pump (%)	8.42	13.6	18	31.2	54.5	74.9	84.5
Sales of space heating units - Electric Resistance (%)	9.49	12.2	11.8	10.4	7.78	5.17	3.89
Sales of space heating units - Fossil (%)	24.2	34.8	32.7	26.6	17	10.3	7.7
Sales of space heating units - Gas (%)	57.9	39.4	37.5	31.8	20.7	9.65	3.89
Sales of water heating units - Electric Heat Pump (%)	0	0.823	3.14	10.1	22.7	34.2	39.8
Sales of water heating units - Electric Resistance (%)	35.5	52.7	52.6	52.6	53.5	55.2	56.4
Sales of water heating units - Gas Furnace (%)	58.8	42.8	40.8	34.6	22.4	10	3.56
Sales of water heating units - Other (%)	5.73	3.74	3.46	2.63	1.37	0.535	0.247

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	699	2,363	7,431	10,827
Public EV charging plugs - DC Fast (1000 units)	0.267	0	1.09	0	5.72	0	16
Public EV charging plugs - L2 (1000 units)	1.32	0	26.2	0	137	0	383
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 (%)	1.45	1.88	2.04	1.61	1.02	0.523	0.225
Vehicle sales - Light-duty - EV (%)	2.03	4.99	12.5	26.8	49.4	72.7	87.8
Vehicle sales - Light-duty - gasoline (%)	91.3	86.9	78.6	65.4	45	24.1	10.7
Vehicle sales - Light-duty - hybrid (%)	4.99	5.77	6.44	5.8	4.29	2.5	1.2
Vehicle sales - Light-duty - hydrogen FC (%)	0.112	0.377	0.319	0.241	0.17	0.094	0.044
Vehicle sales - Light-duty - other (%)	0.098	0.101	0.091	0.079	0.057	0.031	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)	388	381	378	375	368	359	349
Final energy use - Industry (PJ)	791	783	769	764	735	716	676
Final energy use - Residential (PJ)	467	428	403	379	349	315	281
Final energy use - Transportation (PJ)	817	772	705	650	607	555	495

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	59,150	64,632	0	0	0	0
Sales of cooking units - Electric Resistance (%)	18.5	21.6	27.5	43	64.5	77.7	82.3
Sales of cooking units - Gas (%)	81.5	78.4	72.5	57	35.5	22.3	17.7
Sales of space heating units - Electric Heat Pump (%)	2.56	7.82	11.2	21.8	42.1	62.6	73.2
Sales of space heating units - Electric Resistance (%)	5.59	3.46	4.4	7.36	12.7	16.8	19
Sales of space heating units - Fossil (%)	19.4	17.2	16.4	12.8	6.63	2.21	0.78
Sales of space heating units - Gas Furnace (%)	72.4	71.6	67.9	58.1	38.6	18.3	7.04
Sales of water heating units - Electric Heat Pump (%)	0.624	1.34	4.16	12.7	28.8	44.1	51.9
Sales of water heating units - Electric Resistance (%)	3.49	2.59	4.34	9.88	21.2	33.5	40.1
Sales of water heating units - Gas Furnace (%)	94.2	94.7	90.2	76.4	49.4	22.1	7.82
Sales of water heating units - Other (%)	1.74	1.35	1.32	1.03	0.608	0.33	0.23

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	5.07	5.09	7.06	7.31	10.1	10.6

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	-304
Carbon sink potential - Aggressive deployment - Cropland measures (1000 tCO2e/y)	0	0	-2,059
Carbon sink potential - Aggressive deployment - Permanent conservation cover (1000 tCO2e/y)	0	0	-95.2
Carbon sink potential - Aggressive deployment - Total (1000 tCO2e/y)	0	0	-2,458

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	-304
Carbon sink potential - Moderate deployment - Cropland measures (1000 tCO2e/y)	0	0	-1,086
Carbon sink potential - Moderate deployment - Permanent conservation cover (1000 tCO2e/y)	0	0	-47.6
Carbon sink potential - Moderate deployment - Total (1000 tCO2e/y)	0	0	-1,437
Land impacted for carbon sink - Aggressive deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	139
Land impacted for carbon sink - Aggressive deployment - Cropland measures (1000 hectares)	0	0	1,571
Land impacted for carbon sink - Aggressive deployment - Permanent conservation cover (1000 hectares)	0	0	173
Land impacted for carbon sink - Aggressive deployment - Total (1000 hectares)	0	0	1,884
Land impacted for carbon sink - Moderate deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	139
Land impacted for carbon sink - Moderate deployment - Cropland measures (1000 hectares)	0	0	829
Land impacted for carbon sink - Moderate deployment - Permanent conservation cover (1000 hectares)	0	0	86.6
Land impacted for carbon sink - Moderate deployment - Total (1000 hectares)	0	0	1,055

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

Item	2020	2025	2050
Carbon sink potential - High - Accelerate regeneration (1000 tCO2e/y)	0	0	291
Carbon sink potential - High - All (not counting overlap) (1000 tCO2e/y)	0	0	27,852
Carbon sink potential - High - Avoid deforestation (1000 tCO2e/y)	0	0	3,104
Carbon sink potential - High - Extend rotation length (1000 tCO2e/y)	0	0	8,777
Carbon sink potential - High - Improve plantations (1000 tCO2e/y)	0	0	440
Carbon sink potential - High - Increase retention of HWP (1000 tCO2e/y)	0	0	5,935
Carbon sink potential - High - Increase trees outside forests (1000 tCO2e/y)	0	0	1,121
Carbon sink potential - High - Reforest cropland (1000 tCO2e/y)	0	0	186
Carbon sink potential - High - Reforest pasture (1000 tCO2e/y)	0	0	4,122
Carbon sink potential - High - Restore productivity (1000 tCO2e/y)	0	0	3,875
Carbon sink potential - Low - Accelerate regeneration (1000 tCO2e/y)	0	0	146
Carbon sink potential - Low - All (not counting overlap) (1000 tCO2e/y)	0	0	8,341
Carbon sink potential - Low - Avoid deforestation (1000 tCO2e/y)	0	0	517
Carbon sink potential - Low - Extend rotation length (1000 tCO2e/y)	0	0	3,371
Carbon sink potential - Low - Improve plantations (1000 tCO2e/y)	0	0	224

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	1,978
Carbon sink potential - Low - Increase trees outside forests (1000 tCO2e/y)	0	0	392
Carbon sink potential - Low - Reforest cropland (1000 tCO2e/y)	0	0	93.2
Carbon sink potential - Low - Reforest pasture (1000 tCO2e/y)	0	0	312
Carbon sink potential - Low - Restore productivity (1000 tCO2e/y)	0	0	1,306
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO2e/y)	0	0	218
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO2e/y)	0	0	18,092
Carbon sink potential - Mid - Avoid deforestation (1000 tCO2e/y)	0	0	1,811
Carbon sink potential - Mid - Extend rotation length (1000 tCO2e/y)	0	0	6,074
Carbon sink potential - Mid - Improve plantations (1000 tCO2e/y)	0	0	328
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO2e/y)	0	0	3,957
Carbon sink potential - Mid - Increase trees outside forests (1000 tCO2e/y)	0	0	757
Carbon sink potential - Mid - Reforest cropland (1000 tCO2e/y)	0	0	140
Carbon sink potential - Mid - Reforest pasture (1000 tCO2e/y)	0	0	2,217
Carbon sink potential - Mid - Restore productivity (1000 tCO2e/y)	0	0	2,591
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)	0	0	47.6
Land impacted for carbon sink potential - High - Avoid deforestation (over 30 years) (1000 hectares)	0	0	420
Land impacted for carbon sink potential - High - Extend rotation length (1000 hectares)	0	0	4,476
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)	0	0	162
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	107
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)	0	0	12.3
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)	0	0	117
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)	0	0	1,285
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)	0	0	6,626
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)	0	0	23.8
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)	0	0	395
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)	0	0	1,715
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)	0	0	81
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	56.1
Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares)	0	0	6.16
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)	0	0	20.3
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)	0	0	777
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)	0	0	3,074
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)	0	0	35.7
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)	0	0	407
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)	0	0	3,095
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)	0	0	122
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	81.3
Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares)	0	0	9.24
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)	0	0	147
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)	0	0	1,565
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)	0	0	5,463

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

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal (million 2019$)	0	2,390	1.63	1.62	1.48	1.01	0.081
Monetary damages from air pollution - Natural Gas (million 2019$)	0	589	375	166	77.4	25.1	16.2
Monetary damages from air pollution - Transportation (million 2019$)	0	4,245	4,272	4,139	3,715	2,952	2,023
Premature deaths from air pollution - Coal (deaths)	0	268	0.183	0.181	0.166	0.113	0.009
Premature deaths from air pollution - Natural Gas (deaths)	0	66.5	42.4	18.8	8.74	2.84	1.83
Premature deaths from air pollution - Transportation (deaths)	0	477	480	466	418	332	228

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	12.5	0	0	0	0
Sales of cooking units - Electric Resistance (%)	55.4	64.9	94	99.7	100	100	100
Sales of cooking units - Gas (%)	44.6	35.1	6.01	0.303	0	0	0
Sales of space heating units - Electric Heat Pump (%)	8.42	19.7	58.8	85.6	89.5	89.7	89.7
Sales of space heating units - Electric Resistance (%)	9.49	11.8	7.94	3.83	3.14	3.17	3.29
Sales of space heating units - Fossil (%)	24.2	31.3	12.5	6.86	6.43	6.34	6.23
Sales of space heating units - Gas (%)	57.9	37.3	20.7	3.68	0.918	0.75	0.749
Sales of water heating units - Electric Heat Pump (%)	0	3.85	24.2	40.2	42.6	42.8	42.8

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

Item	2020	2025	2030	2035	2040	2045	2050
Sales of water heating units - Electric Resistance (%)	35.5	52.4	52.4	56.3	57.1	57.1	57.1
Sales of water heating units - Gas Furnace (%)	58.8	40.5	22.7	3.36	0.193	0	0
Sales of water heating units - Other (%)	5.73	3.25	0.692	0.122	0.097	0.097	0.098

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	2,057	5,276	8,545	12,946	14,088	13,433
Public EV charging plugs - DC Fast (1000 units)	0.267	0	3.52	0	15.4	0	24.9
Public EV charging plugs - L2 (1000 units)	1.32	0	84.6	0	370	0	599
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 (%)	1.43	1.71	1.21	0.386	0.073	0.013	0
Vehicle sales - Light-duty - EV (%)	4.31	16.4	48.3	82.5	96.4	99.3	100
Vehicle sales - Light-duty - gasoline (%)	89.2	76.6	46.9	15.8	3.2	0.587	0
Vehicle sales - Light-duty - hybrid (%)	4.8	4.82	3.34	1.23	0.301	0.066	0
Vehicle sales - Light-duty - hydrogen FC (%)	0.11	0.333	0.194	0.06	0.012	0.002	0
Vehicle sales - Light-duty - other (%)	0.096	0.092	0.059	0.021	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)	388	381	368	346	323	310	307
Final energy use - Industry (PJ)	791	783	767	757	724	706	669
Final energy use - Residential (PJ)	467	427	389	337	289	255	236
Final energy use - Transportation (PJ)	816	765	673	560	457	393	364

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	59,163	64,630	0	0	0	0
Sales of cooking units - Electric Resistance (%)	18.5	33.7	75.3	83.5	83.9	84	84
Sales of cooking units - Gas (%)	81.5	66.3	24.7	16.5	16.1	16	16
Sales of space heating units - Electric Heat Pump (%)	2.56	11.7	42	73.7	78.6	79.2	79.1
Sales of space heating units - Electric Resistance (%)	5.59	4.8	13.3	19	20.2	19.9	20
Sales of space heating units - Fossil (%)	19.4	14.8	2.91	0.126	0	0	0
Sales of space heating units - Gas Furnace (%)	72.4	68.7	41.8	7.14	1.21	0.873	0.87
Sales of water heating units - Electric Heat Pump (%)	0.624	4.78	29.6	52.2	55.8	56	56
Sales of water heating units - Electric Resistance (%)	3.49	4.26	19.8	40.2	43.6	43.8	43.8
Sales of water heating units - Gas Furnace (%)	94.2	89.8	50.2	7.42	0.426	0	0
Sales of water heating units - Other (%)	1.74	1.19	0.379	0.186	0.177	0.178	0.178

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	6.13	6.27	11.6	12.4	12.4	13.1

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	3.22	5.38	30.1	47.8	37.4	20.4
Capital invested - Wind - Base (billion $2018)	0	0	0	0	0	53	92.8

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

Item	2020	2025	2030	2035	2040	2045	2050
Solar - Base land use assumptions (GWh)	169	4,271	7,915	46,819	78,275	63,857	39,202
Solar - Constrained land use assumptions (GWh)	169	5,843	13,364	70,137	70,469	30,013	55,423
Wind - Base land use assumptions (GWh)	6,912	0	0	0	0	92,150	140,459
Wind - Constrained land use assumptions (GWh)	6,912	0	0	127,912	58,224	0	0

Table 32: *E+RE+ scenario - PILLAR 6: Land sinks - Agriculture*

Item	2020	2025	2050
Carbon sink potential - Aggressive deployment - Corn-ethanol to energy grasses (1000 tCO2e/y)	0	0	-304
Carbon sink potential - Aggressive deployment - Cropland measures (1000 tCO2e/y)	0	0	-2,059
Carbon sink potential - Aggressive deployment - Permanent conservation cover (1000 tCO2e/y)	0	0	-95.2
Carbon sink potential - Aggressive deployment - Total (1000 tCO2e/y)	0	0	-2,458
Carbon sink potential - Moderate deployment - Corn-ethanol to energy grasses (1000 tCO2e/y)	0	0	-304
Carbon sink potential - Moderate deployment - Cropland measures (1000 tCO2e/y)	0	0	-1,086
Carbon sink potential - Moderate deployment - Permanent conservation cover (1000 tCO2e/y)	0	0	-47.6
Carbon sink potential - Moderate deployment - Total (1000 tCO2e/y)	0	0	-1,437
Land impacted for carbon sink - Aggressive deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	139
Land impacted for carbon sink - Aggressive deployment - Cropland measures (1000 hectares)	0	0	1,571
Land impacted for carbon sink - Aggressive deployment - Permanent conservation cover (1000 hectares)	0	0	173
Land impacted for carbon sink - Aggressive deployment - Total (1000 hectares)	0	0	1,884
Land impacted for carbon sink - Moderate deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	139
Land impacted for carbon sink - Moderate deployment - Cropland measures (1000 hectares)	0	0	829
Land impacted for carbon sink - Moderate deployment - Permanent conservation cover (1000 hectares)	0	0	86.6
Land impacted for carbon sink - Moderate deployment - Total (1000 hectares)	0	0	1,055

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	291
Carbon sink potential - High - All (not counting overlap) (1000 tCO2e/y)	0	0	27,852
Carbon sink potential - High - Avoid deforestation (1000 tCO2e/y)	0	0	3,104
Carbon sink potential - High - Extend rotation length (1000 tCO2e/y)	0	0	8,777
Carbon sink potential - High - Improve plantations (1000 tCO2e/y)	0	0	440
Carbon sink potential - High - Increase retention of HWP (1000 tCO2e/y)	0	0	5,935
Carbon sink potential - High - Increase trees outside forests (1000 tCO2e/y)	0	0	1,121
Carbon sink potential - High - Reforest cropland (1000 tCO2e/y)	0	0	186
Carbon sink potential - High - Reforest pasture (1000 tCO2e/y)	0	0	4,122
Carbon sink potential - High - Restore productivity (1000 tCO2e/y)	0	0	3,875
Carbon sink potential - Low - Accelerate regeneration (1000 tCO2e/y)	0	0	146
Carbon sink potential - Low - All (not counting overlap) (1000 tCO2e/y)	0	0	8,341
Carbon sink potential - Low - Avoid deforestation (1000 tCO2e/y)	0	0	517
Carbon sink potential - Low - Extend rotation length (1000 tCO2e/y)	0	0	3,371
Carbon sink potential - Low - Improve plantations (1000 tCO2e/y)	0	0	224
Carbon sink potential - Low - Increase retention of HWP (1000 tCO2e/y)	0	0	1,978
Carbon sink potential - Low - Increase trees outside forests (1000 tCO2e/y)	0	0	392
Carbon sink potential - Low - Reforest cropland (1000 tCO2e/y)	0	0	93.2
Carbon sink potential - Low - Reforest pasture (1000 tCO2e/y)	0	0	312
Carbon sink potential - Low - Restore productivity (1000 tCO2e/y)	0	0	1,306
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO2e/y)	0	0	218
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO2e/y)	0	0	18,092
Carbon sink potential - Mid - Avoid deforestation (1000 tCO2e/y)	0	0	1,811
Carbon sink potential - Mid - Extend rotation length (1000 tCO2e/y)	0	0	6,074
Carbon sink potential - Mid - Improve plantations (1000 tCO2e/y)	0	0	328
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO2e/y)	0	0	3,957
Carbon sink potential - Mid - Increase trees outside forests (1000 tCO2e/y)	0	0	757
Carbon sink potential - Mid - Reforest cropland (1000 tCO2e/y)	0	0	140
Carbon sink potential - Mid - Reforest pasture (1000 tCO2e/y)	0	0	2,217
Carbon sink potential - Mid - Restore productivity (1000 tCO2e/y)	0	0	2,591
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)	0	0	47.6

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	420
Land impacted for carbon sink potential - High - Extend rotation length (1000 hectares)	0	0	4,476
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)	0	0	162
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	107
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)	0	0	12.3
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)	0	0	117
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)	0	0	1,285
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)	0	0	6,626
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)	0	0	23.8
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)	0	0	395
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)	0	0	1,715
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)	0	0	81
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	56.1
Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares)	0	0	6.16
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)	0	0	20.3
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)	0	0	777
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)	0	0	3,074
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)	0	0	35.7
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)	0	0	407
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)	0	0	3,095
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)	0	0	122
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	81.3
Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares)	0	0	9.24
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)	0	0	147
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)	0	0	1,565
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)	0	0	5,463

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

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal (million 2019$)	0	2,390	1.63	1.62	1.48	1.01	0.081
Monetary damages from air pollution - Natural Gas (million 2019$)	0	547	388	233	166	59	11.4
Monetary damages from air pollution - Transportation (million 2019$)	0	4,170	3,868	2,927	1,689	768	300
Premature deaths from air pollution - Coal (deaths)	0	268	0.183	0.181	0.166	0.113	0.009
Premature deaths from air pollution - Natural Gas (deaths)	0	61.8	43.8	26.3	18.8	6.67	1.29
Premature deaths from air pollution - Transportation (deaths)	0	469	435	329	190	86.4	33.7

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	12.5	0	0	0	0
Sales of cooking units - Electric Resistance (%)	55.4	64.9	94	99.7	100	100	100
Sales of cooking units - Gas (%)	44.6	35.1	6.01	0.303	0	0	0
Sales of space heating units - Electric Heat Pump (%)	8.42	19.7	58.8	85.6	89.5	89.7	89.7
Sales of space heating units - Electric Resistance (%)	9.49	11.8	7.94	3.83	3.14	3.17	3.29
Sales of space heating units - Fossil (%)	24.2	31.3	12.5	6.86	6.43	6.34	6.23
Sales of space heating units - Gas (%)	57.9	37.3	20.7	3.68	0.918	0.75	0.749
Sales of water heating units - Electric Heat Pump (%)	0	3.85	24.2	40.2	42.6	42.8	42.8
Sales of water heating units - Electric Resistance (%)	35.5	52.4	52.4	56.3	57.1	57.1	57.1
Sales of water heating units - Gas Furnace (%)	58.8	40.5	22.7	3.36	0.193	0	0
Sales of water heating units - Other (%)	5.73	3.25	0.692	0.122	0.097	0.097	0.098

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	2,057	5,276	8,545	12,946	14,088	13,433
Public EV charging plugs - DC Fast (1000 units)	0.267	0	3.52	0	15.4	0	24.9
Public EV charging plugs - L2 (1000 units)	1.32	0	84.6	0	370	0	599
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 (%)	1.43	1.71	1.21	0.386	0.073	0.013	0
Vehicle sales - Light-duty - EV (%)	4.31	16.4	48.3	82.5	96.4	99.3	100
Vehicle sales - Light-duty - gasoline (%)	89.2	76.6	46.9	15.8	3.2	0.587	0
Vehicle sales - Light-duty - hybrid (%)	4.8	4.82	3.34	1.23	0.301	0.066	0
Vehicle sales - Light-duty - hydrogen FC (%)	0.11	0.333	0.194	0.06	0.012	0.002	0
Vehicle sales - Light-duty - other (%)	0.096	0.092	0.059	0.021	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)	388	381	368	346	323	310	307
Final energy use - Industry (PJ)	791	783	767	757	724	706	669
Final energy use - Residential (PJ)	467	427	389	337	289	255	236
Final energy use - Transportation (PJ)	816	765	673	560	457	393	364

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	59,163	64,630	0	0	0	0
Sales of cooking units - Electric Resistance (%)	18.5	33.7	75.3	83.5	83.9	84	84
Sales of cooking units - Gas (%)	81.5	66.3	24.7	16.5	16.1	16	16
Sales of space heating units - Electric Heat Pump (%)	2.56	11.7	42	73.7	78.6	79.2	79.1
Sales of space heating units - Electric Resistance (%)	5.59	4.8	13.3	19	20.2	19.9	20
Sales of space heating units - Fossil (%)	19.4	14.8	2.91	0.126	0	0	0
Sales of space heating units - Gas Furnace (%)	72.4	68.7	41.8	7.14	1.21	0.873	0.87
Sales of water heating units - Electric Heat Pump (%)	0.624	4.78	29.6	52.2	55.8	56	56
Sales of water heating units - Electric Resistance (%)	3.49	4.26	19.8	40.2	43.6	43.8	43.8
Sales of water heating units - Gas Furnace (%)	94.2	89.8	50.2	7.42	0.426	0	0
Sales of water heating units - Other (%)	1.74	1.19	0.379	0.186	0.177	0.178	0.178

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	6.13	6.27	11.6	12.4	12.4	13.1

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

Item	2020	2025	2030	2035	2040	2045	2050
Capital invested - Solar PV - Base (billion $2018)	0	0	0.794	0.689	1.23	1.11	0
Capital invested - Solar PV - Constrained (billion $2018)	0	0.746	2.35	1.42	1.73	4.6	0.659
Capital invested - Wind - Base (billion $2018)	0	0	0	0	0	0	0
Capital invested - Wind - Constrained (billion $2018)	0	0	0	0	0	0	0

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

Item	2020	2025	2030	2035	2040	2045	2050
Solar - Base land use assumptions (GWh)	169	0	1,190	1,106	2,111	1,988	0
Solar - Constrained land use assumptions (GWh)	169	997	3,506	2,291	2,931	8,269	1,241
Wind - Base land use assumptions (GWh)	6,912	0	0	0	0	0	0
Wind - Constrained land use assumptions (GWh)	6,912	0	0	0	0	0	0

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

Item	2020	2025	2050
Carbon sink potential - Aggressive deployment - Corn-ethanol to energy grasses (1000 tCO2e/y)	0	0	-304
Carbon sink potential - Aggressive deployment - Cropland measures (1000 tCO2e/y)	0	0	-2,059
Carbon sink potential - Aggressive deployment - Permanent conservation cover (1000 tCO2e/y)	0	0	-95.2
Carbon sink potential - Aggressive deployment - Total (1000 tCO2e/y)	0	0	-2,458
Carbon sink potential - Moderate deployment - Corn-ethanol to energy grasses (1000 tCO2e/y)	0	0	-304

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

Item	2020	2025	2050
Carbon sink potential - Moderate deployment - Cropland measures (1000 tCO2e/y)	0	0	-1,086
Carbon sink potential - Moderate deployment - Permanent conservation cover (1000 tCO2e/y)	0	0	-47.6
Carbon sink potential - Moderate deployment - Total (1000 tCO2e/y)	0	0	-1,437
Land impacted for carbon sink - Aggressive deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	139
Land impacted for carbon sink - Aggressive deployment - Cropland measures (1000 hectares)	0	0	1,571
Land impacted for carbon sink - Aggressive deployment - Permanent conservation cover (1000 hectares)	0	0	173
Land impacted for carbon sink - Aggressive deployment - Total (1000 hectares)	0	0	1,884
Land impacted for carbon sink - Moderate deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	139
Land impacted for carbon sink - Moderate deployment - Cropland measures (1000 hectares)	0	0	829
Land impacted for carbon sink - Moderate deployment - Permanent conservation cover (1000 hectares)	0	0	86.6
Land impacted for carbon sink - Moderate deployment - Total (1000 hectares)	0	0	1,055

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	291
Carbon sink potential - High - All (not counting overlap) (1000 tCO2e/y)	0	0	27,852
Carbon sink potential - High - Avoid deforestation (1000 tCO2e/y)	0	0	3,104
Carbon sink potential - High - Extend rotation length (1000 tCO2e/y)	0	0	8,777
Carbon sink potential - High - Improve plantations (1000 tCO2e/y)	0	0	440
Carbon sink potential - High - Increase retention of HWP (1000 tCO2e/y)	0	0	5,935
Carbon sink potential - High - Increase trees outside forests (1000 tCO2e/y)	0	0	1,121
Carbon sink potential - High - Reforest cropland (1000 tCO2e/y)	0	0	186
Carbon sink potential - High - Reforest pasture (1000 tCO2e/y)	0	0	4,122
Carbon sink potential - High - Restore productivity (1000 tCO2e/y)	0	0	3,875
Carbon sink potential - Low - Accelerate regeneration (1000 tCO2e/y)	0	0	146
Carbon sink potential - Low - All (not counting overlap) (1000 tCO2e/y)	0	0	8,341
Carbon sink potential - Low - Avoid deforestation (1000 tCO2e/y)	0	0	517
Carbon sink potential - Low - Extend rotation length (1000 tCO2e/y)	0	0	3,371
Carbon sink potential - Low - Improve plantations (1000 tCO2e/y)	0	0	224
Carbon sink potential - Low - Increase retention of HWP (1000 tCO2e/y)	0	0	1,978

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	392
Carbon sink potential - Low - Reforest cropland (1000 tCO2e/y)	0	0	93.2
Carbon sink potential - Low - Reforest pasture (1000 tCO2e/y)	0	0	312
Carbon sink potential - Low - Restore productivity (1000 tCO2e/y)	0	0	1,306
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO2e/y)	0	0	218
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO2e/y)	0	0	18,092
Carbon sink potential - Mid - Avoid deforestation (1000 tCO2e/y)	0	0	1,811
Carbon sink potential - Mid - Extend rotation length (1000 tCO2e/y)	0	0	6,074
Carbon sink potential - Mid - Improve plantations (1000 tCO2e/y)	0	0	328
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO2e/y)	0	0	3,957
Carbon sink potential - Mid - Increase trees outside forests (1000 tCO2e/y)	0	0	757
Carbon sink potential - Mid - Reforest cropland (1000 tCO2e/y)	0	0	140
Carbon sink potential - Mid - Reforest pasture (1000 tCO2e/y)	0	0	2,217
Carbon sink potential - Mid - Restore productivity (1000 tCO2e/y)	0	0	2,591
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)	0	0	47.6
Land impacted for carbon sink potential - High - Avoid deforestation (over 30 years) (1000 hectares)	0	0	420
Land impacted for carbon sink potential - High - Extend rotation length (1000 hectares)	0	0	4,476
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)	0	0	162
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	107
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)	0	0	12.3
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)	0	0	117
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)	0	0	1,285
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)	0	0	6,626
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)	0	0	23.8
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)	0	0	395
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)	0	0	1,715
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)	0	0	81
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	56.1

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	6.16
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)	0	0	20.3
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)	0	0	777
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)	0	0	3,074
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)	0	0	35.7
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)	0	0	407
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)	0	0	3,095
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)	0	0	122
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	81.3
Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares)	0	0	9.24
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)	0	0	147
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)	0	0	1,565
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)	0	0	5,463

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

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal (million 2019$)	0	2,390	1.63	1.62	1.48	1.01	0.081
Monetary damages from air pollution - Natural Gas (million 2019$)	0	620	483	572	436	166	51.7
Monetary damages from air pollution - Transportation (million 2019$)	0	4,170	3,868	2,927	1,689	768	300
Premature deaths from air pollution - Coal (deaths)	0	268	0.183	0.181	0.166	0.113	0.009
Premature deaths from air pollution - Natural Gas (deaths)	0	70.1	54.5	64.6	49.2	18.8	5.84
Premature deaths from air pollution - Transportation (deaths)	0	469	435	329	190	86.4	33.7

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	10.8	13	0	0	0	0
Sales of cooking units - Electric Resistance (%)	55.2	56.3	60.5	71.3	86.3	95.6	98.8
Sales of cooking units - Gas (%)	44.8	43.7	39.5	28.7	13.7	4.42	1.19
Sales of space heating units - Electric Heat Pump (%)	8.42	13.6	18	31.2	54.5	74.9	84.5
Sales of space heating units - Electric Resistance (%)	9.49	12.2	11.8	10.4	7.78	5.17	3.89
Sales of space heating units - Fossil (%)	24.2	34.8	32.7	26.6	17	10.3	7.7
Sales of space heating units - Gas (%)	57.9	39.4	37.5	31.8	20.7	9.65	3.89
Sales of water heating units - Electric Heat Pump (%)	0	0.823	3.14	10.1	22.7	34.2	39.8
Sales of water heating units - Electric Resistance (%)	35.5	52.7	52.6	52.6	53.5	55.2	56.4

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 (%)	58.8	42.8	40.8	34.6	22.4	10	3.56
Sales of water heating units - Other (%)	5.73	3.74	3.46	2.63	1.37	0.535	0.247

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	699	2,363	7,431	10,827
Public EV charging plugs - DC Fast (1000 units)	0.267	0	1.09	0	5.72	0	16
Public EV charging plugs - L2 (1000 units)	1.32	0	26.2	0	137	0	383
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 (%)	1.45	1.88	2.04	1.61	1.02	0.523	0.225
Vehicle sales - Light-duty - EV (%)	2.03	4.99	12.5	26.8	49.4	72.7	87.8
Vehicle sales - Light-duty - gasoline (%)	91.3	86.9	78.6	65.4	45	24.1	10.7
Vehicle sales - Light-duty - hybrid (%)	4.99	5.77	6.44	5.8	4.29	2.5	1.2
Vehicle sales - Light-duty - hydrogen FC (%)	0.112	0.377	0.319	0.241	0.17	0.094	0.044
Vehicle sales - Light-duty - other (%)	0.098	0.101	0.091	0.079	0.057	0.031	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)	388	381	378	375	368	359	349
Final energy use - Industry (PJ)	791	783	769	764	735	716	676
Final energy use - Residential (PJ)	467	428	403	379	349	315	281
Final energy use - Transportation (PJ)	817	772	705	650	607	555	495

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	59,150	64,632	0	0	0	0
Sales of cooking units - Electric Resistance (%)	18.5	21.6	27.5	43	64.5	77.7	82.3
Sales of cooking units - Gas (%)	81.5	78.4	72.5	57	35.5	22.3	17.7
Sales of space heating units - Electric Heat Pump (%)	2.56	7.82	11.2	21.8	42.1	62.6	73.2
Sales of space heating units - Electric Resistance (%)	5.59	3.46	4.4	7.36	12.7	16.8	19
Sales of space heating units - Fossil (%)	19.4	17.2	16.4	12.8	6.63	2.21	0.78
Sales of space heating units - Gas Furnace (%)	72.4	71.6	67.9	58.1	38.6	18.3	7.04
Sales of water heating units - Electric Heat Pump (%)	0.624	1.34	4.16	12.7	28.8	44.1	51.9
Sales of water heating units - Electric Resistance (%)	3.49	2.59	4.34	9.88	21.2	33.5	40.1
Sales of water heating units - Gas Furnace (%)	94.2	94.7	90.2	76.4	49.4	22.1	7.82
Sales of water heating units - Other (%)	1.74	1.35	1.32	1.03	0.608	0.33	0.23

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	5.07	5.09	7.06	7.31	10.1	10.6

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

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

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

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

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

Item	2020	2025	2030	2035	2040	2045	2050
Biomass purchases (million $2018/year)	0	0	0	0	0	0	1,316
Conversion capital investment - Cumulative 5-yr (million $2018)	0	0	0	0	0	0	14,912
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	0	0
Number of facilities - Diesel (quantity)	0	0	0	0	0	0	0
Number of facilities - Diesel ccu (quantity)	0	0	0	0	0	0	0
Number of facilities - Power (quantity)	0	0	0	0	0	0	0
Number of facilities - Power ccu (quantity)	0	0	0	0	0	0	0
Number of facilities - Pyrolysis (quantity)	0	0	0	0	0	0	15
Number of facilities - Pyrolysis ccu (quantity)	0	0	0	0	0	0	0
Number of facilities - Sng (quantity)	0	0	0	0	0	0	0
Number of facilities - Sng ccu (quantity)	0	0	0	0	0	0	0

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

Item	2020	2025	2030	2035	2040	2045	2050
Annual - All (MMT)	0	0	0	3.35	3.32	6.84	7.07
Annual - BECCS (MMT)	0	0	0	0	0	0	0
Annual - Cement and lime (MMT)	0	0	0	3.35	3.32	6.84	7.07
Annual - NGCC (MMT)	0	0	0	0	0	0	0
Cumulative - All (MMT)	0	0	0	3.35	6.67	13.5	20.6
Cumulative - BECCS (MMT)	0	0	0	0	0	0	0
Cumulative - Cement and lime (MMT)	0	0	0	3.35	6.67	13.5	20.6
Cumulative - NGCC (MMT)	0	0	0	0	0	0	0

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	0	0	0	0
Wells and facilities construction costs (million $2020)	0	0	0	0	0	0	0

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

Item	2020	2025	2030	2035	2040	2045	2050
All (km)	0	0	622	826	826	1,084	909
Cumulative investment - All (million $2018)	0	0	1,668	2,627	2,627	3,210	3,121
Cumulative investment - Spur (million $2018)	0	0	54.5	97.9	97.7	272	183
Cumulative investment - Trunk (million $2018)	0	0	1,614	2,529	2,529	2,938	2,938
Spur (km)	0	0	107	157	157	416	241
Trunk (km)	0	0	515	669	669	669	669

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	-627
Carbon sink potential - Aggressive deployment - Cropland measures (1000 tCO2e/y)	0	0	-1,912
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	-88.1
Carbon sink potential - Aggressive deployment - Total (1000 tCO2e/y)	0	0	-2,627
Carbon sink potential - Moderate deployment - Corn-ethanol to energy grasses (1000 tCO2e/y)	0	0	-627
Carbon sink potential - Moderate deployment - Cropland measures (1000 tCO2e/y)	0	0	-1,009
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	-44.1
Carbon sink potential - Moderate deployment - Total (1000 tCO2e/y)	0	0	-1,680
Land impacted for carbon sink - Aggressive deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	253
Land impacted for carbon sink - Aggressive deployment - Cropland measures (1000 hectares)	0	0	3,594
Land impacted for carbon sink - Aggressive deployment - Cropland to woody energy crops (1000 hectares)	0	0	14.8
Land impacted for carbon sink - Aggressive deployment - Pasture to energy crops (1000 hectares)	0	0	58.1
Land impacted for carbon sink - Aggressive deployment - Permanent conservation cover (1000 hectares)	0	0	160
Land impacted for carbon sink - Aggressive deployment - Total (1000 hectares)	0	0	4,080
Land impacted for carbon sink - Moderate deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	253
Land impacted for carbon sink - Moderate deployment - Cropland measures (1000 hectares)	0	0	768
Land impacted for carbon sink - Moderate deployment - Cropland to woody energy crops (1000 hectares)	0	0	14.8
Land impacted for carbon sink - Moderate deployment - Pasture to energy crops (1000 hectares)	0	0	58.1
Land impacted for carbon sink - Moderate deployment - Permanent conservation cover (1000 hectares)	0	0	80.2
Land impacted for carbon sink - Moderate deployment - Total (1000 hectares)	0	0	1,174

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	291
Carbon sink potential - High - All (not counting overlap) (1000 tCO2e/y)	0	0	27,852
Carbon sink potential - High - Avoid deforestation (1000 tCO2e/y)	0	0	3,104
Carbon sink potential - High - Extend rotation length (1000 tCO2e/y)	0	0	8,777
Carbon sink potential - High - Improve plantations (1000 tCO2e/y)	0	0	440
Carbon sink potential - High - Increase retention of HWP (1000 tCO2e/y)	0	0	5,935
Carbon sink potential - High - Increase trees outside forests (1000 tCO2e/y)	0	0	1,121
Carbon sink potential - High - Reforest cropland (1000 tCO2e/y)	0	0	186
Carbon sink potential - High - Reforest pasture (1000 tCO2e/y)	0	0	4,122
Carbon sink potential - High - Restore productivity (1000 tCO2e/y)	0	0	3,875
Carbon sink potential - Low - Accelerate regeneration (1000 tCO2e/y)	0	0	146
Carbon sink potential - Low - All (not counting overlap) (1000 tCO2e/y)	0	0	8,341
Carbon sink potential - Low - Avoid deforestation (1000 tCO2e/y)	0	0	517
Carbon sink potential - Low - Extend rotation length (1000 tCO2e/y)	0	0	3,371
Carbon sink potential - Low - Improve plantations (1000 tCO2e/y)	0	0	224
Carbon sink potential - Low - Increase retention of HWP (1000 tCO2e/y)	0	0	1,978
Carbon sink potential - Low - Increase trees outside forests (1000 tCO2e/y)	0	0	392
Carbon sink potential - Low - Reforest cropland (1000 tCO2e/y)	0	0	93.2
Carbon sink potential - Low - Reforest pasture (1000 tCO2e/y)	0	0	312
Carbon sink potential - Low - Restore productivity (1000 tCO2e/y)	0	0	1,306
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO2e/y)	0	0	218
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO2e/y)	0	0	18,092
Carbon sink potential - Mid - Avoid deforestation (1000 tCO2e/y)	0	0	1,811
Carbon sink potential - Mid - Extend rotation length (1000 tCO2e/y)	0	0	6,074
Carbon sink potential - Mid - Improve plantations (1000 tCO2e/y)	0	0	328
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO2e/y)	0	0	3,957
Carbon sink potential - Mid - Increase trees outside forests (1000 tCO2e/y)	0	0	757
Carbon sink potential - Mid - Reforest cropland (1000 tCO2e/y)	0	0	140
Carbon sink potential - Mid - Reforest pasture (1000 tCO2e/y)	0	0	2,217
Carbon sink potential - Mid - Restore productivity (1000 tCO2e/y)	0	0	2,591
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)	0	0	47.6

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	420
Land impacted for carbon sink potential - High - Extend rotation length (1000 hectares)	0	0	4,476
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)	0	0	162
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	107
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)	0	0	12.3
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)	0	0	117
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)	0	0	1,285
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)	0	0	6,626
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)	0	0	23.8
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)	0	0	395
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)	0	0	1,715
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)	0	0	81
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	56.1
Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares)	0	0	6.16
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)	0	0	20.3
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)	0	0	777
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)	0	0	3,074
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)	0	0	35.7
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)	0	0	407
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)	0	0	3,095
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)	0	0	122
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	81.3
Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares)	0	0	9.24
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)	0	0	147
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)	0	0	1,565
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)	0	0	5,463

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	10.4	10.9	0	0	0	0
Sales of cooking units - Electric Resistance (%)	54.8	54.8	54.8	54.8	54.8	54.8	54.8
Sales of cooking units - Gas (%)	45.2	45.2	45.2	45.2	45.2	45.2	45.2
Sales of space heating units - Electric Heat Pump (%)	6.94	20.6	21.2	22	22.5	23	23.7
Sales of space heating units - Electric Resistance (%)	9.71	11.3	11.1	10.9	10.7	10.1	9.42
Sales of space heating units - Fossil (%)	24.6	29.7	17.7	10.2	9.79	9.79	9.79
Sales of space heating units - Gas (%)	58.8	38.5	50	56.9	57	57	57.1
Sales of water heating units - Electric Heat Pump (%)	0	0	0	0	0	0	0
Sales of water heating units - Electric Resistance (%)	35.5	52.7	52.6	52.5	52.4	52.4	52.3
Sales of water heating units - Gas Furnace (%)	58.8	43.5	43.6	43.7	43.7	43.8	43.9
Sales of water heating units - Other (%)	5.73	3.84	3.85	3.85	3.86	3.86	3.87

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 (%)	1.44	1.87	2.16	2.02	1.81	1.69	1.6
Vehicle sales - Light-duty - EV (%)	3.95	6.1	6.91	8.53	10.3	11.9	13.1
Vehicle sales - Light-duty - gasoline (%)	89.6	85.9	83.6	81.6	79.5	77.5	76
Vehicle sales - Light-duty - hybrid (%)	4.82	5.65	6.89	7.44	7.98	8.5	8.88
Vehicle sales - Light-duty - hydrogen FC (%)	0.11	0.373	0.339	0.3	0.296	0.295	0.306
Vehicle sales - Light-duty - other (%)	0.097	0.101	0.097	0.097	0.097	0.095	0.098
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)	388	385	387	386	389	402	426
Final energy use - Industry (PJ)	792	798	821	830	852	875	887
Final energy use - Residential (PJ)	467	430	411	398	391	386	383
Final energy use - Transportation (PJ)	816	774	716	682	684	705	733

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	58,459	60,226	0	0	0	0
Sales of cooking units - Electric Resistance (%)	18.5	19.4	19.4	19.6	19.7	19.8	19.9
Sales of cooking units - Gas (%)	81.5	80.6	80.6	80.4	80.3	80.2	80.1
Sales of space heating units - Electric Heat Pump (%)	2.56	12.8	39.8	61.7	65	65.6	65.5
Sales of space heating units - Electric Resistance (%)	5.59	4.04	8.87	21.3	31.9	33.3	33.6
Sales of space heating units - Fossil (%)	19.4	16.7	13	5.8	0.885	0.071	0
Sales of space heating units - Gas Furnace (%)	72.4	66.4	38.4	11.1	2.19	0.955	0.868
Sales of water heating units - Electric Heat Pump (%)	0.624	0.33	0.331	0.332	0.331	0.334	0.334

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 (%)	3.49	1.96	1.94	1.95	1.94	1.94	1.94
Sales of water heating units - Gas Furnace (%)	94.2	96.3	96.3	96.3	96.3	96.2	96.2
Sales of water heating units - Other (%)	1.74	1.38	1.45	1.44	1.45	1.49	1.49

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	5.28	5.32	8.01	8.36	9.84	10.3

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

Item	2020	2025	2030	2050
Business-as-usual carbon sink - Natural uptake (Mt CO2e/y)	-32.9	0	-14.7	-13.1
Business-as-usual carbon sink - Retained in Hardwood Products (Mt CO2e/y)	-1.61	0	-2.91	-3.02
Business-as-usual carbon sink - Total (Mt CO2e/y)	-34.5	0	-17.6	-16.2
Carbon sink potential - High - Accelerate regeneration (1000 tCO2e/y)	0	0	0	291
Carbon sink potential - High - All (not counting overlap) (1000 tCO2e/y)	0	0	0	27,852
Carbon sink potential - High - Avoid deforestation (1000 tCO2e/y)	0	0	0	3,104
Carbon sink potential - High - Extend rotation length (1000 tCO2e/y)	0	0	0	8,777
Carbon sink potential - High - Improve plantations (1000 tCO2e/y)	0	0	0	440
Carbon sink potential - High - Increase retention of HWP (1000 tCO2e/y)	0	0	0	5,935
Carbon sink potential - High - Increase trees outside forests (1000 tCO2e/y)	0	0	0	1,121
Carbon sink potential - High - Reforest cropland (1000 tCO2e/y)	0	0	0	186
Carbon sink potential - High - Reforest pasture (1000 tCO2e/y)	0	0	0	4,122
Carbon sink potential - High - Restore productivity (1000 tCO2e/y)	0	0	0	3,875
Carbon sink potential - Low - Accelerate regeneration (1000 tCO2e/y)	0	0	0	146
Carbon sink potential - Low - All (not counting overlap) (1000 tCO2e/y)	0	0	0	8,341
Carbon sink potential - Low - Avoid deforestation (1000 tCO2e/y)	0	0	0	517
Carbon sink potential - Low - Extend rotation length (1000 tCO2e/y)	0	0	0	3,371
Carbon sink potential - Low - Improve plantations (1000 tCO2e/y)	0	0	0	224
Carbon sink potential - Low - Increase retention of HWP (1000 tCO2e/y)	0	0	0	1,978
Carbon sink potential - Low - Increase trees outside forests (1000 tCO2e/y)	0	0	0	392
Carbon sink potential - Low - Reforest cropland (1000 tCO2e/y)	0	0	0	93.2
Carbon sink potential - Low - Reforest pasture (1000 tCO2e/y)	0	0	0	312
Carbon sink potential - Low - Restore productivity (1000 tCO2e/y)	0	0	0	1,306
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO2e/y)	0	0	0	218
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO2e/y)	0	0	0	18,092

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	1,811
Carbon sink potential - Mid - Extend rotation length (1000 tCO2e/y)	0	0	0	6,074
Carbon sink potential - Mid - Improve plantations (1000 tCO2e/y)	0	0	0	328
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO2e/y)	0	0	0	3,957
Carbon sink potential - Mid - Increase trees outside forests (1000 tCO2e/y)	0	0	0	757
Carbon sink potential - Mid - Reforest cropland (1000 tCO2e/y)	0	0	0	140
Carbon sink potential - Mid - Reforest pasture (1000 tCO2e/y)	0	0	0	2,217
Carbon sink potential - Mid - Restore productivity (1000 tCO2e/y)	0	0	0	2,591
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)	0	0	0	47.6
Land impacted for carbon sink potential - High - Avoid deforestation (over 30 years) (1000 hectares)	0	0	0	420
Land impacted for carbon sink potential - High - Extend rotation length (1000 hectares)	0	0	0	4,476
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)	0	0	0	162
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	107
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)	0	0	0	12.3
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)	0	0	0	117
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)	0	0	0	1,285
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)	0	0	0	6,626
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)	0	0	0	23.8
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)	0	0	0	395
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)	0	0	0	1,715
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)	0	0	0	81
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	56.1
Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares)	0	0	0	6.16
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)	0	0	0	20.3
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)	0	0	0	777
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)	0	0	0	3,074
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)	0	0	0	35.7
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)	0	0	0	407

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

Item	2020	2025	2030	2050
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)	0	0	0	3,095
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)	0	0	0	122
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	81.3
Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares)	0	0	0	9.24
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)	0	0	0	147
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)	0	0	0	1,565
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)	0	0	0	5,463

Table 64: *REF scenario - IMPACTS - Health*

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal (million 2019$)	0	6,257	3,948	3,681	3,563	3,489	3,171
Monetary damages from air pollution - Natural Gas (million 2019$)	0	452	501	642	655	647	588
Monetary damages from air pollution - Transportation (million 2019$)	0	4,236	4,322	4,405	4,511	4,620	4,736
Premature deaths from air pollution - Coal (deaths)	0	702	443	413	400	392	356
Premature deaths from air pollution - Natural Gas (deaths)	0	51.1	56.6	72.5	74	73	66.4
Premature deaths from air pollution - Transportation (deaths)	0	476	486	495	507	520	533