

Net-Zero America - District Of Columbia 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:

E. Larson, C. Greig, J. Jenkins, E. Mayfield, A. Pascale, C. Zhang, J. Drossman, R. Williams, S. Pacala, R. Socolow, EJ Baik, R. Birdsey, R. Duke, R. Jones, B. Haley, E. Leslie, K. Paustian, and A. Swan, Net-Zero America: Potential Pathways, Infrastructure, and Impacts, Final Report, Princeton University, Princeton, NJ, 29 October 2021. Report available at https://net-zeroamerica.princeton.edu.

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Table 1: E+ scenario - IMPACTS - Health

Table 1: E+ scenario - IMPACTS - Health Item	2020	2025	2030	2035	2040	2045	2050
Premature deaths from air pollution -	2020	8.25	0.006	0.006	0.005	0.004	2050
Fuel Comb - Electric Generation - Coal (deaths)		0.23	0.000	0.000	0.000	0.004	0
Premature deaths from air pollution - Fuel Comb - Electric Generation - Natural Gas (deaths)		3.65	2.73	1.72	1.58	0.958	0.406
Premature deaths from air pollution - Mobile - On-Road (deaths)		46.2	42.1	31.4	17.9	7.93	2.84
Premature deaths from air pollution - Gas Stations (deaths)		2.74	2.47	1.82	1.05	0.481	0.196
Premature deaths from air pollution - Fuel Comb - Residential - Natural Gas (deaths)		4.89	3.86	2.49	1.33	0.627	0.284
Premature deaths from air pollution - Fuel Comb - Residential - Oil (deaths)		1.49	1.2	0.799	0.453	0.196	0.063
Premature deaths from air pollution - Fuel Comb - Residential - Other (deaths)		0.448	0.395	0.302	0.205	0.121	0.069
Premature deaths from air pollution - Fuel Comb - Comm/Institutional - Coal (deaths)		0.198	0.187	0.176	0.167	0.156	0.145
Premature deaths from air pollution - Fuel Comb - Comm/Institutional - Natural Gas (deaths)		4.63	3.88	2.69	1.59	0.926	0.578
Premature deaths from air pollution - Fuel Comb - Comm/Institutional - Oil (deaths)		1.14	0.899	0.645	0.426	0.279	0.177
Premature deaths from air pollution - Fuel Comb - Comm/Institutional - Other (deaths)		0.464	0.389	0.319	0.25	0.184	0.121
Premature deaths from air pollution - Industrial Processes - Coal Mining (deaths)		0.118	0.067	0.066	0.065	0.065	0.064
Premature deaths from air pollution - Industrial Processes - Oil & Gas Production (deaths)		5.38	4.84	4.16	3.21	2.25	1.32
Monetary damages from air pollution - Fuel Comb - Electric Generation - Coal (million \$2019)		73.1	0.05	0.049	0.045	0.032	0.003
Monetary damages from air pollution - Fuel Comb - Electric Generation - Natural Gas (million \$2019)		32.3	24.2	15.2	14	8.49	3.59
Monetary damages from air pollution - Mobile - On-Road (million \$2019)		411	374	279	160	70.5	25.3
Monetary damages from air pollution - Gas Stations (million \$2019)		24.3	21.9	16.2	9.32	4.26	1.74
Monetary damages from air pollution - Fuel Comb - Residential - Natural Gas (million \$2019)		43.3	34.2	22.1	11.8	5.56	2.52
Monetary damages from air pollution - Fuel Comb - Residential - Oil (million \$2019)		13.2	10.6	7.08	4.02	1.73	0.554
Monetary damages from air pollution - Fuel Comb - Residential - Other (million \$2019)		3.97	3.5	2.68	1.82	1.07	0.614
Monetary damages from air pollution - Fuel Comb - Comm/Institutional - Coal (million \$2019)		1.75	1.65	1.56	1.47	1.38	1.28
Monetary damages from air pollution - Fuel Comb - Comm/Institutional - Natural Gas (million \$2019)		41	34.4	23.8	14.1	8.19	5.12

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

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution -		10.1	7.96	5.71	3.77	2.47	1.57
Fuel Comb - Comm/Institutional - Oil							
(million \$2019)							
Monetary damages from air pollution -		4.1	3.45	2.82	2.22	1.63	1.07
Fuel Comb - Comm/Institutional - Other							
(million \$2019)							
Monetary damages from air pollution -		1.04	0.587	0.581	0.572	0.578	0.567
Industrial Processes - Coal Mining							
(million \$2019)							
Monetary damages from air pollution -		47.8	43	36.9	28.5	20	11.7
Industrial Processes - Oil & Gas							
Production (million \$2019)							

Table 2: E+ scenario - IMPACTS - Jobs

Table 2: E+ scenario - IMPACTS - Jobs							
Item	2020	2025	2030	2035	2040	2045	2050
By economic sector - Agriculture (jobs)		7.81	15.9	6.06	4.7	3.46	2.57
By economic sector - Construction (jobs)		99.2	91.7	176	170	138	139
By economic sector - Manufacturing (jobs)		35.7	33.4	48.8	44.3	34.6	32.9
By economic sector - Mining (jobs)		60	41.4	25.8	14.6	6.81	2.93
By economic sector - Other (jobs)		1.83	2.08	8.47	8.7	7.36	7.68
By economic sector - Pipeline (jobs)		23	19.1	14.8	10.7	6.48	4.14
By economic sector - Professional (jobs)		42.9	42	63.7	59.8	48.3	46.9
By economic sector - Trade (jobs)		33.3	27.2	39.1	35	27.4	26.3
By economic sector - Utilities (jobs)		117	111	264	260	213	215
By resource sector - Biomass (jobs)		33.5	43.7	17.3	14.2	12.6	11
By resource sector - CO2 (jobs)		0	0	0	0	0	0
By resource sector - Grid (jobs)		82.6	97.3	450	469	398	424
By resource sector - Natural Gas (jobs)		220	180	140	103	66.1	42.7
By resource sector - Nuclear (jobs)		0	0	0	0	0	0
By resource sector - Oil (jobs)		84.6	63	39.5	21	8.21	0
By education level - All sectors - High school diploma or less (jobs)		176	165	278	262	210	208
By education level - All sectors -		131	119	211	200	160	158
Associates degree or some college (jobs)							
By education level - All sectors - Bachelors degree (jobs)		89	78.3	124	115	90.5	88.2
By education level - All sectors - Masters or professional degree (jobs)		21.3	19	30.3	28.1	22.3	21.8
By education level - All sectors - Doctoral degree (jobs)		2.84	2.54	3.54	3.21	2.52	2.41
Related work experience - All sectors - None (jobs)		61.8	57.1	96.5	90.7	72.5	71.4
Related work experience - All sectors - Up to 1 year (jobs)		79.1	74.3	124	117	93.8	92.9
Related work experience - All sectors - 1		154	140	234	219	175	172
to 4 years (jobs)							
Related work experience - All sectors - 4 to 10 years (jobs)		99.9	89.6	153	143	114	112
Related work experience - All sectors -		26.1	23.2	39.6	37.1	29.6	29.1
Over 10 years (jobs)		2011	20.2	0,10	0	27.0	27.1
On-the-Job Training - All sectors - None		22.1	19.8	32.1	29.8	23.7	23.3
(jobs)							
On-the-Job Training - All sectors - Up to 1 year (jobs)		275	252	417	390	311	306
On-the-Job Training - All sectors - 1 to 4 years (jobs)		90.3	81.6	144	136	109	107
On-the-Job Training - All sectors - 4 to 10 years (jobs)		29.6	26.9	49	46.4	37.2	36.8

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

Item	2020	2025	2030	2035	2040	2045	2050
On-the-Job Training - All sectors - Over 10 years (jobs)		3.85	3.41	5.5	5.1	4.03	3.93
On-Site or In-Plant Training - All sectors - None (jobs)		66.6	60.8	99.3	92.7	73.8	72.4
On-Site or In-Plant Training - All sectors - Up to 1 year (jobs)		250	229	382	358	286	281
On-Site or In-Plant Training - All sectors - 1 to 4 years (jobs)		69.7	63.1	111	105	83.7	82.7
On-Site or In-Plant Training - All sectors - 4 to 10 years (jobs)		30.7	27.7	49.2	46.4	37.1	36.6
On-Site or In-Plant Training - All sectors - Over 10 years (jobs)		3.69	3.38	6.22	5.91	4.74	4.7
Wage income - All (million \$2019)		28.4	26	43.9	41.5	33.5	33.3

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

Item	2020	2025	2030	2035	2040	2045	2050
Oil consumption - Annual (million bbls)		1.9	1.54	1.05	0.601	0.251	0
Oil consumption - Cumulative (million							33.1
bbls)							
Oil production - Annual (million bbls)		0	0	0	0	0	0
Natural gas consumption - Annual (tcf)		24.4	20.5	16.5	12.4	7.8	5.41
Natural gas consumption - Cumulative							496
(tcf)							
Natural gas production - Annual (tcf)		0	0	0	0	0	0

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

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Transportation (PJ)	31	28.7	26.1	22.8	19.8	18	17.2
Final energy use - Residential (PJ)	19.8	18.7	17.2	15.1	13.5	12.5	12.1
Final energy use - Commercial (PJ)	46	46	43.8	40.6	38.1	37.2	37.7
Final energy use - Industry (PJ)	5.02	4.93	5.03	5.16	5.31	5.5	5.74

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

Item	2020	2025	2030	2035	2040	2045	2050	
Electricity distribution capital invested - Cumulative 5-yr (billion \$2018)		0.425	0.429	0.84	0.893	0.835	0.874	

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

Item	2020	2025	2030	2035	2040	2045	2050
Vehicle stocks - LDV – EV (1000 units)	9.41	37.6	65.9	165	263	342	421
Vehicle stocks - LDV – All others (1000 units)	351	335	318	232	145	82.2	19.1
Light-duty vehicle capital costs vs. REF - Cumulative 5-yr (million \$2018)		66.3	174	275	420	454	434
Public EV charging plugs - DC Fast (1000 units)	0.087		0.099		0.395		0.632
Public EV charging plugs - L2 (1000 units)	0.517		2.37		9.48		15.2

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

Item	2020	2025	2030	2035	2040	2045	2050
Sales of space heating units - Electric	16.5	34.9	77.8	87.4	87.8	87.8	87.7
Heat Pump (%)							
Sales of space heating units - Electric	22.8	22.2	9.26	6.35	6.2	6.29	6.29
Resistance (%)							
Sales of space heating units - Gas (%)	59	40.4	11.8	5.45	5.16	5.18	5.18

Table 7: E+ scenario - PILLAR 1: Efficiency/Electrification - Residential (continued)

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Item	2020	2025	2030	2035	2040	2045	2050
Sales of space heating units - Fossil (%)	1.63	2.49	1.11	0.815	0.808	0.783	0.781
Sales of water heating units - Electric	0	9.33	49.4	58.4	58.8	58.8	58.8
Heat Pump (%)							
Sales of water heating units - Electric	37.1	50.9	42.3	40.4	40.3	40.2	40.2
Resistance (%)							
Sales of water heating units - Gas Furnace	61.4	38.7	7.32	0.309	0	0	0
(%)							
Sales of water heating units - Other (%)	1.49	1.09	0.957	0.942	0.957	0.984	1
Sales of cooking units - Electric	55.7	65.1	94	99.7	100	100	100
Resistance (%)							
Sales of cooking units - Gas (%)	44.3	34.9	5.97	0.3	0	0	0
Residential HVAC investment in 2020s vs.		0.402	0.417				
REF - Cumulative 5-yr (billion \$2018)							

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

Item	2020	2025	2030	2035	2040	2045	2050
Sales of space heating units - Electric	2.05	28.4	70.8	84.1	85.4	85.4	85.4
Heat Pump (%)							
Sales of space heating units - Electric	2.42	8.17	10.2	12.3	12.6	12.7	12.7
Resistance (%)							
Sales of space heating units - Gas (%)	94.5	59.5	18.2	3.63	1.98	1.93	1.91
Sales of space heating units - Fossil (%)	1.05	3.87	0.737	0.031	0	0	0
Sales of water heating units - Electric	0.085	10.5	54.6	64.5	64.9	64.9	64.9
Heat Pump (%)							
Sales of water heating units - Electric	2.17	10.8	28.3	32.3	32.4	32.4	32.4
Resistance (%)							
Sales of water heating units - Gas (%)	96.6	74.7	14.1	0.595	0	0	0
Sales of water heating units - Other (%)	1.11	3.93	2.93	2.68	2.68	2.68	2.68
Sales of cooking units - Electric	32	46	79.9	86.5	86.9	86.9	86.9
Resistance (%)							
Sales of cooking units - Gas (%)	68	54	20.1	13.5	13.1	13.1	13.1
Commercial HVAC investment in 2020s -		5,166	5,788				
Cumulative 5-yr (million \$2018)							

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

	,	0	, ,				
Item	2020	2025	2030	2035	2040	2045	2050
Installed thermal - Natural gas (MW)	10.8	10.8	10.8	10.8	10.8	0	0
Installed thermal - Nuclear (MW)	0	0	0	0	0	0	0
Installed renewables - Rooftop PV (MW)	71.1	107	142	187	242	305	377
Installed renewables - Solar - Base land use assumptions (MW)	7.17	7.17	7.17	7.17	7.17	7.17	7.17
Capital invested - Solar PV - Base (billion \$2018)		0	0	0	0	0	0
Capital invested - Solar PV - Constrained (billion \$2018)		0.01	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)	16	16	16	16	16	16	16
Wind - Base land use assumptions (GWh)	0	0	0	0	0	0	0
OffshoreWind - Base land use	0	0	0	0	0	0	0
assumptions (GWh)							
Solar - Constrained land use assumptions (GWh)	0	0	0	0	0	0	0
Wind - Constrained land use assumptions (GWh)	0	0	0	0	0	0	0

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

			(continuou)				
Item	2020	2025	2030	2035	2040	2045	2050
OffshoreWind - Constrained land use	0	0	0	0	0	0	0
assumptions (GWh)							

Table 11: E+ scenario - PILLAR 4: CCUS - CO2 capture

Item	2020	2025	2030	2035	2040	2045	2050
Annual - All (MMT)		0	0	0	0	0	0
Annual - BECCS (MMT)		0	0	0	0	0	0
Annual - NGCC (MMT)		0	0	0	0	0	0
Annual - Cement and lime (MMT)		0	0	0	0	0	0
Cumulative - All (MMT)		0	0	0	0	0	0
Cumulative - BECCS (MMT)		0	0	0	0	0	0
Cumulative - NGCC (MMT)		0	0	0	0	0	0
Cumulative - Cement and lime (MMT)		0	0	0	0	0	0

Table 12: E+ scenario - PILLAR 4: CCUS - CO2 pipelines

Item	2020	2025	2030	2035	2040	2045	2050
Trunk (km)		0	0	0	0	0	0
Spur (km)		0	0	0	0	0	0
All (km)		0	0	0	0	0	0
Cumulative investment - Trunk (million \$2018)		0	0	0	0	0	0
Cumulative investment - Spur (million \$2018)		0	0	0	0	0	0
Cumulative investment - All (million \$2018)		0	0	0	0	0	0

Table 13: 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 14: E- scenario - IMPACTS - Health

Item	2020	2025	2030	2035	2040	2045	2050
Premature deaths from air pollution -		8.25	0.006	0.006	0.005	0.004	0
Fuel Comb - Electric Generation - Coal							
(deaths)							
Premature deaths from air pollution -		3.8	2.47	1.14	0.556	0.187	0.121
Fuel Comb - Electric Generation - Natural							
Gas (deaths)							
Premature deaths from air pollution -		47.2	47.1	45.2	40.2	31.6	21.2
Mobile - On-Road (deaths)							
Premature deaths from air pollution - Gas		2.81	2.79	2.66	2.36	1.85	1.24
Stations (deaths)							
Premature deaths from air pollution -		4.94	4.45	3.89	3.12	2.23	1.41
Fuel Comb - Residential - Natural Gas							
(deaths)							
Premature deaths from air pollution -		1.52	1.45	1.38	1.2	0.882	0.541
Fuel Comb - Residential - Oil (deaths)							
Premature deaths from air pollution -		0.455	0.451	0.444	0.404	0.323	0.234
Fuel Comb - Residential - Other (deaths)							

Table 14: E- scenario - IMPACTS - Health (continued)

Table 14: E- scenario - IMPACTS - Health (co Item	2020	2025	2030	2035	2040	2045	2050
Premature deaths from air pollution -		0.198	0.187	0.176	0.167	0.156	0.145
Fuel Comb - Comm/Institutional - Coal							
(deaths)							
Premature deaths from air pollution -		4.68	4.5	4.21	3.63	2.81	1.99
Fuel Comb - Comm/Institutional - Natural			-			_	
Gas (deaths)							
Premature deaths from air pollution -		1.15	0.98	0.822	0.665	0.532	0.418
Fuel Comb - Comm/Institutional - Oil		-					
(deaths)							
Premature deaths from air pollution -		0.464	0.417	0.374	0.331	0.288	0.246
Fuel Comb - Comm/Institutional - Other							
(deaths)							
Premature deaths from air pollution -		0.114	0.067	0.066	0.066	0.066	0.063
Industrial Processes - Coal Mining							
(deaths)							
Premature deaths from air pollution -		5.36	4.57	3.62	2.93	2.43	1.74
Industrial Processes - Oil & Gas							
Production (deaths)							
Monetary damages from air pollution -		73.1	0.05	0.049	0.045	0.032	0.003
Fuel Comb - Electric Generation - Coal			0.00	010 17	01010	0.002	0.000
(million \$2019)							
Monetary damages from air pollution -		33.7	21.9	10.1	4.93	1.66	1.07
Fuel Comb - Electric Generation - Natural		00.1	21.7	10.1	4.70	1.00	1.0
Gas (million \$2019)							
Monetary damages from air pollution -		420	418	402	358	281	189
Mobile - On-Road (million \$2019)		420	410	402	550	201	102
Monetary damages from air pollution -		24.8	24.7	23.6	20.9	16.3	1'
Gas Stations (million \$2019)		24.0	24.1	23.0	20.9	10.5	1
Monetary damages from air pollution -		43.8	39.4	34.4	27.6	19.8	12.5
Fuel Comb - Residential - Natural Gas		43.8	39.4	34.4	27.0	19.0	12.5
(million \$2019)							
Monetary damages from air pollution -		13.5	12.8	12.2	10.6	7.01	4.79
Fuel Comb - Residential - Oil (million		13.5	12.0	12.2	10.6	7.81	4.05
\$2019)		(00		0.00	0.50	0.07	0.07
Monetary damages from air pollution -		4.03	4	3.93	3.58	2.86	2.07
Fuel Comb - Residential - Other (million							
\$2019)		175	1.(5	1 5 /	1 / 7	1.00	1.00
Monetary damages from air pollution -		1.75	1.65	1.56	1.47	1.38	1.28
Fuel Comb - Comm/Institutional - Coal							
(million \$2019)				07.0			
Monetary damages from air pollution -		41.4	39.9	37.3	32.1	24.8	17.6
Fuel Comb - Comm/Institutional - Natural							
Gas (million \$2019)							
Monetary damages from air pollution -		10.2	8.67	7.27	5.88	4.71	3.
Fuel Comb - Comm/Institutional - Oil							
(million \$2019)							
Monetary damages from air pollution -		4.1	3.69	3.31	2.93	2.55	2.1
Fuel Comb - Comm/Institutional - Other							
(million \$2019)							
Monetary damages from air pollution -		1.01	0.588	0.585	0.579	0.578	0.554
Industrial Processes - Coal Mining							
(million \$2019)							
Monetary damages from air pollution -		47.6	40.6	32.2	26	21.6	15.5
Industrial Processes - Oil & Gas							
Production (million \$2019)							

Table 15: E- scenario - IMPACTS - Jobs

Item	2020	2025	2030	2035	2040	2045	2050
By economic sector - Agriculture (jobs)		9.52	12.2	4.66	3	2.71	2.6
By economic sector - Construction (jobs)		92.5	82.2	93.2	91.6	177	177

Table 15: E- scenario - IMPACTS - Jobs (continued)

Table 15: E- Scenurio - IMPAG15 - Jobs (col	пстиейј						
Item	2020	2025	2030	2035	2040	2045	2050
By economic sector - Manufacturing		34.5	31.1	31	28.7	47.2	43.6
(jobs)							
By economic sector - Mining (jobs)		60.4	41.6	28.4	19.3	12.5	6.28
By economic sector - Other (jobs)		1.36	1.62	3.13	3.47	9.24	9.51
By economic sector - Pipeline (jobs)		23	18.1	14	11.5	9.18	6.55
By economic sector - Professional (jobs)		40.7	33.5	32.3	31.1	60.7	58.4
By economic sector - Trade (jobs)		32	26.1	25.8	23.1	37.6	34.6
By economic sector - Utilities (jobs)		105	94.5	120	122	267	270
By resource sector - Biomass (jobs)		36.1	32.8	15.5	12.6	11.6	10.7
By resource sector - CO2 (jobs)		0	0	0	0	0	0
By resource sector - Grid (jobs)		57	72	157	179	500	525
By resource sector - Natural Gas (jobs)		220	167	124	100	83.2	61
By resource sector - Nuclear (jobs)		0	0	0	0	0	0
By resource sector - Oil (jobs)		85.9	69.4	56.1	42	28.4	11.2
By education level - All sectors - High		168	147	151	144	270	264
school diploma or less (jobs)							
By education level - All sectors -		124	105	112	108	205	200
Associates degree or some college (jobs)							
By education level - All sectors -		84.8	69.8	69.8	64.8	117	113
Bachelors degree (jobs)							
By education level - All sectors - Masters		20.3	16.7	16.6	15.5	28.7	27.7
or professional degree (jobs)							
By education level - All sectors - Doctoral		2.73	2.19	2.03	1.86	3.24	3.05
degree (jobs)							
Related work experience - All sectors -		58.7	50.7	52.4	49.7	93	90.8
None (jobs)							
Related work experience - All sectors - Up		75.3	65.7	67.3	63.9	120	118
to 1 year (jobs)							
Related work experience - All sectors - 1		146	124	128	121	225	219
to 4 years (jobs)							
Related work experience - All sectors - 4		94.5	79.8	83.2	78.8	147	143
to 10 years (jobs)				01 (071
Related work experience - All sectors -		24.6	20.7	21.6	20.4	38.1	37.1
Over 10 years (jobs)		01	177	17.0	1(0	0.07	007
On-the-Job Training - All sectors - None		21	17.7	17.9	16.8	30.7	29.7
(jobs) On-the-Job Training - All sectors - Up to 1		0(1	00/	000	015	(00	
		261	224	228	215	400	390
year (jobs) On-the-Job Training - All sectors - 1 to 4		85.1	72.5	77.1	73.6	139	137
-		85.1	(2.5	((.1	(3.0	139	137
years (jobs) On-the-Job Training - All sectors - 4 to 10		27.8	23.8	25.8	24.9	47.5	46.7
years (jobs)		21.0	23.0	25.8	24.9	47.5	40.7
On-the-Job Training - All sectors - Over 10		3.67	3.08	3.13	2.93	5.22	5.04
years (jobs)		3.07	3.00	5.15	2.93	5.22	5.04
On-Site or In-Plant Training - All sectors -		63.4	53.9	54.6	51.3	94.8	92.1
None (jobs)		03.4	55.7	54.0	51.5	94.0	72.1
On-Site or In-Plant Training - All sectors -		237	203	209	197	368	358
Up to 1 year (jobs)		201	205	207	171	500	550
On-Site or In-Plant Training - All sectors -		65.7	56.1	59.5	56.8	107	105
1 to 4 years (jobs)		00.1	50.1	57.5	50.0	101	105
On-Site or In-Plant Training - All sectors -		28.9	24.6	26.3	25.2	47.5	46.5
4 to 10 years (jobs)		20.7	24.0	20.0	20.2	-1.0	40.5
On-Site or In-Plant Training - All sectors -		3.45	2.98	3.26	3.15	6.06	5.96
Over 10 years (jobs)		0.40	2.70	0.20	0.10	0.00	0.70
Wage income - All (million \$2019)		27	23.1	24.1	23	43.1	42.4
		<u> </u>	20.1	27.1	20	-0.1	74.7

Table 16: E- scenario - PILLAR 1: Efficiency/Electrification - Overview

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Transportation (PJ)	31.1	29	27.3	25.8	24.6	23.1	21.2

Table 16: E- scenario - PILLAR 1: Efficiency/Electrification - Overview (continued)

			•				
Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Residential (PJ)	19.8	18.8	18.3	17.7	16.6	15.3	14
Final energy use - Commercial (PJ)	46	46.1	45.5	44.7	43.2	41.6	40.7
Final energy use - Industry (PJ)	5.02	4.93	5.04	5.23	5.42	5.65	5.91

Table 17: E- scenario - PILLAR 1: Efficiency/Electrification - Electricity demand

Item	2020	2025	2030	2035	2040	2045	2050
Electricity distribution capital invested - Cumulative 5-yr (billion \$2018)		0.36	0.356	0.467	0.477	0.862	0.916

Table 18: E- scenario - PILLAR 1: Efficiency/Electrification - Transportation

Item	2020	2025	2030	2035	2040	2045	2050
Vehicle stocks - LDV – EV (1000 units)	7.29	15.6	23.8	62.1	100	185	270
Vehicle stocks - LDV – All others (1000 units)	353	353	353	335	316	244	171
Light-duty vehicle capital costs vs. REF - Cumulative 5-yr (million \$2018)		0	11.4	22.4	77.3	238	349
Public EV charging plugs - DC Fast (1000 units)	0.087		0.036		0.151		0.405
Public EV charging plugs - L2 (1000 units)	0.517		0.857		3.61		9.71

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

Item	2020	2025	2030	2035	2040	2045	2050
Sales of space heating units - Electric	16.5	26.6	31.6	45.8	67.3	81.3	86.2
Heat Pump (%)							
Sales of space heating units - Electric	22.8	24.7	23	18.6	12.2	8.08	6.66
Resistance (%)							
Sales of space heating units - Gas (%)	59	45.9	42.7	33.4	19	9.58	6.31
Sales of space heating units - Fossil (%)	1.63	2.76	2.65	2.23	1.53	1.04	0.878
Sales of water heating units - Electric	0	1.61	6.17	19.3	39.5	52.6	57.2
Heat Pump (%)							
Sales of water heating units - Electric	37.1	52.6	51.5	48.6	44.3	41.5	40.6
Resistance (%)							
Sales of water heating units - Gas Furnace	61.4	44.7	41.2	31	15.2	4.85	1.26
(%)							
Sales of water heating units - Other (%)	1.49	1.12	1.13	1.1	1.04	1.01	1.01
Sales of cooking units - Electric	55.5	56.7	60.7	71.5	86.4	95.6	98.8
Resistance (%)							
Sales of cooking units - Gas (%)	44.5	43.3	39.3	28.5	13.6	4.39	1.18
Residential HVAC investment in 2020s vs.		0.401	0.411				
REF - Cumulative 5-yr (billion \$2018)							

Table 20: E- scenario - PILLAR 1: Efficiency/Electrification - Commercial

Item	2020	2025	2030	2035	2040	2045	2050
Sales of space heating units - Electric Heat Pump (%)	2.05	20.4	25.2	39.3	61.5	77.1	83.1
Sales of space heating units - Electric Resistance (%)	2.42	7.86	8.12	8.85	10.2	11.6	12.4
Sales of space heating units - Gas (%)	94.5	67.3	62.5	48.8	26.8	10.8	4.39
Sales of space heating units - Fossil (%)	1.05	4.47	4.15	3.13	1.52	0.487	0.128
Sales of water heating units - Electric Heat Pump (%)	0.085	2.04	7.05	21.5	43.6	58.1	63.1
Sales of water heating units - Electric Resistance (%)	2.17	7.4	9.35	15.1	24	29.7	31.7
Sales of water heating units - Gas (%)	96.6	86.4	79.5	59.7	29.2	9.32	2.43
Sales of water heating units - Other (%)	1.11	4.12	4.12	3.71	3.21	2.85	2.73

Table 20: E- scenario - PILLAR 1: Efficiency/Electrification - Commercial (continued)

Item	2020	2025	2030	2035	2040	2045	2050			
Sales of cooking units - Electric	32	36.2	40.9	53.4	71	81.7	85.5			
Resistance (%)										
Sales of cooking units - Gas (%)	68	63.8	59.1	46.6	29	18.3	14.5			
Commercial HVAC investment in 2020s -		5,159	5,728							
Cumulative 5-yr (million \$2018)										

Table 21: E- scenario - PILLAR 2: Clean Electricity - Generating capacity

Item	2020	2025	2030	2035	2040	2045	2050
Installed thermal - Natural gas (MW)	10.8	10.8	10.8	10.8	10.8	0	0
Installed thermal - Nuclear (MW)	0	0	0	0	0	0	0

Table 22: E+RE+ scenario - IMPACTS - Health

Item	2020	2025	2030	2035	2040	2045	2050
Premature deaths from air pollution - Fuel Comb - Electric Generation - Coal (deaths)		8.25	0.006	0.006	0.005	0.004	0
Premature deaths from air pollution - Fuel Comb - Electric Generation - Natural Gas (deaths)		3.48	2.32	1.49	1.07	0.374	0.066
Premature deaths from air pollution - Mobile - On-Road (deaths)		46.2	42.1	31.4	17.9	7.93	2.84
Premature deaths from air pollution - Gas Stations (deaths)		2.74	2.47	1.82	1.05	0.481	0.196
Premature deaths from air pollution - Fuel Comb - Residential - Natural Gas (deaths)		4.89	3.86	2.49	1.33	0.627	0.284
Premature deaths from air pollution - Fuel Comb - Residential - Oil (deaths)		1.49	1.2	0.799	0.453	0.196	0.063
Premature deaths from air pollution - Fuel Comb - Residential - Other (deaths)		0.448	0.395	0.302	0.205	0.121	0.069
Premature deaths from air pollution - Fuel Comb - Comm/Institutional - Coal (deaths)		0.198	0.187	0.176	0.167	0.156	0.145
Premature deaths from air pollution - Fuel Comb - Comm/Institutional - Natural Gas (deaths)		4.63	3.88	2.69	1.59	0.926	0.578
Premature deaths from air pollution - Fuel Comb - Comm/Institutional - Oil (deaths)		1.14	0.899	0.645	0.426	0.279	0.177
Premature deaths from air pollution - Fuel Comb - Comm/Institutional - Other (deaths)		0.464	0.389	0.319	0.25	0.184	0.121
Premature deaths from air pollution - Industrial Processes - Coal Mining (deaths)		0.126	0.067	0.066	0.065	0.065	0.061
Premature deaths from air pollution - Industrial Processes - Oil & Gas Production (deaths)		5.25	4.73	3.79	2.66	1.48	0.131
Monetary damages from air pollution - Fuel Comb - Electric Generation - Coal (million \$2019)		73.1	0.05	0.049	0.045	0.032	0.003
Monetary damages from air pollution - Fuel Comb - Electric Generation - Natural Gas (million \$2019)		30.8	20.5	13.2	9.44	3.32	0.589
Monetary damages from air pollution - Mobile - On-Road (million \$2019)		411	374	279	160	70.5	25.3
Monetary damages from air pollution - Gas Stations (million \$2019)		24.3	21.9	16.2	9.32	4.26	1.74

Table 22: E+RE+ scenario - IMPACTS - Health (continued)

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Fuel Comb - Residential - Natural Gas (million \$2019)		43.3	34.2	22.1	11.8	5.56	2.52
Monetary damages from air pollution - Fuel Comb - Residential - Oil (million \$2019)		13.2	10.6	7.08	4.02	1.73	0.554
Monetary damages from air pollution - Fuel Comb - Residential - Other (million \$2019)		3.97	3.5	2.68	1.82	1.07	0.614
Monetary damages from air pollution - Fuel Comb - Comm/Institutional - Coal (million \$2019)		1.75	1.65	1.56	1.47	1.38	1.28
Monetary damages from air pollution - Fuel Comb - Comm/Institutional - Natural Gas (million \$2019)		41	34.4	23.8	14.1	8.19	5.12
Monetary damages from air pollution - Fuel Comb - Comm/Institutional - Oil (million \$2019)		10.1	7.96	5.71	3.77	2.47	1.57
Monetary damages from air pollution - Fuel Comb - Comm/Institutional - Other (million \$2019)		4.1	3.45	2.82	2.22	1.63	1.07
Monetary damages from air pollution - Industrial Processes - Coal Mining (million \$2019)		1.11	0.587	0.58	0.571	0.577	0.538
Monetary damages from air pollution - Industrial Processes - Oil & Gas Production (million \$2019)		46.6	42	33.6	23.7	13.1	1.16

Table 23: E+RE+ scenario - IMPACTS - Jobs

Item	2020	2025	2030	2035	2040	2045	2050
By economic sector - Agriculture (jobs)		7.86	16.3	6.03	3.84	3.1	2.27
By economic sector - Construction (jobs)		96.7	88.1	167	158	128	133
By economic sector - Manufacturing (jobs)		34.8	32.8	46.7	41	31.2	31.9
By economic sector - Mining (jobs)		58.7	39.8	22	10.1	3.19	1.73
By economic sector - Other (jobs)		1.82	2.04	8.46	8.68	7.33	7.68
By economic sector - Pipeline (jobs)		22.2	18.1	12.1	7.36	3.8	2.44
By economic sector - Professional (jobs)		41	43.2	61.9	57.5	46.3	45.9
By economic sector - Trade (jobs)		32.1	26.7	37.3	32.6	24.9	25.6
By economic sector - Utilities (jobs)		114	107	254	248	204	209
By resource sector - Biomass (jobs)		30.6	46	16.2	12.5	11.5	10
By resource sector - CO2 (jobs)		0	0	0	0	0	0
By resource sector - Grid (jobs)		82.6	96.4	450	469	398	424
By resource sector - Natural Gas (jobs)		211	170	113	71	42.7	25.2
By resource sector - Nuclear (jobs)		0	0	0	0	0	0
By resource sector - Oil (jobs)		84.6	61.7	36.8	14.9	0	0
By education level - All sectors - High school diploma or less (jobs)		172	161	265	245	196	200
By education level - All sectors - Associates degree or some college (jobs)		128	115	201	187	149	151
By education level - All sectors - Bachelors degree (jobs)		86.4	76.7	118	107	84.1	84.8
By education level - All sectors - Masters or professional degree (jobs)		20.7	18.7	28.9	26.4	20.9	21
By education level - All sectors - Doctoral degree (jobs)		2.74	2.54	3.37	3	2.34	2.32
Related work experience - All sectors - None (jobs)		60.1	55.5	91.8	84.6	67.5	68.5
Related work experience - All sectors - Up to 1 year (jobs)		77	72.5	118	109	87.7	89.5

Table 23: E+RE+ scenario - IMPACTS - Jobs (continued)

Item	2020	2025	2030	2035	2040	2045	2050
Related work experience - All sectors - 1 to 4 years (jobs)		150	136	223	205	163	165
Related work experience - All sectors - 4 to 10 years (jobs)		97.2	87.2	145	134	106	108
Related work experience - All sectors - Over 10 years (jobs)		25.3	22.6	37.6	34.6	27.6	28
On-the-Job Training - All sectors - None (jobs)		21.5	19.3	30.5	27.9	22.1	22.4
On-the-Job Training - All sectors - Up to 1 year (jobs)		267	246	397	365	290	295
On-the-Job Training - All sectors - 1 to 4 years (jobs)		88	79.1	137	127	102	103
On-the-Job Training - All sectors - 4 to 10 years (jobs)		28.8	26	46.4	43.3	34.7	35.2
On-the-Job Training - All sectors - Over 10 years (jobs)		3.75	3.3	5.19	4.71	3.71	3.75
On-Site or In-Plant Training - All sectors - None (jobs)		64.8	59.4	94.4	86.5	68.7	69.5
On-Site or In-Plant Training - All sectors - Up to 1 year (jobs)		243	223	363	334	266	271
On-Site or In-Plant Training - All sectors - 1 to 4 years (jobs)		67.8	61.3	106	97.8	78.1	79.4
On-Site or In-Plant Training - All sectors - 4 to 10 years (jobs)		29.8	26.8	46.6	43.2	34.5	35
On-Site or In-Plant Training - All sectors - Over 10 years (jobs)		3.58	3.27	5.9	5.52	4.44	4.51
Wage income - All (million \$2019)		27.7	25.4	41.7	38.7	31.1	32

Table 24: E+RE+ scenario - PILLAR 1: Efficiency/Electrification - Overview

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Transportation (PJ)	31	28.7	26.1	22.8	19.8	18	17.2
Final energy use - Residential (PJ)	19.8	18.7	17.2	15.1	13.5	12.5	12.1
Final energy use - Commercial (PJ)	46	46	43.8	40.6	38.1	37.2	37.7
Final energy use - Industry (PJ)	5.02	4.93	5.03	5.16	5.31	5.5	5.74

Table 25: E+RE+ scenario - PILLAR 1: Efficiency/Electrification - Electricity demand

	/						
Item	2020	2025	2030	2035	2040	2045	2050
Electricity distribution capital invested - Cumulative 5-yr (billion \$2018)		0.425	0.429	0.84	0.893	0.835	0.874

Table 26: E+RE+ scenario - PILLAR 1: Efficiency/Electrification - Transportation

Item	2020	2025	2030	2035	2040	2045	2050
Vehicle stocks - LDV – EV (1000 units)	9.41	37.6	65.9	165	263	342	421
Vehicle stocks - LDV – All others (1000 units)	351	335	318	232	145	82.2	19.1
Light-duty vehicle capital costs vs. REF - Cumulative 5-yr (million \$2018)		66.3	174	275	420	454	434
Public EV charging plugs - DC Fast (1000 units)	0.087		0.099		0.395		0.632
Public EV charging plugs - L2 (1000 units)	0.517		2.37		9.48		15.2

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

Item	2020	2025	2030	2035	2040	2045	2050
Sales of space heating units - Electric	16.5	34.9	77.8	87.4	87.8	87.8	87.7
Heat Pump (%)							

Table 27: E+RE+ scenario - PILLAR 1: Efficiency/Electrification - Residential (continued)

	-					
2020	2025	2030	2035	2040	2045	2050
22.8	22.2	9.26	6.35	6.2	6.29	6.29
59	40.4	11.8	5.45	5.16	5.18	5.18
1.63	2.49	1.11	0.815	0.808	0.783	0.781
0	9.33	49.4	58.4	58.8	58.8	58.8
37.1	50.9	42.3	40.4	40.3	40.2	40.2
61.4	38.7	7.32	0.309	0	0	0
1.49	1.09	0.957	0.942	0.957	0.984	1
55.7	65.1	94	99.7	100	100	100
44.3	34.9	5.97	0.3	0	0	0
	0.402	0.417				
	2020 22.8 59 1.63 0 37.1 61.4 1.49 55.7	2020 2025 22.8 22.2 59 40.4 1.63 2.49 0 9.33 37.1 50.9 61.4 38.7 1.49 1.09 55.7 65.1 44.3 34.9	2020 2025 2030 22.8 22.2 9.26 59 40.4 11.8 1.63 2.49 1.11 0 9.33 49.4 37.1 50.9 42.3 61.4 38.7 7.32 1.49 1.09 0.957 55.7 65.1 94 44.3 34.9 5.97	2020 2025 2030 2035 22.8 22.2 9.26 6.35 59 40.4 11.8 5.45 1.63 2.49 1.11 0.815 0 9.33 49.4 58.4 37.1 50.9 42.3 40.4 61.4 38.7 7.32 0.309 1.49 1.09 0.957 0.942 55.7 65.1 94 99.7 44.3 34.9 5.97 0.3	$\begin{array}{c c c c c c c c c c c c c c c c c c c $	$\begin{array}{c c c c c c c c c c c c c c c c c c c $

Table 28: E+RE+ scenario - PILLAR 1: Efficiency/Electrification - Commercial

Item	2020	2025	2030	2035	2040	2045	2050
Sales of space heating units - Electric	2.05	28.4	70.8	84.1	85.4	85.4	85.4
Heat Pump (%)							
Sales of space heating units - Electric	2.42	8.17	10.2	12.3	12.6	12.7	12.7
Resistance (%)							
Sales of space heating units - Gas (%)	94.5	59.5	18.2	3.63	1.98	1.93	1.91
Sales of space heating units - Fossil (%)	1.05	3.87	0.737	0.031	0	0	0
Sales of water heating units - Electric	0.085	10.5	54.6	64.5	64.9	64.9	64.9
Heat Pump (%)							
Sales of water heating units - Electric	2.17	10.8	28.3	32.3	32.4	32.4	32.4
Resistance (%)							
Sales of water heating units - Gas (%)	96.6	74.7	14.1	0.595	0	0	0
Sales of water heating units - Other (%)	1.11	3.93	2.93	2.68	2.68	2.68	2.68
Sales of cooking units - Electric	32	46	79.9	86.5	86.9	86.9	86.9
Resistance (%)							
Sales of cooking units - Gas (%)	68	54	20.1	13.5	13.1	13.1	13.1
Commercial HVAC investment in 2020s -		5,166	5,788				
Cumulative 5-yr (million \$2018)							

Table 29: E+RE+ scenario - PILLAR 2: Clean Electricity - Generating capacity

Item	2020	2025	2030	2035	2040	2045	2050
Installed thermal - Natural gas (MW)	10.8	10.8	10.8	10.8	10.8	0	0
Installed thermal - Nuclear (MW)	0	0	0	0	0	0	0
Installed renewables - Rooftop PV (MW)	71.1	107	142	187	242	305	377
Installed renewables - Solar - Base land use assumptions (MW)	7.17	7.17	7.17	7.17	7.17	7.17	7.17
Installed renewables - Solar - Constrained land use assumptions (MW)	7.18	7.18	7.18	7.18	7.18	7.18	7.18
Installed renewables - Wind - Constrained land use assumptions (MW)	0	0	0	0	0	0	0
Installed renewables - Offshore Wind - Constrained land use assumptions (MW)	0	0	0	0	0	0	0

Table 30: E+RE+ scenario - PILLAR 2: Clean Electricity - Generation

		.,					
Item	2020	2025	2030	2035	2040	2045	2050
Solar - Base land use assumptions (GWh)	16	16	16	16	16	16	16
Wind - Base land use assumptions (GWh)	0	0	0	0	0	0	0
OffshoreWind - Base land use	0	0	0	0	0	0	0
assumptions (GWh)							

Table 30: E+RE+ scenario - PILLAR 2: Clean Electricity - Generation (continued)

		cy denera		acaj			
Item	2020	2025	2030	2035	2040	2045	2050
Solar - Constrained land use assumptions (GWh)	32.1	32.1	32.1	32.1	32.1	32.1	32.1
Wind - Constrained land use assumptions (GWh)	0	0	0	0	0	0	0
OffshoreWind - Constrained land use assumptions (GWh)	0	0	0	0	0	0	0

Table 31: E+RE- scenario - IMPACTS - Health

Table 31: E+RE- scenario - IMPACTS - Healt Item	2020	2025	2030	2035	2040	2045	2050
Premature deaths from air pollution -	2020	8.25	0.006	0.006	0.005	0.004	2030
Fuel Comb - Electric Generation - Coal		0.25	0.006	0.006	0.005	0.004	U
(deaths)		0.00	1.07	0.11	1 (0 5 5 1	0 170
Premature deaths from air pollution -		2.38	1.87	2.11	1.6	0.551	0.178
Fuel Comb - Electric Generation - Natural							
Gas (deaths)							
Premature deaths from air pollution -		46.2	42.1	31.4	17.9	7.93	2.84
Mobile - On-Road (deaths)							
Premature deaths from air pollution - Gas		2.74	2.47	1.82	1.05	0.481	0.196
Stations (deaths)							
Premature deaths from air pollution -		4.89	3.86	2.49	1.33	0.627	0.284
Fuel Comb - Residential - Natural Gas							
(deaths)							
Premature deaths from air pollution -		1.49	1.2	0.799	0.453	0.196	0.063
Fuel Comb - Residential - Oil (deaths)							
Premature deaths from air pollution -		0.448	0.395	0.302	0.205	0.121	0.069
Fuel Comb - Residential - Other (deaths)							
Premature deaths from air pollution -		0.198	0.187	0.176	0.167	0.156	0.145
Fuel Comb - Comm/Institutional - Coal							
(deaths)							
Premature deaths from air pollution -		4.63	3.88	2.69	1.59	0.926	0.578
Fuel Comb - Comm/Institutional - Natural							
Gas (deaths)							
Premature deaths from air pollution -		1.14	0.899	0.645	0.426	0.279	0.177
Fuel Comb - Comm/Institutional - Oil				0.0.0	01.120	0.2.7	•
(deaths)							
Premature deaths from air pollution -		0.464	0.389	0.319	0.25	0.184	0.121
Fuel Comb - Comm/Institutional - Other				0.017	0.20		0
(deaths)							
Premature deaths from air pollution -		0.11	0.066	0.066	0.065	0.065	0.061
Industrial Processes - Coal Mining		0	0.000	0.000	0.000	0.000	0.001
(deaths)							
Premature deaths from air pollution -		5.48	5.15	4.97	4.34	3.63	2.71
Industrial Processes - Oil & Gas		0.40	0.10	4.71	4.04	0.00	2.11
Production (deaths)							
Monetary damages from air pollution -		73.1	0.05	0.049	0.045	0.032	0.003
Fuel Comb - Electric Generation - Coal		10.1	0.00	0.047	0.043	0.002	0.000
(million \$2019)							
Monetary damages from air pollution -		21.1	16.5	18.7	14.2	4.88	1.57
Fuel Comb - Electric Generation - Natural		21.1	10.5	10.1	14.2	4.00	1.01
Gas (million \$2019)							
Monetary damages from air pollution -		411	374	279	160	70.5	25.3
Mobile - On-Road (million \$2019)		411	574	219	100	70.5	20.5
		24.3	21.9	16.2	0.00	(0(1.74
Monetary damages from air pollution - Gas Stations (million \$2019)		24.3	21.9	10.2	9.32	4.26	1.(4
		(0.0	0/ 0	00.1	11.0		0.50
Monetary damages from air pollution -		43.3	34.2	22.1	11.8	5.56	2.52
Fuel Comb - Residential - Natural Gas							
(million \$2019)							0.557
Monetary damages from air pollution -		13.2	10.6	7.08	4.02	1.73	0.554
Fuel Comb - Residential - Oil (million							
\$2019)							

Table 31: *E*+*RE*- scenario - *IMPACTS* - *Health* (continued)

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Fuel Comb - Residential - Other (million \$2019)		3.97	3.5	2.68	1.82	1.07	0.614
Monetary damages from air pollution - Fuel Comb - Comm/Institutional - Coal (million \$2019)		1.75	1.65	1.56	1.47	1.38	1.28
Monetary damages from air pollution - Fuel Comb - Comm/Institutional - Natural Gas (million \$2019)		41	34.4	23.8	14.1	8.19	5.12
Monetary damages from air pollution - Fuel Comb - Comm/Institutional - Oil (million \$2019)		10.1	7.96	5.71	3.77	2.47	1.57
Monetary damages from air pollution - Fuel Comb - Comm/Institutional - Other (million \$2019)		4.1	3.45	2.82	2.22	1.63	1.07
Monetary damages from air pollution - Industrial Processes - Coal Mining (million \$2019)		0.967	0.587	0.581	0.572	0.578	0.538
Monetary damages from air pollution - Industrial Processes - Oil & Gas Production (million \$2019)		48.7	45.7	44.1	38.6	32.2	24

Table 32: E+RE- scenario - IMPACTS - Jobs

Table 52. L+RL- Scenario - IMPACIS - Jubs				0005			
Item	2020	2025	2030	2035	2040	2045	2050
By economic sector - Agriculture (jobs)		8.94	12.8	4.28	3.53	3.25	2.82
By economic sector - Construction (jobs)		102	96.6	189	188	159	161
By economic sector - Manufacturing		35.8	33	50.8	47.3	38.4	37.4
(jobs)							
By economic sector - Mining (jobs)		61.3	43.5	30.4	20.1	12.4	7.66
By economic sector - Other (jobs)		1.82	2.08	8.49	8.71	7.37	7.82
By economic sector - Pipeline (jobs)		23.7	20.5	18.8	16.3	12.8	10.2
By economic sector - Professional (jobs)		41.5	36.6	64.3	61.8	50.9	50.4
By economic sector - Trade (jobs)		32.3	26.8	40.8	37.3	30.1	29.4
By economic sector - Utilities (jobs)		120	117	280	281	237	242
By resource sector - Biomass (jobs)		31.3	32.8	14.7	13.2	12.7	11.7
By resource sector - CO2 (jobs)		0	0	0	0	0	0
By resource sector - Grid (jobs)		82.6	97.3	450	469	398	428
By resource sector - Natural Gas (jobs)		229	196	182	162	131	106
By resource sector - Nuclear (jobs)		0	0	0	0	0	0
By resource sector - Oil (jobs)		84.6	63	39.5	21	9.55	2.83
By education level - All sectors - High		180	167	294	286	238	238
school diploma or less (jobs)							
By education level - All sectors -		134	122	225	219	183	182
Associates degree or some college (jobs)							
By education level - All sectors -		89.6	78.2	131	125	103	101
Bachelors degree (jobs)							
By education level - All sectors - Masters		21.4	18.7	32	30.5	25.1	24.7
or professional degree (jobs)							
By education level - All sectors - Doctoral		2.82	2.4	3.7	3.46	2.82	2.73
degree (jobs)							
Related work experience - All sectors -		62.9	58	102	99.4	82.6	82.2
None (jobs)							
Related work experience - All sectors - Up		80.3	74.5	131	127	106	106
to 1 year (jobs)							
Related work experience - All sectors - 1		156	141	248	240	199	197
to 4 years (jobs)							
Related work experience - All sectors - 4		101	91.3	163	158	131	130
to 10 years (jobs)							

Table 32: E+RE- scenario - IMPACTS - Jobs (continued)

Item	2020	2025	2030	2035	2040	2045	2050
Related work experience - All sectors - Over 10 years (jobs)		26.4	23.6	42.1	40.7	33.7	33.5
On-the-Job Training - All sectors - None (jobs)		22.3	19.9	34	32.6	26.9	26.7
On-the-Job Training - All sectors - Up to 1 year (jobs)		278	253	440	425	352	350
On-the-Job Training - All sectors - 1 to 4 years (jobs)		92.1	83.9	154	150	125	124
On-the-Job Training - All sectors - 4 to 10 years (jobs)		30.3	27.9	52.5	51.5	43	42.9
On-the-Job Training - All sectors - Over 10 years (jobs)		3.92	3.5	5.9	5.67	4.69	4.63
On-Site or In-Plant Training - All sectors - None (jobs)		67.6	61.1	105	101	84	83.3
On-Site or In-Plant Training - All sectors - Up to 1 year (jobs)		253	231	404	390	324	322
On-Site or In-Plant Training - All sectors - 1 to 4 years (jobs)		71	64.8	118	115	95.8	95.4
On-Site or In-Plant Training - All sectors - 4 to 10 years (jobs)		31.3	28.7	52.7	51.5	42.9	42.7
On-Site or In-Plant Training - All sectors - Over 10 years (jobs)		3.76	3.48	6.64	6.51	5.44	5.43
Wage income - All (million \$2019)		28.9	26.3	46.6	45.5	38.2	38.3

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

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Transportation (PJ)	31	28.7	26.1	22.8	19.8	18	17.2
Final energy use - Residential (PJ)	19.8	18.7	17.2	15.1	13.5	12.5	12.1
Final energy use - Commercial (PJ)	46	46	43.8	40.6	38.1	37.2	37.7
Final energy use - Industry (PJ)	5.02	4.93	5.03	5.16	5.31	5.5	5.74

Table 34: E+RE- scenario - PILLAR 1: Efficiency/Electrification - Electricity demand

	,, =						
Item	2020	2025	2030	2035	2040	2045	2050
Electricity distribution capital invested - Cumulative 5-yr (billion \$2018)		0.425	0.429	0.84	0.893	0.835	0.874

Table 35: E+RE- scenario - PILLAR 1: Efficiency/Electrification - Transportation

Item	2020	2025	2030	2035	2040	2045	2050
Vehicle stocks - LDV – EV (1000 units)	9.41	37.6	65.9	165	263	342	421
Vehicle stocks - LDV – All others (1000 units)	351	335	318	232	145	82.2	19.1
Light-duty vehicle capital costs vs. REF - Cumulative 5-yr (million \$2018)		66.3	174	275	420	454	434
Public EV charging plugs - DC Fast (1000 units)	0.087		0.099		0.395		0.632
Public EV charging plugs - L2 (1000 units)	0.517		2.37		9.48		15.2

Table 36: E+RE- scenario - PILLAR 1: Efficiency/Electrification - Residential

Item	2020	2025	2030	2035	2040	2045	2050
Sales of space heating units - Electric	16.5	34.9	77.8	87.4	87.8	87.8	87.7
Heat Pump (%)							
Sales of space heating units - Electric	22.8	22.2	9.26	6.35	6.2	6.29	6.29
Resistance (%)							
Sales of space heating units - Gas (%)	59	40.4	11.8	5.45	5.16	5.18	5.18
Sales of space heating units - Fossil (%)	1.63	2.49	1.11	0.815	0.808	0.783	0.781

Table 36: E+RE- scenario - PILLAR 1: Efficiency/Electrification - Residential (continued)

Item	2020	2025	2030	2035	2040	2045	2050
Sales of water heating units - Electric Heat Pump (%)	0	9.33	49.4	58.4	58.8	58.8	58.8
Sales of water heating units - Electric Resistance (%)	37.1	50.9	42.3	40.4	40.3	40.2	40.2
Sales of water heating units - Gas Furnace (%)	61.4	38.7	7.32	0.309	0	0	0
Sales of water heating units - Other (%)	1.49	1.09	0.957	0.942	0.957	0.984	1
Sales of cooking units - Electric Resistance (%)	55.7	65.1	94	99.7	100	100	100
Sales of cooking units - Gas (%)	44.3	34.9	5.97	0.3	0	0	0
Residential HVAC investment in 2020s vs. REF - Cumulative 5-yr (billion \$2018)		0.402	0.417				

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

Item	2020	2025	2030	2035	2040	2045	2050
Sales of space heating units - Electric	2.05	28.4	70.8	84.1	85.4	85.4	85.4
Heat Pump (%)							
Sales of space heating units - Electric	2.42	8.17	10.2	12.3	12.6	12.7	12.7
Resistance (%)							
Sales of space heating units - Gas (%)	94.5	59.5	18.2	3.63	1.98	1.93	1.91
Sales of space heating units - Fossil (%)	1.05	3.87	0.737	0.031	0	0	0
Sales of water heating units - Electric	0.085	10.5	54.6	64.5	64.9	64.9	64.9
Heat Pump (%)							
Sales of water heating units - Electric	2.17	10.8	28.3	32.3	32.4	32.4	32.4
Resistance (%)							
Sales of water heating units - Gas (%)	96.6	74.7	14.1	0.595	0	0	0
Sales of water heating units - Other (%)	1.11	3.93	2.93	2.68	2.68	2.68	2.68
Sales of cooking units - Electric	32	46	79.9	86.5	86.9	86.9	86.9
Resistance (%)							
Sales of cooking units - Gas (%)	68	54	20.1	13.5	13.1	13.1	13.1
Commercial HVAC investment in 2020s -		5,166	5,788				
Cumulative 5-yr (million \$2018)							

Table 38: E+RE- scenario - PILLAR 2: Clean Electricity - Generating capacity

Item	2020	2025	2030	2035	2040	2045	2050
Installed thermal - Natural gas (MW)	10.8	10.8	10.8	10.8	10.8	0	10.8
Installed thermal - Nuclear (MW)	0	0	0	0	0	0	0
Installed renewables - Rooftop PV (MW)	71.1	107	142	187	242	305	377
Installed renewables - Solar - Base land use assumptions (MW)	7.17	7.17	7.17	7.17	7.17	7.17	7.17
Installed renewables - Solar -	7.18	7.18	7.18	7.18	7.18	7.18	7.18
Constrained land use assumptions (MW)							
Installed renewables - Wind - Constrained land use assumptions (MW)	0	0	0	0	0	0	0
Installed renewables - Offshore Wind - Constrained land use assumptions (MW)	0	0	0	0	0	0	0
Capital invested - Solar PV - Base (billion \$2018)		0	0	0	0	0	0
Capital invested - Solar PV - Constrained (billion \$2018)		0	0	0	0	0	0

Table 39: E+RE- scenario - PILLAR 2: Clean Electricity - Generation

		,					
Item	2020	2025	2030	2035	2040	2045	2050
Solar - Base land use assumptions (GWh)	16	16	16	16	16	16	16
Wind - Base land use assumptions (GWh)	0	0	0	0	0	0	0
OffshoreWind - Base land use	0	0	0	0	0	0	0
assumptions (GWh)							

Table 39: E+RE- scenario - PILLAR 2: Clean Electricity - Generation (continued)

		,					
Item	2020	2025	2030	2035	2040	2045	2050
Solar - Constrained land use assumptions (GWh)	16	16	16	16	16	16	16
Wind - Constrained land use assumptions (GWh)	0	0	0	0	0	0	0
OffshoreWind - Constrained land use assumptions (GWh)	0	0	0	0	0	0	0

Table 40: E-B+ scenario - IMPACTS - Health

Table 40: E-B+ scenario - IMPACTS - Health	2020	2025	2030	2035	2040	2045	2050
Item	2020						
Premature deaths from air pollution - Fuel Comb - Electric Generation - Coal		8.25	0.006	0.006	0.005	0.004	0
(deaths)							
Premature deaths from air pollution -		3.64	2.25	1.32	1.07	0.636	0.184
Fuel Comb - Electric Generation - Natural		3.04	2.25	1.52	1.07	0.030	0.104
Gas (deaths)							
Premature deaths from air pollution -		47.2	47.1	45.2	40.2	31.6	21.2
Mobile - On-Road (deaths)		41.2	41.1	40.2	40.2	51.0	21.2
Premature deaths from air pollution - Gas		2.81	2.79	2.66	2.36	1.85	1.24
Stations (deaths)		2.01	2.17	2.00	2.30	1.00	1.24
Premature deaths from air pollution -		4.94	4.45	3.89	3.12	2.23	1.41
Fuel Comb - Residential - Natural Gas		4.74	4.45	5.09	5.12	2.25	1.41
(deaths)							
Premature deaths from air pollution -		1.52	1.45	1.38	1.2	0.882	0.541
Fuel Comb - Residential - Oil (deaths)		1.52	1.45	1.50	1.2	0.882	0.041
Premature deaths from air pollution -		0.455	0.451	0.444	0.404	0.323	0.234
Fuel Comb - Residential - Other (deaths)		0.455	0.451	0.444	0.404	0.323	0.234
Premature deaths from air pollution -		0.198	0.187	0.176	0.167	0.156	0.145
Fuel Comb - Comm/Institutional - Coal		0.190	0.167	0.170	0.167	0.156	0.145
(deaths)							
Premature deaths from air pollution -		1. 69	/ E	4.21	3.63	2.81	1.99
Fuel Comb - Comm/Institutional - Natural		4.68	4.5	4.21	3.63	2.01	1.99
Gas (deaths)							
Premature deaths from air pollution -		115	0.98	0.822	0.665	0.532	0.418
		1.15	0.98	0.822	0.665	0.532	0.418
Fuel Comb - Comm/Institutional - Oil							
(deaths) Premature deaths from air pollution -		0.464	0.417	0.374	0.331	0.288	0.246
-		0.464	0.417	0.374	0.331	0.288	0.246
Fuel Comb - Comm/Institutional - Other							
(deaths) Premature deaths from air pollution -		0.117	0.067	0.066	0.066	0.066	0.065
Industrial Processes - Coal Mining		0.117	0.067	0.066	0.066	0.066	0.065
(deaths)							
Premature deaths from air pollution -		5.36	(57	3.62	2.93	2.43	1.74
		5.36	4.57	3.62	2.93	2.43	1.74
Industrial Processes - Oil & Gas Production (deaths)							
		73.1	0.05	0.049	0.045	0.032	0.000
Monetary damages from air pollution -		(3.1	0.05	0.049	0.045	0.032	0.003
Fuel Comb - Electric Generation - Coal (million \$2019)							
Monetary damages from air pollution -		20.0	20	11 7	0.4.0	E (/	1.63
		32.3	20	11.7	9.48	5.64	1.03
Fuel Comb - Electric Generation - Natural							
Gas (million \$2019) Monetary damages from air pollution -		(00	/10	(00	250	0.01	100
		420	418	402	358	281	189
Mobile - On-Road (million \$2019) Monetary damages from air pollution -		0/ 0	0/7	00 (00.0	1(0	11
		24.8	24.7	23.6	20.9	16.3	11
Gas Stations (million \$2019)				0.1.1	07.4	10.0	10 5
Monetary damages from air pollution -		43.8	39.4	34.4	27.6	19.8	12.5
Fuel Comb - Residential - Natural Gas							
(million \$2019)		40.5	10.0	10.0	10 (7.04	/ 70
Monetary damages from air pollution -		13.5	12.8	12.2	10.6	7.81	4.79
Fuel Comb - Residential - Oil (million							
\$2019)							

Table 40: E-B+ scenario - IMPACTS - Health (continued)

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Fuel Comb - Residential - Other (million \$2019)		4.03	4	3.93	3.58	2.86	2.07
Monetary damages from air pollution - Fuel Comb - Comm/Institutional - Coal (million \$2019)		1.75	1.65	1.56	1.47	1.38	1.28
Monetary damages from air pollution - Fuel Comb - Comm/Institutional - Natural Gas (million \$2019)		41.4	39.9	37.3	32.1	24.8	17.6
Monetary damages from air pollution - Fuel Comb - Comm/Institutional - Oil (million \$2019)		10.2	8.67	7.27	5.88	4.71	3.7
Monetary damages from air pollution - Fuel Comb - Comm/Institutional - Other fmillion \$2019)		4.1	3.69	3.31	2.93	2.55	2.17
Monetary damages from air pollution - Industrial Processes - Coal Mining (million \$2019)		1.03	0.588	0.585	0.579	0.585	0.571
Monetary damages from air pollution - Industrial Processes - Oil & Gas Production (million \$2019)		47.6	40.6	32.2	26	21.6	15.5

Table 41: E-B+ scenario - IMPACTS - Jobs

Table 41. L-D+ Scenario - IMPACIS - Jubs							
Item	2020	2025	2030	2035	2040	2045	2050
By economic sector - Agriculture (jobs)		8.71	12.2	4.56	3.37	2.8	2.47
By economic sector - Construction (jobs)		91.6	82	94.1	92.9	176	175
By economic sector - Manufacturing		34.1	31	31.2	29.8	47.3	43.1
(jobs)							
By economic sector - Mining (jobs)		59.9	41.5	28.7	20.3	12.2	5.67
By economic sector - Other (jobs)		1.36	1.62	3.13	3.48	9.25	9.52
By economic sector - Pipeline (jobs)		22.7	18.1	14.3	11.8	8.85	6.09
By economic sector - Professional (jobs)		40.1	33.5	32.4	32.2	61.4	58.6
By economic sector - Trade (jobs)		31.9	26.1	26	24	37.8	34.3
By economic sector - Utilities (jobs)		104	94.3	121	123	266	268
By resource sector - Biomass (jobs)		34.6	32.8	15.4	14.2	13	11.7
By resource sector - CO2 (jobs)		0	0	0	0	0	0
By resource sector - Grid (jobs)		57	72	157	179	500	525
By resource sector - Natural Gas (jobs)		217	166	127	102	79.5	57.5
By resource sector - Nuclear (jobs)		0	0	0	0	0	0
By resource sector - Oil (jobs)		85.9	69.4	56.1	45.3	28.8	9.19
By education level - All sectors - High		165	147	153	147	269	262
school diploma or less (jobs)							
By education level - All sectors -		122	105	114	109	204	199
Associates degree or some college (jobs)							
By education level - All sectors -		83.9	69.7	70.3	66.4	117	112
Bachelors degree (jobs)							
By education level - All sectors - Masters		20.1	16.6	16.8	15.9	28.7	27.5
or professional degree (jobs)							
By education level - All sectors - Doctoral		2.7	2.19	2.05	1.92	3.26	3.04
degree (jobs)							
Related work experience - All sectors -		57.9	50.6	52.9	50.7	92.7	90.1
None (jobs)							
Related work experience - All sectors - Up		74.3	65.6	67.9	65.3	120	117
to 1 year (jobs)							
Related work experience - All sectors - 1		144	124	129	123	224	217
to 4 years (jobs)							
Related work experience - All sectors - 4		93.5	79.6	83.9	80.3	146	142
to 10 years (jobs)							

Table 41: E-B+ scenario - IMPACTS - Jobs (continued)

Item	2020	2025	2030	2035	2040	2045	2050
Related work experience - All sectors - Over 10 years (jobs)		24.4	20.7	21.8	20.8	38	36.8
On-the-Job Training - All sectors - None (jobs)		20.8	17.6	18.1	17.2	30.6	29.5
On-the-Job Training - All sectors - Up to 1 year (jobs)		258	223	230	220	400	387
On-the-Job Training - All sectors - 1 to 4 years (jobs)		84.2	72.4	77.8	74.8	139	135
On-the-Job Training - All sectors - 4 to 10 years (jobs)		27.5	23.8	26.1	25.2	47.2	46.3
On-the-Job Training - All sectors - Over 10 years (jobs)		3.63	3.07	3.16	2.99	5.2	4.99
On-Site or In-Plant Training - All sectors - None (jobs)		62.7	53.8	55	52.4	94.5	91.4
On-Site or In-Plant Training - All sectors - Up to 1 year (jobs)		235	203	210	201	367	355
On-Site or In-Plant Training - All sectors - 1 to 4 years (jobs)		65	56	60	57.7	107	104
On-Site or In-Plant Training - All sectors - 4 to 10 years (jobs)		28.6	24.6	26.6	25.6	47.2	46.1
On-Site or In-Plant Training - All sectors - Over 10 years (jobs)		3.42	2.98	3.29	3.2	6.03	5.92
Wage income - All (million \$2019)		26.7	23.1	24.3	23.4	42.9	42.1

Table 42: E-B+ scenario - PILLAR 1: Efficiency/Electrification - Overview

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Transportation (PJ)	31.1	29	27.3	25.8	24.6	23.1	21.2
Final energy use - Residential (PJ)	19.8	18.8	18.3	17.7	16.6	15.3	14
Final energy use - Commercial (PJ)	46	46.1	45.5	44.7	43.2	41.6	40.7
Final energy use - Industry (PJ)	5.02	4.93	5.04	5.23	5.42	5.65	5.91

Table 43: E-B+ scenario - PILLAR 1: Efficiency/Electrification - Electricity demand

			,				
Item	2020	2025	2030	2035	2040	2045	2050
Electricity distribution capital invested - Cumulative 5-yr (billion \$2018)		0.36	0.356	0.467	0.477	0.862	0.916

Table 44: E-B+ scenario - PILLAR 1: Efficiency/Electrification - Transportation

Item	2020	2025	2030	2035	2040	2045	2050
Vehicle stocks - LDV – EV (1000 units)	7.29	15.6	23.8	62.1	100	185	270
Vehicle stocks - LDV – All others (1000 units)	353	353	353	335	316	244	171
Light-duty vehicle capital costs vs. REF - Cumulative 5-yr (million \$2018)		0	11.4	22.4	77.3	238	349
Public EV charging plugs - DC Fast (1000 units)	0.087		0.036		0.151		0.405
Public EV charging plugs - L2 (1000 units)	0.517		0.857		3.61		9.71

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

Item	2020	2025	2030	2035	2040	2045	2050
Sales of space heating units - Electric	16.5	26.6	31.6	45.8	67.3	81.3	86.2
Heat Pump (%)							
Sales of space heating units - Electric	22.8	24.7	23	18.6	12.2	8.08	6.66
Resistance (%)							
Sales of space heating units - Gas (%)	59	45.9	42.7	33.4	19	9.58	6.31
Sales of space heating units - Fossil (%)	1.63	2.76	2.65	2.23	1.53	1.04	0.878

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

Item	2020	2025	2030	2035	2040	2045	2050
Sales of water heating units - Electric Heat Pump (%)	0	1.61	6.17	19.3	39.5	52.6	57.2
Sales of water heating units - Electric Resistance (%)	37.1	52.6	51.5	48.6	44.3	41.5	40.6
Sales of water heating units - Gas Furnace (%)	61.4	44.7	41.2	31	15.2	4.85	1.26
Sales of water heating units - Other (%)	1.49	1.12	1.13	1.1	1.04	1.01	1.01
Sales of cooking units - Electric Resistance (%)	55.5	56.7	60.7	71.5	86.4	95.6	98.8
Sales of cooking units - Gas (%)	44.5	43.3	39.3	28.5	13.6	4.39	1.18
Residential HVAC investment in 2020s vs. REF - Cumulative 5-yr (billion \$2018)		0.401	0.411				

Table 46: E-B+ scenario - PILLAR 1: Efficiency/Electrification - Commercial

Item	2020	2025	2030	2035	2040	2045	2050
Sales of space heating units - Electric	2.05	20.4	25.2	39.3	61.5	77.1	83.1
Heat Pump (%)							
Sales of space heating units - Electric	2.42	7.86	8.12	8.85	10.2	11.6	12.4
Resistance (%)							
Sales of space heating units - Gas (%)	94.5	67.3	62.5	48.8	26.8	10.8	4.39
Sales of space heating units - Fossil (%)	1.05	4.47	4.15	3.13	1.52	0.487	0.128
Sales of water heating units - Electric	0.085	2.04	7.05	21.5	43.6	58.1	63.1
Heat Pump (%)							
Sales of water heating units - Electric	2.17	7.4	9.35	15.1	24	29.7	31.7
Resistance (%)							
Sales of water heating units - Gas (%)	96.6	86.4	79.5	59.7	29.2	9.32	2.43
Sales of water heating units - Other (%)	1.11	4.12	4.12	3.71	3.21	2.85	2.73
Sales of cooking units - Electric	32	36.2	40.9	53.4	71	81.7	85.5
Resistance (%)							
Sales of cooking units - Gas (%)	68	63.8	59.1	46.6	29	18.3	14.5
Commercial HVAC investment in 2020s -		5,159	5,728				
Cumulative 5-yr (million \$2018)							

Table 47: E-B+ scenario - PILLAR 2: Clean Electricity - Generating capacity

	,		J				
Item	2020	2025	2030	2035	2040	2045	2050
Installed thermal - Natural gas (MW)	10.8	10.8	10.8	10.8	10.8	0	0
Installed thermal - Nuclear (MW)	0	0	0	0	0	0	0

Table 48: E-B+ scenario - PILLAR 4: CCUS - CO2 capture

Item	2020	2025	2030	2035	2040	2045	2050
Annual - All (MMT)		0	0	0	0	0	0
Annual - BECCS (MMT)		0	0	0	0	0	0
Annual - NGCC (MMT)		0	0	0	0	0	0
Annual - Cement and lime (MMT)		0	0	0	0	0	0
Cumulative - All (MMT)		0	0	0	0	0	0
Cumulative - BECCS (MMT)		0	0	0	0	0	0
Cumulative - NGCC (MMT)		0	0	0	0	0	0
Cumulative - Cement and lime (MMT)		0	0	0	0	0	0

Table 49: E-B+ scenario - PILLAR 4: CCUS - CO2 pipelines

Item	2020	2025	2030	2035	2040	2045	2050
Trunk (km)		0	0	0	0	0	0
Spur (km)		0	0	0	0	0	0
All (km)		0	0	0	0	0	0
Cumulative investment - Trunk (million \$2018)		0	0	0	0	0	0

Table 49: E-B+ scenario - PILLAR 4: CCUS - CO2 pipelines (continued)

Item	2020	2025	2030	2035	2040	2045	2050
Cumulative investment - Spur (million \$2018)		0	0	0	0	0	0
Cumulative investment - All (million \$2018)		0	0	0	0	0	0

Table 50: 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 51: REF scenario - IMPACTS - Health

Table 51: REF scenario - IMPACTS - Health							
Item	2020	2025	2030	2035	2040	2045	2050
Premature deaths from air pollution - Fuel Comb - Electric Generation - Coal (deaths)		21.8	13.5	12.6	12.2	12	11
Premature deaths from air pollution - Fuel Comb - Electric Generation - Natural Gas (deaths)		3.09	3.36	3.87	3.92	3.63	3.56
Premature deaths from air pollution - Mobile - On-Road (deaths)		47	47.5	48	48.9	49.7	50.2
Premature deaths from air pollution - Gas Stations (deaths)		2.79	2.81	2.83	2.88	2.91	2.92
Premature deaths from air pollution - Fuel Comb - Residential - Natural Gas (deaths)		4.85	4.45	4.19	4.1	4.12	4.11
Premature deaths from air pollution - Fuel Comb - Residential - Oil (deaths)		1.45	1.19	0.827	0.525	0.312	0.196
Premature deaths from air pollution - Fuel Comb - Residential - Other (deaths)		0.434	0.423	0.42	0.426	0.434	0.439
Premature deaths from air pollution - Fuel Comb - Comm/Institutional - Coal (deaths)		0.206	0.204	0.203	0.201	0.199	0.195
Premature deaths from air pollution - Fuel Comb - Comm/Institutional - Natural Gas (deaths)		4.71	4.57	4.23	3.86	3.7	3.78
Premature deaths from air pollution - Fuel Comb - Comm/Institutional - Oil (deaths)		1.17	1.07	0.955	0.846	0.784	0.749
Premature deaths from air pollution - Fuel Comb - Comm/Institutional - Other (deaths)		0.484	0.495	0.508	0.521	0.532	0.542
Premature deaths from air pollution - Industrial Processes - Coal Mining (deaths)		0.211	0.155	0.132	0.126	0.123	0.116
Premature deaths from air pollution - Industrial Processes - Oil & Gas Production (deaths)		5.41	5.76	5.94	5.65	5.65	5.4
Monetary damages from air pollution - Fuel Comb - Electric Generation - Coal (million \$2019)		193	119	111	108	106	97.9
Monetary damages from air pollution - Fuel Comb - Electric Generation - Natural Gas (million \$2019)		27.4	29.7	34.2	34.7	32.1	31.5
Monetary damages from air pollution - Mobile - On-Road (million \$2019)		418	422	427	435	442	447

Table 51: REF scenario - IMPACTS - Health (continued)

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Gas Stations (million \$2019)		24.7	24.9	25	25.5	25.8	25.9
Monetary damages from air pollution - Fuel Comb - Residential - Natural Gas (million \$2019)		43	39.4	37.2	36.3	36.5	36.4
Monetary damages from air pollution - Fuel Comb - Residential - Oil (million \$2019)		12.8	10.5	7.33	4.65	2.76	1.73
Monetary damages from air pollution - Fuel Comb - Residential - Other (million \$2019)		3.84	3.75	3.72	3.78	3.84	3.89
Monetary damages from air pollution - Fuel Comb - Comm/Institutional - Coal (million \$2019)		1.83	1.81	1.79	1.78	1.76	1.73
Monetary damages from air pollution - Fuel Comb - Comm/Institutional - Natural Gas (million \$2019)		41.7	40.5	37.5	34.2	32.8	33.5
Monetary damages from air pollution - Fuel Comb - Comm/Institutional - Oil (million \$2019)		10.4	9.44	8.45	7.49	6.94	6.63
Monetary damages from air pollution - Fuel Comb - Comm/Institutional - Other (million \$2019)		4.29	4.38	4.5	4.61	4.71	4.8
Monetary damages from air pollution - Industrial Processes - Coal Mining (million \$2019)		1.86	1.37	1.16	1.11	1.09	1.03
Monetary damages from air pollution - Industrial Processes - Oil & Gas Production (million \$2019)		48	51.2	52.7	50.2	50.2	48

Table 52: REF scenario - IMPACTS - Jobs

Item	2020	2025	2030	2035	2040	2045	2050
By economic sector - Agriculture (jobs)		8.26	7.41	7.32	5.96	5.95	6.45
By economic sector - Construction (jobs)		94.9	105	208	210	226	234
By economic sector - Manufacturing (jobs)		34.4	34.2	58.2	57.7	60.7	62.1
By economic sector - Mining (jobs)		61.3	51.5	42.9	34	28.8	24.1
By economic sector - Other (jobs)		1.4	1.63	8.23	8.48	9.18	9.49
By economic sector - Pipeline (jobs)		23.5	25	25.6	23.7	23.9	23.4
By economic sector - Professional (jobs)		39.6	39.7	76.5	74.6	77.4	77.1
By economic sector - Trade (jobs)		31.7	29.1	46.6	45.3	46.8	46.8
By economic sector - Utilities (jobs)		108	122	295	296	317	324
By resource sector - Biomass (jobs)		31.9	29.8	27.7	24.8	25.3	25.8
By resource sector - CO2 (jobs)		0	0	0	0	0	0
By resource sector - Grid (jobs)		59.6	73.6	436	454	495	519
By resource sector - Natural Gas (jobs)		226	241	245	222	223	212
By resource sector - Nuclear (jobs)		0	0	0	0	0	0
By resource sector - Oil (jobs)		86.2	70.7	60.3	55.2	52.6	50.7
By education level - All sectors - High school diploma or less (jobs)		169	175	328	324	342	349
By education level - All sectors - Associates degree or some college (jobs)		126	131	250	247	260	264
By education level - All sectors - Bachelors degree (jobs)		85.5	85.5	150	146	152	153
By education level - All sectors - Masters or professional degree (jobs)		20.4	20.4	36.5	35.5	36.9	37
By education level - All sectors - Doctoral degree (jobs)		2.71	2.66	4.4	4.22	4.34	4.3
Related work experience - All sectors - None (jobs)		59.3	61.4	114	113	119	121

Table 52: REF scenario - IMPACTS - Jobs (continued)

Item	2020	2025	2030	2035	2040	2045	2050
Related work experience - All sectors - Up to 1 year (jobs)		75.7	77.7	146	144	152	155
Related work experience - All sectors - 1 to 4 years (jobs)		147	151	279	274	288	292
Related work experience - All sectors - 4 to 10 years (jobs)		95.8	99	183	180	189	191
Related work experience - All sectors - Over 10 years (jobs)		25	25.6	47.2	46.4	48.7	49.3
On-the-Job Training - All sectors - None (jobs)		21.2	21.4	38.3	37.5	39.3	39.7
On-the-Job Training - All sectors - Up to 1 year (jobs)		263	269	494	486	510	518
On-the-Job Training - All sectors - 1 to 4 years (jobs)		86.6	90.7	171	169	178	181
On-the-Job Training - All sectors - 4 to 10 years (jobs)		28.4	30.3	58.2	57.6	61	62.1
On-the-Job Training - All sectors - Over 10 years (jobs)		3.73	3.84	6.69	6.56	6.89	6.98
On-Site or In-Plant Training - All sectors - None (jobs)		64	65.4	119	116	122	123
On-Site or In-Plant Training - All sectors - Up to 1 year (jobs)		240	245	452	445	468	475
On-Site or In-Plant Training - All sectors - 1 to 4 years (jobs)		66.8	69.7	132	130	137	139
On-Site or In-Plant Training - All sectors - 4 to 10 years (jobs)		29.4	31.2	58.7	58	61.2	62.3
On-Site or In-Plant Training - All sectors - Over 10 years (jobs)		3.52	3.76	7.33	7.27	7.69	7.84
Wage income - All (million \$2019)		27.3	28.3	52.4	52	55.3	56.7

Table 53: REF scenario - PILLAR 1: Efficiency/Electrification - Overview

	,,						
Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Transportation (PJ)	31	28.9	27.4	26.4	26.6	27.2	27.9
Final energy use - Residential (PJ)	19.8	18.9	18.7	18.7	18.9	19.4	20
Final energy use - Commercial (PJ)	46	46.7	47.1	47.1	47.3	48.7	51.4
Final energy use - Industry (PJ)	5.02	5.07	5.32	5.71	6.12	6.59	7.12

Table 54: REF scenario - PILLAR 1: Efficiency/Electrification - Electricity demand

			,				
Item	2020	2025	2030	2035	2040	2045	2050
Electricity distribution capital invested - Cumulative 5-yr (billion \$2018)		0.398	0.398	0.818	0.868	0.949	1

Table 55: REF scenario - PILLAR 1: Efficiency/Electrification - Residential

Item	2020	2025	2030	2035	2040	2045	2050
Sales of space heating units - Electric	14.5	42.1	43.3	45	46.3	47.7	49.7
Heat Pump (%)							
Sales of space heating units - Electric	23.5	20.4	19.9	19.2	18.5	17.2	14.9
Resistance (%)							
Sales of space heating units - Gas (%)	60.3	35.3	35.4	34.6	34.1	34	34.2
Sales of space heating units - Fossil (%)	1.66	2.13	1.42	1.13	1.1	1.11	1.16
Sales of water heating units - Electric	0	0	0	0	0	0	0
Heat Pump (%)							
Sales of water heating units - Electric	37.1	52.9	52.8	52.7	52.7	52.6	52.5
Resistance (%)							
Sales of water heating units - Gas Furnace	61.4	46	46	46.1	46.1	46.2	46.2
(%)							
Sales of water heating units - Other (%)	1.49	1.13	1.16	1.18	1.2	1.22	1.24

Table 55: REF scenario - PILLAR 1: Efficiency/Electrification - Residential (continued)

Item	2020	2025	2030	2035	2040	2045	2050	
Sales of cooking units - Electric	55.1	55.1	55.1	55.1	55.1	55.1	55.1	
Resistance (%)								
Sales of cooking units - Gas (%)	44.9	44.9	44.9	44.9	44.9	44.9	44.9	
Residential HVAC investment in 2020s vs.		0.375	0.389					
REF - Cumulative 5-yr (billion \$2018)								

Table 56: REF scenario - PILLAR 1: Efficiency/Electrification - Commercial

Item	2020	2025	2030	2035	2040	2045	2050
Sales of space heating units - Electric	2.05	24.3	48.7	68.8	72.1	72.4	72.4
Heat Pump (%)							
Sales of space heating units - Electric	2.42	8.6	12.6	19.8	24.7	25.6	25.7
Resistance (%)							
Sales of space heating units - Gas (%)	94.5	62.7	35.5	10	2.95	1.99	1.92
Sales of space heating units - Fossil (%)	1.05	4.35	3.2	1.36	0.197	0.016	0
Sales of water heating units - Electric	0.085	0.274	0.27	0.271	0.273	0.271	0.272
Heat Pump (%)							
Sales of water heating units - Electric	2.17	6.7	6.64	6.64	6.67	6.65	6.67
Resistance (%)							
Sales of water heating units - Gas (%)	96.6	88.9	88.8	88.9	88.8	88.8	88.8
Sales of water heating units - Other (%)	1.11	4.16	4.29	4.22	4.28	4.31	4.29
Sales of cooking units - Electric	32	34.3	34.3	34.3	34.4	34.3	34.3
Resistance (%)							
Sales of cooking units - Gas (%)	68	65.7	65.7	65.7	65.6	65.7	65.7
Commercial HVAC investment in 2020s -		5,089	5,292				
Cumulative 5-yr (million \$2018)							

Table 57: REF scenario - PILLAR 2: Clean Electricity - Generating capacity

			, ,				
Item	2020	2025	2030	2035	2040	2045	2050
Installed thermal - Natural gas (MW)	10.8	10.8	10.8	10.8	10.8	0	0
Installed thermal - Nuclear (MW)	0	0	0	0	0	0	0
Installed renewables - Rooftop PV (MW)	71.1	107	142	187	242	305	377
Installed renewables - Solar - Base land	7.17	7.17	7.17	7.17	7.17	7.17	7.17
use assumptions (MW)							

Table 58: REF scenario - PILLAR 2: Clean Electricity - Generation

	,						
Item	2020	2025	2030	2035	2040	2045	2050
Solar - Base land use assumptions (GWh)	16	16	16	16	16	16	16
Wind - Base land use assumptions (GWh)	0	0	0	0	0	0	0
OffshoreWind - Base land use	0	0	0	0	0	0	0
assumptions (GWh)							