Net-Zero America - Michigan 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)		115	0.107	0.105	0.09	0.062	0.005
Premature deaths from air pollution - Fuel Comb - Electric Generation - Natural Gas (deaths)		32.4	24.8	16.3	14.8	7.91	3.33
Premature deaths from air pollution - Mobile - On-Road (deaths)		300	278	210	121	55.5	22.4
Premature deaths from air pollution - Gas Stations (deaths)		26.2	23.9	17.9	10.4	4.88	2.12
Premature deaths from air pollution - Fuel Comb - Residential - Natural Gas (deaths)		78.4	69.2	50.6	29.8	14.3	4.88
Premature deaths from air pollution - Fuel Comb - Residential - Oil (deaths)		3.85	3.16	2.18	1.27	0.525	0.164
Premature deaths from air pollution - Fuel Comb - Residential - Other (deaths)		9.99	9.78	8.05	5.53	2.99	1.26
Premature deaths from air pollution - Fuel Comb - Comm/Institutional - Coal (deaths)		5.87	5.62	5.34	5.04	4.73	4.41
Premature deaths from air pollution - Fuel Comb - Comm/Institutional - Natural Gas (deaths)		53.5	48.5	37.8	24.4	13.4	5.97
Premature deaths from air pollution - Fuel Comb - Comm/Institutional - Oil (deaths)		4.24	3.51	2.69	1.9	1.27	0.802
Premature deaths from air pollution - Fuel Comb - Comm/Institutional - Other (deaths)		3.76	3.14	2.54	1.97	1.44	0.937
Premature deaths from air pollution - Industrial Processes - Coal Mining (deaths)		1.06	0.38	0.372	0.36	0.358	0.352
Premature deaths from air pollution - Industrial Processes - Oil & Gas Production (deaths)		89	83.3	75.3	58.5	43.2	26.6
Monetary damages from air pollution - Fuel Comb - Electric Generation - Coal (million $2019)		1,018	0.945	0.929	0.796	0.545	0.041
Monetary damages from air pollution - Fuel Comb - Electric Generation - Natural Gas (million $2019)		287	220	144	131	70.1	29.5
Monetary damages from air pollution - Mobile - On-Road (million $2019)		2,671	2,473	1,869	1,078	494	199
Monetary damages from air pollution - Gas Stations (million $2019)		232	212	158	92.2	43.2	18.7
Monetary damages from air pollution - Fuel Comb - Residential - Natural Gas (million $2019)		694	613	449	264	127	43.2
Monetary damages from air pollution - Fuel Comb - Residential - Oil (million $2019)		34.1	28	19.3	11.2	4.66	1.45
Monetary damages from air pollution - Fuel Comb - Residential - Other (million $2019)		88.5	86.6	71.4	49	26.5	11.1
Monetary damages from air pollution - Fuel Comb - Comm/Institutional - Coal (million $2019)		52	49.8	47.3	44.6	41.9	39
Monetary damages from air pollution - Fuel Comb - Comm/Institutional - Natural Gas (million $2019)		474	430	335	216	119	52.9

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)		37.6	31	23.8	16.8	11.2	7.1
Monetary damages from air pollution - Fuel Comb - Comm/Institutional - Other (million $2019)		33.3	27.8	22.5	17.5	12.7	8.29
Monetary damages from air pollution - Industrial Processes - Coal Mining (million $2019)		9.37	3.36	3.28	3.17	3.16	3.11
Monetary damages from air pollution - Industrial Processes - Oil & Gas Production (million $2019)		791	740	669	519	383	237

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

Item	2020	2025	2030	2035	2040	2045	2050
By economic sector - Agriculture (jobs)		775	973	712	420	131	1,044
By economic sector - Construction (jobs)		8,144	9,840	13,819	15,537	15,742	17,879
By economic sector - Manufacturing (jobs)		5,250	5,762	6,727	6,615	5,246	6,546
By economic sector - Mining (jobs)		4,478	3,235	2,220	1,394	828	473
By economic sector - Other (jobs)		434	582	1,383	1,494	1,960	2,162
By economic sector - Pipeline (jobs)		908	962	630	487	340	381
By economic sector - Professional (jobs)		4,949	5,538	7,568	8,942	9,660	12,673
By economic sector - Trade (jobs)		3,861	3,788	4,807	5,244	5,660	6,815
By economic sector - Utilities (jobs)		10,967	11,588	14,535	18,274	16,168	18,870
By resource sector - Biomass (jobs)		2,189	2,402	1,676	1,059	505	4,552
By resource sector - CO2 (jobs)		0	1,568	160	270	348	1,462
By resource sector - Coal (jobs)		1,528	195	0	0	0	0
By resource sector - Grid (jobs)		10,416	12,985	20,915	27,497	25,252	30,297
By resource sector - Natural Gas (jobs)		9,760	7,781	6,815	7,236	4,509	3,508
By resource sector - Nuclear (jobs)		2,009	1,739	1,712	1,685	1,659	1,633
By resource sector - Oil (jobs)		8,747	7,126	5,367	3,718	2,557	1,677
By resource sector - Solar (jobs)		942	1,248	5,493	4,082	6,440	5,738
By resource sector - Wind (jobs)		4,177	7,226	10,262	12,859	14,467	17,975
By education level - All sectors - High school diploma or less (jobs)		16,506	17,781	22,018	24,232	22,851	27,509
By education level - All sectors - Associates degree or some college (jobs)		12,137	13,056	16,524	18,744	17,956	21,267
By education level - All sectors - Bachelors degree (jobs)		8,706	8,934	10,788	11,976	11,521	13,889
By education level - All sectors - Masters or professional degree (jobs)		2,120	2,189	2,684	3,021	2,961	3,616
By education level - All sectors - Doctoral degree (jobs)		297	309	387	433	447	562
Related work experience - All sectors - None (jobs)		5,738	6,131	7,597	8,470	8,043	9,671
Related work experience - All sectors - Up to 1 year (jobs)		7,772	8,378	10,454	11,442	10,901	13,278
Related work experience - All sectors - 1 to 4 years (jobs)		14,444	15,259	18,845	21,067	20,135	24,091
Related work experience - All sectors - 4 to 10 years (jobs)		9,314	9,872	12,264	13,808	13,222	15,722
Related work experience - All sectors - Over 10 years (jobs)		2,499	2,630	3,241	3,619	3,436	4,080
On-the-Job Training - All sectors - None (jobs)		2,169	2,268	2,808	3,079	2,985	3,585
On-the-Job Training - All sectors - Up to 1 year (jobs)		26,471	27,986	34,396	38,049	36,180	43,766

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)		8,216	8,827	11,107	12,595	12,040	14,185
On-the-Job Training - All sectors - 4 to 10 years (jobs)		2,543	2,792	3,597	4,147	4,019	4,704
On-the-Job Training - All sectors - Over 10 years (jobs)		369	396	493	536	514	601
On-Site or In-Plant Training - All sectors - None (jobs)		6,385	6,787	8,425	9,361	9,023	10,880
On-Site or In-Plant Training - All sectors - Up to 1 year (jobs)		24,007	25,385	31,251	34,614	32,900	39,681
On-Site or In-Plant Training - All sectors - 1 to 4 years (jobs)		6,382	6,847	8,596	9,704	9,261	10,935
On-Site or In-Plant Training - All sectors - 4 to 10 years (jobs)		2,662	2,888	3,666	4,195	4,047	4,745
On-Site or In-Plant Training - All sectors - Over 10 years (jobs)		331	363	463	531	506	600
Wage income - All (million $2019)		2,283	2,435	3,030	3,441	3,319	4,019

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

Item	2020	2025	2030	2035	2040	2045	2050
Oil consumption - Annual (million bbls)		161	139	108	79	56.3	40.2
Oil consumption - Cumulative (million bbls)							3,351
Oil production - Annual (million bbls)		7.01	7.03	7.02	5.56	4.52	3.01
Natural gas consumption - Annual (tcf)		747	630	505	380	239	166
Natural gas consumption - Cumulative (tcf)							15,217
Natural gas production - Annual (tcf)		108	102	88.6	74.9	59.4	46.2

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

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Transportation (PJ)	808	750	656	541	437	372	341
Final energy use - Residential (PJ)	562	524	489	423	347	286	245
Final energy use - Commercial (PJ)	316	311	299	277	251	231	220
Final energy use - Industry (PJ)	501	510	519	515	526	536	540

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)		5.19	5.33	9.38	9.99	8.85	9.24

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	724	1,409	3,808	6,207	8,123	10,040
Vehicle stocks - LDV – All others (1000 units)	8,372	7,972	7,571	5,518	3,464	1,960	456
Light-duty vehicle capital costs vs. REF - Cumulative 5-yr (million $2018)		1,610	4,124	6,688	10,128	11,025	10,511
Public EV charging plugs - DC Fast (1000 units)	0.242		2.84		12.5		20.2
Public EV charging plugs - L2 (1000 units)	0.857		68.2		300		486

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 (%)	2.17	6.93	32.9	84	93.6	94.2	94.2
Sales of space heating units - Electric Resistance (%)	5.77	9.31	7.39	3.21	2.39	2.33	2.44
Sales of space heating units - Gas (%)	85.1	70.8	50	8.51	0.73	0.191	0.189
Sales of space heating units - Fossil (%)	6.93	12.9	9.76	4.29	3.31	3.24	3.18
Sales of water heating units - Electric Heat Pump (%)	0	0.892	12.3	37.3	42	42.4	42.4
Sales of water heating units - Electric Resistance (%)	13.3	25.8	34.3	53.6	57.3	57.5	57.5
Sales of water heating units - Gas Furnace (%)	86.7	73.2	53.3	9.02	0.593	0.008	0
Sales of water heating units - Other (%)	0.036	0.089	0.089	0.089	0.088	0.088	0.089
Sales of cooking units - Electric Resistance (%)	35.7	49.4	91.3	99.6	100	100	100
Sales of cooking units - Gas (%)	64.3	50.6	8.66	0.436	0	0	0
Residential HVAC investment in 2020s vs. REF - Cumulative 5-yr (billion $2018)		7.71	9.81				

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 (%)	0.384	6.16	30.1	79.2	88.5	89.1	89.1
Sales of space heating units - Electric Resistance (%)	1.64	3.48	5.48	9.74	10.5	10.6	10.6
Sales of space heating units - Gas (%)	95.4	88	64	11.1	1.06	0.368	0.359
Sales of space heating units - Fossil (%)	2.54	2.36	0.454	0.019	0	0	0
Sales of water heating units - Electric Heat Pump (%)	0.161	1.36	14.4	43	48.4	48.8	48.8
Sales of water heating units - Electric Resistance (%)	1.64	4.19	17	45.3	50.6	51	51
Sales of water heating units - Gas (%)	98.1	94.3	68.5	11.6	0.763	0.01	0
Sales of water heating units - Other (%)	0.093	0.184	0.185	0.186	0.185	0.186	0.186
Sales of cooking units - Electric Resistance (%)	41	54.2	82.9	88.6	88.9	88.9	88.9
Sales of cooking units - Gas (%)	59	45.8	17.1	11.4	11.1	11.1	11.1
Commercial HVAC investment in 2020s - Cumulative 5-yr (million $2018)		29,341	32,040				

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

Item	2020	2025	2030	2035	2040	2045	2050
Installed thermal - Coal (MW)	8,466	1,466	0	0	0	0	0
Installed thermal - Natural gas (MW)	7,052	11,221	12,546	14,510	19,696	17,345	16,712
Installed thermal - Nuclear (MW)	4,314	3,502	3,502	3,502	3,502	3,502	3,502
Installed renewables - Rooftop PV (MW)	79.1	119	158	208	269	339	419
Installed renewables - Solar - Base land use assumptions (MW)	76.9	76.9	183	3,593	4,957	8,685	10,405
Installed renewables - Wind - Base land use assumptions (MW)	2,232	2,562	10,468	17,038	25,452	26,285	27,329
Installed renewables - Solar - Constrained land use assumptions (MW)	76.9	76.9	894	1,806	4,938	8,676	12,797
Installed renewables - Wind - Constrained land use assumptions (MW)	2,562	2,562	9,565	11,360	11,512	11,770	12,060
Capital invested - Solar PV - Base (billion $2018)		0	0.127	3.76	1.42	3.66	1.59
Capital invested - Wind - Base (billion $2018)		0	10.5	8.15	9.94	0.935	1.1

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)		0.126	0.092	3.16	1.11	4.22	2.15
Capital invested - Wind - Constrained (billion $2018)		0	9.73	1.89	0.139	0.288	4.17
Capital invested - Biomass power plant (billion $2018)	0	0	0	0	0	0	0
Capital invested - Biomass w/ccu allam power plant (billion $2018)	0	0	0	0	0	0	0
Capital invested - Biomass w/ccu power plant (billion $2018)	0	0	0	0	0	0	0

Table 10: *E+ scenario - PILLAR 2: Clean Electricity - Generation*

Item	2020	2025	2030	2035	2040	2045	2050
Solar - Base land use assumptions (GWh)	155	155	336	6,145	8,467	14,755	17,683
Wind - Base land use assumptions (GWh)	9,704	9,704	35,628	56,685	83,224	86,111	89,686
OffshoreWind - Base land use assumptions (GWh)	0	0	0	0	0	0	0
Solar - Constrained land use assumptions (GWh)	155	155	1,549	3,097	8,431	14,731	21,695
Wind - Constrained land use assumptions (GWh)	9,704	9,704	32,156	38,030	38,556	39,428	40,354
OffshoreWind - Constrained land use assumptions (GWh)	0	0	0	0	0	0	0
Biomass power plant (GWh)	0	0	0	0	0	0	0
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	0	0	0	0	0	0
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	0	0	0	14
Number of facilities - Diesel (quantity)	0	0	0	0	0	0	0
Number of facilities - Diesel ccu (quantity)	0	0	0	0	0	0	0
Number of facilities - Pyrolysis (quantity)	0	0	0	0	0	0	2
Number of facilities - Pyrolysis ccu (quantity)	0	0	0	0	0	0	0
Number of facilities - Sng (quantity)	0	0	0	0	0	0	0
Number of facilities - Sng ccu (quantity)	0	0	0	0	0	0	0
Conversion capital investment - Cumulative 5-yr (million $2018)		0	0	0	0	0	15,722
Biomass purchases (million $2018/y)		0	0	0	0	0	999

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

Item	2020	2025	2030	2035	2040	2045	2050
Annual - All (MMT)		0	3.24	3.35	6.64	6.84	24.3
Annual - BECCS (MMT)		0	0	0	0	0	17.2
Annual - NGCC (MMT)		0	0	0	0	0	0
Annual - Cement and lime (MMT)		0	3.24	3.35	6.64	6.84	7.07
Cumulative - All (MMT)		0	3.24	6.59	13.2	20.1	44.4
Cumulative - BECCS (MMT)		0	0	0	0	0	17.2
Cumulative - NGCC (MMT)		0	0	0	0	0	0
Cumulative - Cement and lime (MMT)		0	3.24	6.59	13.2	20.1	27.1

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

Item	2020	2025	2030	2035	2040	2045	2050
Trunk (km)		0	437	437	437	437	437
Spur (km)		0	201	201	314	314	1,452
All (km)		0	638	638	751	751	1,890
Cumulative investment - Trunk (million $2018)		0	1,376	1,376	1,376	1,376	1,376
Cumulative investment - Spur (million $2018)		0	202	206	316	322	1,226
Cumulative investment - All (million $2018)		0	1,578	1,582	1,692	1,698	2,602

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)							-202
Carbon sink potential - Low - Avoid deforestation (1000 tCO2e/y)							-518
Carbon sink potential - Low - Extend rotation length (1000 tCO2e/y)							-4,236
Carbon sink potential - Low - Improve plantations (1000 tCO2e/y)							-615
Carbon sink potential - Low - Increase retention of HWP (1000 tCO2e/y)							-2,521
Carbon sink potential - Low - Increase trees outside forests (1000 tCO2e/y)							-529
Carbon sink potential - Low - Reforest cropland (1000 tCO2e/y)							-472
Carbon sink potential - Low - Reforest pasture (1000 tCO2e/y)							-361
Carbon sink potential - Low - Restore productivity (1000 tCO2e/y)							-1,529
Carbon sink potential - Low - All (not counting overlap) (1000 tCO2e/y)							-10,983
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO2e/y)							-303
Carbon sink potential - Mid - Avoid deforestation (1000 tCO2e/y)							-1,812
Carbon sink potential - Mid - Extend rotation length (1000 tCO2e/y)							-7,632
Carbon sink potential - Mid - Improve plantations (1000 tCO2e/y)							-901
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO2e/y)							-5,042
Carbon sink potential - Mid - Increase trees outside forests (1000 tCO2e/y)							-1,020
Carbon sink potential - Mid - Reforest cropland (1000 tCO2e/y)							-708

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 tCO2e/y)							-2,560
Carbon sink potential - Mid - Restore productivity (1000 tCO2e/y)							-3,033
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO2e/y)							-23,011
Carbon sink potential - High - Accelerate regeneration (1000 tCO2e/y)							-403
Carbon sink potential - High - Avoid deforestation (1000 tCO2e/y)							-3,106
Carbon sink potential - High - Extend rotation length (1000 tCO2e/y)							-11,028
Carbon sink potential - High - Improve plantations (1000 tCO2e/y)							-1,209
Carbon sink potential - High - Increase retention of HWP (1000 tCO2e/y)							-7,563
Carbon sink potential - High - Increase trees outside forests (1000 tCO2e/y)							-1,511
Carbon sink potential - High - Reforest cropland (1000 tCO2e/y)							-944
Carbon sink potential - High - Reforest pasture (1000 tCO2e/y)							-4,759
Carbon sink potential - High - All (not counting overlap) (1000 tCO2e/y)							-35,061
Carbon sink potential - High - Restore productivity (1000 tCO2e/y)							-4,537
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)							33
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)							395
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)							2,155
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)							223
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)							75.6
Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares)							31.2
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)							23.4
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)							910
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)							3,845
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)							49.5
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)							408

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)							3,889
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)							335
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)							110
Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares)							46.8
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)							169
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)							1,833
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)							6,840
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)							66
Land impacted for carbon sink potential - High - Avoid deforestation (over 30 years) (1000 hectares)							421
Land impacted for carbon sink potential - High - Extend rotation length (1000 hectares)							5,624
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)							445
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)							144
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)							62.4
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)							135
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)							1,504
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)							8,401

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 tCO2e/y)							-699
Carbon sink potential - Moderate deployment - Cropland measures (1000 tCO2e/y)							-2,176

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 tCO2e/y)							-74
Carbon sink potential - Moderate deployment - Total (1000 tCO2e/y)							-2,949
Carbon sink potential - Aggressive deployment - Corn-ethanol to energy grasses (1000 tCO2e/y)							-699
Carbon sink potential - Aggressive deployment - Cropland measures (1000 tCO2e/y)							-4,144
Carbon sink potential - Aggressive deployment - Permanent conservation cover (1000 tCO2e/y)							-148
Carbon sink potential - Aggressive deployment - Total (1000 tCO2e/y)							-4,990
Land impacted for carbon sink - Moderate deployment - Corn-ethanol to energy grasses (1000 hectares)							292
Land impacted for carbon sink - Moderate deployment - Cropland measures (1000 hectares)							1,392
Land impacted for carbon sink - Moderate deployment - Permanent conservation cover (1000 hectares)							135
Land impacted for carbon sink - Moderate deployment - Total (1000 hectares)							1,818
Land impacted for carbon sink - Aggressive deployment - Corn-ethanol to energy grasses (1000 hectares)							292
Land impacted for carbon sink - Aggressive deployment - Cropland measures (1000 hectares)							2,649
Land impacted for carbon sink - Aggressive deployment - Permanent conservation cover (1000 hectares)							269
Land impacted for carbon sink - Aggressive deployment - Total (1000 hectares)							3,209

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)		115	0.107	0.105	0.09	0.062	0.005
Premature deaths from air pollution - Fuel Comb - Electric Generation - Natural Gas (deaths)		29.3	18.6	8.12	3.77	1.15	0.776
Premature deaths from air pollution - Mobile - On-Road (deaths)		306	307	296	265	210	143
Premature deaths from air pollution - Gas Stations (deaths)		26.7	26.8	25.6	22.8	17.9	12.2
Premature deaths from air pollution - Fuel Comb - Residential - Natural Gas (deaths)		78.6	72.5	65.6	56.7	44.5	30.7
Premature deaths from air pollution - Fuel Comb - Residential - Oil (deaths)		3.92	3.8	3.65	3.23	2.45	1.64
Premature deaths from air pollution - Fuel Comb - Residential - Other (deaths)		10	10.4	10.6	10.1	8.32	6.07

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)		5.87	5.62	5.34	5.04	4.73	4.41
Premature deaths from air pollution - Fuel Comb - Comm/Institutional - Natural Gas (deaths)		53.6	51.6	49.1	44.4	37	28
Premature deaths from air pollution - Fuel Comb - Comm/Institutional - Oil (deaths)		4.26	3.89	3.52	3.03	2.48	1.95
Premature deaths from air pollution - Fuel Comb - Comm/Institutional - Other (deaths)		3.76	3.36	2.98	2.61	2.25	1.91
Premature deaths from air pollution - Industrial Processes - Coal Mining (deaths)		1.02	0.382	0.378	0.37	0.359	0.331
Premature deaths from air pollution - Industrial Processes - Oil & Gas Production (deaths)		88.8	80.1	69.1	60.1	52.9	37
Monetary damages from air pollution - Fuel Comb - Electric Generation - Coal (million $2019)		1,018	0.945	0.929	0.796	0.545	0.041
Monetary damages from air pollution - Fuel Comb - Electric Generation - Natural Gas (million $2019)		259	165	71.9	33.4	10.2	6.87
Monetary damages from air pollution - Mobile - On-Road (million $2019)		2,716	2,725	2,633	2,356	1,865	1,273
Monetary damages from air pollution - Gas Stations (million $2019)		237	237	227	202	159	108
Monetary damages from air pollution - Fuel Comb - Residential - Natural Gas (million $2019)		696	642	582	502	395	272
Monetary damages from air pollution - Fuel Comb - Residential - Oil (million $2019)		34.7	33.7	32.4	28.6	21.8	14.6
Monetary damages from air pollution - Fuel Comb - Residential - Other (million $2019)		88.9	92.1	93.9	89.4	73.8	53.8
Monetary damages from air pollution - Fuel Comb - Comm/Institutional - Coal (million $2019)		52	49.8	47.3	44.6	41.9	39
Monetary damages from air pollution - Fuel Comb - Comm/Institutional - Natural Gas (million $2019)		474	457	434	393	328	248
Monetary damages from air pollution - Fuel Comb - Comm/Institutional - Oil (million $2019)		37.7	34.4	31.2	26.8	21.9	17.3
Monetary damages from air pollution - Fuel Comb - Comm/Institutional - Other (million $2019)		33.3	29.8	26.4	23.1	19.9	16.9
Monetary damages from air pollution - Industrial Processes - Coal Mining (million $2019)		8.99	3.37	3.34	3.27	3.17	2.92
Monetary damages from air pollution - Industrial Processes - Oil & Gas Production (million $2019)		789	711	614	534	470	329

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

Item	2020	2025	2030	2035	2040	2045	2050
By economic sector - Agriculture (jobs)		817	883	677	378	113	1,044
By economic sector - Construction (jobs)		7,668	9,554	11,542	12,529	15,566	18,933

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

Item	2020	2025	2030	2035	2040	2045	2050
By economic sector - Manufacturing (jobs)		5,240	5,701	5,955	5,961	6,198	7,807
By economic sector - Mining (jobs)		4,555	3,286	2,420	1,762	1,246	724
By economic sector - Other (jobs)		398	537	1,143	1,224	1,995	2,281
By economic sector - Pipeline (jobs)		912	1,079	644	570	495	608
By economic sector - Professional (jobs)		4,765	5,161	6,575	7,606	9,818	13,792
By economic sector - Trade (jobs)		3,824	3,710	4,447	4,748	5,967	7,534
By economic sector - Utilities (jobs)		9,968	10,564	10,915	12,667	14,018	18,178
By resource sector - Biomass (jobs)		2,252	2,133	1,632	1,020	479	4,403
By resource sector - CO2 (jobs)		0	2,688	275	463	597	2,507
By resource sector - Coal (jobs)		1,768	317	0	0	0	0
By resource sector - Grid (jobs)		8,777	10,498	14,658	17,950	21,434	28,609
By resource sector - Natural Gas (jobs)		9,200	6,724	5,262	4,913	3,605	2,625
By resource sector - Nuclear (jobs)		2,009	1,739	1,712	1,685	1,659	1,633
By resource sector - Oil (jobs)		8,835	7,554	6,475	5,338	4,235	2,680
By resource sector - Solar (jobs)		981	1,300	4,521	3,571	7,045	5,810
By resource sector - Wind (jobs)		4,323	7,521	9,783	12,506	16,361	22,632
By education level - All sectors - High school diploma or less (jobs)		15,859	17,045	18,602	19,625	22,692	29,072
By education level - All sectors - Associates degree or some college (jobs)		11,562	12,477	13,772	14,980	17,692	22,482
By education level - All sectors - Bachelors degree (jobs)		8,397	8,572	9,296	9,964	11,608	14,872
By education level - All sectors - Masters or professional degree (jobs)		2,040	2,085	2,306	2,504	2,965	3,863
By education level - All sectors - Doctoral degree (jobs)		288	295	341	374	458	611
Related work experience - All sectors - None (jobs)		5,492	5,865	6,393	6,826	7,951	10,210
Related work experience - All sectors - Up to 1 year (jobs)		7,489	8,030	8,890	9,357	10,894	14,101
Related work experience - All sectors - 1 to 4 years (jobs)		13,858	14,602	15,950	17,131	20,026	25,558
Related work experience - All sectors - 4 to 10 years (jobs)		8,910	9,455	10,339	11,183	13,116	16,686
Related work experience - All sectors - Over 10 years (jobs)		2,397	2,521	2,744	2,950	3,429	4,344
On-the-Job Training - All sectors - None (jobs)		2,092	2,183	2,415	2,555	3,005	3,828
On-the-Job Training - All sectors - Up to 1 year (jobs)		25,476	26,798	29,255	31,118	36,147	46,518
On-the-Job Training - All sectors - 1 to 4 years (jobs)		7,822	8,443	9,261	10,064	11,842	14,975
On-the-Job Training - All sectors - 4 to 10 years (jobs)		2,399	2,665	2,963	3,262	3,899	4,930
On-the-Job Training - All sectors - Over 10 years (jobs)		356	385	423	447	523	649
On-Site or In-Plant Training - All sectors - None (jobs)		6,139	6,509	7,165	7,672	9,030	11,604
On-Site or In-Plant Training - All sectors - Up to 1 year (jobs)		23,087	24,306	26,543	28,252	32,818	42,130
On-Site or In-Plant Training - All sectors - 1 to 4 years (jobs)		6,086	6,551	7,186	7,776	9,128	11,549
On-Site or In-Plant Training - All sectors - 4 to 10 years (jobs)		2,521	2,762	3,042	3,328	3,947	4,987
On-Site or In-Plant Training - All sectors - Over 10 years (jobs)		313	346	382	418	492	631
Wage income - All (million $2019)		2,186	2,328	2,559	2,788	3,285	4,250

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

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Transportation (PJ)	809	757	687	629	583	530	468
Final energy use - Residential (PJ)	562	525	498	472	439	392	339
Final energy use - Commercial (PJ)	316	311	304	297	288	275	260
Final energy use - Industry (PJ)	501	510	521	522	536	546	548

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)		4.21	4.23	5.79	5.99	8.36	8.82

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	232	433	1,366	2,300	4,365	6,431
Vehicle stocks - LDV – All others (1000 units)	8,406	8,406	8,406	7,974	7,541	5,811	4,081
Light-duty vehicle capital costs vs. REF - Cumulative 5-yr (million $2018)		0	260	547	1,847	5,817	8,473
Public EV charging plugs - DC Fast (1000 units)	0.242		0.872		4.63		13
Public EV charging plugs - L2 (1000 units)	0.857		21		111		311

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 (%)	2.17	5.44	8.25	17.5	39.1	65.5	80.9
Sales of space heating units - Electric Resistance (%)	5.77	9.38	9.14	8.42	6.65	4.54	3.4
Sales of space heating units - Gas (%)	85.1	72	69.7	62.4	45	23.5	11
Sales of space heating units - Fossil (%)	6.93	13.2	12.9	11.7	9.27	6.38	4.68
Sales of water heating units - Electric Heat Pump (%)	0	0.449	1.69	5.81	15.8	28.5	36
Sales of water heating units - Electric Resistance (%)	13.3	25.5	26.2	29.4	37	46.8	52.5
Sales of water heating units - Gas Furnace (%)	86.7	74	72	64.7	47.1	24.6	11.4
Sales of water heating units - Other (%)	0.036	0.089	0.089	0.089	0.089	0.089	0.089
Sales of cooking units - Electric Resistance (%)	35.5	37.1	43	58.6	80.3	93.6	98.3
Sales of cooking units - Gas (%)	64.5	62.9	57	41.4	19.7	6.37	1.71
Residential HVAC investment in 2020s vs. REF - Cumulative 5-yr (billion $2018)		7.67	9.61				

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 (%)	0.384	4.93	7.53	16.1	36.4	61.5	76.2
Sales of space heating units - Electric Resistance (%)	1.64	3.4	3.62	4.32	6.01	8.19	9.45
Sales of space heating units - Gas (%)	95.4	88.9	86.3	77.6	56.5	29.8	14.1
Sales of space heating units - Fossil (%)	2.54	2.74	2.58	1.99	1.1	0.499	0.282
Sales of water heating units - Electric Heat Pump (%)	0.161	0.855	2.27	6.98	18.4	32.9	41.5
Sales of water heating units - Electric Resistance (%)	1.64	3.69	5.06	9.72	21	35.3	43.8
Sales of water heating units - Gas (%)	98.1	95.3	92.5	83.1	60.4	31.6	14.6
Sales of water heating units - Other (%)	0.093	0.184	0.185	0.186	0.185	0.186	0.186

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

Item	2020	2025	2030	2035	2040	2045	2050
Sales of cooking units - Electric Resistance (%)	41	45.8	49.8	60.5	75.4	84.5	87.7
Sales of cooking units - Gas (%)	59	54.2	50.2	39.5	24.6	15.5	12.3
Commercial HVAC investment in 2020s - Cumulative 5-yr (million $2018)		29,338	32,023				

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

Item	2020	2025	2030	2035	2040	2045	2050
Installed thermal - Coal (MW)	8,466	1,466	0	0	0	0	0
Installed thermal - Natural gas (MW)	7,052	8,327	8,254	7,727	5,417	4,762	4,919
Installed thermal - Nuclear (MW)	4,314	3,502	3,502	3,502	3,502	3,502	3,502

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)							-202
Carbon sink potential - Low - Avoid deforestation (1000 tCO2e/y)							-518
Carbon sink potential - Low - Extend rotation length (1000 tCO2e/y)							-4,236
Carbon sink potential - Low - Improve plantations (1000 tCO2e/y)							-615
Carbon sink potential - Low - Increase retention of HWP (1000 tCO2e/y)							-2,521
Carbon sink potential - Low - Increase trees outside forests (1000 tCO2e/y)							-529
Carbon sink potential - Low - Reforest cropland (1000 tCO2e/y)							-472
Carbon sink potential - Low - Reforest pasture (1000 tCO2e/y)							-361
Carbon sink potential - Low - Restore productivity (1000 tCO2e/y)							-1,529
Carbon sink potential - Low - All (not counting overlap) (1000 tCO2e/y)							-10,983
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO2e/y)							-303
Carbon sink potential - Mid - Avoid deforestation (1000 tCO2e/y)							-1,812
Carbon sink potential - Mid - Extend rotation length (1000 tCO2e/y)							-7,632
Carbon sink potential - Mid - Improve plantations (1000 tCO2e/y)							-901
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO2e/y)							-5,042
Carbon sink potential - Mid - Increase trees outside forests (1000 tCO2e/y)							-1,020
Carbon sink potential - Mid - Reforest cropland (1000 tCO2e/y)							-708
Carbon sink potential - Mid - Reforest pasture (1000 tCO2e/y)							-2,560
Carbon sink potential - Mid - Restore productivity (1000 tCO2e/y)							-3,033
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO2e/y)							-23,011
Carbon sink potential - High - Accelerate regeneration (1000 tCO2e/y)							-403
Carbon sink potential - High - Avoid deforestation (1000 tCO2e/y)							-3,106

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)							-11,028
Carbon sink potential - High - Improve plantations (1000 tCO2e/y)							-1,209
Carbon sink potential - High - Increase retention of HWP (1000 tCO2e/y)							-7,563
Carbon sink potential - High - Increase trees outside forests (1000 tCO2e/y)							-1,511
Carbon sink potential - High - Reforest cropland (1000 tCO2e/y)							-944
Carbon sink potential - High - Reforest pasture (1000 tCO2e/y)							-4,759
Carbon sink potential - High - All (not counting overlap) (1000 tCO2e/y)							-35,061
Carbon sink potential - High - Restore productivity (1000 tCO2e/y)							-4,537
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)							33
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)							395
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)							2,155
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)							223
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)							75.6
Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares)							31.2
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)							23.4
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)							910
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)							3,845
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)							49.5
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)							408
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)							3,889
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)							335
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)							110

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)							46.8
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)							169
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)							1,833
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)							6,840
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)							66
Land impacted for carbon sink potential - High - Avoid deforestation (over 30 years) (1000 hectares)							421
Land impacted for carbon sink potential - High - Extend rotation length (1000 hectares)							5,624
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)							445
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)							144
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)							62.4
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)							135
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)							1,504
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)							8,401

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)							-699
Carbon sink potential - Moderate deployment - Cropland measures (1000 tCO2e/y)							-2,176
Carbon sink potential - Moderate deployment - Permanent conservation cover (1000 tCO2e/y)							-74
Carbon sink potential - Moderate deployment - Total (1000 tCO2e/y)							-2,949
Carbon sink potential - Aggressive deployment - Corn-ethanol to energy grasses (1000 tCO2e/y)							-699
Carbon sink potential - Aggressive deployment - Cropland measures (1000 tCO2e/y)							-4,144

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 tCO2e/y)							-148
Carbon sink potential - Aggressive deployment - Total (1000 tCO2e/y)							-4,990
Land impacted for carbon sink - Moderate deployment - Corn-ethanol to energy grasses (1000 hectares)							292
Land impacted for carbon sink - Moderate deployment - Cropland measures (1000 hectares)							1,392
Land impacted for carbon sink - Moderate deployment - Permanent conservation cover (1000 hectares)							135
Land impacted for carbon sink - Moderate deployment - Total (1000 hectares)							1,818
Land impacted for carbon sink - Aggressive deployment - Corn-ethanol to energy grasses (1000 hectares)							292
Land impacted for carbon sink - Aggressive deployment - Cropland measures (1000 hectares)							2,649
Land impacted for carbon sink - Aggressive deployment - Permanent conservation cover (1000 hectares)							269
Land impacted for carbon sink - Aggressive deployment - Total (1000 hectares)							3,209

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)		115	0.107	0.105	0.09	0.062	0.005
Premature deaths from air pollution - Fuel Comb - Electric Generation - Natural Gas (deaths)		28	20.4	11.8	8.18	2.71	0.698
Premature deaths from air pollution - Mobile - On-Road (deaths)		300	278	210	121	55.5	22.4
Premature deaths from air pollution - Gas Stations (deaths)		26.2	23.9	17.9	10.4	4.88	2.12
Premature deaths from air pollution - Fuel Comb - Residential - Natural Gas (deaths)		78.4	69.2	50.6	29.8	14.3	4.88
Premature deaths from air pollution - Fuel Comb - Residential - Oil (deaths)		3.85	3.16	2.18	1.27	0.525	0.164
Premature deaths from air pollution - Fuel Comb - Residential - Other (deaths)		9.99	9.78	8.05	5.53	2.99	1.26
Premature deaths from air pollution - Fuel Comb - Comm/Institutional - Coal (deaths)		5.87	5.62	5.34	5.04	4.73	4.41
Premature deaths from air pollution - Fuel Comb - Comm/Institutional - Natural Gas (deaths)		53.5	48.5	37.8	24.4	13.4	5.97
Premature deaths from air pollution - Fuel Comb - Comm/Institutional - Oil (deaths)		4.24	3.51	2.69	1.9	1.27	0.802
Premature deaths from air pollution - Fuel Comb - Comm/Institutional - Other (deaths)		3.76	3.14	2.54	1.97	1.44	0.937

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)		1.18	0.38	0.371	0.358	0.357	0.305
Premature deaths from air pollution - Industrial Processes - Oil & Gas Production (deaths)		87.5	82	70.3	50.5	30.7	4.48
Monetary damages from air pollution - Fuel Comb - Electric Generation - Coal (million $2019)		1,018	0.945	0.929	0.796	0.545	0.041
Monetary damages from air pollution - Fuel Comb - Electric Generation - Natural Gas (million $2019)		248	181	104	72.5	24	6.19
Monetary damages from air pollution - Mobile - On-Road (million $2019)		2,671	2,473	1,869	1,078	494	199
Monetary damages from air pollution - Gas Stations (million $2019)		232	212	158	92.2	43.2	18.7
Monetary damages from air pollution - Fuel Comb - Residential - Natural Gas (million $2019)		694	613	449	264	127	43.2
Monetary damages from air pollution - Fuel Comb - Residential - Oil (million $2019)		34.1	28	19.3	11.2	4.66	1.45
Monetary damages from air pollution - Fuel Comb - Residential - Other (million $2019)		88.5	86.6	71.4	49	26.5	11.1
Monetary damages from air pollution - Fuel Comb - Comm/Institutional - Coal (million $2019)		52	49.8	47.3	44.6	41.9	39
Monetary damages from air pollution - Fuel Comb - Comm/Institutional - Natural Gas (million $2019)		474	430	335	216	119	52.9
Monetary damages from air pollution - Fuel Comb - Comm/Institutional - Oil (million $2019)		37.6	31	23.8	16.8	11.2	7.1
Monetary damages from air pollution - Fuel Comb - Comm/Institutional - Other (million $2019)		33.3	27.8	22.5	17.5	12.7	8.29
Monetary damages from air pollution - Industrial Processes - Coal Mining (million $2019)		10.4	3.36	3.28	3.16	3.15	2.7
Monetary damages from air pollution - Industrial Processes - Oil & Gas Production (million $2019)		777	729	625	448	272	39.8

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

Item	2020	2025	2030	2035	2040	2045	2050
By economic sector - Agriculture (jobs)		776	984	711	399	122	1,040
By economic sector - Construction (jobs)		7,887	11,383	17,729	22,280	47,650	33,875
By economic sector - Manufacturing (jobs)		5,402	6,491	8,408	8,741	11,344	12,042
By economic sector - Mining (jobs)		4,476	3,164	2,045	1,156	584	84.4
By economic sector - Other (jobs)		420	1,013	2,152	3,155	9,762	5,267
By economic sector - Pipeline (jobs)		884	738	520	337	196	76.6
By economic sector - Professional (jobs)		4,850	6,571	9,670	12,787	25,366	22,922
By economic sector - Trade (jobs)		3,849	4,367	6,003	7,608	16,292	12,940
By economic sector - Utilities (jobs)		10,316	11,632	16,424	19,721	32,606	30,544
By resource sector - Biomass (jobs)		2,116	2,458	1,651	1,019	478	4,673
By resource sector - CO2 (jobs)		0	0	0	0	0	0
By resource sector - Coal (jobs)		1,768	317	0	0	0	0
By resource sector - Grid (jobs)		9,671	14,560	25,410	32,280	60,750	57,510

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

Item	2020	2025	2030	2035	2040	2045	2050
By resource sector - Natural Gas (jobs)		8,929	7,463	5,796	5,132	3,451	2,985
By resource sector - Nuclear (jobs)		2,009	1,739	1,712	1,458	656	0
By resource sector - Oil (jobs)		8,748	7,047	5,164	3,251	1,871	116
By resource sector - Solar (jobs)		1,036	4,550	10,467	14,587	52,097	18,964
By resource sector - Wind (jobs)		4,584	8,209	13,462	18,457	24,618	34,545
By education level - All sectors - High school diploma or less (jobs)		16,153	19,501	26,780	31,696	60,260	48,934
By education level - All sectors - Associates degree or some college (jobs)		11,818	14,313	20,163	24,466	46,715	38,280
By education level - All sectors - Bachelors degree (jobs)		8,527	9,767	12,994	15,486	28,454	24,260
By education level - All sectors - Masters or professional degree (jobs)		2,072	2,410	3,247	3,938	7,348	6,330
By education level - All sectors - Doctoral degree (jobs)		291	351	478	596	1,146	987
Related work experience - All sectors - None (jobs)		5,593	6,696	9,210	11,012	20,968	17,190
Related work experience - All sectors - Up to 1 year (jobs)		7,626	9,290	12,814	15,228	29,134	23,737
Related work experience - All sectors - 1 to 4 years (jobs)		14,114	16,698	22,842	27,363	51,575	42,718
Related work experience - All sectors - 4 to 10 years (jobs)		9,084	10,786	14,873	17,908	33,646	27,929
Related work experience - All sectors - Over 10 years (jobs)		2,444	2,873	3,922	4,671	8,599	7,218
On-the-Job Training - All sectors - None (jobs)		2,126	2,517	3,437	4,115	7,948	6,397
On-the-Job Training - All sectors - Up to 1 year (jobs)		25,927	30,704	41,726	49,600	92,968	77,447
On-the-Job Training - All sectors - 1 to 4 years (jobs)		7,991	9,635	13,501	16,332	31,030	25,384
On-the-Job Training - All sectors - 4 to 10 years (jobs)		2,454	3,048	4,389	5,412	10,607	8,482
On-the-Job Training - All sectors - Over 10 years (jobs)		363	440	609	723	1,370	1,081
On-Site or In-Plant Training - All sectors - None (jobs)		6,249	7,495	10,301	12,383	23,536	19,383
On-Site or In-Plant Training - All sectors - Up to 1 year (jobs)		23,502	27,830	37,898	45,072	84,603	70,277
On-Site or In-Plant Training - All sectors - 1 to 4 years (jobs)		6,215	7,482	10,449	12,600	23,944	19,564
On-Site or In-Plant Training - All sectors - 4 to 10 years (jobs)		2,574	3,141	4,451	5,443	10,536	8,488
On-Site or In-Plant Training - All sectors - Over 10 years (jobs)		320	395	562	685	1,303	1,079
Wage income - All (million $2019)		2,226	2,648	3,649	4,415	8,337	7,059

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

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Transportation (PJ)	808	750	656	541	437	372	341
Final energy use - Residential (PJ)	562	524	489	423	347	286	245
Final energy use - Commercial (PJ)	316	311	299	277	251	231	220
Final energy use - Industry (PJ)	501	510	519	515	526	536	540

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)		5.19	5.33	9.38	9.99	8.85	9.24

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	724	1,409	3,808	6,207	8,123	10,040
Vehicle stocks - LDV – All others (1000 units)	8,372	7,972	7,571	5,518	3,464	1,960	456
Light-duty vehicle capital costs vs. REF - Cumulative 5-yr (million $2018)		1,610	4,124	6,688	10,128	11,025	10,511
Public EV charging plugs - DC Fast (1000 units)	0.242		2.84		12.5		20.2
Public EV charging plugs - L2 (1000 units)	0.857		68.2		300		486

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 (%)	2.17	6.93	32.9	84	93.6	94.2	94.2
Sales of space heating units - Electric Resistance (%)	5.77	9.31	7.39	3.21	2.39	2.33	2.44
Sales of space heating units - Gas (%)	85.1	70.8	50	8.51	0.73	0.191	0.189
Sales of space heating units - Fossil (%)	6.93	12.9	9.76	4.29	3.31	3.24	3.18
Sales of water heating units - Electric Heat Pump (%)	0	0.892	12.3	37.3	42	42.4	42.4
Sales of water heating units - Electric Resistance (%)	13.3	25.8	34.3	53.6	57.3	57.5	57.5
Sales of water heating units - Gas Furnace (%)	86.7	73.2	53.3	9.02	0.593	0.008	0
Sales of water heating units - Other (%)	0.036	0.089	0.089	0.089	0.088	0.088	0.089
Sales of cooking units - Electric Resistance (%)	35.7	49.4	91.3	99.6	100	100	100
Sales of cooking units - Gas (%)	64.3	50.6	8.66	0.436	0	0	0
Residential HVAC investment in 2020s vs. REF - Cumulative 5-yr (billion $2018)		7.71	9.81				

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 (%)	0.384	6.16	30.1	79.2	88.5	89.1	89.1
Sales of space heating units - Electric Resistance (%)	1.64	3.48	5.48	9.74	10.5	10.6	10.6
Sales of space heating units - Gas (%)	95.4	88	64	11.1	1.06	0.368	0.359
Sales of space heating units - Fossil (%)	2.54	2.36	0.454	0.019	0	0	0
Sales of water heating units - Electric Heat Pump (%)	0.161	1.36	14.4	43	48.4	48.8	48.8
Sales of water heating units - Electric Resistance (%)	1.64	4.19	17	45.3	50.6	51	51
Sales of water heating units - Gas (%)	98.1	94.3	68.5	11.6	0.763	0.01	0
Sales of water heating units - Other (%)	0.093	0.184	0.185	0.186	0.185	0.186	0.186
Sales of cooking units - Electric Resistance (%)	41	54.2	82.9	88.6	88.9	88.9	88.9
Sales of cooking units - Gas (%)	59	45.8	17.1	11.4	11.1	11.1	11.1
Commercial HVAC investment in 2020s - Cumulative 5-yr (million $2018)		29,341	32,040				

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

Item	2020	2025	2030	2035	2040	2045	2050
Installed thermal - Coal (MW)	8,466	2,384	0	0	0	0	0
Installed thermal - Natural gas (MW)	7,052	8,407	11,569	13,872	13,464	14,125	17,370

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

Item	2020	2025	2030	2035	2040	2045	2050
Installed thermal - Nuclear (MW)	4,314	3,502	3,502	3,502	2,350	0	0
Installed renewables - Rooftop PV (MW)	79.1	119	158	208	269	339	419
Installed renewables - Solar - Base land use assumptions (MW)	76.9	76.9	2,325	8,916	17,217	55,580	58,136
Installed renewables - Wind - Base land use assumptions (MW)	2,562	2,562	13,701	21,814	27,363	28,486	30,287
Installed renewables - Solar - Constrained land use assumptions (MW)	76.9	183	558	7,837	19,135	40,576	46,673
Installed renewables - Wind - Constrained land use assumptions (MW)	2,854	2,854	11,126	11,687	12,028	12,449	31,409
Installed renewables - Offshore Wind - Constrained land use assumptions (MW)	0	0	0	0	0	0	0
Capital invested - Solar PV - Base (billion $2018)		0	2.69	7.27	8.63	37.6	2.37
Capital invested - Wind - Base (billion $2018)		0	14.8	10.1	6.56	1.26	1.91

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

Item	2020	2025	2030	2035	2040	2045	2050
Solar - Base land use assumptions (GWh)	155	155	3,984	15,147	29,199	94,231	98,602
Wind - Base land use assumptions (GWh)	9,704	9,704	46,048	71,803	89,535	93,442	99,583
OffshoreWind - Base land use assumptions (GWh)	0	0	0	0	0	0	0
Solar - Constrained land use assumptions (GWh)	310	672	1,958	26,565	64,735	137,400	158,179
Wind - Constrained land use assumptions (GWh)	19,408	19,408	72,440	76,306	78,636	81,297	203,238
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)							-202
Carbon sink potential - Low - Avoid deforestation (1000 tCO2e/y)							-518
Carbon sink potential - Low - Extend rotation length (1000 tCO2e/y)							-4,236
Carbon sink potential - Low - Improve plantations (1000 tCO2e/y)							-615
Carbon sink potential - Low - Increase retention of HWP (1000 tCO2e/y)							-2,521
Carbon sink potential - Low - Increase trees outside forests (1000 tCO2e/y)							-529
Carbon sink potential - Low - Reforest cropland (1000 tCO2e/y)							-472
Carbon sink potential - Low - Reforest pasture (1000 tCO2e/y)							-361
Carbon sink potential - Low - Restore productivity (1000 tCO2e/y)							-1,529
Carbon sink potential - Low - All (not counting overlap) (1000 tCO2e/y)							-10,983
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO2e/y)							-303
Carbon sink potential - Mid - Avoid deforestation (1000 tCO2e/y)							-1,812
Carbon sink potential - Mid - Extend rotation length (1000 tCO2e/y)							-7,632

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 tCO2e/y)							-901
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO2e/y)							-5,042
Carbon sink potential - Mid - Increase trees outside forests (1000 tCO2e/y)							-1,020
Carbon sink potential - Mid - Reforest cropland (1000 tCO2e/y)							-708
Carbon sink potential - Mid - Reforest pasture (1000 tCO2e/y)							-2,560
Carbon sink potential - Mid - Restore productivity (1000 tCO2e/y)							-3,033
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO2e/y)							-23,011
Carbon sink potential - High - Accelerate regeneration (1000 tCO2e/y)							-403
Carbon sink potential - High - Avoid deforestation (1000 tCO2e/y)							-3,106
Carbon sink potential - High - Extend rotation length (1000 tCO2e/y)							-11,028
Carbon sink potential - High - Improve plantations (1000 tCO2e/y)							-1,209
Carbon sink potential - High - Increase retention of HWP (1000 tCO2e/y)							-7,563
Carbon sink potential - High - Increase trees outside forests (1000 tCO2e/y)							-1,511
Carbon sink potential - High - Reforest cropland (1000 tCO2e/y)							-944
Carbon sink potential - High - Reforest pasture (1000 tCO2e/y)							-4,759
Carbon sink potential - High - All (not counting overlap) (1000 tCO2e/y)							-35,061
Carbon sink potential - High - Restore productivity (1000 tCO2e/y)							-4,537
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)							33
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)							395
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)							2,155
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)							223
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)							75.6
Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares)							31.2
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)							23.4
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)							910

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)							3,845
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)							49.5
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)							408
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)							3,889
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)							335
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)							110
Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares)							46.8
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)							169
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)							1,833
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)							6,840
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)							66
Land impacted for carbon sink potential - High - Avoid deforestation (over 30 years) (1000 hectares)							421
Land impacted for carbon sink potential - High - Extend rotation length (1000 hectares)							5,624
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)							445
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)							144
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)							62.4
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)							135
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)							1,504
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)							8,401

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 tCO2e/y)							-699
Carbon sink potential - Moderate deployment - Cropland measures (1000 tCO2e/y)							-2,176
Carbon sink potential - Moderate deployment - Permanent conservation cover (1000 tCO2e/y)							-74
Carbon sink potential - Moderate deployment - Total (1000 tCO2e/y)							-2,949
Carbon sink potential - Aggressive deployment - Corn-ethanol to energy grasses (1000 tCO2e/y)							-699
Carbon sink potential - Aggressive deployment - Cropland measures (1000 tCO2e/y)							-4,144
Carbon sink potential - Aggressive deployment - Permanent conservation cover (1000 tCO2e/y)							-148
Carbon sink potential - Aggressive deployment - Total (1000 tCO2e/y)							-4,990
Land impacted for carbon sink - Moderate deployment - Corn-ethanol to energy grasses (1000 hectares)							292
Land impacted for carbon sink - Moderate deployment - Cropland measures (1000 hectares)							1,392
Land impacted for carbon sink - Moderate deployment - Permanent conservation cover (1000 hectares)							135
Land impacted for carbon sink - Moderate deployment - Total (1000 hectares)							1,818
Land impacted for carbon sink - Aggressive deployment - Corn-ethanol to energy grasses (1000 hectares)							292
Land impacted for carbon sink - Aggressive deployment - Cropland measures (1000 hectares)							2,649
Land impacted for carbon sink - Aggressive deployment - Permanent conservation cover (1000 hectares)							269
Land impacted for carbon sink - Aggressive deployment - Total (1000 hectares)							3,209

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)		115	0.107	0.105	0.09	0.062	0.005
Premature deaths from air pollution - Fuel Comb - Electric Generation - Natural Gas (deaths)		31.9	24.2	30.6	22.5	7.76	2.49
Premature deaths from air pollution - Mobile - On-Road (deaths)		300	278	210	121	55.5	22.4
Premature deaths from air pollution - Gas Stations (deaths)		26.2	23.9	17.9	10.4	4.88	2.12

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)		78.4	69.2	50.6	29.8	14.3	4.88
Premature deaths from air pollution - Fuel Comb - Residential - Oil (deaths)		3.85	3.16	2.18	1.27	0.525	0.164
Premature deaths from air pollution - Fuel Comb - Residential - Other (deaths)		9.99	9.78	8.05	5.53	2.99	1.26
Premature deaths from air pollution - Fuel Comb - Comm/Institutional - Coal (deaths)		5.87	5.62	5.34	5.04	4.73	4.41
Premature deaths from air pollution - Fuel Comb - Comm/Institutional - Natural Gas (deaths)		53.5	48.5	37.8	24.4	13.4	5.97
Premature deaths from air pollution - Fuel Comb - Comm/Institutional - Oil (deaths)		4.24	3.51	2.69	1.9	1.27	0.802
Premature deaths from air pollution - Fuel Comb - Comm/Institutional - Other (deaths)		3.76	3.14	2.54	1.97	1.44	0.937
Premature deaths from air pollution - Industrial Processes - Coal Mining (deaths)		0.951	0.379	0.372	0.359	0.358	0.305
Premature deaths from air pollution - Industrial Processes - Oil & Gas Production (deaths)		90.1	86.9	84.7	71.5	59.5	44.1
Monetary damages from air pollution - Fuel Comb - Electric Generation - Coal (million $2019)		1,018	0.945	0.929	0.796	0.545	0.041
Monetary damages from air pollution - Fuel Comb - Electric Generation - Natural Gas (million $2019)		283	215	271	199	68.7	22.1
Monetary damages from air pollution - Mobile - On-Road (million $2019)		2,671	2,473	1,869	1,078	494	199
Monetary damages from air pollution - Gas Stations (million $2019)		232	212	158	92.2	43.2	18.7
Monetary damages from air pollution - Fuel Comb - Residential - Natural Gas (million $2019)		694	613	449	264	127	43.2
Monetary damages from air pollution - Fuel Comb - Residential - Oil (million $2019)		34.1	28	19.3	11.2	4.66	1.45
Monetary damages from air pollution - Fuel Comb - Residential - Other (million $2019)		88.5	86.6	71.4	49	26.5	11.1
Monetary damages from air pollution - Fuel Comb - Comm/Institutional - Coal (million $2019)		52	49.8	47.3	44.6	41.9	39
Monetary damages from air pollution - Fuel Comb - Comm/Institutional - Natural Gas (million $2019)		474	430	335	216	119	52.9
Monetary damages from air pollution - Fuel Comb - Comm/Institutional - Oil (million $2019)		37.6	31	23.8	16.8	11.2	7.1
Monetary damages from air pollution - Fuel Comb - Comm/Institutional - Other (million $2019)		33.3	27.8	22.5	17.5	12.7	8.29
Monetary damages from air pollution - Industrial Processes - Coal Mining (million $2019)		8.39	3.35	3.28	3.17	3.16	2.69

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)		800	771	752	635	528	392

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

Item	2020	2025	2030	2035	2040	2045	2050
By economic sector - Agriculture (jobs)		803	898	668	391	126	1,046
By economic sector - Construction (jobs)		7,500	8,817	8,963	9,877	11,579	13,344
By economic sector - Manufacturing (jobs)		4,716	4,269	4,117	3,938	4,110	4,291
By economic sector - Mining (jobs)		4,492	3,324	2,417	1,626	1,077	705
By economic sector - Other (jobs)		377	425	538	713	882	1,006
By economic sector - Pipeline (jobs)		933	1,189	772	692	583	744
By economic sector - Professional (jobs)		4,500	4,337	5,303	5,295	8,063	9,199
By economic sector - Trade (jobs)		3,607	3,270	3,390	3,287	4,147	4,477
By economic sector - Utilities (jobs)		9,796	10,624	15,477	13,588	28,243	26,231
By resource sector - Biomass (jobs)		2,134	2,133	1,613	1,035	508	4,444
By resource sector - CO2 (jobs)		0	3,037	311	523	674	2,832
By resource sector - Coal (jobs)		1,346	102	0	0	0	0
By resource sector - Grid (jobs)		8,550	9,566	14,156	16,177	20,170	24,053
By resource sector - Natural Gas (jobs)		9,440	8,224	7,458	7,998	6,827	5,642
By resource sector - Nuclear (jobs)		2,009	1,739	7,445	2,844	20,074	14,129
By resource sector - Oil (jobs)		8,746	7,126	5,367	3,718	2,658	1,921
By resource sector - Solar (jobs)		817	763	749	1,207	1,307	1,277
By resource sector - Wind (jobs)		3,683	4,463	4,547	5,907	6,591	6,744
By education level - All sectors - High school diploma or less (jobs)		15,259	15,703	17,093	16,346	23,052	24,690
By education level - All sectors - Associates degree or some college (jobs)		11,134	11,477	12,764	12,514	18,093	18,869
By education level - All sectors - Bachelors degree (jobs)		8,086	7,813	9,164	8,210	13,627	13,476
By education level - All sectors - Masters or professional degree (jobs)		1,968	1,899	2,299	2,052	3,521	3,491
By education level - All sectors - Doctoral degree (jobs)		277	262	327	286	517	516
Related work experience - All sectors - None (jobs)		5,297	5,427	5,963	5,725	8,218	8,712
Related work experience - All sectors - Up to 1 year (jobs)		7,183	7,307	8,124	7,634	11,147	11,869
Related work experience - All sectors - 1 to 4 years (jobs)		13,345	13,422	15,103	14,256	21,495	22,157
Related work experience - All sectors - 4 to 10 years (jobs)		8,591	8,697	9,801	9,333	14,068	14,423
Related work experience - All sectors - Over 10 years (jobs)		2,308	2,301	2,656	2,462	3,881	3,881
On-the-Job Training - All sectors - None (jobs)		2,013	1,989	2,292	2,084	3,333	3,369
On-the-Job Training - All sectors - Up to 1 year (jobs)		24,478	24,492	27,522	25,697	38,668	40,172
On-the-Job Training - All sectors - 1 to 4 years (jobs)		7,557	7,815	8,716	8,488	12,428	12,859
On-the-Job Training - All sectors - 4 to 10 years (jobs)		2,334	2,510	2,728	2,779	3,823	4,088
On-the-Job Training - All sectors - Over 10 years (jobs)		342	347	388	361	556	555
On-Site or In-Plant Training - All sectors - None (jobs)		5,903	5,926	6,716	6,281	9,684	9,961
On-Site or In-Plant Training - All sectors - Up to 1 year (jobs)		22,193	22,252	25,012	23,400	35,152	36,477

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)		5,875	6,055	6,735	6,537	9,529	9,890
On-Site or In-Plant Training - All sectors - 4 to 10 years (jobs)		2,451	2,599	2,837	2,836	3,978	4,206
On-Site or In-Plant Training - All sectors - Over 10 years (jobs)		303	321	346	353	466	508
Wage income - All (million $2019)		2,112	2,154	2,491	2,358	3,720	3,843

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

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Transportation (PJ)	808	750	656	541	437	372	341
Final energy use - Residential (PJ)	562	524	489	423	347	286	245
Final energy use - Commercial (PJ)	316	311	299	277	251	231	220
Final energy use - Industry (PJ)	501	510	519	515	526	536	540

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)		5.19	5.33	9.38	9.99	8.85	9.24

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	724	1,409	3,808	6,207	8,123	10,040
Vehicle stocks - LDV – All others (1000 units)	8,372	7,972	7,571	5,518	3,464	1,960	456
Light-duty vehicle capital costs vs. REF - Cumulative 5-yr (million $2018)		1,610	4,124	6,688	10,128	11,025	10,511
Public EV charging plugs - DC Fast (1000 units)	0.242		2.84		12.5		20.2
Public EV charging plugs - L2 (1000 units)	0.857		68.2		300		486

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 (%)	2.17	6.93	32.9	84	93.6	94.2	94.2
Sales of space heating units - Electric Resistance (%)	5.77	9.31	7.39	3.21	2.39	2.33	2.44
Sales of space heating units - Gas (%)	85.1	70.8	50	8.51	0.73	0.191	0.189
Sales of space heating units - Fossil (%)	6.93	12.9	9.76	4.29	3.31	3.24	3.18
Sales of water heating units - Electric Heat Pump (%)	0	0.892	12.3	37.3	42	42.4	42.4
Sales of water heating units - Electric Resistance (%)	13.3	25.8	34.3	53.6	57.3	57.5	57.5
Sales of water heating units - Gas Furnace (%)	86.7	73.2	53.3	9.02	0.593	0.008	0
Sales of water heating units - Other (%)	0.036	0.089	0.089	0.089	0.088	0.088	0.089
Sales of cooking units - Electric Resistance (%)	35.7	49.4	91.3	99.6	100	100	100
Sales of cooking units - Gas (%)	64.3	50.6	8.66	0.436	0	0	0
Residential HVAC investment in 2020s vs. REF - Cumulative 5-yr (billion $2018)		7.71	9.81				

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 (%)	0.384	6.16	30.1	79.2	88.5	89.1	89.1
Sales of space heating units - Electric Resistance (%)	1.64	3.48	5.48	9.74	10.5	10.6	10.6
Sales of space heating units - Gas (%)	95.4	88	64	11.1	1.06	0.368	0.359
Sales of space heating units - Fossil (%)	2.54	2.36	0.454	0.019	0	0	0
Sales of water heating units - Electric Heat Pump (%)	0.161	1.36	14.4	43	48.4	48.8	48.8
Sales of water heating units - Electric Resistance (%)	1.64	4.19	17	45.3	50.6	51	51
Sales of water heating units - Gas (%)	98.1	94.3	68.5	11.6	0.763	0.01	0
Sales of water heating units - Other (%)	0.093	0.184	0.185	0.186	0.185	0.186	0.186
Sales of cooking units - Electric Resistance (%)	41	54.2	82.9	88.6	88.9	88.9	88.9
Sales of cooking units - Gas (%)	59	45.8	17.1	11.4	11.1	11.1	11.1
Commercial HVAC investment in 2020s - Cumulative 5-yr (million $2018)		29,341	32,040				

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

Item	2020	2025	2030	2035	2040	2045	2050
Installed thermal - Coal (MW)	8,466	769	0	0	0	0	0
Installed thermal - Natural gas (MW)	7,058	8,028	8,948	9,964	12,233	15,630	16,222
Installed thermal - Nuclear (MW)	4,314	3,502	3,502	5,910	5,910	13,398	16,867
Installed renewables - Rooftop PV (MW)	79.1	119	158	208	269	339	419
Installed renewables - Solar - Base land use assumptions (MW)	76.9	76.9	76.9	76.9	576	1,124	1,124
Installed renewables - Wind - Base land use assumptions (MW)	2,562	2,939	6,519	6,519	7,423	7,656	7,839
Installed renewables - Solar - Constrained land use assumptions (MW)	76.9	76.9	76.9	308	308	1,260	1,260
Installed renewables - Wind - Constrained land use assumptions (MW)	2,562	2,705	5,436	5,505	6,268	6,657	6,817
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	0.519	0.537	0
Capital invested - Wind - Base (billion $2018)		0.555	4.61	0	0.985	0.262	0.194
Capital invested - Solar PV - Constrained (billion $2018)		0	0	0.254	0	0.933	0
Capital invested - Wind - Constrained (billion $2018)		0.211	3.64	0.086	0.901	0.436	0.169

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

Item	2020	2025	2030	2035	2040	2045	2050
Solar - Base land use assumptions (GWh)	155	155	155	155	1,006	1,937	1,937
Wind - Base land use assumptions (GWh)	9,704	11,014	22,540	22,540	25,227	25,977	26,570
OffshoreWind - Base land use assumptions (GWh)	0	0	0	0	0	0	0
Solar - Constrained land use assumptions (GWh)	155	155	155	549	549	2,170	2,170
Wind - Constrained land use assumptions (GWh)	9,704	10,194	19,079	19,327	21,853	23,145	23,668
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 tCO2e/y)							-202
Carbon sink potential - Low - Avoid deforestation (1000 tCO2e/y)							-518
Carbon sink potential - Low - Extend rotation length (1000 tCO2e/y)							-4,236
Carbon sink potential - Low - Improve plantations (1000 tCO2e/y)							-615
Carbon sink potential - Low - Increase retention of HWP (1000 tCO2e/y)							-2,521
Carbon sink potential - Low - Increase trees outside forests (1000 tCO2e/y)							-529
Carbon sink potential - Low - Reforest cropland (1000 tCO2e/y)							-472
Carbon sink potential - Low - Reforest pasture (1000 tCO2e/y)							-361
Carbon sink potential - Low - Restore productivity (1000 tCO2e/y)							-1,529
Carbon sink potential - Low - All (not counting overlap) (1000 tCO2e/y)							-10,983
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO2e/y)							-303
Carbon sink potential - Mid - Avoid deforestation (1000 tCO2e/y)							-1,812
Carbon sink potential - Mid - Extend rotation length (1000 tCO2e/y)							-7,632
Carbon sink potential - Mid - Improve plantations (1000 tCO2e/y)							-901
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO2e/y)							-5,042
Carbon sink potential - Mid - Increase trees outside forests (1000 tCO2e/y)							-1,020
Carbon sink potential - Mid - Reforest cropland (1000 tCO2e/y)							-708
Carbon sink potential - Mid - Reforest pasture (1000 tCO2e/y)							-2,560
Carbon sink potential - Mid - Restore productivity (1000 tCO2e/y)							-3,033
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO2e/y)							-23,011
Carbon sink potential - High - Accelerate regeneration (1000 tCO2e/y)							-403
Carbon sink potential - High - Avoid deforestation (1000 tCO2e/y)							-3,106
Carbon sink potential - High - Extend rotation length (1000 tCO2e/y)							-11,028
Carbon sink potential - High - Improve plantations (1000 tCO2e/y)							-1,209
Carbon sink potential - High - Increase retention of HWP (1000 tCO2e/y)							-7,563
Carbon sink potential - High - Increase trees outside forests (1000 tCO2e/y)							-1,511
Carbon sink potential - High - Reforest cropland (1000 tCO2e/y)							-944
Carbon sink potential - High - Reforest pasture (1000 tCO2e/y)							-4,759
Carbon sink potential - High - All (not counting overlap) (1000 tCO2e/y)							-35,061
Carbon sink potential - High - Restore productivity (1000 tCO2e/y)							-4,537

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)							33
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)							395
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)							2,155
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)							223
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)							75.6
Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares)							31.2
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)							23.4
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)							910
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)							3,845
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)							49.5
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)							408
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)							3,889
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)							335
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)							110
Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares)							46.8
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)							169
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)							1,833
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)							6,840
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)							66
Land impacted for carbon sink potential - High - Avoid deforestation (over 30 years) (1000 hectares)							421

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)							5,624
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)							445
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)							144
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)							62.4
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)							135
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)							1,504
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)							8,401

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 tCO2e/y)							-699
Carbon sink potential - Moderate deployment - Cropland measures (1000 tCO2e/y)							-2,176
Carbon sink potential - Moderate deployment - Permanent conservation cover (1000 tCO2e/y)							-74
Carbon sink potential - Moderate deployment - Total (1000 tCO2e/y)							-2,949
Carbon sink potential - Aggressive deployment - Corn-ethanol to energy grasses (1000 tCO2e/y)							-699
Carbon sink potential - Aggressive deployment - Cropland measures (1000 tCO2e/y)							-4,144
Carbon sink potential - Aggressive deployment - Permanent conservation cover (1000 tCO2e/y)							-148
Carbon sink potential - Aggressive deployment - Total (1000 tCO2e/y)							-4,990
Land impacted for carbon sink - Moderate deployment - Corn-ethanol to energy grasses (1000 hectares)							292
Land impacted for carbon sink - Moderate deployment - Cropland measures (1000 hectares)							1,392
Land impacted for carbon sink - Moderate deployment - Permanent conservation cover (1000 hectares)							135
Land impacted for carbon sink - Moderate deployment - Total (1000 hectares)							1,818

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)							292
Land impacted for carbon sink - Aggressive deployment - Cropland measures (1000 hectares)							2,649
Land impacted for carbon sink - Aggressive deployment - Permanent conservation cover (1000 hectares)							269
Land impacted for carbon sink - Aggressive deployment - Total (1000 hectares)							3,209

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)		115	0.107	0.105	0.09	0.062	0.005
Premature deaths from air pollution - Fuel Comb - Electric Generation - Natural Gas (deaths)		29.7	16.9	10	6.95	3.15	1.05
Premature deaths from air pollution - Mobile - On-Road (deaths)		306	307	296	265	210	143
Premature deaths from air pollution - Gas Stations (deaths)		26.7	26.8	25.6	22.8	17.9	12.2
Premature deaths from air pollution - Fuel Comb - Residential - Natural Gas (deaths)		78.6	72.5	65.6	56.7	44.5	30.7
Premature deaths from air pollution - Fuel Comb - Residential - Oil (deaths)		3.92	3.8	3.65	3.23	2.45	1.64
Premature deaths from air pollution - Fuel Comb - Residential - Other (deaths)		10	10.4	10.6	10.1	8.32	6.07
Premature deaths from air pollution - Fuel Comb - Comm/Institutional - Coal (deaths)		5.87	5.62	5.34	5.04	4.73	4.41
Premature deaths from air pollution - Fuel Comb - Comm/Institutional - Natural Gas (deaths)		53.6	51.6	49.1	44.4	37	28
Premature deaths from air pollution - Fuel Comb - Comm/Institutional - Oil (deaths)		4.26	3.89	3.52	3.03	2.48	1.95
Premature deaths from air pollution - Fuel Comb - Comm/Institutional - Other (deaths)		3.76	3.36	2.98	2.61	2.25	1.91
Premature deaths from air pollution - Industrial Processes - Coal Mining (deaths)		1.06	0.382	0.378	0.371	0.369	0.358
Premature deaths from air pollution - Industrial Processes - Oil & Gas Production (deaths)		88.8	80.1	69.1	60.1	52.9	37
Monetary damages from air pollution - Fuel Comb - Electric Generation - Coal (million $2019)		1,018	0.945	0.929	0.796	0.545	0.041
Monetary damages from air pollution - Fuel Comb - Electric Generation - Natural Gas (million $2019)		263	150	88.6	61.6	27.9	9.31
Monetary damages from air pollution - Mobile - On-Road (million $2019)		2,716	2,725	2,633	2,356	1,865	1,273
Monetary damages from air pollution - Gas Stations (million $2019)		237	237	227	202	159	108

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)		696	642	582	502	395	272
Monetary damages from air pollution - Fuel Comb - Residential - Oil (million $2019)		34.7	33.7	32.4	28.6	21.8	14.6
Monetary damages from air pollution - Fuel Comb - Residential - Other (million $2019)		88.9	92.1	93.9	89.4	73.8	53.8
Monetary damages from air pollution - Fuel Comb - Comm/Institutional - Coal (million $2019)		52	49.8	47.3	44.6	41.9	39
Monetary damages from air pollution - Fuel Comb - Comm/Institutional - Natural Gas (million $2019)		474	457	434	393	328	248
Monetary damages from air pollution - Fuel Comb - Comm/Institutional - Oil (million $2019)		37.7	34.4	31.2	26.8	21.9	17.3
Monetary damages from air pollution - Fuel Comb - Comm/Institutional - Other (million $2019)		33.3	29.8	26.4	23.1	19.9	16.9
Monetary damages from air pollution - Industrial Processes - Coal Mining (million $2019)		9.33	3.37	3.34	3.27	3.26	3.16
Monetary damages from air pollution - Industrial Processes - Oil & Gas Production (million $2019)		789	711	614	534	470	329

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

Item	2020	2025	2030	2035	2040	2045	2050
By economic sector - Agriculture (jobs)		797	883	675	387	115	1,702
By economic sector - Construction (jobs)		7,567	9,664	11,084	10,800	12,787	16,493
By economic sector - Manufacturing (jobs)		5,231	5,752	5,539	4,583	4,714	7,077
By economic sector - Mining (jobs)		4,486	3,283	2,434	1,822	1,244	685
By economic sector - Other (jobs)		393	545	1,057	1,002	1,493	1,901
By economic sector - Pipeline (jobs)		903	1,086	653	587	488	598
By economic sector - Professional (jobs)		4,696	5,201	6,320	6,477	7,813	12,817
By economic sector - Trade (jobs)		3,747	3,735	4,303	4,175	4,820	6,574
By economic sector - Utilities (jobs)		9,727	10,605	10,692	11,181	12,614	16,757
By resource sector - Biomass (jobs)		2,216	2,134	1,631	1,058	514	8,123
By resource sector - CO2 (jobs)		0	2,759	282	475	613	2,573
By resource sector - Coal (jobs)		1,528	195	0	0	0	0
By resource sector - Grid (jobs)		8,443	10,633	14,151	14,972	18,608	25,878
By resource sector - Natural Gas (jobs)		9,109	6,712	5,373	5,031	3,886	2,719
By resource sector - Nuclear (jobs)		2,009	1,739	1,712	1,685	1,659	1,633
By resource sector - Oil (jobs)		8,835	7,554	6,475	5,550	4,263	2,531
By resource sector - Solar (jobs)		971	1,286	3,910	2,690	4,744	5,241
By resource sector - Wind (jobs)		4,435	7,741	9,223	9,553	11,802	15,905
By education level - All sectors - High school diploma or less (jobs)		15,595	17,168	17,939	16,973	18,911	26,772
By education level - All sectors - Associates degree or some college (jobs)		11,374	12,567	13,271	12,883	14,692	20,152
By education level - All sectors - Bachelors degree (jobs)		8,281	8,624	8,986	8,657	9,655	13,577
By education level - All sectors - Masters or professional degree (jobs)		2,012	2,098	2,231	2,176	2,458	3,537
By education level - All sectors - Doctoral degree (jobs)		285	297	330	325	373	565

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

Item	2020	2025	2030	2035	2040	2045	2050
Related work experience - All sectors - None (jobs)		5,404	5,905	6,172	5,912	6,632	9,356
Related work experience - All sectors - Up to 1 year (jobs)		7,370	8,089	8,561	8,059	9,003	13,060
Related work experience - All sectors - 1 to 4 years (jobs)		13,636	14,700	15,397	14,833	16,684	23,222
Related work experience - All sectors - 4 to 10 years (jobs)		8,773	9,520	9,980	9,668	10,919	15,048
Related work experience - All sectors - Over 10 years (jobs)		2,363	2,539	2,646	2,543	2,852	3,919
On-the-Job Training - All sectors - None (jobs)		2,062	2,198	2,329	2,214	2,485	3,509
On-the-Job Training - All sectors - Up to 1 year (jobs)		25,077	26,979	28,222	26,900	30,040	42,741
On-the-Job Training - All sectors - 1 to 4 years (jobs)		7,697	8,503	8,936	8,687	9,874	13,393
On-the-Job Training - All sectors - 4 to 10 years (jobs)		2,358	2,685	2,863	2,829	3,260	4,382
On-the-Job Training - All sectors - Over 10 years (jobs)		352	388	407	383	429	579
On-Site or In-Plant Training - All sectors - None (jobs)		6,050	6,554	6,904	6,613	7,462	10,571
On-Site or In-Plant Training - All sectors - Up to 1 year (jobs)		22,722	24,470	25,610	24,433	27,300	38,646
On-Site or In-Plant Training - All sectors - 1 to 4 years (jobs)		5,988	6,598	6,932	6,714	7,611	10,366
On-Site or In-Plant Training - All sectors - 4 to 10 years (jobs)		2,479	2,782	2,942	2,894	3,306	4,453
On-Site or In-Plant Training - All sectors - Over 10 years (jobs)		308	348	368	360	411	567
Wage income - All (million $2019)		2,152	2,343	2,475	2,423	2,750	3,868

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

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Transportation (PJ)	809	757	687	629	583	530	468
Final energy use - Residential (PJ)	562	525	498	472	439	392	339
Final energy use - Commercial (PJ)	316	311	304	297	288	275	260
Final energy use - Industry (PJ)	501	510	521	522	536	546	548

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)		4.21	4.23	5.79	5.99	8.36	8.82

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	232	433	1,366	2,300	4,365	6,431
Vehicle stocks - LDV – All others (1000 units)	8,406	8,406	8,406	7,974	7,541	5,811	4,081
Light-duty vehicle capital costs vs. REF - Cumulative 5-yr (million $2018)		0	260	547	1,847	5,817	8,473
Public EV charging plugs - DC Fast (1000 units)	0.242		0.872		4.63		13
Public EV charging plugs - L2 (1000 units)	0.857		21		111		311

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 (%)	2.17	5.44	8.25	17.5	39.1	65.5	80.9
Sales of space heating units - Electric Resistance (%)	5.77	9.38	9.14	8.42	6.65	4.54	3.4
Sales of space heating units - Gas (%)	85.1	72	69.7	62.4	45	23.5	11
Sales of space heating units - Fossil (%)	6.93	13.2	12.9	11.7	9.27	6.38	4.68
Sales of water heating units - Electric Heat Pump (%)	0	0.449	1.69	5.81	15.8	28.5	36
Sales of water heating units - Electric Resistance (%)	13.3	25.5	26.2	29.4	37	46.8	52.5
Sales of water heating units - Gas Furnace (%)	86.7	74	72	64.7	47.1	24.6	11.4
Sales of water heating units - Other (%)	0.036	0.089	0.089	0.089	0.089	0.089	0.089
Sales of cooking units - Electric Resistance (%)	35.5	37.1	43	58.6	80.3	93.6	98.3
Sales of cooking units - Gas (%)	64.5	62.9	57	41.4	19.7	6.37	1.71
Residential HVAC investment in 2020s vs. REF - Cumulative 5-yr (billion $2018)		7.67	9.61				

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 (%)	0.384	4.93	7.53	16.1	36.4	61.5	76.2
Sales of space heating units - Electric Resistance (%)	1.64	3.4	3.62	4.32	6.01	8.19	9.45
Sales of space heating units - Gas (%)	95.4	88.9	86.3	77.6	56.5	29.8	14.1
Sales of space heating units - Fossil (%)	2.54	2.74	2.58	1.99	1.1	0.499	0.282
Sales of water heating units - Electric Heat Pump (%)	0.161	0.855	2.27	6.98	18.4	32.9	41.5
Sales of water heating units - Electric Resistance (%)	1.64	3.69	5.06	9.72	21	35.3	43.8
Sales of water heating units - Gas (%)	98.1	95.3	92.5	83.1	60.4	31.6	14.6
Sales of water heating units - Other (%)	0.093	0.184	0.185	0.186	0.185	0.186	0.186
Sales of cooking units - Electric Resistance (%)	41	45.8	49.8	60.5	75.4	84.5	87.7
Sales of cooking units - Gas (%)	59	54.2	50.2	39.5	24.6	15.5	12.3
Commercial HVAC investment in 2020s - Cumulative 5-yr (million $2018)		29,338	32,023				

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

Item	2020	2025	2030	2035	2040	2045	2050
Installed thermal - Coal (MW)	8,466	2,384	0	0	0	0	0
Installed thermal - Natural gas (MW)	7,052	8,407	8,334	7,807	5,707	7,034	6,924
Installed thermal - Nuclear (MW)	4,314	3,502	3,502	3,502	3,502	3,502	3,502
Capital invested - Biomass power plant (billion $2018)	0	0	0	0	0	0	0
Capital invested - Biomass w/ccu allam power plant (billion $2018)	0	0	0	0	0	0	0
Capital invested - Biomass w/ccu power plant (billion $2018)	0	0	0	0	0	0	0

Table 57: *E-B+ scenario - PILLAR 2: Clean Electricity - Generation*

Item	2020	2025	2030	2035	2040	2045	2050
Biomass power plant (GWh)	0	0	0	0	0	0	0
Biomass w/ccu 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	0	0	0	0	0	0
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	0	0	0	18
Number of facilities - Diesel (quantity)	0	0	0	0	0	0	1
Number of facilities - Diesel ccu (quantity)	0	0	0	0	0	0	0
Number of facilities - Pyrolysis (quantity)	0	0	0	0	0	0	8
Number of facilities - Pyrolysis ccu (quantity)	0	0	0	0	0	0	1
Number of facilities - Sng (quantity)	0	0	0	0	0	0	1
Number of facilities - Sng ccu (quantity)	0	0	0	0	0	0	0
Conversion capital investment - Cumulative 5-yr (million $2018)		0	0	0	0	0	25,514
Biomass purchases (million $2018/y)		0	0	0	0	0	2,362

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

Item	2020	2025	2030	2035	2040	2045	2050
Annual - All (MMT)		0	3.24	3.35	6.64	6.84	28.4
Annual - BECCS (MMT)		0	0	0	0	0	21.4
Annual - NGCC (MMT)		0	0	0	0	0	0
Annual - Cement and lime (MMT)		0	3.24	3.35	6.64	6.84	7.07
Cumulative - All (MMT)		0	3.24	6.59	13.2	20.1	48.5
Cumulative - BECCS (MMT)		0	0	0	0	0	21.4
Cumulative - NGCC (MMT)		0	0	0	0	0	0
Cumulative - Cement and lime (MMT)		0	3.24	6.59	13.2	20.1	27.1

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

Item	2020	2025	2030	2035	2040	2045	2050
Trunk (km)		0	437	437	437	437	437
Spur (km)		0	201	201	314	314	1,173
All (km)		0	638	638	751	751	1,610
Cumulative investment - Trunk (million $2018)		0	1,376	1,376	1,376	1,716	1,716
Cumulative investment - Spur (million $2018)		0	200	204	315	320	1,128
Cumulative investment - All (million $2018)		0	1,576	1,580	1,691	2,036	2,844

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)							-202
Carbon sink potential - Low - Avoid deforestation (1000 tCO2e/y)							-518
Carbon sink potential - Low - Extend rotation length (1000 tCO2e/y)							-4,236
Carbon sink potential - Low - Improve plantations (1000 tCO2e/y)							-615
Carbon sink potential - Low - Increase retention of HWP (1000 tCO2e/y)							-2,521
Carbon sink potential - Low - Increase trees outside forests (1000 tCO2e/y)							-529
Carbon sink potential - Low - Reforest cropland (1000 tCO2e/y)							-472
Carbon sink potential - Low - Reforest pasture (1000 tCO2e/y)							-361
Carbon sink potential - Low - Restore productivity (1000 tCO2e/y)							-1,529
Carbon sink potential - Low - All (not counting overlap) (1000 tCO2e/y)							-10,983
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO2e/y)							-303
Carbon sink potential - Mid - Avoid deforestation (1000 tCO2e/y)							-1,812
Carbon sink potential - Mid - Extend rotation length (1000 tCO2e/y)							-7,632
Carbon sink potential - Mid - Improve plantations (1000 tCO2e/y)							-901
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO2e/y)							-5,042
Carbon sink potential - Mid - Increase trees outside forests (1000 tCO2e/y)							-1,020
Carbon sink potential - Mid - Reforest cropland (1000 tCO2e/y)							-708
Carbon sink potential - Mid - Reforest pasture (1000 tCO2e/y)							-2,560
Carbon sink potential - Mid - Restore productivity (1000 tCO2e/y)							-3,033
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO2e/y)							-23,011
Carbon sink potential - High - Accelerate regeneration (1000 tCO2e/y)							-403
Carbon sink potential - High - Avoid deforestation (1000 tCO2e/y)							-3,106
Carbon sink potential - High - Extend rotation length (1000 tCO2e/y)							-11,028
Carbon sink potential - High - Improve plantations (1000 tCO2e/y)							-1,209
Carbon sink potential - High - Increase retention of HWP (1000 tCO2e/y)							-7,563
Carbon sink potential - High - Increase trees outside forests (1000 tCO2e/y)							-1,511
Carbon sink potential - High - Reforest cropland (1000 tCO2e/y)							-944
Carbon sink potential - High - Reforest pasture (1000 tCO2e/y)							-4,759
Carbon sink potential - High - All (not counting overlap) (1000 tCO2e/y)							-35,061
Carbon sink potential - High - Restore productivity (1000 tCO2e/y)							-4,537

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)							33
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)							395
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)							2,155
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)							223
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)							75.6
Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares)							31.2
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)							23.4
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)							910
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)							3,845
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)							49.5
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)							408
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)							3,889
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)							335
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)							110
Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares)							46.8
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)							169
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)							1,833
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)							6,840
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)							66
Land impacted for carbon sink potential - High - Avoid deforestation (over 30 years) (1000 hectares)							421

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)							5,624
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)							445
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)							144
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)							62.4
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)							135
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)							1,504
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)							8,401

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 tCO2e/y)							-809
Carbon sink potential - Moderate deployment - Cropland measures (1000 tCO2e/y)							-2,042
Carbon sink potential - Moderate deployment - Permanent conservation cover (1000 tCO2e/y)							-69.1
Carbon sink potential - Moderate deployment - Cropland to woody energy crops (1000 tCO2e/y)							0
Carbon sink potential - Moderate deployment - Pasture to energy crops (1000 tCO2e/y)							0
Carbon sink potential - Moderate deployment - Total (1000 tCO2e/y)							-2,920
Carbon sink potential - Aggressive deployment - Corn-ethanol to energy grasses (1000 tCO2e/y)							-809
Carbon sink potential - Aggressive deployment - Cropland measures (1000 tCO2e/y)							-3,890
Carbon sink potential - Aggressive deployment - Permanent conservation cover (1000 tCO2e/y)							-138
Carbon sink potential - Aggressive deployment - Cropland to woody energy crops (1000 tCO2e/y)							0
Carbon sink potential - Aggressive deployment - Pasture to energy crops (1000 tCO2e/y)							0
Carbon sink potential - Aggressive deployment - Total (1000 tCO2e/y)							-4,837

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)							462
Land impacted for carbon sink - Moderate deployment - Cropland measures (1000 hectares)							1,306
Land impacted for carbon sink - Moderate deployment - Permanent conservation cover (1000 hectares)							126
Land impacted for carbon sink - Moderate deployment - Cropland to woody energy crops (1000 hectares)							9.95
Land impacted for carbon sink - Moderate deployment - Pasture to energy crops (1000 hectares)							39
Land impacted for carbon sink - Moderate deployment - Total (1000 hectares)							1,943
Land impacted for carbon sink - Aggressive deployment - Corn-ethanol to energy grasses (1000 hectares)							462
Land impacted for carbon sink - Aggressive deployment - Cropland measures (1000 hectares)							6,140
Land impacted for carbon sink - Aggressive deployment - Permanent conservation cover (1000 hectares)							251
Land impacted for carbon sink - Aggressive deployment - Cropland to woody energy crops (1000 hectares)							9.95
Land impacted for carbon sink - Aggressive deployment - Pasture to energy crops (1000 hectares)							39
Land impacted for carbon sink - Aggressive deployment - Total (1000 hectares)							6,902

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)		378	231	179	156	148	140
Premature deaths from air pollution - Fuel Comb - Electric Generation - Natural Gas (deaths)		27.2	30.1	40.2	37.9	34.6	30.8
Premature deaths from air pollution - Mobile - On-Road (deaths)		305	310	315	321	327	333
Premature deaths from air pollution - Gas Stations (deaths)		26.6	27	27.2	27.7	28	28.3
Premature deaths from air pollution - Fuel Comb - Residential - Natural Gas (deaths)		78.1	72.6	67.7	64.2	61.8	59.6
Premature deaths from air pollution - Fuel Comb - Residential - Oil (deaths)		3.81	3.27	2.37	1.51	0.816	0.434
Premature deaths from air pollution - Fuel Comb - Residential - Other (deaths)		9.73	10	10.4	10.8	10.7	10.4
Premature deaths from air pollution - Fuel Comb - Comm/Institutional - Coal (deaths)		6.14	6.15	6.13	6.08	6.03	5.94

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)		54.1	52.6	47.9	42.2	38.7	37.8
Premature deaths from air pollution - Fuel Comb - Comm/Institutional - Oil (deaths)		4.39	4.31	4.08	3.75	3.5	3.37
Premature deaths from air pollution - Fuel Comb - Comm/Institutional - Other (deaths)		3.92	3.99	4.06	4.11	4.16	4.21
Premature deaths from air pollution - Industrial Processes - Coal Mining (deaths)		2.35	1.61	1.29	1.22	1.17	1.08
Premature deaths from air pollution - Industrial Processes - Oil & Gas Production (deaths)		89.3	94	96	91.6	90.7	84.7
Monetary damages from air pollution - Fuel Comb - Electric Generation - Coal (million $2019)		3,353	2,045	1,583	1,384	1,308	1,245
Monetary damages from air pollution - Fuel Comb - Electric Generation - Natural Gas (million $2019)		241	267	356	336	306	272
Monetary damages from air pollution - Mobile - On-Road (million $2019)		2,712	2,758	2,801	2,856	2,909	2,963
Monetary damages from air pollution - Gas Stations (million $2019)		236	239	241	245	248	250
Monetary damages from air pollution - Fuel Comb - Residential - Natural Gas (million $2019)		692	643	600	569	548	528
Monetary damages from air pollution - Fuel Comb - Residential - Oil (million $2019)		33.8	29	21	13.4	7.24	3.85
Monetary damages from air pollution - Fuel Comb - Residential - Other (million $2019)		86.2	88.8	92.6	95.4	94.5	92.2
Monetary damages from air pollution - Fuel Comb - Comm/Institutional - Coal (million $2019)		54.3	54.5	54.3	53.9	53.3	52.6
Monetary damages from air pollution - Fuel Comb - Comm/Institutional - Natural Gas (million $2019)		479	466	424	373	343	335
Monetary damages from air pollution - Fuel Comb - Comm/Institutional - Oil (million $2019)		38.9	38.1	36.1	33.2	31	29.8
Monetary damages from air pollution - Fuel Comb - Comm/Institutional - Other (million $2019)		34.7	35.3	35.9	36.4	36.8	37.3
Monetary damages from air pollution - Industrial Processes - Coal Mining (million $2019)		20.8	14.2	11.4	10.7	10.3	9.57
Monetary damages from air pollution - Industrial Processes - Oil & Gas Production (million $2019)		793	835	852	813	806	752

Table 65: *REF scenario - IMPACTS - Jobs*

Item	2020	2025	2030	2035	2040	2045	2050
By economic sector - Agriculture (jobs)		786	765	763	730	730	742
By economic sector - Construction (jobs)		7,184	7,300	8,251	9,286	9,845	9,796
By economic sector - Manufacturing (jobs)		3,600	3,704	3,958	4,342	4,190	3,996
By economic sector - Mining (jobs)		4,737	3,825	3,167	2,569	2,168	1,740

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

Item	2020	2025	2030	2035	2040	2045	2050
By economic sector - Other (jobs)		321	347	423	537	591	658
By economic sector - Pipeline (jobs)		929	970	984	928	939	930
By economic sector - Professional (jobs)		4,390	4,036	4,278	4,871	5,052	4,942
By economic sector - Trade (jobs)		3,779	3,296	3,273	3,474	3,522	3,400
By economic sector - Utilities (jobs)		10,542	9,554	11,053	12,543	12,921	11,834
By resource sector - Biomass (jobs)		2,148	2,060	1,974	1,871	1,858	1,843
By resource sector - CO2 (jobs)		0	0	0	0	0	0
By resource sector - Coal (jobs)		2,411	1,219	845	804	767	294
By resource sector - Grid (jobs)		9,620	9,004	11,456	13,655	14,956	14,402
By resource sector - Natural Gas (jobs)		9,510	9,371	10,307	10,756	10,553	9,594
By resource sector - Nuclear (jobs)		2,009	1,739	1,712	1,685	1,435	1,096
By resource sector - Oil (jobs)		8,870	7,678	6,808	6,280	5,934	5,581
By resource sector - Solar (jobs)			438	569	567	595	1,055
By resource sector - Wind (jobs)		1,700	2,287	2,480	3,662	3,860	4,171
By education level - All sectors - High school diploma or less (jobs)		15,068	14,167	15,229	16,524	16,869	16,143
By education level - All sectors - Associates degree or some college (jobs)		10,985	10,295	11,180	12,294	12,570	11,975
By education level - All sectors - Bachelors degree (jobs)		7,993	7,308	7,626	8,181	8,218	7,743
By education level - All sectors - Masters or professional degree (jobs)		1,952	1,781	1,861	2,007	2,023	1,912
By education level - All sectors - Doctoral degree (jobs)		271	247	254	274	276	264
Related work experience - All sectors - None (jobs)		5,247	4,908	5,280	5,748	5,865	5,597
Related work experience - All sectors - Up to 1 year (jobs)		7,040	6,606	7,058	7,657	7,796	7,469
Related work experience - All sectors - 1 to 4 years (jobs)		13,233	12,278	13,103	14,217	14,448	13,725
Related work experience - All sectors - 4 to 10 years (jobs)		8,489	7,901	8,468	9,227	9,388	8,916
Related work experience - All sectors - Over 10 years (jobs)		2,259	2,103	2,241	2,431	2,460	2,331
On-the-Job Training - All sectors - None (jobs)		1,981	1,831	1,923	2,069	2,089	1,987
On-the-Job Training - All sectors - Up to 1 year (jobs)		24,155	22,435	23,853	25,810	26,182	24,902
On-the-Job Training - All sectors - 1 to 4 years (jobs)		7,473	7,010	7,605	8,339	8,528	8,121
On-the-Job Training - All sectors - 4 to 10 years (jobs)		2,336	2,213	2,440	2,705	2,798	2,683
On-the-Job Training - All sectors - Over 10 years (jobs)		325	309	329	356	360	344
On-Site or In-Plant Training - All sectors - None (jobs)		5,776	5,376	5,718	6,207	6,292	5,988
On-Site or In-Plant Training - All sectors - Up to 1 year (jobs)		21,932	20,377	21,693	23,486	23,840	22,675
On-Site or In-Plant Training - All sectors - 1 to 4 years (jobs)		5,810	5,447	5,896	6,453	6,595	6,283
On-Site or In-Plant Training - All sectors - 4 to 10 years (jobs)		2,451	2,313	2,529	2,786	2,870	2,746
On-Site or In-Plant Training - All sectors - Over 10 years (jobs)		300	285	314	349	361	346
Wage income - All (million $2019)		2,100	1,974	2,136	2,347	2,417	2,324

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

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Transportation (PJ)	808	759	697	659	657	674	697

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

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Residential (PJ)	562	526	505	490	480	473	466
Final energy use - Commercial (PJ)	316	316	313	306	298	298	306
Final energy use - Industry (PJ)	502	527	542	555	576	598	623

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)		4.63	4.71	5.78	5.97	5.98	6.15

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 (%)	1.35	8.6	8.97	9.55	9.94	10.2	10.7
Sales of space heating units - Electric Resistance (%)	5.84	9.06	8.98	8.84	8.56	8.18	7.87
Sales of space heating units - Gas (%)	85.6	70	70	69.8	69.7	69.7	69.7
Sales of space heating units - Fossil (%)	7.19	12.3	12	11.8	11.8	11.8	11.8
Sales of water heating units - Electric Heat Pump (%)	0	0	0	0	0	0	0
Sales of water heating units - Electric Resistance (%)	13.3	25.1	24.9	24.9	24.9	24.8	24.8
Sales of water heating units - Gas Furnace (%)	86.7	74.8	75	75	75	75.1	75.1
Sales of water heating units - Other (%)	0.036	0.089	0.089	0.09	0.09	0.09	0.09
Sales of cooking units - Electric Resistance (%)	34.9	34.9	34.9	34.9	34.9	34.9	34.9
Sales of cooking units - Gas (%)	65.1	65.1	65.1	65.1	65.1	65.1	65.1
Residential HVAC investment in 2020s vs. REF - Cumulative 5-yr (billion $2018)		7.41	7.89				

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 (%)	0.384	11.5	43.9	70.8	75.3	75.8	75.8
Sales of space heating units - Electric Resistance (%)	1.64	4.29	8.99	17.2	22.8	23.7	23.8
Sales of space heating units - Gas (%)	95.4	81.7	45.8	11.7	1.81	0.444	0.359
Sales of space heating units - Fossil (%)	2.54	2.52	1.3	0.232	0.026	0.001	0
Sales of water heating units - Electric Heat Pump (%)	0.161	0.341	0.345	0.344	0.338	0.341	0.34
Sales of water heating units - Electric Resistance (%)	1.64	3.18	3.15	3.16	3.15	3.14	3.14
Sales of water heating units - Gas (%)	98.1	96.3	96.3	96.3	96.3	96.3	96.3
Sales of water heating units - Other (%)	0.093	0.184	0.185	0.186	0.185	0.186	0.186
Sales of cooking units - Electric Resistance (%)	41	44.2	44.3	44.3	44.3	44.4	44.5
Sales of cooking units - Gas (%)	59	55.8	55.7	55.7	55.7	55.6	55.5
Commercial HVAC investment in 2020s - Cumulative 5-yr (million $2018)		29,025	30,109				

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

Item	2020	2025	2030	2035	2040	2045	2050
Installed thermal - Coal (MW)	8,466	4,847	2,384	2,384	2,384	2,384	0
Installed thermal - Natural gas (MW)	7,049	8,929	9,203	13,083	16,416	20,770	20,966
Installed thermal - Nuclear (MW)	4,314	3,502	3,502	3,502	3,502	2,350	2,350
Installed renewables - Rooftop PV (MW)	79.1	119	158	208	269	339	419

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)	76.9	76.9	76.9	76.9	76.9	76.9	76.9
Installed renewables - Wind - Base land use assumptions (MW)	2,489	2,489	4,587	5,175	7,424	7,649	7,841
Installed renewables - Wind - Constrained land use assumptions (MW)	72.8	72.8	72.8	72.8	72.8	72.8	72.8

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

Item	2020	2025	2030	2035	2040	2045	2050
Solar - Base land use assumptions (GWh)	155	155	155	155	155	155	155
Wind - Base land use assumptions (GWh)	9,704	9,704	16,851	18,794	25,463	26,190	26,812
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)	-36.6		-17.7				-15.8
Business-as-usual carbon sink - Retained in Hardwood Products (Mt CO2e/y)	-2.06		-3.7				-3.85
Business-as-usual carbon sink - Total (Mt CO2e/y)	-38.7		-21.4				-19.7

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)							-202
Carbon sink potential - Low - Avoid deforestation (1000 tCO2e/y)							-518
Carbon sink potential - Low - Extend rotation length (1000 tCO2e/y)							-4,236
Carbon sink potential - Low - Improve plantations (1000 tCO2e/y)							-615
Carbon sink potential - Low - Increase retention of HWP (1000 tCO2e/y)							-2,521
Carbon sink potential - Low - Increase trees outside forests (1000 tCO2e/y)							-529
Carbon sink potential - Low - Reforest cropland (1000 tCO2e/y)							-472
Carbon sink potential - Low - Reforest pasture (1000 tCO2e/y)							-361
Carbon sink potential - Low - Restore productivity (1000 tCO2e/y)							-1,529
Carbon sink potential - Low - All (not counting overlap) (1000 tCO2e/y)							-10,983
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO2e/y)							-303
Carbon sink potential - Mid - Avoid deforestation (1000 tCO2e/y)							-1,812
Carbon sink potential - Mid - Extend rotation length (1000 tCO2e/y)							-7,632
Carbon sink potential - Mid - Improve plantations (1000 tCO2e/y)							-901
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO2e/y)							-5,042
Carbon sink potential - Mid - Increase trees outside forests (1000 tCO2e/y)							-1,020

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 tCO2e/y)							-708
Carbon sink potential - Mid - Reforest pasture (1000 tCO2e/y)							-2,560
Carbon sink potential - Mid - Restore productivity (1000 tCO2e/y)							-3,033
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO2e/y)							-23,011
Carbon sink potential - High - Accelerate regeneration (1000 tCO2e/y)							-403
Carbon sink potential - High - Avoid deforestation (1000 tCO2e/y)							-3,106
Carbon sink potential - High - Extend rotation length (1000 tCO2e/y)							-11,028
Carbon sink potential - High - Improve plantations (1000 tCO2e/y)							-1,209
Carbon sink potential - High - Increase retention of HWP (1000 tCO2e/y)							-7,563
Carbon sink potential - High - Increase trees outside forests (1000 tCO2e/y)							-1,511
Carbon sink potential - High - Reforest cropland (1000 tCO2e/y)							-944
Carbon sink potential - High - Reforest pasture (1000 tCO2e/y)							-4,759
Carbon sink potential - High - All (not counting overlap) (1000 tCO2e/y)							-35,061
Carbon sink potential - High - Restore productivity (1000 tCO2e/y)							-4,537
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)							33
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)							395
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)							2,155
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)							223
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)							75.6
Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares)							31.2
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)							23.4
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)							910
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)							3,845
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)							49.5

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)							408
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)							3,889
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)							335
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)							110
Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares)							46.8
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)							169
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)							1,833
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)							6,840
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)							66
Land impacted for carbon sink potential - High - Avoid deforestation (over 30 years) (1000 hectares)							421
Land impacted for carbon sink potential - High - Extend rotation length (1000 hectares)							5,624
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)							445
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)							144
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)							62.4
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)							135
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)							1,504
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)							8,401