



Net-Zero America - Minnesota data

October 29, 2021 (updated November 17, 2023)

See the [Data Sheet Guide](#) for explanations of the contents of this document. The data herein underlie graphs and tables found in Princeton's Net-Zero America report:

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Table 1: *E+ scenario - IMPACTS - Health*

Item	2020	2025	2030	2035	2040	2045	2050
Premature deaths from air pollution - Fuel Comb - Electric Generation - Coal (deaths)		32.6	0.024	0.023	0.018	0.012	0
Premature deaths from air pollution - Fuel Comb - Electric Generation - Natural Gas (deaths)		11.8	7.55	3.44	2.24	1.68	0.801
Premature deaths from air pollution - Mobile - On-Road (deaths)		171	162	126	74.2	35.4	15.6
Premature deaths from air pollution - Gas Stations (deaths)		11	10.2	7.88	4.79	2.44	1.26
Premature deaths from air pollution - Fuel Comb - Residential - Natural Gas (deaths)		36.1	32.9	25.2	15.7	8.28	3.45
Premature deaths from air pollution - Fuel Comb - Residential - Oil (deaths)		1.7	1.44	1.01	0.59	0.232	0.053
Premature deaths from air pollution - Fuel Comb - Residential - Other (deaths)		4.38	4.39	3.73	2.61	1.4	0.522
Premature deaths from air pollution - Fuel Comb - Comm/Institutional - Coal (deaths)		3.19	3.1	3	2.88	2.75	2.61
Premature deaths from air pollution - Fuel Comb - Comm/Institutional - Natural Gas (deaths)		8.63	7.74	6.12	4.14	2.44	1.21
Premature deaths from air pollution - Fuel Comb - Comm/Institutional - Oil (deaths)		3.3	2.71	2.07	1.46	0.983	0.608
Premature deaths from air pollution - Fuel Comb - Comm/Institutional - Other (deaths)		1.08	0.923	0.762	0.602	0.446	0.296
Premature deaths from air pollution - Industrial Processes - Coal Mining (deaths)		0.566	0.099	0.094	0.087	0.083	0.081
Premature deaths from air pollution - Industrial Processes - Oil & Gas Production (deaths)		48.7	46.2	42.6	33.4	25.1	15.8
Monetary damages from air pollution - Fuel Comb - Electric Generation - Coal (million \$2019)		289	0.209	0.2	0.163	0.109	0.003
Monetary damages from air pollution - Fuel Comb - Electric Generation - Natural Gas (million \$2019)		104	66.9	30.5	19.8	14.9	7.09
Monetary damages from air pollution - Mobile - On-Road (million \$2019)		1,518	1,442	1,116	659	315	138
Monetary damages from air pollution - Gas Stations (million \$2019)		97	90.7	69.8	42.4	21.6	11.2
Monetary damages from air pollution - Fuel Comb - Residential - Natural Gas (million \$2019)		320	291	224	139	73.4	30.6
Monetary damages from air pollution - Fuel Comb - Residential - Oil (million \$2019)		15	12.7	8.95	5.23	2.06	0.473
Monetary damages from air pollution - Fuel Comb - Residential - Other (million \$2019)		38.9	38.9	33.1	23.1	12.4	4.63
Monetary damages from air pollution - Fuel Comb - Comm/Institutional - Coal (million \$2019)		28.2	27.5	26.6	25.5	24.3	23.1
Monetary damages from air pollution - Fuel Comb - Comm/Institutional - Natural Gas (million \$2019)		76.4	68.5	54.2	36.6	21.6	10.7

Table 1: *E+ scenario - IMPACTS - Health (continued)*

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Fuel Comb - Comm/Institutional - Oil (million \$2019)		29.2	24	18.3	13	8.7	5.38
Monetary damages from air pollution - Fuel Comb - Comm/Institutional - Other (million \$2019)		9.6	8.17	6.75	5.33	3.95	2.62
Monetary damages from air pollution - Industrial Processes - Coal Mining (million \$2019)		4.99	0.874	0.829	0.765	0.734	0.716
Monetary damages from air pollution - Industrial Processes - Oil & Gas Production (million \$2019)		432	411	378	297	223	140

Table 2: *E+ scenario - IMPACTS - Jobs*

Item	2020	2025	2030	2035	2040	2045	2050
By economic sector - Agriculture (jobs)		2,172	2,403	2,601	1,713	1,803	4,969
By economic sector - Construction (jobs)		8,566	10,471	14,824	18,348	22,038	30,612
By economic sector - Manufacturing (jobs)		4,282	4,734	5,715	5,549	5,661	9,128
By economic sector - Mining (jobs)		2,121	1,497	1,016	663	417	271
By economic sector - Other (jobs)		632	839	1,284	1,725	2,193	3,050
By economic sector - Pipeline (jobs)		486	417	391	259	181	534
By economic sector - Professional (jobs)		5,492	7,121	10,158	12,848	17,029	27,198
By economic sector - Trade (jobs)		3,952	4,392	5,658	6,854	8,585	12,566
By economic sector - Utilities (jobs)		8,815	9,988	14,360	17,895	21,966	31,047
By resource sector - Biomass (jobs)		5,397	5,656	6,198	4,446	6,669	21,547
By resource sector - CO2 (jobs)		0	0	457	14.3	21.8	3,367
By resource sector - Coal (jobs)		886	204	0	0	0	0
By resource sector - Grid (jobs)		11,890	14,519	23,661	31,870	39,970	54,497
By resource sector - Natural Gas (jobs)		4,133	3,754	3,166	2,912	2,869	2,800
By resource sector - Nuclear (jobs)		944	929	658	168	0	0
By resource sector - Oil (jobs)		4,752	3,903	2,946	2,166	1,601	1,202
By resource sector - Solar (jobs)		1,268	1,165	1,524	1,653	1,636	2,291
By resource sector - Wind (jobs)		7,248	11,731	17,397	22,623	27,106	33,668
By education level - All sectors - High school diploma or less (jobs)		16,046	18,204	24,014	27,452	32,766	49,497
By education level - All sectors - Associates degree or some college (jobs)		10,841	12,582	17,228	20,782	25,291	36,929
By education level - All sectors - Bachelors degree (jobs)		7,477	8,549	11,360	13,514	16,664	25,087
By education level - All sectors - Masters or professional degree (jobs)		1,876	2,189	2,947	3,547	4,436	6,740
By education level - All sectors - Doctoral degree (jobs)		279	338	457	556	715	1,121
Related work experience - All sectors - None (jobs)		5,404	6,166	8,214	9,566	11,552	17,367
Related work experience - All sectors - Up to 1 year (jobs)		7,895	8,992	11,779	13,331	15,897	24,350
Related work experience - All sectors - 1 to 4 years (jobs)		12,858	14,758	19,852	23,588	28,809	42,890
Related work experience - All sectors - 4 to 10 years (jobs)		8,200	9,466	12,829	15,401	18,803	27,687
Related work experience - All sectors - Over 10 years (jobs)		2,161	2,480	3,333	3,967	4,811	7,080
On-the-Job Training - All sectors - None (jobs)		2,020	2,296	3,020	3,516	4,264	6,441
On-the-Job Training - All sectors - Up to 1 year (jobs)		24,620	28,063	37,172	43,162	52,284	79,176

Table 2: *E+ scenario - IMPACTS - Jobs (continued)*

Item	2020	2025	2030	2035	2040	2045	2050
On-the-Job Training - All sectors - 1 to 4 years (jobs)		7,234	8,395	11,504	13,907	16,909	24,535
On-the-Job Training - All sectors - 4 to 10 years (jobs)		2,314	2,727	3,807	4,682	5,720	8,210
On-the-Job Training - All sectors - Over 10 years (jobs)		330	380	503	586	694	1,012
On-Site or In-Plant Training - All sectors - None (jobs)		5,859	6,766	9,054	10,666	13,018	19,592
On-Site or In-Plant Training - All sectors - Up to 1 year (jobs)		22,281	25,378	33,653	39,140	47,356	71,439
On-Site or In-Plant Training - All sectors - 1 to 4 years (jobs)		5,671	6,554	8,933	10,729	13,020	18,980
On-Site or In-Plant Training - All sectors - 4 to 10 years (jobs)		2,396	2,800	3,867	4,718	5,754	8,304
On-Site or In-Plant Training - All sectors - Over 10 years (jobs)		312	363	499	599	724	1,058
Wage income - All (million \$2019)		2,189	2,546	3,471	4,174	5,152	7,759

Table 3: *E+ scenario - IMPACTS - Fossil fuel industries*

Item	2020	2025	2030	2035	2040	2045	2050
Oil consumption - Annual (million bbls)		107	95.7	78.2	61.9	49	39.2
Oil consumption - Cumulative (million bbls)							2,407
Oil production - Annual (million bbls)		0	0	0	0	0	0
Natural gas consumption - Annual (tcf)		380	320	257	193	122	84.3
Natural gas consumption - Cumulative (tcf)							7,731
Natural gas production - Annual (tcf)		0	0	0	0	0	0

Table 4: *E+ scenario - PILLAR 1: Efficiency/Electrification - Overview*

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Transportation (PJ)	552	519	460	389	325	285	269
Final energy use - Residential (PJ)	296	280	265	236	202	173	153
Final energy use - Commercial (PJ)	221	216	207	194	179	168	160
Final energy use - Industry (PJ)	391	405	406	401	400	399	401

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)		3.87	3.99	7.91	8.48	7.13	7.47

Table 6: *E+ scenario - PILLAR 1: Efficiency/Electrification - Transportation*

Item	2020	2025	2030	2035	2040	2045	2050
Vehicle stocks - LDV – EV (1000 units)	38.9	480	920	2,462	4,005	5,237	6,470
Vehicle stocks - LDV – All others (1000 units)	5,395	5,137	4,879	3,555	2,232	1,263	294
Light-duty vehicle capital costs vs. REF - Cumulative 5-yr (million \$2018)		1,035	2,659	4,300	6,517	7,089	6,761
Public EV charging plugs - DC Fast (1000 units)	0.168		1.92		8.36		13.5
Public EV charging plugs - L2 (1000 units)	0.739		46.2		201		325

Table 7: *E+ scenario - PILLAR 1: Efficiency/Electrification - Residential*

Item	2020	2025	2030	2035	2040	2045	2050
Sales of space heating units - Electric Heat Pump (%)	3.41	7.97	30.9	76.7	90.3	91.9	91.7
Sales of space heating units - Electric Resistance (%)	9.83	13.9	11.3	5.52	3.76	3.59	3.79
Sales of space heating units - Gas (%)	77.8	62.6	46.3	12.4	2.5	1.41	1.31
Sales of space heating units - Fossil (%)	8.97	15.5	11.4	5.34	3.47	3.15	3.18
Sales of water heating units - Electric Heat Pump (%)	0	0.704	9.95	31.7	37.9	38.6	38.6
Sales of water heating units - Electric Resistance (%)	20.7	35.3	41.3	56	60.8	61.3	61.3
Sales of water heating units - Gas Furnace (%)	79.2	64	48.7	12.3	1.29	0.072	0
Sales of water heating units - Other (%)	0.018	0.021	0.021	0.021	0.02	0.02	0.02
Sales of cooking units - Electric Resistance (%)	58.9	67.6	94.5	99.7	100	100	100
Sales of cooking units - Gas (%)	41.1	32.4	5.54	0.279	0	0	0
Residential HVAC investment in 2020s vs. REF - Cumulative 5-yr (billion \$2018)		4.14	4.85				

Table 8: *E+ scenario - PILLAR 1: Efficiency/Electrification - Commercial*

Item	2020	2025	2030	2035	2040	2045	2050
Sales of space heating units - Electric Heat Pump (%)	1.8	6.82	26.5	71.8	85.3	86.8	86.9
Sales of space heating units - Electric Resistance (%)	3.09	5.73	8.18	11.9	12.6	12.6	12.6
Sales of space heating units - Gas (%)	90.3	85.4	64.9	16.3	2.07	0.546	0.457
Sales of space heating units - Fossil (%)	4.77	2.09	0.407	0.017	0	0	0
Sales of water heating units - Electric Heat Pump (%)	0.491	1.66	12.6	38.5	46.3	47.1	47.2
Sales of water heating units - Electric Resistance (%)	4.33	7.76	18.5	43.6	51.2	52.1	52.2
Sales of water heating units - Gas (%)	94.1	89.6	68.2	17.2	1.81	0.101	0
Sales of water heating units - Other (%)	1.03	0.934	0.727	0.678	0.674	0.676	0.676
Sales of cooking units - Electric Resistance (%)	44.8	57.1	84	89.3	89.6	89.6	89.6
Sales of cooking units - Gas (%)	55.2	42.9	16	10.7	10.4	10.4	10.4
Commercial HVAC investment in 2020s - Cumulative 5-yr (million \$2018)		15,866	17,271				

Table 9: *E+ scenario - PILLAR 2: Clean Electricity - Generating capacity*

Item	2020	2025	2030	2035	2040	2045	2050
Installed thermal - Coal (MW)	3,581	1,536	0	0	0	0	0
Installed thermal - Natural gas (MW)	6,010	6,010	7,382	7,970	6,619	11,457	11,308
Installed thermal - Nuclear (MW)	1,871	1,871	1,871	593	0	0	0
Installed renewables - Rooftop PV (MW)	114	204	260	347	460	594	751
Installed renewables - Solar - Base land use assumptions (MW)	267	267	267	267	267	267	267
Installed renewables - Wind - Base land use assumptions (MW)	3,939	12,681	18,318	30,015	42,271	58,936	84,661
Installed renewables - Solar - Constrained land use assumptions (MW)	70.3	70.3	70.3	70.3	70.3	70.3	70.3
Installed renewables - Wind - Constrained land use assumptions (MW)	4,989	5,969	8,262	13,014	16,884	20,901	26,441
Capital invested - Solar PV - Base (billion \$2018)		0	0	0	0	0	0
Capital invested - Wind - Base (billion \$2018)		11.3	7.51	14.5	14.5	18.7	27.2

Table 9: *E+ scenario - PILLAR 2: Clean Electricity - Generating capacity (continued)*

Item	2020	2025	2030	2035	2040	2045	2050
Capital invested - Solar PV - Constrained (billion \$2018)		0.395	0	0	0	0	0
Capital invested - Wind - Constrained (billion \$2018)		2.2	2.94	6.21	4.37	4.58	5.58
Capital invested - Biomass power plant (billion \$2018)	0	0.049	0.493	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 10: *E+ scenario - PILLAR 2: Clean Electricity - Generation*

Item	2020	2025	2030	2035	2040	2045	2050
Solar - Base land use assumptions (GWh)	558	558	558	558	558	558	558
Wind - Base land use assumptions (GWh)	20,531	48,195	68,014	108,212	149,718	205,466	290,764
OffshoreWind - Base land use assumptions (GWh)	0	0	0	0	0	0	0
Solar - Constrained land use assumptions (GWh)	148	148	148	148	148	148	148
Wind - Constrained land use assumptions (GWh)	20,531	23,945	31,665	47,316	59,631	72,336	89,178
OffshoreWind - Constrained land use assumptions (GWh)	0	0	0	0	0	0	0
Biomass power plant (GWh)	0	93.4	1,062	1,062	1,062	1,062	1,062
Biomass w/ccu power plant (GWh)	0	0	0	0	0	0	0
Biomass w/ccu allam power plant (GWh)	0	0	0	0	0	0	0

Table 11: *E+ scenario - PILLAR 3: Clean fuels - Bioenergy*

Item	2020	2025	2030	2035	2040	2045	2050
Number of facilities - Power (quantity)	0	1	1	1	1	1	1
Number of facilities - Power ccu (quantity)	0	0	0	0	0	0	0
Number of facilities - Allam power w ccu (quantity)	0	0	0	0	0	0	0
Number of facilities - Beccs hydrogen (quantity)	0	0	0	3	5	20	24
Number of facilities - Diesel (quantity)	0	0	0	1	1	1	2
Number of facilities - Diesel ccu (quantity)	0	0	0	0	0	0	1
Number of facilities - Pyrolysis (quantity)	0	0	0	1	1	1	7
Number of facilities - Pyrolysis ccu (quantity)	0	0	0	0	0	0	45
Number of facilities - Sng (quantity)	0	1	1	1	1	1	2
Number of facilities - Sng ccu (quantity)	0	0	0	0	0	0	1
Conversion capital investment - Cumulative 5-yr (million \$2018)		53.2	550	3,269	1,168	11,639	78,446
Biomass purchases (million \$2018/y)		27.2	161	399	483	1,328	4,925

Table 12: *E+ scenario - PILLAR 4: CCUS - CO2 capture*

Item	2020	2025	2030	2035	2040	2045	2050
Annual - All (MMT)		0	0	4.17	5.67	20.6	58.9
Annual - BECCS (MMT)		0	0	4.17	5.67	20.6	58.9
Annual - NGCC (MMT)		0	0	0	0	0	0
Annual - Cement and lime (MMT)		0	0	0	0	0	0
Cumulative - All (MMT)		0	0	4.17	9.84	30.5	89.4
Cumulative - BECCS (MMT)		0	0	4.17	9.84	30.5	89.4
Cumulative - NGCC (MMT)		0	0	0	0	0	0
Cumulative - Cement and lime (MMT)		0	0	0	0	0	0

Table 13: *E+ scenario - PILLAR 4: CCUS - CO2 pipelines*

Item	2020	2025	2030	2035	2040	2045	2050
Trunk (km)		0	0	88.1	88.1	88.1	88.1
Spur (km)		0	0	16.7	157	334	4,121
All (km)		0	0	105	245	422	4,209
Cumulative investment - Trunk (million \$2018)		0	0	437	437	437	437
Cumulative investment - Spur (million \$2018)		0	0	22.3	127	275	3,294
Cumulative investment - All (million \$2018)		0	0	459	564	713	3,731

Table 14: *E+ scenario - PILLAR 4: CCUS - CO2 storage*

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

Table 15: *E+ scenario - PILLAR 6: Land sinks - Forests*

Item	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - Low - Accelerate regeneration (1000 tCO2e/y)							-240
Carbon sink potential - Low - Avoid deforestation (1000 tCO2e/y)							-312
Carbon sink potential - Low - Extend rotation length (1000 tCO2e/y)							-3,267
Carbon sink potential - Low - Improve plantations (1000 tCO2e/y)							-404
Carbon sink potential - Low - Increase retention of HWP (1000 tCO2e/y)							-1,556
Carbon sink potential - Low - Increase trees outside forests (1000 tCO2e/y)							-1,054
Carbon sink potential - Low - Reforest cropland (1000 tCO2e/y)							-4,034
Carbon sink potential - Low - Reforest pasture (1000 tCO2e/y)							-630
Carbon sink potential - Low - Restore productivity (1000 tCO2e/y)							-1,455
Carbon sink potential - Low - All (not counting overlap) (1000 tCO2e/y)							-12,952
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO2e/y)							-359
Carbon sink potential - Mid - Avoid deforestation (1000 tCO2e/y)							-1,091
Carbon sink potential - Mid - Extend rotation length (1000 tCO2e/y)							-5,887
Carbon sink potential - Mid - Improve plantations (1000 tCO2e/y)							-591
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO2e/y)							-3,112
Carbon sink potential - Mid - Increase trees outside forests (1000 tCO2e/y)							-2,033
Carbon sink potential - Mid - Reforest cropland (1000 tCO2e/y)							-6,052

Table 15: *E+ scenario - PILLAR 6: Land sinks - Forests (continued)*

Item	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - Mid - Reforest pasture (1000 tCO ₂ e/y)							-4,472
Carbon sink potential - Mid - Restore productivity (1000 tCO ₂ e/y)							-2,887
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO ₂ e/y)							-26,484
Carbon sink potential - High - Accelerate regeneration (1000 tCO ₂ e/y)							-479
Carbon sink potential - High - Avoid deforestation (1000 tCO ₂ e/y)							-1,871
Carbon sink potential - High - Extend rotation length (1000 tCO ₂ e/y)							-8,507
Carbon sink potential - High - Improve plantations (1000 tCO ₂ e/y)							-793
Carbon sink potential - High - Increase retention of HWP (1000 tCO ₂ e/y)							-4,667
Carbon sink potential - High - Increase trees outside forests (1000 tCO ₂ e/y)							-3,012
Carbon sink potential - High - Reforest cropland (1000 tCO ₂ e/y)							-8,069
Carbon sink potential - High - Reforest pasture (1000 tCO ₂ e/y)							-8,313
Carbon sink potential - High - All (not counting overlap) (1000 tCO ₂ e/y)							-40,029
Carbon sink potential - High - Restore productivity (1000 tCO ₂ e/y)							-4,318
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)							39.1
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)							238
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)							1,662
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)							146
Land impacted for carbon sink potential - Low - Increase retention of HWP (1000 hectares)							0
Land impacted for carbon sink potential - Low - Increase trees outside forests (1000 hectares)							151
Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares)							267
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)							40.9
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)							866
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)							3,409
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)							58.7
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)							246

Table 15: *E+ scenario - PILLAR 6: Land sinks - Forests (continued)*

Item	2020	2025	2030	2035	2040	2045	2050
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)							3,000
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)							220
Land impacted for carbon sink potential - Mid - Increase retention of HWP (1000 hectares)							0
Land impacted for carbon sink potential - Mid - Increase trees outside forests (1000 hectares)							218
Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares)							400
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)							296
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)							1,744
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)							6,183
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)							78.3
Land impacted for carbon sink potential - High - Avoid deforestation (over 30 years) (1000 hectares)							253
Land impacted for carbon sink potential - High - Extend rotation length (1000 hectares)							4,338
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)							292
Land impacted for carbon sink potential - High - Increase retention of HWP (1000 hectares)							0
Land impacted for carbon sink potential - High - Increase trees outside forests (1000 hectares)							286
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)							533
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)							236
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)							1,431
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)							7,449

Table 16: *E+ scenario - PILLAR 6: Land sinks - Agriculture*

Item	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - Moderate deployment - Corn-ethanol to energy grasses (1000 tCO ₂ e/y)							-2,423
Carbon sink potential - Moderate deployment - Cropland measures (1000 tCO ₂ e/y)							-7,283

Table 16: *E+ scenario - PILLAR 6: Land sinks - Agriculture (continued)*

Item	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - Moderate deployment - Permanent conservation cover (1000 tCO ₂ e/y)							-207
Carbon sink potential - Moderate deployment - Total (1000 tCO ₂ e/y)							-9,914
Carbon sink potential - Aggressive deployment - Corn-ethanol to energy grasses (1000 tCO ₂ e/y)							-2,423
Carbon sink potential - Aggressive deployment - Cropland measures (1000 tCO ₂ e/y)							-13,821
Carbon sink potential - Aggressive deployment - Permanent conservation cover (1000 tCO ₂ e/y)							-414
Carbon sink potential - Aggressive deployment - Total (1000 tCO ₂ e/y)							-16,658
Land impacted for carbon sink - Moderate deployment - Corn-ethanol to energy grasses (1000 hectares)							1,097
Land impacted for carbon sink - Moderate deployment - Cropland measures (1000 hectares)							3,675
Land impacted for carbon sink - Moderate deployment - Permanent conservation cover (1000 hectares)							376
Land impacted for carbon sink - Moderate deployment - Total (1000 hectares)							5,149
Land impacted for carbon sink - Aggressive deployment - Corn-ethanol to energy grasses (1000 hectares)							1,097
Land impacted for carbon sink - Aggressive deployment - Cropland measures (1000 hectares)							6,974
Land impacted for carbon sink - Aggressive deployment - Permanent conservation cover (1000 hectares)							753
Land impacted for carbon sink - Aggressive deployment - Total (1000 hectares)							8,824

Table 17: *E- scenario - IMPACTS - Health*

Item	2020	2025	2030	2035	2040	2045	2050
Premature deaths from air pollution - Fuel Comb - Electric Generation - Coal (deaths)		32.6	0.024	0.023	0.018	0.012	0
Premature deaths from air pollution - Fuel Comb - Electric Generation - Natural Gas (deaths)		11.6	6.23	2.42	1.14	0.531	0.508
Premature deaths from air pollution - Mobile - On-Road (deaths)		174	178	177	163	132	92.6
Premature deaths from air pollution - Gas Stations (deaths)		11.2	11.4	11.2	10.2	8.26	5.85
Premature deaths from air pollution - Fuel Comb - Residential - Natural Gas (deaths)		36.2	34.2	32	29.4	26.2	22.4
Premature deaths from air pollution - Fuel Comb - Residential - Oil (deaths)		1.73	1.75	1.78	1.71	1.5	1.26
Premature deaths from air pollution - Fuel Comb - Residential - Other (deaths)		4.4	4.63	4.84	4.82	4.32	3.62

Table 17: *E- scenario - IMPACTS - Health (continued)*

Item	2020	2025	2030	2035	2040	2045	2050
Premature deaths from air pollution - Fuel Comb - Comm/Institutional - Coal (deaths)		3.19	3.1	3	2.88	2.75	2.61
Premature deaths from air pollution - Fuel Comb - Comm/Institutional - Natural Gas (deaths)		8.65	8.34	7.95	7.31	6.42	5.38
Premature deaths from air pollution - Fuel Comb - Comm/Institutional - Oil (deaths)		3.31	2.92	2.53	2.14	1.81	1.55
Premature deaths from air pollution - Fuel Comb - Comm/Institutional - Other (deaths)		1.08	0.99	0.894	0.796	0.698	0.604
Premature deaths from air pollution - Industrial Processes - Coal Mining (deaths)		0.536	0.1	0.098	0.094	0.084	0.066
Premature deaths from air pollution - Industrial Processes - Oil & Gas Production (deaths)		48.6	44.7	39.5	35.1	31.5	22.1
Monetary damages from air pollution - Fuel Comb - Electric Generation - Coal (million \$2019)		289	0.209	0.2	0.163	0.109	0.003
Monetary damages from air pollution - Fuel Comb - Electric Generation - Natural Gas (million \$2019)		103	55.2	21.4	10.1	4.7	4.5
Monetary damages from air pollution - Mobile - On-Road (million \$2019)		1,543	1,586	1,574	1,446	1,174	823
Monetary damages from air pollution - Gas Stations (million \$2019)		99	101	99.2	90.3	73.1	51.8
Monetary damages from air pollution - Fuel Comb - Residential - Natural Gas (million \$2019)		321	303	283	261	232	198
Monetary damages from air pollution - Fuel Comb - Residential - Oil (million \$2019)		15.3	15.5	15.7	15.2	13.3	11.2
Monetary damages from air pollution - Fuel Comb - Residential - Other (million \$2019)		39	41	42.9	42.7	38.3	32.1
Monetary damages from air pollution - Fuel Comb - Comm/Institutional - Coal (million \$2019)		28.2	27.5	26.6	25.5	24.3	23.1
Monetary damages from air pollution - Fuel Comb - Comm/Institutional - Natural Gas (million \$2019)		76.6	73.8	70.3	64.7	56.8	47.7
Monetary damages from air pollution - Fuel Comb - Comm/Institutional - Oil (million \$2019)		29.3	25.9	22.4	18.9	16	13.7
Monetary damages from air pollution - Fuel Comb - Comm/Institutional - Other (million \$2019)		9.6	8.76	7.91	7.04	6.18	5.35
Monetary damages from air pollution - Industrial Processes - Coal Mining (million \$2019)		4.73	0.884	0.867	0.83	0.74	0.585
Monetary damages from air pollution - Industrial Processes - Oil & Gas Production (million \$2019)		431	397	351	312	280	196

Table 18: *E- scenario - IMPACTS - Jobs*

Item	2020	2025	2030	2035	2040	2045	2050
By economic sector - Agriculture (jobs)		2,207	2,531	3,034	2,139	2,426	4,967
By economic sector - Construction (jobs)		8,539	10,427	13,812	17,905	25,514	36,151

Table 18: E- scenario - IMPACTS - Jobs (continued)

Item	2020	2025	2030	2035	2040	2045	2050
By economic sector - Manufacturing (jobs)		4,324	4,824	5,517	5,829	7,435	10,470
By economic sector - Mining (jobs)		2,136	1,542	1,155	855	611	393
By economic sector - Other (jobs)		633	844	1,200	1,682	2,476	3,539
By economic sector - Pipeline (jobs)		488	408	435	296	251	879
By economic sector - Professional (jobs)		5,523	7,279	10,239	13,591	20,457	30,797
By economic sector - Trade (jobs)		3,966	4,474	5,669	7,170	10,191	14,638
By economic sector - Utilities (jobs)		8,612	9,537	12,458	16,979	25,793	36,455
By resource sector - Biomass (jobs)		5,450	5,976	7,946	7,032	10,331	20,825
By resource sector - CO2 (jobs)		0	0	784	24.5	37.4	5,774
By resource sector - Coal (jobs)		886	204	0	0	0	0
By resource sector - Grid (jobs)		11,427	13,851	19,733	29,496	47,363	62,979
By resource sector - Natural Gas (jobs)		4,136	3,363	2,672	3,206	3,149	2,873
By resource sector - Nuclear (jobs)		944	929	658	168	0	0
By resource sector - Oil (jobs)		4,800	4,146	3,581	2,998	2,419	1,751
By resource sector - Solar (jobs)		1,304	1,205	1,365	1,522	1,730	2,316
By resource sector - Wind (jobs)		7,480	12,195	16,779	21,999	30,126	41,771
By education level - All sectors - High school diploma or less (jobs)		16,012	18,233	23,058	27,722	39,152	57,146
By education level - All sectors - Associates degree or some college (jobs)		10,795	12,513	16,184	20,691	29,897	43,112
By education level - All sectors - Bachelors degree (jobs)		7,467	8,578	10,962	13,810	19,946	28,995
By education level - All sectors - Masters or professional degree (jobs)		1,874	2,200	2,857	3,635	5,300	7,759
By education level - All sectors - Doctoral degree (jobs)		280	343	457	585	858	1,277
Related work experience - All sectors - None (jobs)		5,389	6,161	7,857	9,653	13,773	20,099
Related work experience - All sectors - Up to 1 year (jobs)		7,888	9,033	11,408	13,572	19,069	27,980
Related work experience - All sectors - 1 to 4 years (jobs)		12,824	14,758	18,943	23,782	34,280	49,732
Related work experience - All sectors - 4 to 10 years (jobs)		8,173	9,441	12,156	15,454	22,306	32,237
Related work experience - All sectors - Over 10 years (jobs)		2,154	2,474	3,155	3,983	5,726	8,242
On-the-Job Training - All sectors - None (jobs)		2,018	2,305	2,922	3,589	5,106	7,434
On-the-Job Training - All sectors - Up to 1 year (jobs)		24,579	28,138	35,791	43,851	62,591	91,340
On-the-Job Training - All sectors - 1 to 4 years (jobs)		7,201	8,343	10,782	13,803	19,941	28,694
On-the-Job Training - All sectors - 4 to 10 years (jobs)		2,300	2,700	3,544	4,613	6,693	9,638
On-the-Job Training - All sectors - Over 10 years (jobs)		330	381	479	588	823	1,183
On-Site or In-Plant Training - All sectors - None (jobs)		5,853	6,787	8,711	10,817	15,514	22,650
On-Site or In-Plant Training - All sectors - Up to 1 year (jobs)		22,235	25,422	32,324	39,685	56,643	82,507
On-Site or In-Plant Training - All sectors - 1 to 4 years (jobs)		5,647	6,521	8,399	10,676	15,387	22,160
On-Site or In-Plant Training - All sectors - 4 to 10 years (jobs)		2,383	2,776	3,618	4,671	6,755	9,736
On-Site or In-Plant Training - All sectors - Over 10 years (jobs)		310	360	467	595	856	1,237
Wage income - All (million \$2019)		2,181	2,542	3,303	4,199	6,125	9,002

Table 19: E- scenario - PILLAR 1: Efficiency/Electrification - Overview

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Transportation (PJ)	552	523	479	445	418	387	350
Final energy use - Residential (PJ)	296	280	269	259	249	237	223
Final energy use - Commercial (PJ)	221	216	210	204	198	192	187
Final energy use - Industry (PJ)	391	406	408	408	409	409	410

Table 20: 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)		3.06	3.08	4.07	4.2	6.25	6.61

Table 21: E- scenario - PILLAR 1: Efficiency/Electrification - Transportation

Item	2020	2025	2030	2035	2040	2045	2050
Vehicle stocks - LDV – EV (1000 units)	30.1	160	289	889	1,489	2,816	4,144
Vehicle stocks - LDV – All others (1000 units)	5,417	5,417	5,417	5,138	4,859	3,745	2,630
Light-duty vehicle capital costs vs. REF - Cumulative 5-yr (million \$2018)		0	168	352	1,190	3,738	5,448
Public EV charging plugs - DC Fast (1000 units)	0.168		0.604		3.11		8.65
Public EV charging plugs - L2 (1000 units)	0.739		14.5		74.8		208

Table 22: E- scenario - PILLAR 1: Efficiency/Electrification - Residential

Item	2020	2025	2030	2035	2040	2045	2050
Sales of space heating units - Electric Heat Pump (%)	3.41	6.07	7.47	11.9	22.3	35.6	44
Sales of space heating units - Electric Resistance (%)	9.83	14.1	13.8	13.3	12.1	10.4	9.55
Sales of space heating units - Gas (%)	77.8	63.8	62.8	59.6	52.3	42.7	36.3
Sales of space heating units - Fossil (%)	8.97	16.1	15.9	15.1	13.3	11.3	10.2
Sales of water heating units - Electric Heat Pump (%)	0	0.188	0.757	2.61	7.15	13.2	17.1
Sales of water heating units - Electric Resistance (%)	20.7	35	35.3	36.5	39.6	43.7	46.5
Sales of water heating units - Gas Furnace (%)	79.2	64.8	63.9	60.9	53.3	43.1	36.4
Sales of water heating units - Other (%)	0.018	0.021	0.021	0.021	0.021	0.021	0.02
Sales of cooking units - Electric Resistance (%)	58.7	59.8	63.6	73.5	87.4	95.9	98.9
Sales of cooking units - Gas (%)	41.3	40.2	36.4	26.5	12.6	4.07	1.1
Residential HVAC investment in 2020s vs. REF - Cumulative 5-yr (billion \$2018)		4.12	4.74				

Table 23: E- scenario - PILLAR 1: Efficiency/Electrification - Commercial

Item	2020	2025	2030	2035	2040	2045	2050
Sales of space heating units - Electric Heat Pump (%)	1.8	5.6	6.81	10.6	19.8	32.1	40.2
Sales of space heating units - Electric Resistance (%)	3.09	5.44	5.57	6.02	6.98	8.07	8.69
Sales of space heating units - Gas (%)	90.3	86.5	85.2	81.2	71.4	58.3	49.7
Sales of space heating units - Fossil (%)	4.77	2.45	2.43	2.18	1.78	1.47	1.36
Sales of water heating units - Electric Heat Pump (%)	0.491	1.03	1.71	3.92	9.33	16.6	21.3
Sales of water heating units - Electric Resistance (%)	4.33	7.15	7.85	9.96	15.2	22.3	26.9
Sales of water heating units - Gas (%)	94.1	90.8	89.5	85.2	74.6	60.3	50.9
Sales of water heating units - Other (%)	1.03	0.978	0.967	0.931	0.876	0.845	0.834

Table 23: E- scenario - PILLAR 1: Efficiency/Electrification - Commercial (continued)

Item	2020	2025	2030	2035	2040	2045	2050
Sales of cooking units - Electric Resistance (%)	44.8	49.3	53.1	63	76.9	85.5	88.5
Sales of cooking units - Gas (%)	55.2	50.7	46.9	37	23.1	14.5	11.5
Commercial HVAC investment in 2020s - Cumulative 5-yr (million \$2018)		15,866	17,291				

Table 24: E- scenario - PILLAR 2: Clean Electricity - Generating capacity

Item	2020	2025	2030	2035	2040	2045	2050
Installed thermal - Coal (MW)	3,581	1,536	0	0	0	0	0
Installed thermal - Natural gas (MW)	6,020	6,010	6,371	6,318	7,901	11,998	10,302
Installed thermal - Nuclear (MW)	1,871	1,871	1,871	593	0	0	0

Table 25: E- scenario - PILLAR 6: Land sinks - Forests

Item	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - Low - Accelerate regeneration (1000 tCO2e/y)							-240
Carbon sink potential - Low - Avoid deforestation (1000 tCO2e/y)							-312
Carbon sink potential - Low - Extend rotation length (1000 tCO2e/y)							-3,267
Carbon sink potential - Low - Improve plantations (1000 tCO2e/y)							-404
Carbon sink potential - Low - Increase retention of HWP (1000 tCO2e/y)							-1,556
Carbon sink potential - Low - Increase trees outside forests (1000 tCO2e/y)							-1,054
Carbon sink potential - Low - Reforest cropland (1000 tCO2e/y)							-4,034
Carbon sink potential - Low - Reforest pasture (1000 tCO2e/y)							-630
Carbon sink potential - Low - Restore productivity (1000 tCO2e/y)							-1,455
Carbon sink potential - Low - All (not counting overlap) (1000 tCO2e/y)							-12,952
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO2e/y)							-359
Carbon sink potential - Mid - Avoid deforestation (1000 tCO2e/y)							-1,091
Carbon sink potential - Mid - Extend rotation length (1000 tCO2e/y)							-5,887
Carbon sink potential - Mid - Improve plantations (1000 tCO2e/y)							-591
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO2e/y)							-3,112
Carbon sink potential - Mid - Increase trees outside forests (1000 tCO2e/y)							-2,033
Carbon sink potential - Mid - Reforest cropland (1000 tCO2e/y)							-6,052
Carbon sink potential - Mid - Reforest pasture (1000 tCO2e/y)							-4,472
Carbon sink potential - Mid - Restore productivity (1000 tCO2e/y)							-2,887
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO2e/y)							-26,484
Carbon sink potential - High - Accelerate regeneration (1000 tCO2e/y)							-479
Carbon sink potential - High - Avoid deforestation (1000 tCO2e/y)							-1,871

Table 25: E- scenario - PILLAR 6: Land sinks - Forests (continued)

Item	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - High - Extend rotation length (1000 tCO2e/y)							-8,507
Carbon sink potential - High - Improve plantations (1000 tCO2e/y)							-793
Carbon sink potential - High - Increase retention of HWP (1000 tCO2e/y)							-4,667
Carbon sink potential - High - Increase trees outside forests (1000 tCO2e/y)							-3,012
Carbon sink potential - High - Reforest cropland (1000 tCO2e/y)							-8,069
Carbon sink potential - High - Reforest pasture (1000 tCO2e/y)							-8,313
Carbon sink potential - High - All (not counting overlap) (1000 tCO2e/y)							-40,029
Carbon sink potential - High - Restore productivity (1000 tCO2e/y)							-4,318
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)							39.1
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)							238
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)							1,662
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)							146
Land impacted for carbon sink potential - Low - Increase retention of HWP (1000 hectares)							0
Land impacted for carbon sink potential - Low - Increase trees outside forests (1000 hectares)							151
Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares)							267
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)							40.9
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)							866
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)							3,409
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)							58.7
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)							246
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)							3,000
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)							220
Land impacted for carbon sink potential - Mid - Increase retention of HWP (1000 hectares)							0
Land impacted for carbon sink potential - Mid - Increase trees outside forests (1000 hectares)							218

Table 25: E- scenario - PILLAR 6: Land sinks - Forests (continued)

Item	2020	2025	2030	2035	2040	2045	2050
Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares)							400
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)							296
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)							1,744
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)							6,183
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)							78.3
Land impacted for carbon sink potential - High - Avoid deforestation (over 30 years) (1000 hectares)							253
Land impacted for carbon sink potential - High - Extend rotation length (1000 hectares)							4,338
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)							292
Land impacted for carbon sink potential - High - Increase retention of HWP (1000 hectares)							0
Land impacted for carbon sink potential - High - Increase trees outside forests (1000 hectares)							286
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)							533
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)							236
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)							1,431
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)							7,449

Table 26: E- scenario - PILLAR 6: Land sinks - Agriculture

Item	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - Moderate deployment - Corn-ethanol to energy grasses (1000 tCO2e/y)							-2,423
Carbon sink potential - Moderate deployment - Cropland measures (1000 tCO2e/y)							-7,283
Carbon sink potential - Moderate deployment - Permanent conservation cover (1000 tCO2e/y)							-207
Carbon sink potential - Moderate deployment - Total (1000 tCO2e/y)							-9,914
Carbon sink potential - Aggressive deployment - Corn-ethanol to energy grasses (1000 tCO2e/y)							-2,423
Carbon sink potential - Aggressive deployment - Cropland measures (1000 tCO2e/y)							-13,821

Table 26: E- scenario - PILLAR 6: Land sinks - Agriculture (continued)

Item	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - Aggressive deployment - Permanent conservation cover (1000 tCO ₂ e/y)							-414
Carbon sink potential - Aggressive deployment - Total (1000 tCO ₂ e/y)							-16,658
Land impacted for carbon sink - Moderate deployment - Corn-ethanol to energy grasses (1000 hectares)							1,097
Land impacted for carbon sink - Moderate deployment - Cropland measures (1000 hectares)							3,675
Land impacted for carbon sink - Moderate deployment - Permanent conservation cover (1000 hectares)							376
Land impacted for carbon sink - Moderate deployment - Total (1000 hectares)							5,149
Land impacted for carbon sink - Aggressive deployment - Corn-ethanol to energy grasses (1000 hectares)							1,097
Land impacted for carbon sink - Aggressive deployment - Cropland measures (1000 hectares)							6,974
Land impacted for carbon sink - Aggressive deployment - Permanent conservation cover (1000 hectares)							753
Land impacted for carbon sink - Aggressive deployment - Total (1000 hectares)							8,824

Table 27: E+RE+ scenario - IMPACTS - Health

Item	2020	2025	2030	2035	2040	2045	2050
Premature deaths from air pollution - Fuel Comb - Electric Generation - Coal (deaths)		32.6	0.024	0.023	0.018	0.012	0
Premature deaths from air pollution - Fuel Comb - Electric Generation - Natural Gas (deaths)		10.9	6.5	2.07	1.23	0.626	0.488
Premature deaths from air pollution - Mobile - On-Road (deaths)		171	162	126	74.2	35.4	15.6
Premature deaths from air pollution - Gas Stations (deaths)		11	10.2	7.88	4.79	2.44	1.26
Premature deaths from air pollution - Fuel Comb - Residential - Natural Gas (deaths)		36.1	32.9	25.2	15.7	8.28	3.45
Premature deaths from air pollution - Fuel Comb - Residential - Oil (deaths)		1.7	1.44	1.01	0.59	0.232	0.053
Premature deaths from air pollution - Fuel Comb - Residential - Other (deaths)		4.38	4.39	3.73	2.61	1.4	0.522
Premature deaths from air pollution - Fuel Comb - Comm/Institutional - Coal (deaths)		3.19	3.1	3	2.88	2.75	2.61
Premature deaths from air pollution - Fuel Comb - Comm/Institutional - Natural Gas (deaths)		8.63	7.74	6.12	4.14	2.44	1.21
Premature deaths from air pollution - Fuel Comb - Comm/Institutional - Oil (deaths)		3.3	2.71	2.07	1.46	0.983	0.608
Premature deaths from air pollution - Fuel Comb - Comm/Institutional - Other (deaths)		1.08	0.923	0.762	0.602	0.446	0.296

Table 27: *E+RE+ scenario - IMPACTS - Health (continued)*

Item	2020	2025	2030	2035	2040	2045	2050
Premature deaths from air pollution - Industrial Processes - Coal Mining (deaths)		0.644	0.099	0.093	0.086	0.082	0.048
Premature deaths from air pollution - Industrial Processes - Oil & Gas Production (deaths)		47.9	45.6	40	29.1	18.1	2.85
Monetary damages from air pollution - Fuel Comb - Electric Generation - Coal (million \$2019)		289	0.209	0.2	0.163	0.109	0.003
Monetary damages from air pollution - Fuel Comb - Electric Generation - Natural Gas (million \$2019)		96.3	57.6	18.4	10.9	5.55	4.32
Monetary damages from air pollution - Mobile - On-Road (million \$2019)		1,518	1,442	1,116	659	315	138
Monetary damages from air pollution - Gas Stations (million \$2019)		97	90.7	69.8	42.4	21.6	11.2
Monetary damages from air pollution - Fuel Comb - Residential - Natural Gas (million \$2019)		320	291	224	139	73.4	30.6
Monetary damages from air pollution - Fuel Comb - Residential - Oil (million \$2019)		15	12.7	8.95	5.23	2.06	0.473
Monetary damages from air pollution - Fuel Comb - Residential - Other (million \$2019)		38.9	38.9	33.1	23.1	12.4	4.63
Monetary damages from air pollution - Fuel Comb - Comm/Institutional - Coal (million \$2019)		28.2	27.5	26.6	25.5	24.3	23.1
Monetary damages from air pollution - Fuel Comb - Comm/Institutional - Natural Gas (million \$2019)		76.4	68.5	54.2	36.6	21.6	10.7
Monetary damages from air pollution - Fuel Comb - Comm/Institutional - Oil (million \$2019)		29.2	24	18.3	13	8.7	5.38
Monetary damages from air pollution - Fuel Comb - Comm/Institutional - Other (million \$2019)		9.6	8.17	6.75	5.33	3.95	2.62
Monetary damages from air pollution - Industrial Processes - Coal Mining (million \$2019)		5.68	0.874	0.824	0.757	0.728	0.422
Monetary damages from air pollution - Industrial Processes - Oil & Gas Production (million \$2019)		426	405	355	258	161	25.3

Table 28: *E+RE+ scenario - IMPACTS - Jobs*

Item	2020	2025	2030	2035	2040	2045	2050
By economic sector - Agriculture (jobs)		2,173	2,347	2,555	1,651	1,563	4,982
By economic sector - Construction (jobs)		8,688	10,895	18,205	25,847	34,255	51,116
By economic sector - Manufacturing (jobs)		4,398	5,079	6,998	7,689	9,425	14,252
By economic sector - Mining (jobs)		2,101	1,466	946	570	317	27
By economic sector - Other (jobs)		648	887	1,609	2,498	3,428	5,595
By economic sector - Pipeline (jobs)		474	401	291	199	126	38.1
By economic sector - Professional (jobs)		5,602	7,476	12,437	17,954	25,499	42,696
By economic sector - Trade (jobs)		3,995	4,564	6,786	9,466	13,079	20,940
By economic sector - Utilities (jobs)		8,704	9,925	17,472	25,265	34,289	51,338
By resource sector - Biomass (jobs)		5,336	5,524	5,970	4,411	5,889	22,255
By resource sector - CO2 (jobs)		0	0	0	0	0	0
By resource sector - Coal (jobs)		886	204	0	0	0	0
By resource sector - Grid (jobs)		11,677	14,588	30,964	46,273	64,438	97,805

Table 28: *E+RE+ scenario - IMPACTS - Jobs (continued)*

Item	2020	2025	2030	2035	2040	2045	2050
By resource sector - Natural Gas (jobs)		4,001	3,569	2,685	2,974	2,443	2,338
By resource sector - Nuclear (jobs)		944	790	342	0	0	0
By resource sector - Oil (jobs)		4,753	3,864	2,863	1,975	1,268	0.034
By resource sector - Solar (jobs)		1,332	1,399	1,911	2,797	2,941	5,555
By resource sector - Wind (jobs)		7,855	13,102	22,567	32,708	45,002	63,031
By education level - All sectors - High school diploma or less (jobs)		16,146	18,650	28,611	37,677	49,687	78,222
By education level - All sectors - Associates degree or some college (jobs)		10,924	12,975	20,922	29,044	39,073	60,164
By education level - All sectors - Bachelors degree (jobs)		7,538	8,808	13,666	18,727	25,410	40,080
By education level - All sectors - Masters or professional degree (jobs)		1,893	2,256	3,551	4,920	6,739	10,757
By education level - All sectors - Doctoral degree (jobs)		283	351	551	770	1,071	1,760
Related work experience - All sectors - None (jobs)		5,436	6,322	9,825	13,191	17,566	27,604
Related work experience - All sectors - Up to 1 year (jobs)		7,955	9,230	13,998	18,259	24,052	38,334
Related work experience - All sectors - 1 to 4 years (jobs)		12,951	15,176	23,921	32,710	44,026	68,791
Related work experience - All sectors - 4 to 10 years (jobs)		8,263	9,756	15,524	21,453	28,910	44,775
Related work experience - All sectors - Over 10 years (jobs)		2,179	2,557	4,033	5,525	7,426	11,480
On-the-Job Training - All sectors - None (jobs)		2,036	2,363	3,611	4,851	6,485	10,263
On-the-Job Training - All sectors - Up to 1 year (jobs)		24,797	28,827	44,481	59,481	79,461	125,596
On-the-Job Training - All sectors - 1 to 4 years (jobs)		7,287	8,648	13,967	19,431	26,125	40,026
On-the-Job Training - All sectors - 4 to 10 years (jobs)		2,329	2,808	4,634	6,561	8,835	13,459
On-the-Job Training - All sectors - Over 10 years (jobs)		334	395	606	815	1,075	1,640
On-Site or In-Plant Training - All sectors - None (jobs)		5,912	6,973	10,883	14,767	19,844	31,247
On-Site or In-Plant Training - All sectors - Up to 1 year (jobs)		22,436	26,065	40,297	53,981	72,075	113,609
On-Site or In-Plant Training - All sectors - 1 to 4 years (jobs)		5,712	6,747	10,824	14,961	20,077	30,862
On-Site or In-Plant Training - All sectors - 4 to 10 years (jobs)		2,411	2,881	4,691	6,594	8,866	13,545
On-Site or In-Plant Training - All sectors - Over 10 years (jobs)		314	374	605	836	1,118	1,720
Wage income - All (million \$2019)		2,203	2,615	4,178	5,785	7,873	12,451

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

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Transportation (PJ)	552	519	460	389	325	285	269
Final energy use - Residential (PJ)	296	280	265	236	202	173	153
Final energy use - Commercial (PJ)	221	216	207	194	179	168	160
Final energy use - Industry (PJ)	391	405	406	401	400	399	401

Table 30: *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)		3.87	3.99	7.91	8.48	7.13	7.47

Table 31: *E+RE+ scenario - PILLAR 1: Efficiency/Electrification - Transportation*

Item	2020	2025	2030	2035	2040	2045	2050
Vehicle stocks - LDV – EV (1000 units)	38.9	480	920	2,462	4,005	5,237	6,470
Vehicle stocks - LDV – All others (1000 units)	5,395	5,137	4,879	3,555	2,232	1,263	294
Light-duty vehicle capital costs vs. REF - Cumulative 5-yr (million \$2018)		1,035	2,659	4,300	6,517	7,089	6,761
Public EV charging plugs - DC Fast (1000 units)	0.168		1.92		8.36		13.5
Public EV charging plugs - L2 (1000 units)	0.739		46.2		201		325

Table 32: *E+RE+ scenario - PILLAR 1: Efficiency/Electrification - Residential*

Item	2020	2025	2030	2035	2040	2045	2050
Sales of space heating units - Electric Heat Pump (%)	3.41	7.97	30.9	76.7	90.3	91.9	91.7
Sales of space heating units - Electric Resistance (%)	9.83	13.9	11.3	5.52	3.76	3.59	3.79
Sales of space heating units - Gas (%)	77.8	62.6	46.3	12.4	2.5	1.41	1.31
Sales of space heating units - Fossil (%)	8.97	15.5	11.4	5.34	3.47	3.15	3.18
Sales of water heating units - Electric Heat Pump (%)	0	0.704	9.95	31.7	37.9	38.6	38.6
Sales of water heating units - Electric Resistance (%)	20.7	35.3	41.3	56	60.8	61.3	61.3
Sales of water heating units - Gas Furnace (%)	79.2	64	48.7	12.3	1.29	0.072	0
Sales of water heating units - Other (%)	0.018	0.021	0.021	0.021	0.02	0.02	0.02
Sales of cooking units - Electric Resistance (%)	58.9	67.6	94.5	99.7	100	100	100
Sales of cooking units - Gas (%)	41.1	32.4	5.54	0.279	0	0	0
Residential HVAC investment in 2020s vs. REF - Cumulative 5-yr (billion \$2018)		4.14	4.85				

Table 33: *E+RE+ scenario - PILLAR 1: Efficiency/Electrification - Commercial*

Item	2020	2025	2030	2035	2040	2045	2050
Sales of space heating units - Electric Heat Pump (%)	1.8	6.82	26.5	71.8	85.3	86.8	86.9
Sales of space heating units - Electric Resistance (%)	3.09	5.73	8.18	11.9	12.6	12.6	12.6
Sales of space heating units - Gas (%)	90.3	85.4	64.9	16.3	2.07	0.546	0.457
Sales of space heating units - Fossil (%)	4.77	2.09	0.407	0.017	0	0	0
Sales of water heating units - Electric Heat Pump (%)	0.491	1.66	12.6	38.5	46.3	47.1	47.2
Sales of water heating units - Electric Resistance (%)	4.33	7.76	18.5	43.6	51.2	52.1	52.2
Sales of water heating units - Gas (%)	94.1	89.6	68.2	17.2	1.81	0.101	0
Sales of water heating units - Other (%)	1.03	0.934	0.727	0.678	0.674	0.676	0.676
Sales of cooking units - Electric Resistance (%)	44.8	57.1	84	89.3	89.6	89.6	89.6
Sales of cooking units - Gas (%)	55.2	42.9	16	10.7	10.4	10.4	10.4
Commercial HVAC investment in 2020s - Cumulative 5-yr (million \$2018)		15,866	17,271				

Table 34: *E+RE+ scenario - PILLAR 2: Clean Electricity - Generating capacity*

Item	2020	2025	2030	2035	2040	2045	2050
Installed thermal - Coal (MW)	3,581	1,536	0	0	0	0	0
Installed thermal - Natural gas (MW)	6,014	6,010	7,216	7,676	9,627	12,198	10,502

Table 34: *E+RE+ scenario - PILLAR 2: Clean Electricity - Generating capacity (continued)*

Item	2020	2025	2030	2035	2040	2045	2050
Installed thermal - Nuclear (MW)	1,871	1,871	1,186	0	0	0	0
Installed renewables - Rooftop PV (MW)	114	204	260	347	460	594	751
Installed renewables - Solar - Base land use assumptions (MW)	267	267	267	267	776	776	3,370
Installed renewables - Wind - Base land use assumptions (MW)	4,989	13,656	20,048	34,266	57,528	92,970	129,876
Installed renewables - Solar - Constrained land use assumptions (MW)	267	267	267	267	1,171	1,411	8,517
Installed renewables - Wind - Constrained land use assumptions (MW)	5,546	6,924	9,186	15,026	21,222	27,828	67,376
Installed renewables - Offshore Wind - Constrained land use assumptions (MW)	0	0	0	0	0	0	0
Capital invested - Solar PV - Base (billion \$2018)		0	0	0	0.529	0	2.4
Capital invested - Wind - Base (billion \$2018)		12.8	8.51	17.6	27.5	39.7	39.1

Table 35: *E+RE+ scenario - PILLAR 2: Clean Electricity - Generation*

Item	2020	2025	2030	2035	2040	2045	2050
Solar - Base land use assumptions (GWh)	558	558	558	558	1,453	1,453	6,011
Wind - Base land use assumptions (GWh)	20,531	51,648	74,029	122,673	200,761	317,866	435,531
OffshoreWind - Base land use assumptions (GWh)	0	0	0	0	0	0	0
Solar - Constrained land use assumptions (GWh)	1,116	1,116	1,116	1,116	4,287	5,128	30,084
Wind - Constrained land use assumptions (GWh)	41,063	50,665	65,777	104,100	143,207	183,267	455,176
OffshoreWind - Constrained land use assumptions (GWh)	0	0	0	0	0	0	0

Table 36: *E+RE+ scenario - PILLAR 6: Land sinks - Forests*

Item	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - Low - Accelerate regeneration (1000 tCO2e/y)							-240
Carbon sink potential - Low - Avoid deforestation (1000 tCO2e/y)							-312
Carbon sink potential - Low - Extend rotation length (1000 tCO2e/y)							-3,267
Carbon sink potential - Low - Improve plantations (1000 tCO2e/y)							-404
Carbon sink potential - Low - Increase retention of HWP (1000 tCO2e/y)							-1,556
Carbon sink potential - Low - Increase trees outside forests (1000 tCO2e/y)							-1,054
Carbon sink potential - Low - Reforest cropland (1000 tCO2e/y)							-4,034
Carbon sink potential - Low - Reforest pasture (1000 tCO2e/y)							-630
Carbon sink potential - Low - Restore productivity (1000 tCO2e/y)							-1,455
Carbon sink potential - Low - All (not counting overlap) (1000 tCO2e/y)							-12,952
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO2e/y)							-359
Carbon sink potential - Mid - Avoid deforestation (1000 tCO2e/y)							-1,091
Carbon sink potential - Mid - Extend rotation length (1000 tCO2e/y)							-5,887

Table 36: *E+RE+ scenario - PILLAR 6: Land sinks - Forests (continued)*

Item	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - Mid - Improve plantations (1000 tCO ₂ e/y)							-591
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO ₂ e/y)							-3,112
Carbon sink potential - Mid - Increase trees outside forests (1000 tCO ₂ e/y)							-2,033
Carbon sink potential - Mid - Reforest cropland (1000 tCO ₂ e/y)							-6,052
Carbon sink potential - Mid - Reforest pasture (1000 tCO ₂ e/y)							-4,472
Carbon sink potential - Mid - Restore productivity (1000 tCO ₂ e/y)							-2,887
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO ₂ e/y)							-26,484
Carbon sink potential - High - Accelerate regeneration (1000 tCO ₂ e/y)							-479
Carbon sink potential - High - Avoid deforestation (1000 tCO ₂ e/y)							-1,871
Carbon sink potential - High - Extend rotation length (1000 tCO ₂ e/y)							-8,507
Carbon sink potential - High - Improve plantations (1000 tCO ₂ e/y)							-793
Carbon sink potential - High - Increase retention of HWP (1000 tCO ₂ e/y)							-4,667
Carbon sink potential - High - Increase trees outside forests (1000 tCO ₂ e/y)							-3,012
Carbon sink potential - High - Reforest cropland (1000 tCO ₂ e/y)							-8,069
Carbon sink potential - High - Reforest pasture (1000 tCO ₂ e/y)							-8,313
Carbon sink potential - High - All (not counting overlap) (1000 tCO ₂ e/y)							-40,029
Carbon sink potential - High - Restore productivity (1000 tCO ₂ e/y)							-4,318
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)							39.1
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)							238
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)							1,662
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)							146
Land impacted for carbon sink potential - Low - Increase retention of HWP (1000 hectares)							0
Land impacted for carbon sink potential - Low - Increase trees outside forests (1000 hectares)							151
Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares)							267
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)							40.9
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)							866

Table 36: *E+RE+ scenario - PILLAR 6: Land sinks - Forests (continued)*

Item	2020	2025	2030	2035	2040	2045	2050
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)							3,409
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)							58.7
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)							246
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)							3,000
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)							220
Land impacted for carbon sink potential - Mid - Increase retention of HWP (1000 hectares)							0
Land impacted for carbon sink potential - Mid - Increase trees outside forests (1000 hectares)							218
Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares)							400
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)							296
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)							1,744
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)							6,183
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)							78.3
Land impacted for carbon sink potential - High - Avoid deforestation (over 30 years) (1000 hectares)							253
Land impacted for carbon sink potential - High - Extend rotation length (1000 hectares)							4,338
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)							292
Land impacted for carbon sink potential - High - Increase retention of HWP (1000 hectares)							0
Land impacted for carbon sink potential - High - Increase trees outside forests (1000 hectares)							286
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)							533
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)							236
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)							1,431
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)							7,449

Table 37: *E+RE+ scenario - PILLAR 6: Land sinks - Agriculture*

Item	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - Moderate deployment - Corn-ethanol to energy grasses (1000 tCO ₂ e/y)							-2,423
Carbon sink potential - Moderate deployment - Cropland measures (1000 tCO ₂ e/y)							-7,283
Carbon sink potential - Moderate deployment - Permanent conservation cover (1000 tCO ₂ e/y)							-207
Carbon sink potential - Moderate deployment - Total (1000 tCO ₂ e/y)							-9,914
Carbon sink potential - Aggressive deployment - Corn-ethanol to energy grasses (1000 tCO ₂ e/y)							-2,423
Carbon sink potential - Aggressive deployment - Cropland measures (1000 tCO ₂ e/y)							-13,821
Carbon sink potential - Aggressive deployment - Permanent conservation cover (1000 tCO ₂ e/y)							-414
Carbon sink potential - Aggressive deployment - Total (1000 tCO ₂ e/y)							-16,658
Land impacted for carbon sink - Moderate deployment - Corn-ethanol to energy grasses (1000 hectares)							1,097
Land impacted for carbon sink - Moderate deployment - Cropland measures (1000 hectares)							3,675
Land impacted for carbon sink - Moderate deployment - Permanent conservation cover (1000 hectares)							376
Land impacted for carbon sink - Moderate deployment - Total (1000 hectares)							5,149
Land impacted for carbon sink - Aggressive deployment - Corn-ethanol to energy grasses (1000 hectares)							1,097
Land impacted for carbon sink - Aggressive deployment - Cropland measures (1000 hectares)							6,974
Land impacted for carbon sink - Aggressive deployment - Permanent conservation cover (1000 hectares)							753
Land impacted for carbon sink - Aggressive deployment - Total (1000 hectares)							8,824

Table 38: *E+RE- scenario - IMPACTS - Health*

Item	2020	2025	2030	2035	2040	2045	2050
Premature deaths from air pollution - Fuel Comb - Electric Generation - Coal (deaths)		32.6	0.024	0.023	0.018	0.012	0
Premature deaths from air pollution - Fuel Comb - Electric Generation - Natural Gas (deaths)		12.3	7.72	9.61	6.53	3.17	1.23
Premature deaths from air pollution - Mobile - On-Road (deaths)		171	162	126	74.2	35.4	15.6
Premature deaths from air pollution - Gas Stations (deaths)		11	10.2	7.88	4.79	2.44	1.26

Table 38: E+RE- scenario - IMPACTS - Health (continued)

Item	2020	2025	2030	2035	2040	2045	2050
Premature deaths from air pollution - Fuel Comb - Residential - Natural Gas (deaths)		36.1	32.9	25.2	15.7	8.28	3.45
Premature deaths from air pollution - Fuel Comb - Residential - Oil (deaths)		1.7	1.44	1.01	0.59	0.232	0.053
Premature deaths from air pollution - Fuel Comb - Residential - Other (deaths)		4.38	4.39	3.73	2.61	1.4	0.522
Premature deaths from air pollution - Fuel Comb - Comm/Institutional - Coal (deaths)		3.19	3.1	3	2.88	2.75	2.61
Premature deaths from air pollution - Fuel Comb - Comm/Institutional - Natural Gas (deaths)		8.63	7.74	6.12	4.14	2.44	1.21
Premature deaths from air pollution - Fuel Comb - Comm/Institutional - Oil (deaths)		3.3	2.71	2.07	1.46	0.983	0.608
Premature deaths from air pollution - Fuel Comb - Comm/Institutional - Other (deaths)		1.08	0.923	0.762	0.602	0.446	0.296
Premature deaths from air pollution - Industrial Processes - Coal Mining (deaths)		0.489	0.098	0.094	0.086	0.083	0.048
Premature deaths from air pollution - Industrial Processes - Oil & Gas Production (deaths)		49.2	48	47.3	40	33.5	24.9
Monetary damages from air pollution - Fuel Comb - Electric Generation - Coal (million \$2019)		289	0.209	0.2	0.163	0.109	0.003
Monetary damages from air pollution - Fuel Comb - Electric Generation - Natural Gas (million \$2019)		109	68.4	85.1	57.8	28.1	10.9
Monetary damages from air pollution - Mobile - On-Road (million \$2019)		1,518	1,442	1,116	659	315	138
Monetary damages from air pollution - Gas Stations (million \$2019)		97	90.7	69.8	42.4	21.6	11.2
Monetary damages from air pollution - Fuel Comb - Residential - Natural Gas (million \$2019)		320	291	224	139	73.4	30.6
Monetary damages from air pollution - Fuel Comb - Residential - Oil (million \$2019)		15	12.7	8.95	5.23	2.06	0.473
Monetary damages from air pollution - Fuel Comb - Residential - Other (million \$2019)		38.9	38.9	33.1	23.1	12.4	4.63
Monetary damages from air pollution - Fuel Comb - Comm/Institutional - Coal (million \$2019)		28.2	27.5	26.6	25.5	24.3	23.1
Monetary damages from air pollution - Fuel Comb - Comm/Institutional - Natural Gas (million \$2019)		76.4	68.5	54.2	36.6	21.6	10.7
Monetary damages from air pollution - Fuel Comb - Comm/Institutional - Oil (million \$2019)		29.2	24	18.3	13	8.7	5.38
Monetary damages from air pollution - Fuel Comb - Comm/Institutional - Other (million \$2019)		9.6	8.17	6.75	5.33	3.95	2.62
Monetary damages from air pollution - Industrial Processes - Coal Mining (million \$2019)		4.31	0.868	0.826	0.761	0.735	0.421

Table 38: *E+RE- scenario - IMPACTS - Health (continued)*

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Industrial Processes - Oil & Gas Production (million \$2019)		437	426	420	355	297	221

Table 39: *E+RE- scenario - IMPACTS - Jobs*

Item	2020	2025	2030	2035	2040	2045	2050
By economic sector - Agriculture (jobs)		2,195	2,565	3,041	1,947	1,999	4,957
By economic sector - Construction (jobs)		8,367	9,190	11,303	12,301	14,362	17,624
By economic sector - Manufacturing (jobs)		4,097	4,045	4,351	4,008	4,203	5,789
By economic sector - Mining (jobs)		2,141	1,529	1,088	748	508	360
By economic sector - Other (jobs)		605	702	891	1,075	1,315	1,531
By economic sector - Pipeline (jobs)		498	440	505	346	283	1,009
By economic sector - Professional (jobs)		5,240	6,077	7,656	8,446	11,065	16,532
By economic sector - Trade (jobs)		3,830	3,871	4,330	4,548	5,381	6,839
By economic sector - Utilities (jobs)		9,010	9,821	12,424	13,319	15,786	18,110
By resource sector - Biomass (jobs)		5,350	5,996	8,089	5,802	7,879	20,929
By resource sector - CO2 (jobs)		0	0	885	277	42.3	6,524
By resource sector - Coal (jobs)		886	204	0	0	0	0
By resource sector - Grid (jobs)		12,320	14,064	19,435	22,487	28,047	26,331
By resource sector - Natural Gas (jobs)		4,271	4,339	3,967	4,142	3,664	3,187
By resource sector - Nuclear (jobs)		944	929	658	168	0	0
By resource sector - Oil (jobs)		4,751	3,903	2,946	2,166	1,642	1,330
By resource sector - Solar (jobs)		1,148	906	1,028	1,132	1,172	1,708
By resource sector - Wind (jobs)		6,312	7,900	8,581	10,816	12,455	12,742
By education level - All sectors - High school diploma or less (jobs)		15,860	16,847	20,058	19,940	23,015	30,978
By education level - All sectors - Associates degree or some college (jobs)		10,682	11,405	13,737	14,511	17,116	21,883
By education level - All sectors - Bachelors degree (jobs)		7,334	7,723	9,094	9,454	11,314	15,145
By education level - All sectors - Masters or professional degree (jobs)		1,837	1,970	2,347	2,459	2,986	4,058
By education level - All sectors - Doctoral degree (jobs)		269	296	354	376	472	686
Related work experience - All sectors - None (jobs)		5,339	5,686	6,796	6,883	8,031	10,738
Related work experience - All sectors - Up to 1 year (jobs)		7,777	8,272	9,801	9,647	11,114	15,280
Related work experience - All sectors - 1 to 4 years (jobs)		12,671	13,463	16,081	16,666	19,743	25,987
Related work experience - All sectors - 4 to 10 years (jobs)		8,070	8,577	10,254	10,768	12,747	16,539
Related work experience - All sectors - Over 10 years (jobs)		2,126	2,243	2,658	2,776	3,267	4,206
On-the-Job Training - All sectors - None (jobs)		1,982	2,085	2,452	2,489	2,921	3,942
On-the-Job Training - All sectors - Up to 1 year (jobs)		24,256	25,720	30,542	30,891	36,247	48,862
On-the-Job Training - All sectors - 1 to 4 years (jobs)		7,136	7,622	9,176	9,706	11,435	14,511
On-the-Job Training - All sectors - 4 to 10 years (jobs)		2,286	2,475	3,025	3,247	3,834	4,830
On-the-Job Training - All sectors - Over 10 years (jobs)		323	339	395	406	466	606
On-Site or In-Plant Training - All sectors - None (jobs)		5,753	6,135	7,307	7,508	8,890	11,979
On-Site or In-Plant Training - All sectors - Up to 1 year (jobs)		21,961	23,264	27,628	27,997	32,800	43,931

Table 39: *E+RE- scenario - IMPACTS - Jobs (continued)*

Item	2020	2025	2030	2035	2040	2045	2050
On-Site or In-Plant Training - All sectors - 1 to 4 years (jobs)		5,596	5,964	7,165	7,524	8,847	11,291
On-Site or In-Plant Training - All sectors - 4 to 10 years (jobs)		2,365	2,545	3,087	3,288	3,873	4,919
On-Site or In-Plant Training - All sectors - Over 10 years (jobs)		308	332	403	422	493	631
Wage income - All (million \$2019)		2,160	2,329	2,822	2,957	3,534	4,698

Table 40: *E+RE- scenario - PILLAR 1: Efficiency/Electrification - Overview*

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Transportation (PJ)	552	519	460	389	325	285	269
Final energy use - Residential (PJ)	296	280	265	236	202	173	153
Final energy use - Commercial (PJ)	221	216	207	194	179	168	160
Final energy use - Industry (PJ)	391	405	406	401	400	399	401

Table 41: *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)		3.87	3.99	7.91	8.48	7.13	7.47

Table 42: *E+RE- scenario - PILLAR 1: Efficiency/Electrification - Transportation*

Item	2020	2025	2030	2035	2040	2045	2050
Vehicle stocks - LDV – EV (1000 units)	38.9	480	920	2,462	4,005	5,237	6,470
Vehicle stocks - LDV – All others (1000 units)	5,395	5,137	4,879	3,555	2,232	1,263	294
Light-duty vehicle capital costs vs. REF - Cumulative 5-yr (million \$2018)		1,035	2,659	4,300	6,517	7,089	6,761
Public EV charging plugs - DC Fast (1000 units)	0.168		1.92		8.36		13.5
Public EV charging plugs - L2 (1000 units)	0.739		46.2		201		325

Table 43: *E+RE- scenario - PILLAR 1: Efficiency/Electrification - Residential*

Item	2020	2025	2030	2035	2040	2045	2050
Sales of space heating units - Electric Heat Pump (%)	3.41	7.97	30.9	76.7	90.3	91.9	91.7
Sales of space heating units - Electric Resistance (%)	9.83	13.9	11.3	5.52	3.76	3.59	3.79
Sales of space heating units - Gas (%)	77.8	62.6	46.3	12.4	2.5	1.41	1.31
Sales of space heating units - Fossil (%)	8.97	15.5	11.4	5.34	3.47	3.15	3.18
Sales of water heating units - Electric Heat Pump (%)	0	0.704	9.95	31.7	37.9	38.6	38.6
Sales of water heating units - Electric Resistance (%)	20.7	35.3	41.3	56	60.8	61.3	61.3
Sales of water heating units - Gas Furnace (%)	79.2	64	48.7	12.3	1.29	0.072	0
Sales of water heating units - Other (%)	0.018	0.021	0.021	0.021	0.02	0.02	0.02
Sales of cooking units - Electric Resistance (%)	58.9	67.6	94.5	99.7	100	100	100
Sales of cooking units - Gas (%)	41.1	32.4	5.54	0.279	0	0	0
Residential HVAC investment in 2020s vs. REF - Cumulative 5-yr (billion \$2018)		4.14	4.85				

Table 44: *E+RE- scenario - PILLAR 1: Efficiency/Electrification - Commercial*

Item	2020	2025	2030	2035	2040	2045	2050
Sales of space heating units - Electric Heat Pump (%)	1.8	6.82	26.5	71.8	85.3	86.8	86.9
Sales of space heating units - Electric Resistance (%)	3.09	5.73	8.18	11.9	12.6	12.6	12.6
Sales of space heating units - Gas (%)	90.3	85.4	64.9	16.3	2.07	0.546	0.457
Sales of space heating units - Fossil (%)	4.77	2.09	0.407	0.017	0	0	0
Sales of water heating units - Electric Heat Pump (%)	0.491	1.66	12.6	38.5	46.3	47.1	47.2
Sales of water heating units - Electric Resistance (%)	4.33	7.76	18.5	43.6	51.2	52.1	52.2
Sales of water heating units - Gas (%)	94.1	89.6	68.2	17.2	1.81	0.101	0
Sales of water heating units - Other (%)	1.03	0.934	0.727	0.678	0.674	0.676	0.676
Sales of cooking units - Electric Resistance (%)	44.8	57.1	84	89.3	89.6	89.6	89.6
Sales of cooking units - Gas (%)	55.2	42.9	16	10.7	10.4	10.4	10.4
Commercial HVAC investment in 2020s - Cumulative 5-yr (million \$2018)		15,866	17,271				

Table 45: *E+RE- scenario - PILLAR 2: Clean Electricity - Generating capacity*

Item	2020	2025	2030	2035	2040	2045	2050
Installed thermal - Coal (MW)	3,581	1,536	0	0	0	0	0
Installed thermal - Natural gas (MW)	6,014	6,009	9,093	9,510	8,961	11,056	7,582
Installed thermal - Nuclear (MW)	1,871	1,871	1,871	593	0	0	0
Installed renewables - Rooftop PV (MW)	114	204	260	347	460	594	751
Installed renewables - Solar - Base land use assumptions (MW)	267	267	267	267	267	267	267
Installed renewables - Wind - Base land use assumptions (MW)	4,989	8,359	14,343	18,485	24,464	33,492	33,635
Installed renewables - Solar - Constrained land use assumptions (MW)	267	267	267	267	267	267	267
Installed renewables - Wind - Constrained land use assumptions (MW)	4,989	5,395	6,367	8,337	10,965	14,287	14,389
Installed renewables - Offshore Wind - Constrained land use assumptions (MW)	0	0	0	0	0	0	0
Capital invested - Solar PV - Base (billion \$2018)		0	0	0	0	0	0
Capital invested - Wind - Base (billion \$2018)		4.96	8.01	5.14	7.11	10.2	0.152
Capital invested - Solar PV - Constrained (billion \$2018)		0	0	0	0	0	0
Capital invested - Wind - Constrained (billion \$2018)		0.597	1.29	2.44	3.11	3.72	0.108

Table 46: *E+RE- scenario - PILLAR 2: Clean Electricity - Generation*

Item	2020	2025	2030	2035	2040	2045	2050
Solar - Base land use assumptions (GWh)	558	558	558	558	558	558	558
Wind - Base land use assumptions (GWh)	20,531	32,719	54,161	68,730	89,499	120,671	121,150
OffshoreWind - Base land use assumptions (GWh)	0	0	0	0	0	0	0
Solar - Constrained land use assumptions (GWh)	558	558	558	558	558	558	558
Wind - Constrained land use assumptions (GWh)	20,531	21,967	25,332	31,915	40,586	51,465	51,789
OffshoreWind - Constrained land use assumptions (GWh)	0	0	0	0	0	0	0

Table 47: *E+RE- scenario - PILLAR 6: Land sinks - Forests*

Item	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - Low - Accelerate regeneration (1000 tCO ₂ e/y)							-240
Carbon sink potential - Low - Avoid deforestation (1000 tCO ₂ e/y)							-312
Carbon sink potential - Low - Extend rotation length (1000 tCO ₂ e/y)							-3,267
Carbon sink potential - Low - Improve plantations (1000 tCO ₂ e/y)							-404
Carbon sink potential - Low - Increase retention of HWP (1000 tCO ₂ e/y)							-1,556
Carbon sink potential - Low - Increase trees outside forests (1000 tCO ₂ e/y)							-1,054
Carbon sink potential - Low - Reforest cropland (1000 tCO ₂ e/y)							-4,034
Carbon sink potential - Low - Reforest pasture (1000 tCO ₂ e/y)							-630
Carbon sink potential - Low - Restore productivity (1000 tCO ₂ e/y)							-1,455
Carbon sink potential - Low - All (not counting overlap) (1000 tCO ₂ e/y)							-12,952
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO ₂ e/y)							-359
Carbon sink potential - Mid - Avoid deforestation (1000 tCO ₂ e/y)							-1,091
Carbon sink potential - Mid - Extend rotation length (1000 tCO ₂ e/y)							-5,887
Carbon sink potential - Mid - Improve plantations (1000 tCO ₂ e/y)							-591
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO ₂ e/y)							-3,112
Carbon sink potential - Mid - Increase trees outside forests (1000 tCO ₂ e/y)							-2,033
Carbon sink potential - Mid - Reforest cropland (1000 tCO ₂ e/y)							-6,052
Carbon sink potential - Mid - Reforest pasture (1000 tCO ₂ e/y)							-4,472
Carbon sink potential - Mid - Restore productivity (1000 tCO ₂ e/y)							-2,887
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO ₂ e/y)							-26,484
Carbon sink potential - High - Accelerate regeneration (1000 tCO ₂ e/y)							-479
Carbon sink potential - High - Avoid deforestation (1000 tCO ₂ e/y)							-1,871
Carbon sink potential - High - Extend rotation length (1000 tCO ₂ e/y)							-8,507
Carbon sink potential - High - Improve plantations (1000 tCO ₂ e/y)							-793
Carbon sink potential - High - Increase retention of HWP (1000 tCO ₂ e/y)							-4,667
Carbon sink potential - High - Increase trees outside forests (1000 tCO ₂ e/y)							-3,012
Carbon sink potential - High - Reforest cropland (1000 tCO ₂ e/y)							-8,069
Carbon sink potential - High - Reforest pasture (1000 tCO ₂ e/y)							-8,313
Carbon sink potential - High - All (not counting overlap) (1000 tCO ₂ e/y)							-40,029
Carbon sink potential - High - Restore productivity (1000 tCO ₂ e/y)							-4,318

Table 47: *E+RE- scenario - PILLAR 6: Land sinks - Forests (continued)*

Item	2020	2025	2030	2035	2040	2045	2050
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)							39.1
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)							238
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)							1,662
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)							146
Land impacted for carbon sink potential - Low - Increase retention of HWP (1000 hectares)							0
Land impacted for carbon sink potential - Low - Increase trees outside forests (1000 hectares)							151
Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares)							267
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)							40.9
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)							866
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)							3,409
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)							58.7
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)							246
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)							3,000
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)							220
Land impacted for carbon sink potential - Mid - Increase retention of HWP (1000 hectares)							0
Land impacted for carbon sink potential - Mid - Increase trees outside forests (1000 hectares)							218
Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares)							400
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)							296
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)							1,744
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)							6,183
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)							78.3
Land impacted for carbon sink potential - High - Avoid deforestation (over 30 years) (1000 hectares)							253

Table 47: *E+RE- scenario - PILLAR 6: Land sinks - Forests (continued)*

Item	2020	2025	2030	2035	2040	2045	2050
Land impacted for carbon sink potential - High - Extend rotation length (1000 hectares)							4,338
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)							292
Land impacted for carbon sink potential - High - Increase retention of HWP (1000 hectares)							0
Land impacted for carbon sink potential - High - Increase trees outside forests (1000 hectares)							286
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)							533
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)							236
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)							1,431
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)							7,449

Table 48: *E+RE- scenario - PILLAR 6: Land sinks - Agriculture*

Item	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - Moderate deployment - Corn-ethanol to energy grasses (1000 tCO ₂ e/y)							-2,423
Carbon sink potential - Moderate deployment - Cropland measures (1000 tCO ₂ e/y)							-7,283
Carbon sink potential - Moderate deployment - Permanent conservation cover (1000 tCO ₂ e/y)							-207
Carbon sink potential - Moderate deployment - Total (1000 tCO ₂ e/y)							-9,914
Carbon sink potential - Aggressive deployment - Corn-ethanol to energy grasses (1000 tCO ₂ e/y)							-2,423
Carbon sink potential - Aggressive deployment - Cropland measures (1000 tCO ₂ e/y)							-13,821
Carbon sink potential - Aggressive deployment - Permanent conservation cover (1000 tCO ₂ e/y)							-414
Carbon sink potential - Aggressive deployment - Total (1000 tCO ₂ e/y)							-16,658
Land impacted for carbon sink - Moderate deployment - Corn-ethanol to energy grasses (1000 hectares)							1,097
Land impacted for carbon sink - Moderate deployment - Cropland measures (1000 hectares)							3,675
Land impacted for carbon sink - Moderate deployment - Permanent conservation cover (1000 hectares)							376
Land impacted for carbon sink - Moderate deployment - Total (1000 hectares)							5,149

Table 48: *E+RE- scenario - PILLAR 6: Land sinks - Agriculture (continued)*

Item	2020	2025	2030	2035	2040	2045	2050
Land impacted for carbon sink - Aggressive deployment - Corn-ethanol to energy grasses (1000 hectares)							1,097
Land impacted for carbon sink - Aggressive deployment - Cropland measures (1000 hectares)							6,974
Land impacted for carbon sink - Aggressive deployment - Permanent conservation cover (1000 hectares)							753
Land impacted for carbon sink - Aggressive deployment - Total (1000 hectares)							8,824

Table 49: *E-B+ scenario - IMPACTS - Health*

Item	2020	2025	2030	2035	2040	2045	2050
Premature deaths from air pollution - Fuel Comb - Electric Generation - Coal (deaths)		32.6	0.024	0.023	0.018	0.012	0
Premature deaths from air pollution - Fuel Comb - Electric Generation - Natural Gas (deaths)		11.4	5.66	3.02	1.99	0.911	0.503
Premature deaths from air pollution - Mobile - On-Road (deaths)		174	178	177	163	132	92.6
Premature deaths from air pollution - Gas Stations (deaths)		11.2	11.4	11.2	10.2	8.26	5.85
Premature deaths from air pollution - Fuel Comb - Residential - Natural Gas (deaths)		36.2	34.2	32	29.4	26.2	22.4
Premature deaths from air pollution - Fuel Comb - Residential - Oil (deaths)		1.73	1.75	1.78	1.71	1.5	1.26
Premature deaths from air pollution - Fuel Comb - Residential - Other (deaths)		4.4	4.63	4.84	4.82	4.32	3.62
Premature deaths from air pollution - Fuel Comb - Comm/Institutional - Coal (deaths)		3.19	3.1	3	2.88	2.75	2.61
Premature deaths from air pollution - Fuel Comb - Comm/Institutional - Natural Gas (deaths)		8.65	8.34	7.95	7.31	6.42	5.38
Premature deaths from air pollution - Fuel Comb - Comm/Institutional - Oil (deaths)		3.31	2.92	2.53	2.14	1.81	1.55
Premature deaths from air pollution - Fuel Comb - Comm/Institutional - Other (deaths)		1.08	0.99	0.894	0.796	0.698	0.604
Premature deaths from air pollution - Industrial Processes - Coal Mining (deaths)		0.562	0.1	0.098	0.095	0.091	0.086
Premature deaths from air pollution - Industrial Processes - Oil & Gas Production (deaths)		48.6	44.7	39.5	35.1	31.5	22.1
Monetary damages from air pollution - Fuel Comb - Electric Generation - Coal (million \$2019)		289	0.209	0.2	0.163	0.109	0.003
Monetary damages from air pollution - Fuel Comb - Electric Generation - Natural Gas (million \$2019)		101	50.1	26.8	17.7	8.07	4.46
Monetary damages from air pollution - Mobile - On-Road (million \$2019)		1,543	1,586	1,574	1,446	1,174	823
Monetary damages from air pollution - Gas Stations (million \$2019)		99	101	99.2	90.3	73.1	51.8

Table 49: *E-B+ scenario - IMPACTS - Health (continued)*

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Fuel Comb - Residential - Natural Gas (million \$2019)		321	303	283	261	232	198
Monetary damages from air pollution - Fuel Comb - Residential - Oil (million \$2019)		15.3	15.5	15.7	15.2	13.3	11.2
Monetary damages from air pollution - Fuel Comb - Residential - Other (million \$2019)		39	41	42.9	42.7	38.3	32.1
Monetary damages from air pollution - Fuel Comb - Comm/Institutional - Coal (million \$2019)		28.2	27.5	26.6	25.5	24.3	23.1
Monetary damages from air pollution - Fuel Comb - Comm/Institutional - Natural Gas (million \$2019)		76.6	73.8	70.3	64.7	56.8	47.7
Monetary damages from air pollution - Fuel Comb - Comm/Institutional - Oil (million \$2019)		29.3	25.9	22.4	18.9	16	13.7
Monetary damages from air pollution - Fuel Comb - Comm/Institutional - Other (million \$2019)		9.6	8.76	7.91	7.04	6.18	5.35
Monetary damages from air pollution - Industrial Processes - Coal Mining (million \$2019)		4.96	0.883	0.868	0.835	0.802	0.755
Monetary damages from air pollution - Industrial Processes - Oil & Gas Production (million \$2019)		431	397	351	312	280	196

Table 50: *E-B+ scenario - IMPACTS - Jobs*

Item	2020	2025	2030	2035	2040	2045	2050
By economic sector - Agriculture (jobs)		2,190	2,343	3,023	3,335	2,797	6,445
By economic sector - Construction (jobs)		8,608	10,582	13,392	15,282	20,092	31,164
By economic sector - Manufacturing (jobs)		4,345	4,802	5,248	5,467	6,328	10,861
By economic sector - Mining (jobs)		2,129	1,541	1,160	882	609	378
By economic sector - Other (jobs)		640	858	1,158	1,431	1,939	2,906
By economic sector - Pipeline (jobs)		483	407	442	304	247	888
By economic sector - Professional (jobs)		5,572	7,203	9,947	13,587	17,652	29,860
By economic sector - Trade (jobs)		3,991	4,507	5,537	6,747	8,502	13,136
By economic sector - Utilities (jobs)		8,647	9,648	12,088	14,147	20,281	32,437
By resource sector - Biomass (jobs)		5,419	5,470	7,977	12,041	12,879	30,724
By resource sector - CO2 (jobs)		0	0	804	25.1	38.4	5,926
By resource sector - Coal (jobs)		886	204	0	0	0	0
By resource sector - Grid (jobs)		11,516	14,025	18,954	24,298	36,648	55,051
By resource sector - Natural Gas (jobs)		4,087	3,385	2,739	2,781	3,009	2,939
By resource sector - Nuclear (jobs)		944	929	658	168	0	0
By resource sector - Oil (jobs)		4,801	4,146	3,582	3,100	2,431	1,690
By resource sector - Solar (jobs)		1,295	1,194	1,263	1,292	1,409	2,249
By resource sector - Wind (jobs)		7,657	12,539	16,018	17,476	22,033	29,495
By education level - All sectors - High school diploma or less (jobs)		16,076	18,194	22,434	25,857	32,444	53,490
By education level - All sectors - Associates degree or some college (jobs)		10,856	12,580	15,691	18,458	24,232	38,993
By education level - All sectors - Bachelors degree (jobs)		7,507	8,581	10,648	12,868	16,604	27,090
By education level - All sectors - Masters or professional degree (jobs)		1,885	2,196	2,776	3,424	4,432	7,275
By education level - All sectors - Doctoral degree (jobs)		282	341	445	574	735	1,227

Table 50: E-B+ scenario - IMPACTS - Jobs (continued)

Item	2020	2025	2030	2035	2040	2045	2050
Related work experience - All sectors - None (jobs)		5,412	6,159	7,642	8,939	11,385	18,703
Related work experience - All sectors - Up to 1 year (jobs)		7,922	9,004	11,105	12,850	15,958	26,545
Related work experience - All sectors - 1 to 4 years (jobs)		12,888	14,767	18,393	21,827	28,199	45,841
Related work experience - All sectors - 4 to 10 years (jobs)		8,217	9,478	11,796	13,971	18,225	29,438
Related work experience - All sectors - Over 10 years (jobs)		2,166	2,485	3,059	3,595	4,679	7,548
On-the-Job Training - All sectors - None (jobs)		2,028	2,306	2,842	3,358	4,259	6,980
On-the-Job Training - All sectors - Up to 1 year (jobs)		24,690	28,087	34,794	41,018	52,059	85,690
On-the-Job Training - All sectors - 1 to 4 years (jobs)		7,242	8,392	10,454	12,242	16,098	25,787
On-the-Job Training - All sectors - 4 to 10 years (jobs)		2,314	2,724	3,440	4,036	5,361	8,543
On-the-Job Training - All sectors - Over 10 years (jobs)		332	383	464	527	669	1,075
On-Site or In-Plant Training - All sectors - None (jobs)		5,882	6,782	8,460	10,048	12,845	21,050
On-Site or In-Plant Training - All sectors - Up to 1 year (jobs)		22,337	25,397	31,422	36,955	47,005	77,183
On-Site or In-Plant Training - All sectors - 1 to 4 years (jobs)		5,678	6,553	8,147	9,529	12,464	20,023
On-Site or In-Plant Training - All sectors - 4 to 10 years (jobs)		2,396	2,798	3,513	4,120	5,439	8,697
On-Site or In-Plant Training - All sectors - Over 10 years (jobs)		312	363	453	529	693	1,121
Wage income - All (million \$2019)		2,192	2,545	3,209	3,843	5,034	8,295

Table 51: E-B+ scenario - PILLAR 1: Efficiency/Electrification - Overview

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Transportation (PJ)	552	523	479	445	418	387	350
Final energy use - Residential (PJ)	296	280	269	259	249	237	223
Final energy use - Commercial (PJ)	221	216	210	204	198	192	187
Final energy use - Industry (PJ)	391	406	408	408	409	409	410

Table 52: 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)		3.06	3.08	4.07	4.2	6.25	6.61

Table 53: E-B+ scenario - PILLAR 1: Efficiency/Electrification - Transportation

Item	2020	2025	2030	2035	2040	2045	2050
Vehicle stocks - LDV – EV (1000 units)	30.1	160	289	889	1,489	2,816	4,144
Vehicle stocks - LDV – All others (1000 units)	5,417	5,417	5,417	5,138	4,859	3,745	2,630
Light-duty vehicle capital costs vs. REF - Cumulative 5-yr (million \$2018)		0	168	352	1,190	3,738	5,448
Public EV charging plugs - DC Fast (1000 units)	0.168		0.604		3.11		8.65
Public EV charging plugs - L2 (1000 units)	0.739		14.5		74.8		208

Table 54: E-B+ scenario - PILLAR 1: Efficiency/Electrification - Residential

Item	2020	2025	2030	2035	2040	2045	2050
Sales of space heating units - Electric Heat Pump (%)	3.41	6.07	7.47	11.9	22.3	35.6	44
Sales of space heating units - Electric Resistance (%)	9.83	14.1	13.8	13.3	12.1	10.4	9.55
Sales of space heating units - Gas (%)	77.8	63.8	62.8	59.6	52.3	42.7	36.3
Sales of space heating units - Fossil (%)	8.97	16.1	15.9	15.1	13.3	11.3	10.2
Sales of water heating units - Electric Heat Pump (%)	0	0.188	0.757	2.61	7.15	13.2	17.1
Sales of water heating units - Electric Resistance (%)	20.7	35	35.3	36.5	39.6	43.7	46.5
Sales of water heating units - Gas Furnace (%)	79.2	64.8	63.9	60.9	53.3	43.1	36.4
Sales of water heating units - Other (%)	0.018	0.021	0.021	0.021	0.021	0.021	0.02
Sales of cooking units - Electric Resistance (%)	58.7	59.8	63.6	73.5	87.4	95.9	98.9
Sales of cooking units - Gas (%)	41.3	40.2	36.4	26.5	12.6	4.07	1.1
Residential HVAC investment in 2020s vs. REF - Cumulative 5-yr (billion \$2018)		4.12	4.74				

Table 55: E-B+ scenario - PILLAR 1: Efficiency/Electrification - Commercial

Item	2020	2025	2030	2035	2040	2045	2050
Sales of space heating units - Electric Heat Pump (%)	1.8	5.6	6.81	10.6	19.8	32.1	40.2
Sales of space heating units - Electric Resistance (%)	3.09	5.44	5.57	6.02	6.98	8.07	8.69
Sales of space heating units - Gas (%)	90.3	86.5	85.2	81.2	71.4	58.3	49.7
Sales of space heating units - Fossil (%)	4.77	2.45	2.43	2.18	1.78	1.47	1.36
Sales of water heating units - Electric Heat Pump (%)	0.491	1.03	1.71	3.92	9.33	16.6	21.3
Sales of water heating units - Electric Resistance (%)	4.33	7.15	7.85	9.96	15.2	22.3	26.9
Sales of water heating units - Gas (%)	94.1	90.8	89.5	85.2	74.6	60.3	50.9
Sales of water heating units - Other (%)	1.03	0.978	0.967	0.931	0.876	0.845	0.834
Sales of cooking units - Electric Resistance (%)	44.8	49.3	53.1	63	76.9	85.5	88.5
Sales of cooking units - Gas (%)	55.2	50.7	46.9	37	23.1	14.5	11.5
Commercial HVAC investment in 2020s - Cumulative 5-yr (million \$2018)		15,866	17,291				

Table 56: E-B+ scenario - PILLAR 2: Clean Electricity - Generating capacity

Item	2020	2025	2030	2035	2040	2045	2050
Installed thermal - Coal (MW)	3,581	1,536	0	0	0	0	0
Installed thermal - Natural gas (MW)	6,020	6,010	6,542	6,489	5,464	10,651	10,502
Installed thermal - Nuclear (MW)	1,871	1,871	1,871	593	0	0	0
Capital invested - Biomass power plant (billion \$2018)	0	0.046	0.387	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 57: E-B+ scenario - PILLAR 2: Clean Electricity - Generation

Item	2020	2025	2030	2035	2040	2045	2050
Biomass power plant (GWh)	0	88.1	849	849	849	849	849
Biomass w/ccu power plant (GWh)	0	0	0	0	0	0	0
Biomass w/ccu allam power plant (GWh)	0	0	0	0	0	0	0

Table 58: E-B+ scenario - PILLAR 3: Clean fuels - Bioenergy

Item	2020	2025	2030	2035	2040	2045	2050
Number of facilities - Power (quantity)	0	1	1	1	1	1	1
Number of facilities - Power ccu (quantity)	0	0	0	0	0	0	0
Number of facilities - Allam power w ccu (quantity)	0	0	0	0	0	0	0
Number of facilities - Beccs hydrogen (quantity)	0	0	0	9	30	42	42
Number of facilities - Diesel (quantity)	0	0	0	1	1	1	1
Number of facilities - Diesel ccu (quantity)	0	0	0	0	0	0	0
Number of facilities - Pyrolysis (quantity)	0	0	0	1	1	1	47
Number of facilities - Pyrolysis ccu (quantity)	0	0	0	0	0	0	18
Number of facilities - Sng (quantity)	0	1	1	1	1	1	1
Number of facilities - Sng ccu (quantity)	0	0	0	0	0	0	0
Conversion capital investment - Cumulative 5-yr (million \$2018)		50.2	432	8,095	15,433	9,966	67,223
Biomass purchases (million \$2018/y)		31.8	191	951	2,401	3,337	8,444

Table 59: E-B+ scenario - PILLAR 4: CCUS - CO2 capture

Item	2020	2025	2030	2035	2040	2045	2050
Annual - All (MMT)		0	0	10.4	30.2	43	55.1
Annual - BECCS (MMT)		0	0	10.4	30.2	43	55.1
Annual - NGCC (MMT)		0	0	0	0	0	0
Annual - Cement and lime (MMT)		0	0	0	0	0	0
Cumulative - All (MMT)		0	0	10.4	40.6	83.6	139
Cumulative - BECCS (MMT)		0	0	10.4	40.6	83.6	139
Cumulative - NGCC (MMT)		0	0	0	0	0	0
Cumulative - Cement and lime (MMT)		0	0	0	0	0	0

Table 60: E-B+ scenario - PILLAR 4: CCUS - CO2 pipelines

Item	2020	2025	2030	2035	2040	2045	2050
Trunk (km)		0	0	88.1	88.1	88.1	88.1
Spur (km)		0	0	297	999	1,194	1,701
All (km)		0	0	385	1,087	1,282	1,789
Cumulative investment - Trunk (million \$2018)		0	0	464	464	464	464
Cumulative investment - Spur (million \$2018)		0	0	250	759	1,452	1,848
Cumulative investment - All (million \$2018)		0	0	715	1,223	1,916	2,313

Table 61: E-B+ scenario - PILLAR 4: CCUS - CO2 storage

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

Table 62: E-B+ scenario - PILLAR 6: Land sinks - Forests

Item	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - Low - Accelerate regeneration (1000 tCO2e/y)							-240
Carbon sink potential - Low - Avoid deforestation (1000 tCO2e/y)							-312
Carbon sink potential - Low - Extend rotation length (1000 tCO2e/y)							-3,267
Carbon sink potential - Low - Improve plantations (1000 tCO2e/y)							-404
Carbon sink potential - Low - Increase retention of HWP (1000 tCO2e/y)							-1,556
Carbon sink potential - Low - Increase trees outside forests (1000 tCO2e/y)							-1,054
Carbon sink potential - Low - Reforest cropland (1000 tCO2e/y)							-4,034
Carbon sink potential - Low - Reforest pasture (1000 tCO2e/y)							-630
Carbon sink potential - Low - Restore productivity (1000 tCO2e/y)							-1,455
Carbon sink potential - Low - All (not counting overlap) (1000 tCO2e/y)							-12,952
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO2e/y)							-359
Carbon sink potential - Mid - Avoid deforestation (1000 tCO2e/y)							-1,091
Carbon sink potential - Mid - Extend rotation length (1000 tCO2e/y)							-5,887
Carbon sink potential - Mid - Improve plantations (1000 tCO2e/y)							-591
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO2e/y)							-3,112
Carbon sink potential - Mid - Increase trees outside forests (1000 tCO2e/y)							-2,033
Carbon sink potential - Mid - Reforest cropland (1000 tCO2e/y)							-6,052
Carbon sink potential - Mid - Reforest pasture (1000 tCO2e/y)							-4,472
Carbon sink potential - Mid - Restore productivity (1000 tCO2e/y)							-2,887
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO2e/y)							-26,484
Carbon sink potential - High - Accelerate regeneration (1000 tCO2e/y)							-479
Carbon sink potential - High - Avoid deforestation (1000 tCO2e/y)							-1,871
Carbon sink potential - High - Extend rotation length (1000 tCO2e/y)							-8,507
Carbon sink potential - High - Improve plantations (1000 tCO2e/y)							-793
Carbon sink potential - High - Increase retention of HWP (1000 tCO2e/y)							-4,667
Carbon sink potential - High - Increase trees outside forests (1000 tCO2e/y)							-3,012
Carbon sink potential - High - Reforest cropland (1000 tCO2e/y)							-8,069
Carbon sink potential - High - Reforest pasture (1000 tCO2e/y)							-8,313
Carbon sink potential - High - All (not counting overlap) (1000 tCO2e/y)							-40,029
Carbon sink potential - High - Restore productivity (1000 tCO2e/y)							-4,318

Table 62: E-B+ scenario - PILLAR 6: Land sinks - Forests (continued)

Item	2020	2025	2030	2035	2040	2045	2050
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)							39.1
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)							238
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)							1,662
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)							146
Land impacted for carbon sink potential - Low - Increase retention of HWP (1000 hectares)							0
Land impacted for carbon sink potential - Low - Increase trees outside forests (1000 hectares)							151
Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares)							267
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)							40.9
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)							866
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)							3,409
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)							58.7
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)							246
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)							3,000
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)							220
Land impacted for carbon sink potential - Mid - Increase retention of HWP (1000 hectares)							0
Land impacted for carbon sink potential - Mid - Increase trees outside forests (1000 hectares)							218
Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares)							400
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)							296
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)							1,744
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)							6,183
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)							78.3
Land impacted for carbon sink potential - High - Avoid deforestation (over 30 years) (1000 hectares)							253

Table 62: E-B+ scenario - PILLAR 6: Land sinks - Forests (continued)

Item	2020	2025	2030	2035	2040	2045	2050
Land impacted for carbon sink potential - High - Extend rotation length (1000 hectares)							4,338
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)							292
Land impacted for carbon sink potential - High - Increase retention of HWP (1000 hectares)							0
Land impacted for carbon sink potential - High - Increase trees outside forests (1000 hectares)							286
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)							533
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)							236
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)							1,431
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)							7,449

Table 63: E-B+ scenario - PILLAR 6: Land sinks - Agriculture

Item	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - Moderate deployment - Corn-ethanol to energy grasses (1000 tCO ₂ e/y)							-2,914
Carbon sink potential - Moderate deployment - Cropland measures (1000 tCO ₂ e/y)							-6,825
Carbon sink potential - Moderate deployment - Permanent conservation cover (1000 tCO ₂ e/y)							-193
Carbon sink potential - Moderate deployment - Cropland to woody energy crops (1000 tCO ₂ e/y)							0
Carbon sink potential - Moderate deployment - Pasture to energy crops (1000 tCO ₂ e/y)							0
Carbon sink potential - Moderate deployment - Total (1000 tCO ₂ e/y)							-9,932
Carbon sink potential - Aggressive deployment - Corn-ethanol to energy grasses (1000 tCO ₂ e/y)							-2,914
Carbon sink potential - Aggressive deployment - Cropland measures (1000 tCO ₂ e/y)							-12,952
Carbon sink potential - Aggressive deployment - Permanent conservation cover (1000 tCO ₂ e/y)							-386
Carbon sink potential - Aggressive deployment - Cropland to woody energy crops (1000 tCO ₂ e/y)							0
Carbon sink potential - Aggressive deployment - Pasture to energy crops (1000 tCO ₂ e/y)							0
Carbon sink potential - Aggressive deployment - Total (1000 tCO ₂ e/y)							-16,252

Table 63: *E-B+ scenario - PILLAR 6: Land sinks - Agriculture (continued)*

Item	2020	2025	2030	2035	2040	2045	2050
Land impacted for carbon sink - Moderate deployment - Corn-ethanol to energy grasses (1000 hectares)							1,589
Land impacted for carbon sink - Moderate deployment - Cropland measures (1000 hectares)							3,433
Land impacted for carbon sink - Moderate deployment - Permanent conservation cover (1000 hectares)							351
Land impacted for carbon sink - Moderate deployment - Cropland to woody energy crops (1000 hectares)							29.2
Land impacted for carbon sink - Moderate deployment - Pasture to energy crops (1000 hectares)							137
Land impacted for carbon sink - Moderate deployment - Total (1000 hectares)							5,538
Land impacted for carbon sink - Aggressive deployment - Corn-ethanol to energy grasses (1000 hectares)							1,589
Land impacted for carbon sink - Aggressive deployment - Cropland measures (1000 hectares)							16,087
Land impacted for carbon sink - Aggressive deployment - Permanent conservation cover (1000 hectares)							702
Land impacted for carbon sink - Aggressive deployment - Cropland to woody energy crops (1000 hectares)							29.2
Land impacted for carbon sink - Aggressive deployment - Pasture to energy crops (1000 hectares)							137
Land impacted for carbon sink - Aggressive deployment - Total (1000 hectares)							18,543

Table 64: *REF scenario - IMPACTS - Health*

Item	2020	2025	2030	2035	2040	2045	2050
Premature deaths from air pollution - Fuel Comb - Electric Generation - Coal (deaths)		89.5	50	30.2	24.2	21.4	20.8
Premature deaths from air pollution - Fuel Comb - Electric Generation - Natural Gas (deaths)		15.8	17.4	20.2	12.7	9.99	8.79
Premature deaths from air pollution - Mobile - On-Road (deaths)		174	181	189	198	207	216
Premature deaths from air pollution - Gas Stations (deaths)		11.1	11.5	11.9	12.3	12.8	13.2
Premature deaths from air pollution - Fuel Comb - Residential - Natural Gas (deaths)		36.1	34.3	32.7	31.8	31.6	31.4
Premature deaths from air pollution - Fuel Comb - Residential - Oil (deaths)		1.68	1.49	1.11	0.691	0.324	0.108
Premature deaths from air pollution - Fuel Comb - Residential - Other (deaths)		4.28	4.46	4.72	4.94	4.94	4.87
Premature deaths from air pollution - Fuel Comb - Comm/Institutional - Coal (deaths)		3.33	3.4	3.44	3.48	3.5	3.51

Table 64: REF scenario - IMPACTS - Health (continued)

Item	2020	2025	2030	2035	2040	2045	2050
Premature deaths from air pollution - Fuel Comb - Comm/Institutional - Natural Gas (deaths)		8.78	8.7	8.12	7.38	6.95	6.9
Premature deaths from air pollution - Fuel Comb - Comm/Institutional - Oil (deaths)		3.41	3.28	3.09	2.87	2.73	2.67
Premature deaths from air pollution - Fuel Comb - Comm/Institutional - Other (deaths)		1.13	1.17	1.22	1.25	1.29	1.33
Premature deaths from air pollution - Industrial Processes - Coal Mining (deaths)		1.46	0.959	0.738	0.69	0.655	0.603
Premature deaths from air pollution - Industrial Processes - Oil & Gas Production (deaths)		48.8	51.5	52.9	50.9	50.8	47.5
Monetary damages from air pollution - Fuel Comb - Electric Generation - Coal (million \$2019)		793	444	267	215	190	184
Monetary damages from air pollution - Fuel Comb - Electric Generation - Natural Gas (million \$2019)		140	154	179	112	88.5	77.9
Monetary damages from air pollution - Mobile - On-Road (million \$2019)		1,543	1,609	1,680	1,760	1,841	1,924
Monetary damages from air pollution - Gas Stations (million \$2019)		98.6	102	105	109	113	116
Monetary damages from air pollution - Fuel Comb - Residential - Natural Gas (million \$2019)		320	304	290	282	280	279
Monetary damages from air pollution - Fuel Comb - Residential - Oil (million \$2019)		14.9	13.2	9.82	6.12	2.87	0.958
Monetary damages from air pollution - Fuel Comb - Residential - Other (million \$2019)		37.9	39.5	41.8	43.8	43.8	43.1
Monetary damages from air pollution - Fuel Comb - Comm/Institutional - Coal (million \$2019)		29.5	30.1	30.5	30.8	31	31.1
Monetary damages from air pollution - Fuel Comb - Comm/Institutional - Natural Gas (million \$2019)		77.7	77	71.9	65.4	61.5	61.1
Monetary damages from air pollution - Fuel Comb - Comm/Institutional - Oil (million \$2019)		30.1	29	27.4	25.4	24.2	23.7
Monetary damages from air pollution - Fuel Comb - Comm/Institutional - Other (million \$2019)		10	10.4	10.8	11.1	11.4	11.8
Monetary damages from air pollution - Industrial Processes - Coal Mining (million \$2019)		12.9	8.46	6.52	6.09	5.78	5.32
Monetary damages from air pollution - Industrial Processes - Oil & Gas Production (million \$2019)		433	457	470	452	451	422

Table 65: REF scenario - IMPACTS - Jobs

Item	2020	2025	2030	2035	2040	2045	2050
By economic sector - Agriculture (jobs)		2,181	2,164	2,162	2,134	2,134	2,144
By economic sector - Construction (jobs)		6,489	6,811	7,692	8,631	8,871	9,451
By economic sector - Manufacturing (jobs)		3,279	3,348	3,472	3,686	3,545	3,556
By economic sector - Mining (jobs)		2,159	1,760	1,454	1,194	1,015	840

Table 65: REF scenario - IMPACTS - Jobs (continued)

Item	2020	2025	2030	2035	2040	2045	2050
By economic sector - Other (jobs)		386	466	573	707	775	948
By economic sector - Pipeline (jobs)		497	518	526	500	507	505
By economic sector - Professional (jobs)		4,127	4,167	4,597	5,290	5,600	6,070
By economic sector - Trade (jobs)		3,303	3,146	3,243	3,528	3,648	3,906
By economic sector - Utilities (jobs)		8,238	7,936	8,657	9,329	9,314	9,549
By resource sector - Biomass (jobs)		5,363	5,191	5,030	4,863	4,780	4,702
By resource sector - CO2 (jobs)		0	0	0	0	0	0
By resource sector - Coal (jobs)		888	441	347	330	315	121
By resource sector - Grid (jobs)		10,855	10,031	11,748	13,365	13,404	13,648
By resource sector - Natural Gas (jobs)		4,471	4,984	4,997	4,835	4,710	5,302
By resource sector - Nuclear (jobs)		944	929	777	571	562	326
By resource sector - Oil (jobs)		4,829	4,229	3,787	3,541	3,382	3,274
By resource sector - Solar (jobs)			624	872	968	1,031	1,665
By resource sector - Wind (jobs)		3,310	3,886	4,820	6,525	7,226	7,931
By education level - All sectors - High school diploma or less (jobs)		13,651	13,524	14,398	15,438	15,559	16,163
By education level - All sectors - Associates degree or some college (jobs)		8,974	8,929	9,665	10,567	10,720	11,274
By education level - All sectors - Bachelors degree (jobs)		6,254	6,112	6,454	6,964	7,055	7,354
By education level - All sectors - Masters or professional degree (jobs)		1,560	1,530	1,626	1,769	1,807	1,895
By education level - All sectors - Doctoral degree (jobs)		222	220	234	259	268	284
Related work experience - All sectors - None (jobs)		4,590	4,540	4,845	5,220	5,275	5,510
Related work experience - All sectors - Up to 1 year (jobs)		6,678	6,628	7,035	7,544	7,619	7,916
Related work experience - All sectors - 1 to 4 years (jobs)		10,779	10,627	11,358	12,299	12,449	13,010
Related work experience - All sectors - 4 to 10 years (jobs)		6,815	6,744	7,240	7,877	7,985	8,366
Related work experience - All sectors - Over 10 years (jobs)		1,798	1,776	1,898	2,057	2,080	2,168
On-the-Job Training - All sectors - None (jobs)		1,689	1,663	1,757	1,888	1,910	1,990
On-the-Job Training - All sectors - Up to 1 year (jobs)		20,800	20,498	21,764	23,417	23,656	24,623
On-the-Job Training - All sectors - 1 to 4 years (jobs)		5,999	5,970	6,465	7,062	7,163	7,524
On-the-Job Training - All sectors - 4 to 10 years (jobs)		1,907	1,916	2,103	2,319	2,366	2,505
On-the-Job Training - All sectors - Over 10 years (jobs)		266	268	287	311	314	328
On-Site or In-Plant Training - All sectors - None (jobs)		4,857	4,810	5,130	5,554	5,626	5,886
On-Site or In-Plant Training - All sectors - Up to 1 year (jobs)		18,835	18,565	19,729	21,235	21,452	22,330
On-Site or In-Plant Training - All sectors - 1 to 4 years (jobs)		4,720	4,690	5,065	5,519	5,592	5,863
On-Site or In-Plant Training - All sectors - 4 to 10 years (jobs)		1,987	1,988	2,167	2,378	2,422	2,556
On-Site or In-Plant Training - All sectors - Over 10 years (jobs)		261	261	285	312	317	335
Wage income - All (million \$2019)		1,844	1,843	1,999	2,194	2,253	2,386

Table 66: REF scenario - PILLAR 1: Efficiency/Electrification - Overview

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Transportation (PJ)	552	526	489	468	472	488	508

Table 66: REF scenario - PILLAR 1: Efficiency/Electrification - Overview (continued)

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Residential (PJ)	296	281	273	268	265	264	263
Final energy use - Commercial (PJ)	221	221	221	218	216	217	223
Final energy use - Industry (PJ)	391	416	428	441	457	472	491

Table 67: 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)		3.78	3.89	5.19	5.44	4.77	4.91

Table 68: REF scenario - PILLAR 1: Efficiency/Electrification - Residential

Item	2020	2025	2030	2035	2040	2045	2050
Sales of space heating units - Electric Heat Pump (%)	2.72	9.25	9.56	10	10.4	10.8	11.4
Sales of space heating units - Electric Resistance (%)	9.92	13.6	13.4	13.3	13.2	12.7	12.4
Sales of space heating units - Gas (%)	78.2	62.1	62.9	63.2	63.2	63.4	63.2
Sales of space heating units - Fossil (%)	9.2	15	14.2	13.5	13.2	13	13.1
Sales of water heating units - Electric Heat Pump (%)	0	0	0	0	0	0	0
Sales of water heating units - Electric Resistance (%)	20.7	34.9	34.8	34.8	34.8	34.8	34.7
Sales of water heating units - Gas Furnace (%)	79.2	65.1	65.2	65.2	65.2	65.2	65.2
Sales of water heating units - Other (%)	0.018	0.021	0.021	0.021	0.021	0.021	0.021
Sales of cooking units - Electric Resistance (%)	58.3	58.3	58.3	58.3	58.3	58.3	58.3
Sales of cooking units - Gas (%)	41.7	41.7	41.7	41.7	41.7	41.7	41.7
Residential HVAC investment in 2020s vs. REF - Cumulative 5-yr (billion \$2018)		4.02	4.15				

Table 69: REF scenario - PILLAR 1: Efficiency/Electrification - Commercial

Item	2020	2025	2030	2035	2040	2045	2050
Sales of space heating units - Electric Heat Pump (%)	1.8	12.1	41.6	67.7	72.9	73.7	73.7
Sales of space heating units - Electric Resistance (%)	3.09	6.45	11.5	19.7	24.9	25.8	25.8
Sales of space heating units - Gas (%)	90.3	79.1	45.1	11.8	1.99	0.575	0.459
Sales of space heating units - Fossil (%)	4.77	2.37	1.87	0.846	0.129	0.011	0
Sales of water heating units - Electric Heat Pump (%)	0.491	0.81	0.809	0.808	0.806	0.803	0.802
Sales of water heating units - Electric Resistance (%)	4.33	6.94	6.97	6.94	6.93	6.95	6.95
Sales of water heating units - Gas (%)	94.1	91.3	91.2	91.3	91.3	91.3	91.3
Sales of water heating units - Other (%)	1.03	0.982	0.983	0.981	0.978	0.982	0.983
Sales of cooking units - Electric Resistance (%)	44.8	47.8	47.9	47.8	47.9	47.9	48
Sales of cooking units - Gas (%)	55.2	52.2	52.1	52.2	52.1	52.1	52
Commercial HVAC investment in 2020s - Cumulative 5-yr (million \$2018)		15,688	16,188				

Table 70: REF scenario - PILLAR 2: Clean Electricity - Generating capacity

Item	2020	2025	2030	2035	2040	2045	2050
Installed thermal - Coal (MW)	3,581	1,544	978	978	978	978	0
Installed thermal - Natural gas (MW)	5,620	7,166	9,297	9,737	7,486	8,392	9,400
Installed thermal - Nuclear (MW)	1,871	1,871	1,871	1,186	1,186	1,186	0
Installed renewables - Rooftop PV (MW)	114	204	260	347	460	594	751

Table 70: REF scenario - PILLAR 2: Clean Electricity - Generating capacity (continued)

Item	2020	2025	2030	2035	2040	2045	2050
Installed renewables - Solar - Base land use assumptions (MW)	247	247	247	247	247	247	247
Installed renewables - Wind - Base land use assumptions (MW)	4,989	4,989	4,989	8,359	14,267	18,042	19,083
Installed renewables - Solar - Constrained land use assumptions (MW)	19.6	19.6	19.6	19.6	19.6	19.6	19.6

Table 71: REF scenario - PILLAR 2: Clean Electricity - Generation

Item	2020	2025	2030	2035	2040	2045	2050
Solar - Base land use assumptions (GWh)	558	558	558	558	558	558	558
Wind - Base land use assumptions (GWh)	20,531	20,531	20,531	32,719	53,898	67,170	70,930
OffshoreWind - Base land use assumptions (GWh)	0	0	0	0	0	0	0

Table 72: REF scenario - PILLAR 6: Land sinks - Forests - REF only

Item	2020	2025	2030	2035	2040	2045	2050
Business-as-usual carbon sink - Natural uptake (Mt CO2e/y)	-33.3		-15.2				-13.5
Business-as-usual carbon sink - Retained in Hardwood Products (Mt CO2e/y)	-1.27		-2.28				-2.37
Business-as-usual carbon sink - Total (Mt CO2e/y)	-34.5		-17.4				-15.9

Table 73: REF scenario - PILLAR 6: Land sinks - Forests

Item	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - Low - Accelerate regeneration (1000 tCO2e/y)							-240
Carbon sink potential - Low - Avoid deforestation (1000 tCO2e/y)							-312
Carbon sink potential - Low - Extend rotation length (1000 tCO2e/y)							-3,267
Carbon sink potential - Low - Improve plantations (1000 tCO2e/y)							-404
Carbon sink potential - Low - Increase retention of HWP (1000 tCO2e/y)							-1,556
Carbon sink potential - Low - Increase trees outside forests (1000 tCO2e/y)							-1,054
Carbon sink potential - Low - Reforest cropland (1000 tCO2e/y)							-4,034
Carbon sink potential - Low - Reforest pasture (1000 tCO2e/y)							-630
Carbon sink potential - Low - Restore productivity (1000 tCO2e/y)							-1,455
Carbon sink potential - Low - All (not counting overlap) (1000 tCO2e/y)							-12,952
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO2e/y)							-359
Carbon sink potential - Mid - Avoid deforestation (1000 tCO2e/y)							-1,091
Carbon sink potential - Mid - Extend rotation length (1000 tCO2e/y)							-5,887
Carbon sink potential - Mid - Improve plantations (1000 tCO2e/y)							-591
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO2e/y)							-3,112
Carbon sink potential - Mid - Increase trees outside forests (1000 tCO2e/y)							-2,033

Table 73: REF scenario - PILLAR 6: Land sinks - Forests (continued)

Item	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - Mid - Reforest cropland (1000 tCO ₂ e/y)							-6,052
Carbon sink potential - Mid - Reforest pasture (1000 tCO ₂ e/y)							-4,472
Carbon sink potential - Mid - Restore productivity (1000 tCO ₂ e/y)							-2,887
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO ₂ e/y)							-26,484
Carbon sink potential - High - Accelerate regeneration (1000 tCO ₂ e/y)							-479
Carbon sink potential - High - Avoid deforestation (1000 tCO ₂ e/y)							-1,871
Carbon sink potential - High - Extend rotation length (1000 tCO ₂ e/y)							-8,507
Carbon sink potential - High - Improve plantations (1000 tCO ₂ e/y)							-793
Carbon sink potential - High - Increase retention of HWP (1000 tCO ₂ e/y)							-4,667
Carbon sink potential - High - Increase trees outside forests (1000 tCO ₂ e/y)							-3,012
Carbon sink potential - High - Reforest cropland (1000 tCO ₂ e/y)							-8,069
Carbon sink potential - High - Reforest pasture (1000 tCO ₂ e/y)							-8,313
Carbon sink potential - High - All (not counting overlap) (1000 tCO ₂ e/y)							-40,029
Carbon sink potential - High - Restore productivity (1000 tCO ₂ e/y)							-4,318
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)							39.1
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)							238
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)							1,662
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)							146
Land impacted for carbon sink potential - Low - Increase retention of HWP (1000 hectares)							0
Land impacted for carbon sink potential - Low - Increase trees outside forests (1000 hectares)							151
Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares)							267
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)							40.9
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)							866
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)							3,409
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)							58.7

Table 73: REF scenario - PILLAR 6: Land sinks - Forests (continued)

Item	2020	2025	2030	2035	2040	2045	2050
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)							246
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)							3,000
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)							220
Land impacted for carbon sink potential - Mid - Increase retention of HWP (1000 hectares)							0
Land impacted for carbon sink potential - Mid - Increase trees outside forests (1000 hectares)							218
Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares)							400
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)							296
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)							1,744
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)							6,183
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)							78.3
Land impacted for carbon sink potential - High - Avoid deforestation (over 30 years) (1000 hectares)							253
Land impacted for carbon sink potential - High - Extend rotation length (1000 hectares)							4,338
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)							292
Land impacted for carbon sink potential - High - Increase retention of HWP (1000 hectares)							0
Land impacted for carbon sink potential - High - Increase trees outside forests (1000 hectares)							286
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)							533
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)							236
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)							1,431
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)							7,449