

Net-Zero America - Minnesota data

October 29, 2021 (updated November 17, 2023)

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

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Table 1: E+ scenario - IMPACTS - Health

Table 1: <i>E+ scenario - IMPACTS - Health</i> Item	2020	2025	2030	2035	2040	2045	2050
Premature deaths from air pollution -	2020	32.6	0.024	0.023	0.018	0.012	(
Fuel Comb - Electric Generation - Coal							
(deaths) Premature deaths from air pollution -		11.8	7.55	3.44	2.24	1.68	0.80
Fuel Comb - Electric Generation - Natural		11.0	1.55	3.44	2.24	1.00	0.60
Gas (deaths)							
•		171	1/0	107	7/. 0	25.7	15.6
Premature deaths from air pollution -		171	162	126	74.2	35.4	15.6
Mobile - On-Road (deaths) Premature deaths from air pollution - Gas		11	10.2	7.88	4.79	2.44	1.26
		"	10.2	7.00	4.79	2.44	1.20
Stations (deaths)		0/1	00.0	05.0	15.7	0.00	0.71
Premature deaths from air pollution -		36.1	32.9	25.2	15.7	8.28	3.45
Fuel Comb - Residential - Natural Gas							
(deaths)		17	1//	1.01	0.50	0.000	0.05
Premature deaths from air pollution -		1.7	1.44	1.01	0.59	0.232	0.053
Fuel Comb - Residential - Oil (deaths)							
Premature deaths from air pollution -		4.38	4.39	3.73	2.61	1.4	0.52
Fuel Comb - Residential - Other (deaths)							
Premature deaths from air pollution -		3.19	3.1	3	2.88	2.75	2.6
Fuel Comb - Comm/Institutional - Coal							
(deaths)							
Premature deaths from air pollution -		8.63	7.74	6.12	4.14	2.44	1.2
Fuel Comb - Comm/Institutional - Natural							
Gas (deaths)							
Premature deaths from air pollution -		3.3	2.71	2.07	1.46	0.983	0.608
Fuel Comb - Comm/Institutional - Oil							
(deaths)							
Premature deaths from air pollution -		1.08	0.923	0.762	0.602	0.446	0.29
Fuel Comb - Comm/Institutional - Other							
(deaths)							
Premature deaths from air pollution -		0.566	0.099	0.094	0.087	0.083	0.08
Industrial Processes - Coal Mining							
(deaths)							
Premature deaths from air pollution -		48.7	46.2	42.6	33.4	25.1	15.8
Industrial Processes - Oil & Gas							
Production (deaths)							
Monetary damages from air pollution -		289	0.209	0.2	0.163	0.109	0.00
Fuel Comb - Electric Generation - Coal							
(million \$2019)							
Monetary damages from air pollution -		104	66.9	30.5	19.8	14.9	7.0
Fuel Comb - Electric Generation - Natural			00.7	00.0	.,	,	
Gas (million \$2019)							
Monetary damages from air pollution -		1,518	1,442	1,116	659	315	13
Mobile - On-Road (million \$2019)		.,0.0	.,	.,		0.0	
Monetary damages from air pollution -		97	90.7	69.8	42.4	21.6	11.
Gas Stations (million \$2019)		, i	70.1	07.0	72.7	21.0	
Monetary damages from air pollution -		320	291	224	139	73.4	30.
Fuel Comb - Residential - Natural Gas		020	271	224	107	10.4	50.
(million \$2019)							
Monetary damages from air pollution -		15	12.7	8.95	5.23	2.06	0.47
Fuel Comb - Residential - Oil (million		15	12.1	0.93	3.23	2.00	0.41
\$2019)							
Monetary damages from air pollution -		38.9	38.9	22.1	00.1	10 /	4.6
		36.9	36.9	33.1	23.1	12.4	4.0
Fuel Comb - Residential - Other (million							
\$2019)		20.0	07.5	0//	05.5	0/ 0	
Monetary damages from air pollution -		28.2	27.5	26.6	25.5	24.3	23
Fuel Comb - Comm/Institutional - Coal							
(million \$2019)							
Monetary damages from air pollution -		76.4	68.5	54.2	36.6	21.6	10.
Fuel Comb - Comm/Institutional - Natural							
Gas (million \$2019)	I .					1	

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

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

Table 2: E+ scenario - IMPACTS - Jobs

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

Table 2. F+	scenario	- IMPACTS -	Inhe	(continued))
Idule 2. ET	Scellul lu	- IMPAGIS -	JUUS	ICUIILIIIUEUI	,

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

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

Item	2020	2025	2030	2035	2040	2045	2050
Oil consumption - Annual (million bbls)		107	95.7	78.2	61.9	49	39.2
Oil consumption - Cumulative (million							2,407
bbls)							
Oil production - Annual (million bbls)		0	0	0	0	0	0
Natural gas consumption - Annual (tcf)		380	320	257	193	122	84.3
Natural gas consumption - Cumulative							7,731
(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)	552	519	460	389	325	285	269
Final energy use - Residential (PJ)	296	280	265	236	202	173	153
Final energy use - Commercial (PJ)	221	216	207	194	179	168	160
Final energy use - Industry (PJ)	391	405	406	401	400	399	401

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

Item	2020	2025	2030	2035	2040	2045	2050
Electricity distribution capital invested -		3.87	3.99	7.91	8.48	7.13	7.47
Cumulative 5-yr (billion \$2018)							

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

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

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

Item	2020	2025	2030	2035	2040	2045	2050
Sales of space heating units - Electric	3.41	7.97	30.9	76.7	90.3	91.9	91.7
Heat Pump (%)							
Sales of space heating units - Electric	9.83	13.9	11.3	5.52	3.76	3.59	3.79
Resistance (%)							
Sales of space heating units - Gas (%)	77.8	62.6	46.3	12.4	2.5	1.41	1.31
Sales of space heating units - Fossil (%)	8.97	15.5	11.4	5.34	3.47	3.15	3.18
Sales of water heating units - Electric	0	0.704	9.95	31.7	37.9	38.6	38.6
Heat Pump (%)							
Sales of water heating units - Electric	20.7	35.3	41.3	56	60.8	61.3	61.3
Resistance (%)							
Sales of water heating units - Gas Furnace	79.2	64	48.7	12.3	1.29	0.072	0
(%)							
Sales of water heating units - Other (%)	0.018	0.021	0.021	0.021	0.02	0.02	0.02
Sales of cooking units - Electric	58.9	67.6	94.5	99.7	100	100	100
Resistance (%)							
Sales of cooking units - Gas (%)	41.1	32.4	5.54	0.279	0	0	0
Residential HVAC investment in 2020s vs.		4.14	4.85				
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	1.8	6.82	26.5	71.8	85.3	86.8	86.9
Heat Pump (%)							
Sales of space heating units - Electric	3.09	5.73	8.18	11.9	12.6	12.6	12.6
Resistance (%)							
Sales of space heating units - Gas (%)	90.3	85.4	64.9	16.3	2.07	0.546	0.457
Sales of space heating units - Fossil (%)	4.77	2.09	0.407	0.017	0	0	0
Sales of water heating units - Electric	0.491	1.66	12.6	38.5	46.3	47.1	47.2
Heat Pump (%)							
Sales of water heating units - Electric	4.33	7.76	18.5	43.6	51.2	52.1	52.2
Resistance (%)							
Sales of water heating units - Gas (%)	94.1	89.6	68.2	17.2	1.81	0.101	0
Sales of water heating units - Other (%)	1.03	0.934	0.727	0.678	0.674	0.676	0.676
Sales of cooking units - Electric	44.8	57.1	84	89.3	89.6	89.6	89.6
Resistance (%)							
Sales of cooking units - Gas (%)	55.2	42.9	16	10.7	10.4	10.4	10.4
Commercial HVAC investment in 2020s -		15,866	17,271				
Cumulative 5-yr (million \$2018)							

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

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

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

Item	2020	2025	2030	2035	2040	2045	2050
Capital invested - Solar PV - Constrained (billion \$2018)		0.395	0	0	0	0	0
Capital invested - Wind - Constrained (billion \$2018)		2.2	2.94	6.21	4.37	4.58	5.58
Capital invested - Biomass power plant (billion \$2018)	0	0.049	0.493	0	0	0	0
Capital invested - Biomass w/ccu allam power plant (billion \$2018)	0	0	0	0	0	0	0
Capital invested - Biomass w/ccu power plant (billion \$2018)	0	0	0	0	0	0	0

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

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

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

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

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

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

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

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

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

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

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

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

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

Item	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - Mid - Reforest							-4,472
pasture (1000 tC02e/y)							0.007
Carbon sink potential - Mid - Restore							-2,887
productivity (1000 tC02e/y)							0/ / 0/
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO2e/y)							-26,484
Carbon sink potential - High - Accelerate							-479
regeneration (1000 tCO2e/y)							-479
Carbon sink potential - High - Avoid							-1,871
deforestation (1000 tCO2e/y)							-1,071
Carbon sink potential - High - Extend							0.507
,							-8,507
rotation length (1000 tC02e/y)							-793
Carbon sink potential - High - Improve							-193
plantations (1000 tCO2e/y)							1 //7
Carbon sink potential - High - Increase							-4,667
retention of HWP (1000 tCO2e/y)							0.010
Carbon sink potential - High - Increase							-3,012
trees outside forests (1000 tC02e/y)							0.070
Carbon sink potential - High - Reforest							-8,069
cropland (1000 tC02e/y)							0.010
Carbon sink potential - High - Reforest							-8,313
pasture (1000 tC02e/y)							/ 0.000
Carbon sink potential - High - All (not							-40,029
counting overlap) (1000 tC02e/y)							/ 010
Carbon sink potential - High - Restore							-4,318
productivity (1000 tCO2e/y)							
Land impacted for carbon sink potential -							39.1
Low - Accelerate regeneration (1000							
hectares)							200
Land impacted for carbon sink potential -							238
Low - Avoid deforestation (over 30 years)							
(1000 hectares)							1 / / 0
Land impacted for carbon sink potential -							1,662
Low - Extend rotation length (1000							
hectares)							4//
Land impacted for carbon sink potential -							146
Low - Improve plantations (1000							
hectares)							
Land impacted for carbon sink potential -							0
Low - Increase retention of HWP (1000							
hectares)							454
Land impacted for carbon sink potential -							151
Low - Increase trees outside forests							
(1000 hectares)							0/7
Land impacted for carbon sink potential -							267
Low - Reforest cropland (1000 hectares)							
Land impacted for carbon sink potential -							40.9
Low - Reforest pasture (1000 hectares)							
Land impacted for carbon sink potential -							866
Low - Restore productivity (1000							
hectares)							
Land impacted for carbon sink potential -							3,409
Low - Total impacted (over 30 years)			[
(1000 hectares)							
Land impacted for carbon sink potential -							58.7
Mid - Accelerate regeneration (1000							
hectares)							
Land impacted for carbon sink potential -							246
Mid - Avoid deforestation (over 30 years)							
(1000 hectares)							

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

Item	2020	2025	2030	2035	2040	2045	2050
Land impacted for carbon sink potential -							3,000
Mid - Extend rotation length (1000							
hectares)							
Land impacted for carbon sink potential -							220
Mid - Improve plantations (1000 hectares)							
Land impacted for carbon sink potential -							0
Mid - Increase retention of HWP (1000							
hectares)							
Land impacted for carbon sink potential -							218
Mid - Increase trees outside forests (1000							
hectares)							
Land impacted for carbon sink potential -							400
Mid - Reforest cropland (1000 hectares)							
Land impacted for carbon sink potential -							296
Mid - Reforest pasture (1000 hectares)							
Land impacted for carbon sink potential -							1,744
Mid - Restore productivity (1000							
hectares)							
Land impacted for carbon sink potential -							6,183
Mid - Total impacted (over 30 years) (1000							
hectares)							
Land impacted for carbon sink potential -							78.3
High - Accelerate regeneration (1000							
hectares)							
Land impacted for carbon sink potential -							253
High - Avoid deforestation (over 30 years)							
(1000 hectares)							
Land impacted for carbon sink potential -							4,338
High - Extend rotation length (1000							•
hectares)							
Land impacted for carbon sink potential -							292
High - Improve plantations (1000							
hectares)							
Land impacted for carbon sink potential -							0
High - Increase retention of HWP (1000							
hectares)							
Land impacted for carbon sink potential -							286
High - Increase trees outside forests							
(1000 hectares)							
Land impacted for carbon sink potential -							533
High - Reforest cropland (1000 hectares)							
Land impacted for carbon sink potential -							236
High - Reforest pasture (1000 hectares)							
Land impacted for carbon sink potential -		+					1,431
High - Restore productivity (1000							., .01
hectares)							
Land impacted for carbon sink potential -		+					7,449
High - Total impacted (over 30 years)							.,
(1000 hectares)							
(

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

Item	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - Moderate							-2,423
deployment - Corn-ethanol to energy							
grasses (1000 tCO2e/y)							
Carbon sink potential - Moderate							-7,283
deployment - Cropland measures (1000							
tCO2e/y)							

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

Table 16: <i>E+ scenario - PILLAR 6: Land sink</i>	s - Agriculti 2020		-	0005	007.0	20/5	0050
Item Carbon sink potential - Moderate	2020	2025	2030	2035	2040	2045	2050 -207
deployment - Permanent conservation							-201
cover (1000 tC02e/y)							
Carbon sink potential - Moderate			+			+	-9,914
deployment - Total (1000 tC02e/y)							-7,714
Carbon sink potential - Aggressive			+				-2,423
deployment - Corn-ethanol to energy							2,720
grasses (1000 tC02e/y)							
Carbon sink potential - Aggressive							-13,821
deployment - Cropland measures (1000							10,021
tCO2e/y)							
Carbon sink potential - Aggressive							-414
deployment - Permanent conservation							71.
cover (1000 tC02e/y)							
Carbon sink potential - Aggressive			+				-16,658
deployment - Total (1000 tC02e/y)							10,000
Land impacted for carbon sink - Moderate							1,097
deployment - Corn-ethanol to energy							1,071
grasses (1000 hectares)							
Land impacted for carbon sink - Moderate			+				3,675
deployment - Cropland measures (1000							0,010
hectares)							
Land impacted for carbon sink - Moderate			+				376
deployment - Permanent conservation							310
cover (1000 hectares)							
Land impacted for carbon sink - Moderate			+				5,149
deployment - Total (1000 hectares)							0,14
Land impacted for carbon sink -			+				1,097
Aggressive deployment - Corn-ethanol to							1,071
energy grasses (1000 hectares)							
Land impacted for carbon sink -			+				6,974
Aggressive deployment - Cropland							0,71-
measures (1000 hectares)							
Land impacted for carbon sink -			+				753
Aggressive deployment - Permanent							100
conservation cover (1000 hectares)							
Land impacted for carbon sink -			+				8,824
Aggressive deployment - Total (1000							0,02-
hectares)							
nectal coj							
able 17: E- scenario - IMPACTS - Health							
Item	2020	2025	2030	2035	2040	2045	2050
Premature deaths from air pollution -		32.6	0.024	0.023	0.018	0.012	C
Fuel Comb - Electric Generation - Coal							
(deaths)							
Premature deaths from air pollution -		11.6	6.23	2.42	1.14	0.531	0.508
Fuel Comb - Electric Generation - Natural							
Gas (deaths)							
Premature deaths from air pollution -		174	178	177	163	132	92.6
Mobile - On-Road (deaths)							
Premature deaths from air pollution - Gas		11.2	11.4	11.2	10.2	8.26	5.85
Stations (deaths)						0.20	3.50
Premature deaths from air pollution -		36.2	34.2	32	29.4	26.2	22.4
Fuel Comb - Residential - Natural Gas		00.2	54.2	52	27.7	20.2	۷۷.۰
(deaths)							
Premature deaths from air pollution -		1.73	1.75	1.78	1.71	1.5	1.26
Fuel Comb - Residential - Oil (deaths)		1.10	1.10	1.10	1.11	1.0	1.20
Premature deaths from air pollution -		4.4	4.63	4.84	4.82	4.32	3.62
Fuel Comb Decidential Other (deaths)		→.4	4.00	4.04	7.02	4.52	3.02

Fuel Comb - Residential - Other (deaths)

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

Table 11. E- Scendino - IMPAGIS - Heditii (CC	-						
Item	2020	2025	2030	2035	2040	2045	2050
Premature deaths from air pollution -		3.19	3.1	3	2.88	2.75	2.61
Fuel Comb - Comm/Institutional - Coal							
(deaths)							
Premature deaths from air pollution -		8.65	8.34	7.95	7.31	6.42	5.38
Fuel Comb - Comm/Institutional - Natural							
Gas (deaths)							
Premature deaths from air pollution -		3.31	2.92	2.53	2.14	1.81	1.55
Fuel Comb - Comm/Institutional - Oil							
(deaths)		100		0.007	0.707	0.400	0.707
Premature deaths from air pollution -		1.08	0.99	0.894	0.796	0.698	0.604
Fuel Comb - Comm/Institutional - Other							
(deaths)		0.507	0.1	0.000	0.007	0.007	0.077
Premature deaths from air pollution -		0.536	0.1	0.098	0.094	0.084	0.066
Industrial Processes - Coal Mining							
(deaths)		101		00.5	05.1	01.5	00.1
Premature deaths from air pollution -		48.6	44.7	39.5	35.1	31.5	22.1
Industrial Processes - Oil & Gas							
Production (deaths)		000	0.000	0.0	0.1/0	0.100	0.000
Monetary damages from air pollution -		289	0.209	0.2	0.163	0.109	0.003
Fuel Comb - Electric Generation - Coal (million \$2019)							
Monetary damages from air pollution -		103	55.2	21.4	10.1	4.7	4.5
Fuel Comb - Electric Generation - Natural		103	55.2	21.4	10.1	4.7	4.5
Gas (million \$2019)							
Monetary damages from air pollution -		1,543	1,586	1,574	1,446	1,174	823
Mobile - On-Road (million \$2019)		1,543	1,566	1,574	1,446	1,174	623
Monetary damages from air pollution -		99	101	99.2	90.3	73.1	51.8
Gas Stations (million \$2019)		99	101	99.2	90.3	73.1	51.6
Monetary damages from air pollution -	+	321	303	283	261	232	198
Fuel Comb - Residential - Natural Gas		321	303	203	201	232	170
(million \$2019)							
Monetary damages from air pollution -		15.3	15.5	15.7	15.2	13.3	11.2
Fuel Comb - Residential - Oil (million		10.0	10.0	10.1	10.2	10.0	11.2
\$2019)							
Monetary damages from air pollution -		39	41	42.9	42.7	38.3	32.1
Fuel Comb - Residential - Other (million		0,	7.	72.7	72.1	00.0	02.1
\$2019)							
Monetary damages from air pollution -		28.2	27.5	26.6	25.5	24.3	23.1
Fuel Comb - Comm/Institutional - Coal		20.2		20.0	20.0		
(million \$2019)							
Monetary damages from air pollution -		76.6	73.8	70.3	64.7	56.8	47.7
Fuel Comb - Comm/Institutional - Natural							
Gas (million \$2019)							
Monetary damages from air pollution -		29.3	25.9	22.4	18.9	16	13.7
Fuel Comb - Comm/Institutional - Oil							
(million \$2019)							
Monetary damages from air pollution -		9.6	8.76	7.91	7.04	6.18	5.35
Fuel Comb - Comm/Institutional - Other							
(million \$2019)							
Monetary damages from air pollution -		4.73	0.884	0.867	0.83	0.74	0.585
Industrial Processes - Coal Mining							
(million \$2019)							
Monetary damages from air pollution -		431	397	351	312	280	196
Industrial Processes - Oil & Gas							
Production (million \$2019)							

Table 18: E- scenario - IMPACTS - Jobs

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

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

Table 18: E- Scenurio - IMPACTS - Jubs (cur	ıtınueuj						
Item	2020	2025	2030	2035	2040	2045	2050
By economic sector - Manufacturing		4,324	4,824	5,517	5,829	7,435	10,470
(jobs)							
By economic sector - Mining (jobs)		2,136	1,542	1,155	855	611	393
By economic sector - Other (jobs)		633	844	1,200	1,682	2,476	3,539
By economic sector - Pipeline (jobs)		488	408	435	296	251	879
By economic sector - Professional (jobs)		5,523	7,279	10,239	13,591	20,457	30,797
By economic sector - Trade (jobs)		3,966	4,474	5,669	7,170	10,191	14,638
By economic sector - Utilities (jobs)		8,612	9,537	12,458	16,979	25,793	36,455
By resource sector - Biomass (jobs)		5,450	5,976	7,946	7,032	10,331	20,825
By resource sector - CO2 (jobs)		0	0	784	24.5	37.4	5,774
By resource sector - Coal (jobs)		886	204	0	0	0	0
By resource sector - Grid (jobs)		11,427	13,851	19,733	29,496	47,363	62,979
By resource sector - Natural Gas (jobs)		4,136	3,363	2,672	3,206	3,149	2,873
By resource sector - Nuclear (jobs)		944	929	658	168	0	0
By resource sector - Oil (jobs)		4,800	4,146	3,581	2,998	2,419	1,751
By resource sector - Solar (jobs)		1,304	1,205	1,365	1,522	1,730	2,316
By resource sector - Wind (jobs)		7,480	12,195	16,779	21,999	30,126	41,771
By education level - All sectors - High		16,012	18,233	23,058	27,722	39,152	57,146
school diploma or less (jobs)		,	,		,	51,102	
By education level - All sectors -		10,795	12,513	16,184	20,691	29,897	43,112
Associates degree or some college (jobs)			,	, -	-,-	, -	-,
By education level - All sectors -		7,467	8,578	10,962	13,810	19,946	28,995
Bachelors degree (jobs)			.				
By education level - All sectors - Masters		1,874	2,200	2,857	3,635	5,300	7,759
or professional degree (jobs)			,		,	.	·
By education level - All sectors - Doctoral		280	343	457	585	858	1,277
degree (jobs)							
Related work experience - All sectors -		5,389	6,161	7,857	9,653	13,773	20,099
None (jobs)			.		,	,	•
Related work experience - All sectors - Up		7,888	9,033	11,408	13,572	19,069	27,980
to 1 year (jobs)		-					
Related work experience - All sectors - 1		12,824	14,758	18,943	23,782	34,280	49,732
to 4 years (jobs)							•
Related work experience - All sectors - 4		8,173	9,441	12,156	15,454	22,306	32,237
to 10 years (jobs)							
Related work experience - All sectors -		2,154	2,474	3,155	3,983	5,726	8,242
Over 10 years (jobs)							
On-the-Job Training - All sectors - None		2,018	2,305	2,922	3,589	5,106	7,434
(jobs)							
On-the-Job Training - All sectors - Up to 1		24,579	28,138	35,791	43,851	62,591	91,340
year (jobs)			.				
On-the-Job Training - All sectors - 1 to 4		7,201	8,343	10,782	13,803	19,941	28,694
years (jobs)							
On-the-Job Training - All sectors - 4 to 10		2,300	2,700	3,544	4,613	6,693	9,638
years (jobs)		-					
On-the-Job Training - All sectors - Over 10		330	381	479	588	823	1,183
years (jobs)							
On-Site or In-Plant Training - All sectors -		5,853	6,787	8,711	10,817	15,514	22,650
None (jobs)							
On-Site or In-Plant Training - All sectors -		22,235	25,422	32,324	39,685	56,643	82,507
Up to 1 year (jobs)							
On-Site or In-Plant Training - All sectors -		5,647	6,521	8,399	10,676	15,387	22,160
1 to 4 years (jobs)							
On-Site or In-Plant Training - All sectors -		2,383	2,776	3,618	4,671	6,755	9,736
4 to 10 years (jobs)			•	•	•		•
On-Site or In-Plant Training - All sectors -		310	360	467	595	856	1,237
Over 10 years (jobs)							
Wage income - All (million \$2019)		2,181	2,542	3,303	4,199	6,125	9,002

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

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

Table 20: E- scenario - PILLAR 1: Efficiency/Electrification - Electricity demand

Item	2020	2025	2030	2035	2040	2045	2050
Electricity distribution capital invested -		3.06	3.08	4.07	4.2	6.25	6.61
Cumulative 5-yr (billion \$2018)							

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

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

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

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

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

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

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

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

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

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

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

Item	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - Low - Accelerate regeneration (1000 tCO2e/y)							-240
Carbon sink potential - Low - Avoid							-312
deforestation (1000 tC02e/y)							0.2
Carbon sink potential - Low - Extend							-3,267
rotation length (1000 tCO2e/y)							
Carbon sink potential - Low - Improve							-404
plantations (1000 tCO2e/y)							
Carbon sink potential - Low - Increase							-1,556
retention of HWP (1000 tCO2e/y)							
Carbon sink potential - Low - Increase							-1,054
trees outside forests (1000 tC02e/y)							
Carbon sink potential - Low - Reforest							-4,034
cropland (1000 tC02e/y)							/00
Carbon sink potential - Low - Reforest pasture (1000 tCO2e/y)							-630
Carbon sink potential - Low - Restore							-1,455
productivity (1000 tCO2e/y)							-1,455
Carbon sink potential - Low - All (not							-12,952
counting overlap) (1000 tC02e/y)							-12,702
Carbon sink potential - Mid - Accelerate							-359
regeneration (1000 tC02e/y)							007
Carbon sink potential - Mid - Avoid							-1,091
deforestation (1000 tCO2e/y)							.,
Carbon sink potential - Mid - Extend							-5,887
rotation length (1000 tCO2e/y)							·
Carbon sink potential - Mid - Improve							-591
plantations (1000 tCO2e/y)							
Carbon sink potential - Mid - Increase							-3,112
retention of HWP (1000 tCO2e/y)							
Carbon sink potential - Mid - Increase							-2,033
trees outside forests (1000 tCO2e/y)							
Carbon sink potential - Mid - Reforest							-6,052
cropland (1000 tCO2e/y)							
Carbon sink potential - Mid - Reforest							-4,472
pasture (1000 tCO2e/y)							
Carbon sink potential - Mid - Restore							-2,887
productivity (1000 tC02e/y)							07.101
Carbon sink potential - Mid - All (not							-26,484
counting overlap) (1000 tCO2e/y)							/70
Carbon sink potential - High - Accelerate							-479
regeneration (1000 tC02e/y) Carbon sink potential - High - Avoid							-1,871
•							-1,871
deforestation (1000 tCO2e/y)							

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

Item Carbon sink potential - High - Extend	2020	2025	2030	2035	2040	2045	2050 -8,507
rotation length (1000 tCO2e/y)							
Carbon sink potential - High - Improve plantations (1000 tCO2e/y)							-793
Carbon sink potential - High - Increase retention of HWP (1000 tC02e/y)							-4,667
Carbon sink potential - High - Increase trees outside forests (1000 tC02e/y)							-3,012
Carbon sink potential - High - Reforest cropland (1000 tCO2e/y)							-8,069
Carbon sink potential - High - Reforest pasture (1000 tCO2e/y)							-8,313
Carbon sink potential - High - All (not counting overlap) (1000 tC02e/y)							-40,029
Carbon sink potential - High - Restore productivity (1000 tC02e/y)							-4,318
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)							39.1
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)							238
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)							1,662
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)							146
Land impacted for carbon sink potential - Low - Increase retention of HWP (1000 hectares)							0
Land impacted for carbon sink potential - Low - Increase trees outside forests (1000 hectares)							151
Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares)							267
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)							40.9
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)							866
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)							3,409
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)							58.7
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)							246
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)							3,000
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)							220
Land impacted for carbon sink potential - Mid - Increase retention of HWP (1000							0
hectares) Land impacted for carbon sink potential - Mid - Increase trees outside forests (1000 hectares)							218

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

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

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

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

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

Item	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - Aggressive							-414
deployment - Permanent conservation							
cover (1000 tCO2e/y)							
Carbon sink potential - Aggressive							-16,658
deployment - Total (1000 tCO2e/y)							
Land impacted for carbon sink - Moderate							1,097
deployment - Corn-ethanol to energy							
grasses (1000 hectares)							
Land impacted for carbon sink - Moderate							3,675
deployment - Cropland measures (1000							
hectares)							
Land impacted for carbon sink - Moderate							376
deployment - Permanent conservation							
cover (1000 hectares)							
Land impacted for carbon sink - Moderate							5,149
deployment - Total (1000 hectares)							
Land impacted for carbon sink -							1,097
Aggressive deployment - Corn-ethanol to							
energy grasses (1000 hectares)							
Land impacted for carbon sink -							6,974
Aggressive deployment - Cropland							
measures (1000 hectares)							
Land impacted for carbon sink -							753
Aggressive deployment - Permanent							
conservation cover (1000 hectares)							
Land impacted for carbon sink -							8,824
Aggressive deployment - Total (1000							
hectares)							

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

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

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

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

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

	070 0000						
m	2020	2025	2030	2035	2040	2045	2050
economic sector - Agriculture (jobs)	2,173	2,347	2,555	1,651	1,563	4,982
economic sector - Constructior	ı (jobs)	8,688	10,895	18,205	25,847	34,255	51,116
economic sector - Manufacturir	ng	4,398	5,079	6,998	7,689	9,425	14,252
bs)							
economic sector - Mining (jobs)		2,101	1,466	946	570	317	27
economic sector - Other (jobs)		648	887	1,609	2,498	3,428	5,595
economic sector - Pipeline (jobs	3)	474	401	291	199	126	38.1
economic sector - Professional	(jobs)	5,602	7,476	12,437	17,954	25,499	42,696
economic sector - Trade (jobs)		3,995	4,564	6,786	9,466	13,079	20,940
economic sector - Utilities (jobs	s)	8,704	9,925	17,472	25,265	34,289	51,338
resource sector - Biomass (jobs	3)	5,336	5,524	5,970	4,411	5,889	22,255
resource sector - CO2 (jobs)		0	0	0	0	0	0
resource sector - Coal (jobs)		886	204	0	0	0	0
resource sector - Grid (jobs)		11,677	14,588	30,964	46,273	64,438	97,805
resource sector - CO2 (jobs) resource sector - Coal (jobs)	2)	0 886	0 204	0	0		0

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

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

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

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

Table 30: E+RE+ scenario - PILLAR 1: Efficiency/Electrification - Electricity demand

Item	2020	2025	2030	2035	2040	2045	2050
Electricity distribution capital invested -		3.87	3.99	7.91	8.48	7.13	7.47
Cumulative 5-yr (billion \$2018)							

Table 31: E+RE+ scenario - PILLAR 1: Efficiency/Electrifica	ition - Transportatio	on
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Item	2020	2025	2030	2035	2040	2045	2050
Vehicle stocks - LDV – EV (1000 units)	38.9	480	920	2,462	4,005	5,237	6,470
Vehicle stocks - LDV – All others (1000 units)	5,395	5,137	4,879	3,555	2,232	1,263	294
Light-duty vehicle capital costs vs. REF - Cumulative 5-yr (million \$2018)		1,035	2,659	4,300	6,517	7,089	6,761
Public EV charging plugs - DC Fast (1000 units)	0.168		1.92		8.36		13.5
Public EV charging plugs - L2 (1000 units)	0.739		46.2		201		325

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

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

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

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

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

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

 $\textbf{Table 34: } \textit{E+RE+ scenario - PILLAR 2:} \underline{\textit{Clean Electricity - Generating capacity (continued)} \\$

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

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

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

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

Item	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - Low - Accelerate regeneration (1000 tCO2e/y)							-240
Carbon sink potential - Low - Avoid deforestation (1000 tC02e/y)							-312
Carbon sink potential - Low - Extend rotation length (1000 tCO2e/y)							-3,267
Carbon sink potential - Low - Improve plantations (1000 tCO2e/y)							-404
Carbon sink potential - Low - Increase retention of HWP (1000 tCO2e/y)							-1,556
Carbon sink potential - Low - Increase trees outside forests (1000 tCO2e/y)							-1,054
Carbon sink potential - Low - Reforest cropland (1000 tCO2e/y)							-4,034
Carbon sink potential - Low - Reforest pasture (1000 tCO2e/y)							-630
Carbon sink potential - Low - Restore productivity (1000 tC02e/y)							-1,455
Carbon sink potential - Low - All (not counting overlap) (1000 tC02e/y)							-12,952
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO2e/y)							-359
Carbon sink potential - Mid - Avoid deforestation (1000 tC02e/y)							-1,091
Carbon sink potential - Mid - Extend rotation length (1000 tCO2e/y)							-5,887

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

Item	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - Mid - Improve plantations (1000 tCO2e/y)							-591
							0 110
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO2e/y)							-3,112
Carbon sink potential - Mid - Increase							-2,033
trees outside forests (1000 tC02e/y)							-2,033
Carbon sink potential - Mid - Reforest							-6,052
cropland (1000 tCO2e/y)							-0,032
Carbon sink potential - Mid - Reforest							-4,472
pasture (1000 tCO2e/y)							-4,412
Carbon sink potential - Mid - Restore							-2,887
productivity (1000 tC02e/y)							2,001
Carbon sink potential - Mid - All (not							-26,484
counting overlap) (1000 tCO2e/y)							20,404
Carbon sink potential - High - Accelerate							-479
regeneration (1000 tCO2e/y)							717
Carbon sink potential - High - Avoid							-1,871
deforestation (1000 tC02e/y)							1,011
Carbon sink potential - High - Extend							-8,507
rotation length (1000 tC02e/y)							-0,501
Carbon sink potential - High - Improve							-793
plantations (1000 tCO2e/y)							-170
Carbon sink potential - High - Increase							-4,667
retention of HWP (1000 tCO2e/y)							-4,001
Carbon sink potential - High - Increase							-3,012
trees outside forests (1000 tC02e/y)							-0,012
Carbon sink potential - High - Reforest							-8,069
cropland (1000 tCO2e/y)							-0,007
Carbon sink potential - High - Reforest							-8,313
pasture (1000 tCO2e/y)							0,010
Carbon sink potential - High - All (not							-40,029
counting overlap) (1000 tCO2e/y)							-40,027
Carbon sink potential - High - Restore							-4,318
productivity (1000 tC02e/y)							-4,510
Land impacted for carbon sink potential -							39.1
Low - Accelerate regeneration (1000							37.1
hectares)							
Land impacted for carbon sink potential -							238
Low - Avoid deforestation (over 30 years)							200
(1000 hectares)							
Land impacted for carbon sink potential -							1,662
Low - Extend rotation length (1000							1,002
hectares)							
Land impacted for carbon sink potential -							146
Low - Improve plantations (1000							1-10
hectares)							
Land impacted for carbon sink potential -							0
Low - Increase retention of HWP (1000							Ū
hectares)							
Land impacted for carbon sink potential -							151
Low - Increase trees outside forests							
(1000 hectares)							
Land impacted for carbon sink potential -							267
Low - Reforest cropland (1000 hectares)							
Land impacted for carbon sink potential -		+					40.9
Low - Reforest pasture (1000 hectares)							+0.7
Land impacted for carbon sink potential -							866
Low - Restore productivity (1000							000

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 -							3,409
Low - Total impacted (over 30 years)							
(1000 hectares)							
Land impacted for carbon sink potential -							58.7
Mid - Accelerate regeneration (1000							
hectares)							0//
Land impacted for carbon sink potential -							246
Mid - Avoid deforestation (over 30 years) (1000 hectares)							
Land impacted for carbon sink potential -							3,000
Mid - Extend rotation length (1000							3,000
hectares)							
Land impacted for carbon sink potential -						+	220
Mid - Improve plantations (1000 hectares)							220
Land impacted for carbon sink potential -							0
Mid - Increase retention of HWP (1000							
hectares)							
Land impacted for carbon sink potential -						+	218
Mid - Increase trees outside forests (1000							_
hectares)							
Land impacted for carbon sink potential -							400
Mid - Reforest cropland (1000 hectares)							
Land impacted for carbon sink potential -							296
Mid - Reforest pasture (1000 hectares)							
Land impacted for carbon sink potential -							1,744
Mid - Restore productivity (1000							
hectares)							
Land impacted for carbon sink potential -							6,183
Mid - Total impacted (over 30 years) (1000							
hectares)							
Land impacted for carbon sink potential -							78.3
High - Accelerate regeneration (1000							
hectares)							
Land impacted for carbon sink potential -							253
High - Avoid deforestation (over 30 years)							
(1000 hectares)							/ 000
Land impacted for carbon sink potential -							4,338
High - Extend rotation length (1000							
hectares) Land impacted for carbon sink potential -							292
High - Improve plantations (1000							272
hectares)							
Land impacted for carbon sink potential -							0
High - Increase retention of HWP (1000							
hectares)							
Land impacted for carbon sink potential -							286
High - Increase trees outside forests							
(1000 hectares)							
Land impacted for carbon sink potential -							533
High - Reforest cropland (1000 hectares)							
Land impacted for carbon sink potential -							236
High - Reforest pasture (1000 hectares)							
Land impacted for carbon sink potential -							1,431
High - Restore productivity (1000							,
hectares)							
Land impacted for carbon sink potential -							7,449
High - Total impacted (over 30 years)							•
(1000 hectares)							

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

Item	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - Moderate							-2,423
deployment - Corn-ethanol to energy							
grasses (1000 tC02e/y)							
Carbon sink potential - Moderate							-7,283
deployment - Cropland measures (1000							
tC02e/y)							
Carbon sink potential - Moderate							-207
deployment - Permanent conservation							
cover (1000 tC02e/y)							0.047
Carbon sink potential - Moderate							-9,914
deployment - Total (1000 tC02e/y)							
Carbon sink potential - Aggressive							-2,423
deployment - Corn-ethanol to energy							
grasses (1000 tCO2e/y)							
Carbon sink potential - Aggressive							-13,821
deployment - Cropland measures (1000							
tCO2e/y)							
Carbon sink potential - Aggressive							-414
deployment - Permanent conservation							
cover (1000 tC02e/y)							
Carbon sink potential - Aggressive							-16,658
deployment - Total (1000 tCO2e/y)							
Land impacted for carbon sink - Moderate							1,097
deployment - Corn-ethanol to energy							
grasses (1000 hectares)							
Land impacted for carbon sink - Moderate							3,675
deployment - Cropland measures (1000							
hectares)							
Land impacted for carbon sink - Moderate							376
deployment - Permanent conservation							
cover (1000 hectares)							
Land impacted for carbon sink - Moderate							5,149
deployment - Total (1000 hectares)							
Land impacted for carbon sink -							1,097
Aggressive deployment - Corn-ethanol to							
energy grasses (1000 hectares)							
Land impacted for carbon sink -							6,974
Aggressive deployment - Cropland							
measures (1000 hectares)							
Land impacted for carbon sink -							753
Aggressive deployment - Permanent							
conservation cover (1000 hectares)							
Land impacted for carbon sink -							8,824
Aggressive deployment - Total (1000							
hectares)							

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

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

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

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

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

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

Table 39: E+RE- scenario - IMPACTS - Jobs							
Item	2020	2025	2030	2035	2040	2045	2050
By economic sector - Agriculture (jobs)		2,195	2,565	3,041	1,947	1,999	4,957
By economic sector - Construction (jobs)		8,367	9,190	11,303	12,301	14,362	17,624
By economic sector - Manufacturing (jobs)		4,097	4,045	4,351	4,008	4,203	5,789
By economic sector - Mining (jobs)		2,141	1,529	1,088	748	508	360
By economic sector - Other (jobs)		605	702	891	1,075	1,315	1,531
By economic sector - Pipeline (jobs)		498	440	505	346	283	1,009
By economic sector - Professional (jobs)		5,240	6,077	7,656	8,446	11,065	16,532
By economic sector - Trade (jobs)		3,830	3,871	4,330	4,548	5,381	6,839
By economic sector - Utilities (jobs)		9,010	9,821	12,424	13,319	15,786	18,110
By resource sector - Biomass (jobs)		5,350	5,996	8,089	5,802	7,879	20,929
By resource sector - CO2 (jobs)		0	0	885	27.7	42.3	6,524
By resource sector - Coal (jobs)		886	204	0	0	0	0
By resource sector - Grid (jobs)		12,320	14,064	19,435	22,487	28,047	26,331
By resource sector - Natural Gas (jobs)		4,271	4,339	3,967	4,142	3,664	3,187
By resource sector - Nuclear (jobs)		944	929	658	168	0	0
By resource sector - Oil (jobs)		4,751	3,903	2,946	2,166	1,642	1,330
By resource sector - Solar (jobs)		1,148	906	1,028	1,132	1,172	1,708
By resource sector - Wind (jobs)		6,312	7,900	8,581	10,816	12,455	12,742
By education level - All sectors - High		15,860	16,847	20,058	19,940	23,015	30,978
school diploma or less (jobs)					,	.	,
By education level - All sectors -		10,682	11,405	13,737	14,511	17,116	21,883
Associates degree or some college (jobs)		,				.	•
By education level - All sectors -		7,334	7,723	9,094	9,454	11,314	15,145
Bachelors degree (jobs)						.	•
By education level - All sectors - Masters		1,837	1,970	2,347	2,459	2,986	4,058
or professional degree (jobs)		,	, -	,-	, -	,	,
By education level - All sectors - Doctoral		269	296	354	376	472	686
degree (jobs)							
Related work experience - All sectors -		5,339	5,686	6,796	6,883	8,031	10,738
None (jobs)							
Related work experience - All sectors - Up		7,777	8,272	9,801	9,647	11,114	15,280
to 1 year (jobs)							
Related work experience - All sectors - 1		12,671	13,463	16,081	16,666	19,743	25,987
to 4 years (jobs)							
Related work experience - All sectors - 4		8,070	8,577	10,254	10,768	12,747	16,539
to 10 years (jobs)						.	•
Related work experience - All sectors -		2,126	2,243	2,658	2,776	3,267	4,206
Over 10 years (jobs)							
On-the-Job Training - All sectors - None		1,982	2,085	2,452	2,489	2,921	3,942
(jobs)							•
On-the-Job Training - All sectors - Up to 1		24,256	25,720	30,542	30,891	36,247	48,862
year (jobs)							
On-the-Job Training - All sectors - 1 to 4		7,136	7,622	9,176	9,706	11,435	14,511
years (jobs)							
On-the-Job Training - All sectors - 4 to 10		2,286	2,475	3,025	3,247	3,834	4,830
years (jobs)							
On-the-Job Training - All sectors - Over 10		323	339	395	406	466	606
years (jobs)							
On-Site or In-Plant Training - All sectors -		5,753	6,135	7,307	7,508	8,890	11,979
None (jobs)		•	•	•	•	•	-
On-Site or In-Plant Training - All sectors -		21,961	23,264	27,628	27,997	32,800	43,931
Up to 1 year (jobs)		.		•	*		•

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

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

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

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

Table 41: E+RE- scenario - PILLAR 1: Efficiency/Electrification - Electricity demand

Item	2020	2025	2030	2035	2040	2045	2050
Electricity distribution capital invested - Cumulative 5-yr (billion \$2018)		3.87	3.99	7.91	8.48	7.13	7.47

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

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

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

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

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

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

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

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

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

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

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

Item	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - Low - Accelerate							-240
regeneration (1000 tCO2e/y)							
Carbon sink potential - Low - Avoid							-312
deforestation (1000 tCO2e/y)							
Carbon sink potential - Low - Extend							-3,267
rotation length (1000 tCO2e/y)							
Carbon sink potential - Low - Improve							-404
plantations (1000 tCO2e/y)							
Carbon sink potential - Low - Increase							-1,556
retention of HWP (1000 tCO2e/y)							.,
Carbon sink potential - Low - Increase							-1,054
trees outside forests (1000 tC02e/y)							1,004
Carbon sink potential - Low - Reforest							-4,034
cropland (1000 tCO2e/y)							-4,004
Carbon sink potential - Low - Reforest							-630
·							-630
pasture (1000 tC02e/y)							1/55
Carbon sink potential - Low - Restore							-1,455
productivity (1000 tCO2e/y)							
Carbon sink potential - Low - All (not							-12,952
counting overlap) (1000 tCO2e/y)							
Carbon sink potential - Mid - Accelerate							-359
regeneration (1000 tCO2e/y)							
Carbon sink potential - Mid - Avoid							-1,091
deforestation (1000 tCO2e/y)							
Carbon sink potential - Mid - Extend							-5,887
rotation length (1000 tCO2e/y)							
Carbon sink potential - Mid - Improve							-591
plantations (1000 tCO2e/y)							
Carbon sink potential - Mid - Increase							-3,112
retention of HWP (1000 tCO2e/y)							0,112
Carbon sink potential - Mid - Increase						+	-2,033
trees outside forests (1000 tC02e/y)							-2,000
Carbon sink potential - Mid - Reforest							-6,052
· · · · · · · · · · · · · · · · · · ·							-6,032
cropland (1000 tCO2e/y)							
Carbon sink potential - Mid - Reforest							-4,472
pasture (1000 tC02e/y)							
Carbon sink potential - Mid - Restore							-2,887
productivity (1000 tCO2e/y)							
Carbon sink potential - Mid - All (not							-26,484
counting overlap) (1000 tCO2e/y)							
Carbon sink potential - High - Accelerate							-479
regeneration (1000 tCO2e/y)							
Carbon sink potential - High - Avoid							-1,871
deforestation (1000 tCO2e/y)							
Carbon sink potential - High - Extend							-8,507
rotation length (1000 tCO2e/y)							,
Carbon sink potential - High - Improve							-793
plantations (1000 tCO2e/y)							. , ,
Carbon sink potential - High - Increase							-4,667
retention of HWP (1000 tCO2e/y)							7,001
Carbon sink potential - High - Increase							-3,012
							-3,012
trees outside forests (1000 tC02e/y)							0.070
Carbon sink potential - High - Reforest							-8,069
cropland (1000 tC02e/y)							
Carbon sink potential - High - Reforest							-8,313
pasture (1000 tCO2e/y)							
Carbon sink potential - High - All (not							-40,029
counting overlap) (1000 tCO2e/y)							
Carbon sink potential - High - Restore							-4,318
Garbon Sink potential - night - kestore	l I	1	I	J		1	-4,516

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							39.1
hectares)							
Land impacted for carbon sink potential -							238
Low - Avoid deforestation (over 30 years)							
(1000 hectares)							
Land impacted for carbon sink potential -							1,662
Low - Extend rotation length (1000							
hectares)							
Land impacted for carbon sink potential -							146
Low - Improve plantations (1000							
hectares)							
Land impacted for carbon sink potential -							0
Low - Increase retention of HWP (1000							
hectares)							
Land impacted for carbon sink potential -							151
Low - Increase trees outside forests							101
(1000 hectares)							
Land impacted for carbon sink potential -							267
Low - Reforest cropland (1000 hectares)							201
Land impacted for carbon sink potential -							40.9
Low - Reforest pasture (1000 hectares)							40.9
Land impacted for carbon sink potential -							866
Low - Restore productivity (1000							800
. , ,							
hectares)							0 / 00
Land impacted for carbon sink potential -							3,409
Low - Total impacted (over 30 years)							
(1000 hectares)							
Land impacted for carbon sink potential -							58.7
Mid - Accelerate regeneration (1000							
hectares)							
Land impacted for carbon sink potential -							246
Mid - Avoid deforestation (over 30 years)							
(1000 hectares)							
Land impacted for carbon sink potential -							3,000
Mid - Extend rotation length (1000							
hectares)							
Land impacted for carbon sink potential -							220
Mid - Improve plantations (1000 hectares)							
Land impacted for carbon sink potential -							0
Mid - Increase retention of HWP (1000							
hectares)							
Land impacted for carbon sink potential -							218
Mid - Increase trees outside forests (1000							
hectares)							
Land impacted for carbon sink potential -							400
Mid - Reforest cropland (1000 hectares)							
Land impacted for carbon sink potential -							296
Mid - Reforest pasture (1000 hectares)							
Land impacted for carbon sink potential -							1,744
Mid - Restore productivity (1000							.,
hectares)							
Land impacted for carbon sink potential -							6,183
Mid - Total impacted (over 30 years) (1000							0,100
hectares)							
-							70.0
Land impacted for carbon sink potential -							78.3
High - Accelerate regeneration (1000							
hectares)							252
Land impacted for carbon sink potential -							253
High - Avoid deforestation (over 30 years)							
(1000 hectares)		1	1			1	

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

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							-2,423
grasses (1000 tC02e/y)							7,000
Carbon sink potential - Moderate							-7,283
deployment - Cropland measures (1000 tCO2e/y)							
Carbon sink potential - Moderate							-207
deployment - Permanent conservation							
cover (1000 tCO2e/y)							
Carbon sink potential - Moderate							-9,914
deployment - Total (1000 tCO2e/y)							
Carbon sink potential - Aggressive							-2,423
deployment - Corn-ethanol to energy							
grasses (1000 tCO2e/y)							
Carbon sink potential - Aggressive							-13,821
deployment - Cropland measures (1000							
tCO2e/y)							
Carbon sink potential - Aggressive							-414
deployment - Permanent conservation							
cover (1000 tCO2e/y)							
Carbon sink potential - Aggressive							-16,658
deployment - Total (1000 tCO2e/y)							
Land impacted for carbon sink - Moderate							1,097
deployment - Corn-ethanol to energy							
grasses (1000 hectares)							
Land impacted for carbon sink - Moderate							3,675
deployment - Cropland measures (1000							
hectares)							
Land impacted for carbon sink - Moderate							376
deployment - Permanent conservation							
cover (1000 hectares)							
Land impacted for carbon sink - Moderate							5,149
deployment - Total (1000 hectares)							

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

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

Table 49: E-B+ scenario - IMPACTS - Health							
Item	2020	2025	2030	2035	2040	2045	2050
Premature deaths from air pollution - Fuel Comb - Electric Generation - Coal (deaths)		32.6	0.024	0.023	0.018	0.012	0
Premature deaths from air pollution - Fuel Comb - Electric Generation - Natural Gas (deaths)		11.4	5.66	3.02	1.99	0.911	0.503
Premature deaths from air pollution - Mobile - On-Road (deaths)		174	178	177	163	132	92.6
Premature deaths from air pollution - Gas Stations (deaths)		11.2	11.4	11.2	10.2	8.26	5.85
Premature deaths from air pollution - Fuel Comb - Residential - Natural Gas (deaths)		36.2	34.2	32	29.4	26.2	22.4
Premature deaths from air pollution - Fuel Comb - Residential - Oil (deaths)		1.73	1.75	1.78	1.71	1.5	1.26
Premature deaths from air pollution - Fuel Comb - Residential - Other (deaths)		4.4	4.63	4.84	4.82	4.32	3.62
Premature deaths from air pollution - Fuel Comb - Comm/Institutional - Coal (deaths)		3.19	3.1	3	2.88	2.75	2.61
Premature deaths from air pollution - Fuel Comb - Comm/Institutional - Natural Gas (deaths)		8.65	8.34	7.95	7.31	6.42	5.38
Premature deaths from air pollution - Fuel Comb - Comm/Institutional - Oil (deaths)		3.31	2.92	2.53	2.14	1.81	1.55
Premature deaths from air pollution - Fuel Comb - Comm/Institutional - Other (deaths)		1.08	0.99	0.894	0.796	0.698	0.604
Premature deaths from air pollution - Industrial Processes - Coal Mining (deaths)		0.562	0.1	0.098	0.095	0.091	0.086
Premature deaths from air pollution - Industrial Processes - Oil & Gas Production (deaths)		48.6	44.7	39.5	35.1	31.5	22.1
Monetary damages from air pollution - Fuel Comb - Electric Generation - Coal (million \$2019)		289	0.209	0.2	0.163	0.109	0.003
Monetary damages from air pollution - Fuel Comb - Electric Generation - Natural Gas (million \$2019)		101	50.1	26.8	17.7	8.07	4.46
Monetary damages from air pollution - Mobile - On-Road (million \$2019)		1,543	1,586	1,574	1,446	1,174	823
Monetary damages from air pollution - Gas Stations (million \$2019)		99	101	99.2	90.3	73.1	51.8

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

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

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

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

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

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

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

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

Table 52: E-B+ scenario - PILLAR 1: Efficiency/Electrification - Electricity demand

Item	2020	2025	2030	2035	2040	2045	2050
Electricity distribution capital invested - Cumulative 5-vr (billion \$2018)		3.06	3.08	4.07	4.2	6.25	6.61

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

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

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

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

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

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

Item	2020	2025	2030	2035	2040	2045	2050
Installed thermal - Coal (MW)	3,581	1,536	0	0	0	0	0
Installed thermal - Natural gas (MW)	6,020	6,010	6,542	6,489	5,464	10,651	10,502
Installed thermal - Nuclear (MW)	1,871	1,871	1,871	593	0	0	0
Capital invested - Biomass power plant (billion \$2018)	0	0.046	0.387	0	0	0	0
Capital invested - Biomass w/ccu allam power plant (billion \$2018)	0	0	0	0	0	0	0
Capital invested - Biomass w/ccu power plant (billion \$2018)	0	0	0	0	0	0	0

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

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

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

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

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

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

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

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

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

Item	2020	2025	2030	2035	2040	2045	2050
	2020	2023	2030	2033	2040	2043	2030
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

Table 62: E-B+ scenario - PILLAR 6: Land			0000	0005	00/0	00/5	0050
Item	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - Low - Accelerate							-240
regeneration (1000 tCO2e/y)							
Carbon sink potential - Low - Avoid							-312
deforestation (1000 tC02e/y)							
Carbon sink potential - Low - Extend							-3,267
rotation length (1000 tCO2e/y)							
Carbon sink potential - Low - Improve							-404
plantations (1000 tCO2e/y)							
Carbon sink potential - Low - Increase							-1,556
retention of HWP (1000 tCO2e/y)							
Carbon sink potential - Low - Increase							-1,054
trees outside forests (1000 tCO2e/y)							
Carbon sink potential - Low - Reforest							-4,034
cropland (1000 tCO2e/y)							
Carbon sink potential - Low - Reforest							-630
pasture (1000 tC02e/y)							
Carbon sink potential - Low - Restore							-1,455
productivity (1000 tCO2e/y)							1, 100
Carbon sink potential - Low - All (not							-12,952
counting overlap) (1000 tCO2e/y)							-12,702
Carbon sink potential - Mid - Accelerate							-359
·							-337
regeneration (1000 tC02e/y)							1.001
Carbon sink potential - Mid - Avoid							-1,091
deforestation (1000 tC02e/y)							
Carbon sink potential - Mid - Extend							-5,887
rotation length (1000 tCO2e/y)							
Carbon sink potential - Mid - Improve							-591
plantations (1000 tCO2e/y)							
Carbon sink potential - Mid - Increase							-3,112
retention of HWP (1000 tCO2e/y)							
Carbon sink potential - Mid - Increase							-2,033
trees outside forests (1000 tCO2e/y)							
Carbon sink potential - Mid - Reforest							-6,052
cropland (1000 tCO2e/y)							·
Carbon sink potential - Mid - Reforest							-4,472
pasture (1000 tC02e/y)							.,
Carbon sink potential - Mid - Restore							-2,887
productivity (1000 tC02e/y)							2,001
Carbon sink potential - Mid - All (not		+					-26,484
counting overlap) (1000 tCO2e/y)							-20,404
Carbon sink potential - High - Accelerate							-479
							-419
regeneration (1000 tCO2e/y)							1.071
Carbon sink potential - High - Avoid							-1,871
deforestation (1000 tC02e/y)							
Carbon sink potential - High - Extend							-8,507
rotation length (1000 tCO2e/y)							
Carbon sink potential - High - Improve							-793
plantations (1000 tCO2e/y)							
Carbon sink potential - High - Increase							-4,667
retention of HWP (1000 tCO2e/y)							
Carbon sink potential - High - Increase							-3,012
trees outside forests (1000 tC02e/y)							
Carbon sink potential - High - Reforest							-8,069
cropland (1000 tCO2e/y)							
Carbon sink potential - High - Reforest		+	+				-8,313
pasture (1000 tC02e/y)							3,010
Carbon sink potential - High - All (not		-					-40,029
counting overlap) (1000 tC02e/y)							-40,029
							/. 010
Carbon sink potential - High - Restore							-4,318
productivity (1000 tCO2e/y)							

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

Item Item	2020	2025	2030	2035	2040	2045	2050
Land impacted for carbon sink potential -							39.1
Low - Accelerate regeneration (1000							
hectares)							
Land impacted for carbon sink potential -							238
Low - Avoid deforestation (over 30 years)							
(1000 hectares)							
Land impacted for carbon sink potential -							1,662
Low - Extend rotation length (1000							
hectares)							
Land impacted for carbon sink potential -							146
Low - Improve plantations (1000							
hectares)							
Land impacted for carbon sink potential -							0
Low - Increase retention of HWP (1000 hectares)							
Land impacted for carbon sink potential -		-					151
Low - Increase trees outside forests							131
(1000 hectares)							
Land impacted for carbon sink potential -		+					267
Low - Reforest cropland (1000 hectares)							201
Land impacted for carbon sink potential -							40.9
Low - Reforest pasture (1000 hectares)							40.7
Land impacted for carbon sink potential -							866
Low - Restore productivity (1000							000
hectares)							
Land impacted for carbon sink potential -							3,409
Low - Total impacted (over 30 years)							•
(1000 hectares)							
Land impacted for carbon sink potential -							58.7
Mid - Accelerate regeneration (1000							
hectares)							
Land impacted for carbon sink potential -							246
Mid - Avoid deforestation (over 30 years)							
(1000 hectares)							
Land impacted for carbon sink potential -							3,000
Mid - Extend rotation length (1000							
hectares)							
Land impacted for carbon sink potential -							220
Mid - Improve plantations (1000 hectares)							
Land impacted for carbon sink potential -							0
Mid - Increase retention of HWP (1000 hectares)							
Land impacted for carbon sink potential -							218
Mid - Increase trees outside forests (1000							210
hectares)							
Land impacted for carbon sink potential -							400
Mid - Reforest cropland (1000 hectares)							400
Land impacted for carbon sink potential -							296
Mid - Reforest pasture (1000 hectares)							270
Land impacted for carbon sink potential -							1,744
Mid - Restore productivity (1000							.,
hectares)							
Land impacted for carbon sink potential -							6,183
Mid - Total impacted (over 30 years) (1000							
hectares)							
Land impacted for carbon sink potential -							78.3
High - Accelerate regeneration (1000							
hectares)							
Land impacted for carbon sink potential -							253
High - Avoid deforestation (over 30 years)							
(1000 hectares)	1	1					

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

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

Item	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - Moderate							-2,914
deployment - Corn-ethanol to energy							
grasses (1000 tCO2e/y)							
Carbon sink potential - Moderate							-6,825
deployment - Cropland measures (1000							
tCO2e/y)							
Carbon sink potential - Moderate							-193
deployment - Permanent conservation							
cover (1000 tCO2e/y)							
Carbon sink potential - Moderate							0
deployment - Cropland to woody energy							
crops (1000 tCO2e/y)							
Carbon sink potential - Moderate							0
deployment - Pasture to energy crops							
(1000 tC02e/y)							
Carbon sink potential - Moderate							-9,932
deployment - Total (1000 tCO2e/y)							
Carbon sink potential - Aggressive							-2,914
deployment - Corn-ethanol to energy							
grasses (1000 tCO2e/y)							
Carbon sink potential - Aggressive							-12,952
deployment - Cropland measures (1000							
tCO2e/y)							
Carbon sink potential - Aggressive							-386
deployment - Permanent conservation							
cover (1000 tC02e/y)							
Carbon sink potential - Aggressive							0
deployment - Cropland to woody energy							
crops (1000 tC02e/y)							
Carbon sink potential - Aggressive							0
deployment - Pasture to energy crops							
(1000 tCO2e/y)							
Carbon sink potential - Aggressive							-16,252
deployment - Total (1000 tCO2e/y)							•

Item	2020	2025	2030	2035	2040	2045	2050
Land impacted for carbon sink - Moderate							1,589
deployment - Corn-ethanol to energy							
grasses (1000 hectares)							
and impacted for carbon sink - Moderate							3,433
deployment - Cropland measures (1000							
hectares)							
Land impacted for carbon sink - Moderate							351
deployment - Permanent conservation							
cover (1000 hectares)							
Land impacted for carbon sink - Moderate							29.2
deployment - Cropland to woody energy							
crops (1000 hectares)							
and impacted for carbon sink - Moderate							137
deployment - Pasture to energy crops							
(1000 hectares)							
Land impacted for carbon sink - Moderate							5,538
deployment - Total (1000 hectares)							
Land impacted for carbon sink -							1,589
Aggressive deployment - Corn-ethanol to							
energy grasses (1000 hectares)							
and impacted for carbon sink -							16,087
Aggressive deployment - Cropland							
measures (1000 hectares)							
and impacted for carbon sink -							702
Aggressive deployment - Permanent							
conservation cover (1000 hectares)							
Land impacted for carbon sink -							29.2
Aggressive deployment - Cropland to							
woody energy crops (1000 hectares)							
Land impacted for carbon sink -							137
Aggressive deployment - Pasture to							
energy crops (1000 hectares)							
Land impacted for carbon sink -							18,543
Aggressive deployment - Total (1000							
hectares)							
				<u>.</u>			
able 64: REF scenario - IMPACTS - Health	0000	0005	0000	0005	00/0	00/5	0050
Item Dramatura deaths from air pollution	2020	2025	2030	2035	2040	2045	2050
Premature deaths from air pollution -		89.5	50	30.2	24.2	21.4	20.8
Fuel Comb - Electric Generation - Coal							

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

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

Tuble 64. NET beenand Inn Note Treatin (ed	minucuj					
Item	2020 2025	2030	2035	2040	2045	2050
Premature deaths from air pollution -	8.78	8.7	8.12	7.38	6.95	6.9
Fuel Comb - Comm/Institutional - Natural						
Gas (deaths)						
Premature deaths from air pollution -	3.41	3.28	3.09	2.87	2.73	2.67
Fuel Comb - Comm/Institutional - Oil						
(deaths)						
Premature deaths from air pollution -	1.13	1.17	1.22	1.25	1.29	1.33
Fuel Comb - Comm/Institutional - Other						
(deaths)						
Premature deaths from air pollution -	1.46	0.959	0.738	0.69	0.655	0.603
Industrial Processes - Coal Mining						
(deaths)						
Premature deaths from air pollution -	48.8	51.5	52.9	50.9	50.8	47.5
Industrial Processes - Oil & Gas						
Production (deaths)						
Monetary damages from air pollution -	793	444	267	215	190	184
Fuel Comb - Electric Generation - Coal						
(million \$2019)						
Monetary damages from air pollution -	140	154	179	112	88.5	77.9
Fuel Comb - Electric Generation - Natural						
Gas (million \$2019)						
Monetary damages from air pollution -	1,543	1,609	1,680	1,760	1,841	1,924
Mobile - On-Road (million \$2019)						
Monetary damages from air pollution -	98.6	102	105	109	113	116
Gas Stations (million \$2019)						
Monetary damages from air pollution -	320	304	290	282	280	279
Fuel Comb - Residential - Natural Gas						
(million \$2019)						
Monetary damages from air pollution -	14.9	13.2	9.82	6.12	2.87	0.958
Fuel Comb - Residential - Oil (million						
\$2019)						
Monetary damages from air pollution -	37.9	39.5	41.8	43.8	43.8	43.1
Fuel Comb - Residential - Other (million						
\$2019)						
Monetary damages from air pollution -	29.5	30.1	30.5	30.8	31	31.1
Fuel Comb - Comm/Institutional - Coal						
(million \$2019)						
Monetary damages from air pollution -	77.7	77	71.9	65.4	61.5	61.1
Fuel Comb - Comm/Institutional - Natural						
Gas (million \$2019)						
Monetary damages from air pollution -	30.1	29	27.4	25.4	24.2	23.7
Fuel Comb - Comm/Institutional - Oil						
(million \$2019)						
Monetary damages from air pollution -	10	10.4	10.8	11.1	11.4	11.8
Fuel Comb - Comm/Institutional - Other				.	•	
(million \$2019)						
Monetary damages from air pollution -	12.9	8.46	6.52	6.09	5.78	5.32
Industrial Processes - Coal Mining	,	2		0,	0	0.02
(million \$2019)						
Monetary damages from air pollution -	433	457	470	452	451	422
Industrial Processes - Oil & Gas				.02		
Production (million \$2019)						
1 1 0440tion (illillion \$2017)						

Table 65: REF scenario - IMPACTS - Jobs

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

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

(Continueu)						
2020	2025	2030	2035	2040	2045	2050
		466				948
						505
						6,070
						3,906
						9,549
	5,363	5,191	5,030	4,863	4,780	4,702
	0	0	0	0	0	0
						121
						13,648
						5,302
						326
	4,829					3,274
						1,665
						7,931
	13,651	13,524	14,398	15,438	15,559	16,163
	8,974	8,929	9,665	10,567	10,720	11,274
	6,254	6,112	6,454	6,964	7,055	7,354
	1,560	1,530	1,626	1,769	1,807	1,895
	222	220	234	259	268	284
	4,590	4,540	4,845	5,220	5,275	5,510
	6,678	6,628	7,035	7,544	7,619	7,916
	10,779	10,627	11,358	12,299	12,449	13,010
	6,815	6,744	7,240	7,877	7,985	8,366
			1.000			
	1,798	1,776	1,898	2,057	2,080	2,168
	1 (00	1 (()	4757	1.000	1 010	
	1,689	1,663	1,757	1,888	1,910	1,990
	00.000	00.400	017//	00.447	00 (5 (
	20,800	20,498	21,764	23,417	23,656	24,623
	F 000	F 070	/ / / 5	70/0	71/0	7.50/
	5,999	5,970	6,465	7,062	7,163	7,524
	1007	1.017	0.100	0.010	0.077	0.505
	1,907	1,916	2,103	2,319	2,366	2,505
	0//	0/0	007	011	01/	000
	266	268	287	311	314	328
	, 057	/ 010	F 100	F FF/	F (0)	
	4,857	4,810	5,130	5,554	5,626	5,886
	10.005	10.575	10.700	01.005	01 / 50	00.000
	18,835	18,565	19,729	21,235	21,452	22,330
	/ 700	/ /00	F 0/F	F F10	F F00	F 0/2
	4,720	4,690	5,065	5,519	5,592	5,863
	1007	1000	0.1/7	0.070	0.700	0.557
	1,787	1,988	2,161	2,318	2,422	2,556
	0/1	0/1	005	010	017	205
	261	261	285	312	317	335
	1.07.7.	1.07.0	1000	0.107	0.050	2,386
	1,044	1,043	ללל,ו	2,194	2,253	2,386
	·	2020 2025 386 497 4,127 3,303 8,238 5,363	2020 2025 2030 386 466 497 518 4,127 4,167 3,303 3,146 8,238 7,936 5,363 5,191 0 0 888 441 10,855 10,031 4,471 4,984 944 929 4,829 4,229 624 3,310 3,886 13,651 13,524 8,974 8,929 6,254 6,112 1,560 1,530 222 220 4,590 4,540 6,678 6,628 10,779 10,627 6,815 6,744 1,798 1,776 1,689 1,663 20,800 20,498 5,999 5,970 1,907 1,916 266 268 4,857 4,810 1,885 18,565	2020 2025 2030 2035 386 466 573 497 518 526 4,127 4,167 4,597 3,303 3,146 3,243 8,238 7,936 8,657 5,363 5,191 5,030 0 0 0 0 888 441 347 10,855 10,031 11,748 4,471 4,984 4,997 944 929 777 4,829 4,229 3,787 624 872 3,310 3,886 4,820 13,651 13,524 14,398 8,974 8,929 9,665 6,254 6,112 6,454 1,560 1,530 1,626 222 220 234 4,590 4,540 4,845 6,678 6,628 7,035 10,779 10,627 11,358 1,689 <t< td=""><td>2020 2025 2030 2035 2040 386 466 573 707 497 518 526 500 4,127 4,167 4,597 5,290 3,303 3,146 3,243 3,528 8,238 7,936 8,657 9,329 5,363 5,191 5,030 4,863 0 0 0 0 0 10,855 10,031 11,748 13,365 4,471 4,984 4,997 4,835 4,471 4,984 4,997 4,835 4,429 4,229 3,787 3,541 4,829 4,229 3,787 3,541 624 872 968 3,310 3,886 4,820 6,525 13,651 13,524 14,398 15,438 8,974 8,929 9,665 10,567 10,567 4,590 4,540 4,845 5,220 4,590 4,540 4,845 5,220 4,590</td><td>2020 2025 2030 2035 2040 2045 386 466 573 707 775 497 518 526 500 507 4,127 4,167 4,597 5,290 5,600 3,303 3,146 3,243 3,528 3,648 8,238 7,936 8,657 9,329 9,314 5,363 5,191 5,030 4,863 4,780 0 0 0 0 0 0 10,855 10,031 11,748 13,365 13,404 4,471 4,984 4,997 4,835 4,710 944 929 777 571 562 4,829 4,229 3,787 3,541 3,382 4,829 4,229 3,787 3,541 3,382 3,310 3,886 4,820 6,525 7,226 13,651 13,524 14,398 15,438 15,559 8,974</td></t<>	2020 2025 2030 2035 2040 386 466 573 707 497 518 526 500 4,127 4,167 4,597 5,290 3,303 3,146 3,243 3,528 8,238 7,936 8,657 9,329 5,363 5,191 5,030 4,863 0 0 0 0 0 10,855 10,031 11,748 13,365 4,471 4,984 4,997 4,835 4,471 4,984 4,997 4,835 4,429 4,229 3,787 3,541 4,829 4,229 3,787 3,541 624 872 968 3,310 3,886 4,820 6,525 13,651 13,524 14,398 15,438 8,974 8,929 9,665 10,567 10,567 4,590 4,540 4,845 5,220 4,590 4,540 4,845 5,220 4,590	2020 2025 2030 2035 2040 2045 386 466 573 707 775 497 518 526 500 507 4,127 4,167 4,597 5,290 5,600 3,303 3,146 3,243 3,528 3,648 8,238 7,936 8,657 9,329 9,314 5,363 5,191 5,030 4,863 4,780 0 0 0 0 0 0 10,855 10,031 11,748 13,365 13,404 4,471 4,984 4,997 4,835 4,710 944 929 777 571 562 4,829 4,229 3,787 3,541 3,382 4,829 4,229 3,787 3,541 3,382 3,310 3,886 4,820 6,525 7,226 13,651 13,524 14,398 15,438 15,559 8,974

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

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

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

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

Table 67: REF scenario - PILLAR 1: Efficiency/Electrification - Electricity demand

Item	2020	2025	2030	2035	2040	2045	2050
Electricity distribution capital invested -		3.78	3.89	5.19	5.44	4.77	4.91
Cumulative 5-yr (billion \$2018)							

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Item Copper sink potential, Mid. Referent	2020	2025	2030	2035	2040	2045	2050 -6,052
Carbon sink potential - Mid - Reforest cropland (1000 tCO2e/y)							-6,052
Carbon sink potential - Mid - Reforest							-4,472
pasture (1000 tCO2e/y)							-4,412
Carbon sink potential - Mid - Restore							-2,887
productivity (1000 tCO2e/y)							-2,001
Carbon sink potential - Mid - All (not							-26,484
counting overlap) (1000 tC02e/y)							-20,404
Carbon sink potential - High - Accelerate							-479
regeneration (1000 tC02e/y)							717
Carbon sink potential - High - Avoid							-1,871
deforestation (1000 tC02e/y)							1,01
Carbon sink potential - High - Extend							-8,507
rotation length (1000 tCO2e/y)							0,001
Carbon sink potential - High - Improve							-793
plantations (1000 tCO2e/y)							170
Carbon sink potential - High - Increase							-4,667
retention of HWP (1000 tCO2e/y)							4,001
Carbon sink potential - High - Increase							-3,012
trees outside forests (1000 tCO2e/y)							0,012
Carbon sink potential - High - Reforest							-8,069
cropland (1000 tCO2e/y)							0,007
Carbon sink potential - High - Reforest							-8,313
pasture (1000 tC02e/y)							0,010
Carbon sink potential - High - All (not							-40,029
counting overlap) (1000 tCO2e/y)							.0,027
Carbon sink potential - High - Restore							-4,318
productivity (1000 tCO2e/y)							.,0.0
Land impacted for carbon sink potential -							39.1
Low - Accelerate regeneration (1000							-
hectares)							
Land impacted for carbon sink potential -							238
Low - Avoid deforestation (over 30 years)							
(1000 hectares)							
Land impacted for carbon sink potential -							1,662
Low - Extend rotation length (1000							,
hectares)							
Land impacted for carbon sink potential -							146
Low - Improve plantations (1000							
hectares)							
Land impacted for carbon sink potential -							C
Low - Increase retention of HWP (1000							
hectares)							
Land impacted for carbon sink potential -							151
Low - Increase trees outside forests							
(1000 hectares)							
Land impacted for carbon sink potential -							267
Low - Reforest cropland (1000 hectares)							
Land impacted for carbon sink potential -							40.9
Low - Reforest pasture (1000 hectares)							
Land impacted for carbon sink potential -							866
Low - Restore productivity (1000							
hectares)							
Land impacted for carbon sink potential -							3,409
Low - Total impacted (over 30 years)							
(1000 hectares)							
Land impacted for carbon sink potential -							58.7
Mid - Accelerate regeneration (1000							
hectares)		I	 			I	

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

Table 73: REF scenario - PILLAR 6: Land siz	2020	2025	2030	2035	2040	2045	2050
Land impacted for carbon sink potential -							246
Mid - Avoid deforestation (over 30 years)							
(1000 hectares)							
Land impacted for carbon sink potential -							3,000
Mid - Extend rotation length (1000							0,000
hectares)							
Land impacted for carbon sink potential -							220
Mid - Improve plantations (1000 hectares)							
Land impacted for carbon sink potential -							0
Mid - Increase retention of HWP (1000							Ū
hectares)							
Land impacted for carbon sink potential -							218
Mid - Increase trees outside forests (1000							
hectares)							
Land impacted for carbon sink potential -						+	400
Mid - Reforest cropland (1000 hectares)							
Land impacted for carbon sink potential -							296
Mid - Reforest pasture (1000 hectares)							_,,
Land impacted for carbon sink potential -							1,744
Mid - Restore productivity (1000							.,
hectares)							
Land impacted for carbon sink potential -						+	6,183
Mid - Total impacted (over 30 years) (1000							-,
hectares)							
Land impacted for carbon sink potential -						+	78.3
High - Accelerate regeneration (1000							
hectares)							
Land impacted for carbon sink potential -							253
High - Avoid deforestation (over 30 years)							
(1000 hectares)							
Land impacted for carbon sink potential -							4,338
High - Extend rotation length (1000							•
hectares)							
Land impacted for carbon sink potential -							292
High - Improve plantations (1000							
hectares)							
Land impacted for carbon sink potential -							0
High - Increase retention of HWP (1000							
hectares)							
Land impacted for carbon sink potential -							286
High - Increase trees outside forests							
(1000 hectares)							
Land impacted for carbon sink potential -							533
High - Reforest cropland (1000 hectares)							
Land impacted for carbon sink potential -							236
High - Reforest pasture (1000 hectares)							
Land impacted for carbon sink potential -							1,431
High - Restore productivity (1000							
hectares)							
Land impacted for carbon sink potential -							7,449
High - Total impacted (over 30 years)							
(1000 hectares)							