

Net-Zero America - nebraska state report

2021-03-18

These data underlie graphs and tables presented in the Princeton Net-Zero America study:

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Notes

- These data are all data from the study available at https://netzeroamerica.prince-ton.edu.
- The Net-Zero America study describes five pathways to reach net-zero emissions and one "no new policies" reference scenario. In this document, state-level results are grouped by scenario. For some scenarios, the study generated national, but not statelevel results.
- Within results for a given scenario, data tables are organized into corresponding sections of the full net-zero study (e.g., Pillar 1, Pillar 2, etc.)
- For Pillar 6 (Land sinks), values shown are maximum carbon storage potentials.

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

Item	2020	2025	2030	2035	2040	2045	2050
Commercial HVAC investment in 2020s -		5,541	6,031				
Cumulative 5-yr (million \$2018)							
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
Sales of space heating units - Electric	3.92	7.61	30.1	78	86.6	87.1	87.1
Heat Pump (%)							
Sales of space heating units - Electric	6.31	5.8	8.21	11.8	12.4	12.4	12.4
Resistance (%)							
Sales of space heating units - Fossil (%)	0	1.82	0.351	0.015	0	0	0
Sales of space heating units - Gas Furnace	89.8	84.8	61.3	10.2	1.03	0.454	0.456
(%)							
Sales of water heating units - Electric	0.944	1.84	14.5	42	47	47.3	47.3
Heat Pump (%)							
Sales of water heating units - Electric	8.03	8	20.3	47	51.8	52.1	52.1
Resistance (%)							
Sales of water heating units - Gas Furnace	90.2	89.2	64.5	10.3	0.61	0	0
(%)							
Sales of water heating units - Other (%)	0.788	0.941	0.732	0.684	0.681	0.683	0.683

Table 2: E+ scenario - PILLAR 1: Efficiency/Electrification - Electricity demand

Item	2020	2025	2030	2035	2040	2045	2050
Electricity distribution capital invested -		1.62	1.68	2.88	3.08	2.81	2.96
Cumulative 5-yr (billion \$2018)							

Table 3: E+ scenario - PILLAR 1: Efficiency/Electrification - Overview

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Commercial (PJ)	70.8	69.4	66.6	62.4	57.8	54.2	52.1
Final energy use - Industry (PJ)	281	293	298	298	301	304	307
Final energy use - Residential (PJ)	86.4	81.9	77.8	69.7	60.5	53.3	48.7
Final energy use - Transportation (PJ)	182	170	150	125	103	89.2	83.4

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

Item	2020	2025	2030	2035	2040	2045	2050
Residential HVAC investment in 2020s vs.		1.79	2.3				
REF - Cumulative 5-yr (billion \$2018)							
Sales of cooking units - Electric	74.2	79.7	96.5	99.8	100	100	100
Resistance (%)							
Sales of cooking units - Gas (%)	25.8	20.3	3.47	0.175	0	0	0
Sales of space heating units - Electric	6.37	12.2	35.2	81.9	90.3	90.9	90.6
Heat Pump (%)							
Sales of space heating units - Electric	16.5	22	17.4	7.5	5.7	5.65	5.9
Resistance (%)							
Sales of space heating units - Fossil (%)	5.83	9.86	7.69	3.24	2.34	2.21	2.25
Sales of space heating units - Gas (%)	71.3	55.9	39.7	7.36	1.62	1.25	1.22
Sales of water heating units - Electric	0	0.739	10.1	30.7	34.4	34.6	34.6
Heat Pump (%)							
Sales of water heating units - Electric	35.5	51.5	55.3	63.7	65.3	65.4	65.3
Resistance (%)							
Sales of water heating units - Gas Furnace	64.5	47.7	34.5	5.53	0.326	0	0
(%)							
Sales of water heating units - Other (%)	0.03	0.032	0.032	0.032	0.032	0.032	0.032

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

Item	2020	2025	2030	2035	2040	2045	2050
Light-duty vehicle capital costs -		377	964	1,565	2,370	2,580	2,460
Cumulative 5-yr (million \$2018)							
Public EV charging plugs - DC Fast (1000	0.061		0.695		3.07		4.98
units)							
Public EV charging plugs - L2 (1000 units)	0.164		16.7		74		120
Vehicle sales - Heavy-duty - diesel (%)	97.2	92.1	67	23.3	4.22	0.628	0
Vehicle sales - Heavy-duty - EV (%)	0.588	3.81	19	45.6	57.4	59.6	60
Vehicle sales - Heavy-duty - gasoline (%)	0.227	0.227	0.176	0.066	0.013	0.002	0
Vehicle sales - Heavy-duty - hybrid (%)	0.082	0.09	0.077	0.031	0.007	0.001	0
Vehicle sales - Heavy-duty - hydrogen FC	0.392	2.54	12.7	30.4	38.2	39.7	40
(%)							
Vehicle sales - Heavy-duty - other (%)	1.5	1.23	1.07	0.568	0.163	0.038	0
Vehicle sales - Light-duty - diesel (%)	1.66	1.92	1.3	0.418	0.076	0.013	0
Vehicle sales - Light-duty - EV (%)	3.53	14	44.6	81.1	96.2	99.3	100
Vehicle sales - Light-duty - gasoline (%)	90.5	79.4	50.7	17.3	3.39	0.593	0
Vehicle sales - Light-duty - hybrid (%)	4.05	4.27	3.08	1.16	0.28	0.06	0
Vehicle sales - Light-duty - hydrogen FC	0.111	0.346	0.212	0.066	0.013	0.002	0
(%)							
Vehicle sales - Light-duty - other (%)	0.107	0.103	0.068	0.024	0.005	0.001	0
Vehicle sales - Medium-duty - diesel (%)	64.7	59.7	42.3	14.4	2.59	0.384	0
Vehicle sales - Medium-duty - EV (%)	0.784	5.07	25.3	60.8	76.5	79.5	80
Vehicle sales - Medium-duty - gasoline (%)	33.7	33.3	25.5	9.32	1.77	0.277	0
Vehicle sales - Medium-duty - hybrid (%)	0.363	0.402	0.341	0.14	0.03	0.005	0
Vehicle sales - Medium-duty - hydrogen	0.196	1.27	6.33	15.2	19.1	19.9	20
FC (%)							
Vehicle sales - Medium-duty - other (%)	0.253	0.255	0.205	0.083	0.019	0.004	0

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

Item	2020	2025	2030	2035	2040	2045	2050
Capital invested - Biomass power plant (billion \$2018)	0	0	0	0	0	0	0
Capital invested - Biomass w/ccu allam power plant (billion \$2018)	0	0	0	0.013	0.004	0	0
Capital invested - Biomass w/ccu power plant (billion \$2018)	0	0	0	0	0.005	0	0.597
Capital invested - Solar PV - Base (billion \$2018)		2.03	11	9.43	6.82	5.94	15.3
Capital invested - Solar PV - Constrained (billion \$2018)		3.44	13.4	6.07	7	7.8	11.1
Capital invested - Wind - Base (billion \$2018)		0.55	11.5	23.7	25.9	28.6	37
Capital invested - Wind - Constrained (billion \$2018)		17	13.9	23.4	20.3	25.7	27.6
Installed renewables - OffshoreWind - Base land use assumptions (MW)	0	0	0	0	0	0	0
Installed renewables - OffshoreWind - Constrained land use assumptions (MW)	0	0	0	0	0	0	0
Installed renewables - Rooftop PV (MW)	15.1	27	34.4	46	61	78.7	99.6
Installed renewables - Solar - Base land use assumptions (MW)	1.5	1,779	12,489	22,504	30,188	37,276	56,659
Installed renewables - Solar - Constrained land use assumptions (MW)	0	3,386	11,576	18,646	25,610	35,318	52,473
Installed renewables - Wind - Base land use assumptions (MW)	3,194	3,568	12,188	31,309	53,212	78,726	113,660
Installed renewables - Wind - Constrained land use assumptions (MW)	3,194	8,791	19,997	39,271	57,525	81,044	107,406

Item	2020	2025	2030	2035	2040	2045	2050
Biomass power plant (GWh)	0	0	0	0	0	0	0
Biomass w/ccu allam power plant (GWh)	0	0	0	13.1	17.1	17.1	17.1
Biomass w/ccu power plant (GWh)	0	0	0	0	5.71	5.71	676
OffshoreWind - Base land use	0	0	0	0	0	0	0
assumptions (GWh)							
OffshoreWind - Constrained land use	0	0	0	0	0	0	0
assumptions (GWh)							
Solar - Base land use assumptions (GWh)	3.05	2,889	20,389	36,900	49,574	61,323	93,358
Solar - Constrained land use assumptions	0	5,512	18,933	30,594	42,027	58,159	86,542
(GWh)							
Wind - Base land use assumptions (GWh)	13,033	14,343	44,430	110,489	184,905	270,650	387,982
Wind - Constrained land use assumptions	13,033	32,477	70,737	135,918	196,735	274,397	357,973
(GWh)							

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

Item	2020	2025	2030	2035	2040	2045	2050
Biomass purchases (million \$2018/year)		0	0	47.4	122	699	3,814
Conversion capital investment -		0	0	687	1,056	8,178	62,939
Cumulative 5-yr (million \$2018)							
Number of facilities - Allam power w ccu	0	0	0	1	1	1	1
(quantity)							
Number of facilities - Beccs hydrogen	0	0	0	1	2	11	29
(quantity)							
Number of facilities - Diesel (quantity)	0	0	0	0	0	0	0
Number of facilities - Diesel ccu (quantity)	0	0	0	1	1	1	1
Number of facilities - Power (quantity)	0	0	0	0	0	0	0
Number of facilities - Power ccu	0	0	0	0	1	1	2
(quantity)							
Number of facilities - Pyrolysis (quantity)	0	0	0	0	0	0	0
Number of facilities - Pyrolysis ccu	0	0	0	1	1	1	33
(quantity)							
Number of facilities - Sng (quantity)	0	0	0	0	0	0	0
Number of facilities - Sng ccu (quantity)	0	0	0	0	0	0	0

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

Item	2020	2025	2030	2035	2040	2045	2050
Annual - All (MMT)		0	0	0.86	2.21	12.7	56.8
Annual - BECCS (MMT)		0	0	0.86	2.21	12.7	56.8
Annual - Cement and lime (MMT)		0	0	0	0	0	0
Annual - NGCC (MMT)		0	0	0	0	0	0
Cumulative - All (MMT)		0	0	0.86	3.07	15.8	72.6
Cumulative - BECCS (MMT)		0	0	0.86	3.07	15.8	72.6
Cumulative - Cement and lime (MMT)		0	0	0	0	0	0
Cumulative - NGCC (MMT)		0	0	0	0	0	0

Table 10: E+ scenario - PILLAR 4: CCUS - CO2 pipelines

Item	2020	2025	2030	2035	2040	2045	2050
All (km)		0	276	678	573	1,227	4,968
Cumulative investment - All (million \$2018)		0	1,459	2,992	2,939	3,694	6,651
Cumulative investment - Spur (million \$2018)		0	0	72.9	19.6	775	3,732
Cumulative investment - Trunk (million \$2018)		0	1,459	2,919	2,919	2,919	2,919
Spur (km)		0	0	126	21.5	675	4,416
Trunk (km)		0	276	552	552	552	552

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

	•						
Item	2020	2025	2030	2035	2040	2045	2050
CO2 storage (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 12: E+ scenario - PILLAR 6: Land sinks - Agriculture

Item	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - Aggressive							-2,594
deployment - Corn-ethanol to energy							
grasses (1000 tC02e/y)							
Carbon sink potential - Aggressive							-7,779
deployment - Cropland measures (1000							
tCO2e/y)							
Carbon sink potential - Aggressive							-286
deployment - Permanent conservation							
cover (1000 tCO2e/y)							
Carbon sink potential - Aggressive							-10,659
deployment - Total (1000 tCO2e/y)							
Carbon sink potential - Moderate							-2,594
deployment - Corn-ethanol to energy							
grasses (1000 tC02e/y)							
Carbon sink potential - Moderate							-4,000
deployment - Cropland measures (1000							
tCO2e/y)							
Carbon sink potential - Moderate							-143
deployment - Permanent conservation							
cover (1000 tC02e/y)							
Carbon sink potential - Moderate							-6,737
deployment - Total (1000 tC02e/y)							-,
Land impacted for carbon sink -							1,456
Aggressive deployment - Corn-ethanol to							.,
energy grasses (1000 hectares)							
Land impacted for carbon sink -							7,064
Aggressive deployment - Cropland							.,00 .
measures (1000 hectares)							
Land impacted for carbon sink -							489
Aggressive deployment - Permanent							107
conservation cover (1000 hectares)							
Land impacted for carbon sink -							9,008
Aggressive deployment - Total (1000							7,000
hectares)							
Land impacted for carbon sink - Moderate							1,456
deployment - Corn-ethanol to energy							1,400
grasses (1000 hectares)							
Land impacted for carbon sink - Moderate							3,654
deployment - Cropland measures (1000							3,054
hectares)							
Land impacted for carbon sink - Moderate							244
deployment - Permanent conservation							244
cover (1000 hectares)							
Land impacted for carbon sink - Moderate							5,354
							5,354
deployment - Total (1000 hectares)							

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

Item	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - High - Accelerate							-248
regeneration (1000 tC02e/y)							
Carbon sink potential - High - All (not							-17,146
counting overlap) (1000 tC02e/y)							
Carbon sink potential - High - Avoid							-947
deforestation (1000 tC02e/y)							
Carbon sink potential - High - Extend							-427
rotation length (1000 tCO2e/y)							
Carbon sink potential - High - Improve							-46.9
plantations (1000 tCO2e/y)							005
Carbon sink potential - High - Increase							-285
retention of HWP (1000 tC02e/y) Carbon sink potential - High - Increase							0.717
							-2,717
trees outside forests (1000 tC02e/y)							7055
Carbon sink potential - High - Reforest cropland (1000 tCO2e/y)							-7,855
Carbon sink potential - High - Reforest							-4,189
pasture (1000 tC02e/y)							-4,109
Carbon sink potential - High - Restore							-431
productivity (1000 tC02e/y)							-431
Carbon sink potential - Low - Accelerate							-124
regeneration (1000 tCO2e/y)							-124
Carbon sink potential - Low - All (not							-5,906
counting overlap) (1000 tC02e/y)							-3,700
Carbon sink potential - Low - Avoid							-158
deforestation (1000 tC02e/y)							-100
Carbon sink potential - Low - Extend							-164
rotation length (1000 tCO2e/y)							-104
Carbon sink potential - Low - Improve							-23.8
plantations (1000 tCO2e/y)							20.0
Carbon sink potential - Low - Increase							-95
retention of HWP (1000 tCO2e/y)							70
Carbon sink potential - Low - Increase							-951
trees outside forests (1000 tCO2e/y)							701
Carbon sink potential - Low - Reforest							-3,928
cropland (1000 tCO2e/y)							0,, 20
Carbon sink potential - Low - Reforest							-317
pasture (1000 tCO2e/y)							
Carbon sink potential - Low - Restore							-145
productivity (1000 tCO2e/y)							
Carbon sink potential - Mid - Accelerate							-186
regeneration (1000 tCO2e/y)							
Carbon sink potential - Mid - All (not							-11,526
counting overlap) (1000 tC02e/y)							•
Carbon sink potential - Mid - Avoid							-553
deforestation (1000 tCO2e/y)							
Carbon sink potential - Mid - Extend							-296
rotation length (1000 tCO2e/y)							
Carbon sink potential - Mid - Improve							-34.9
plantations (1000 tCO2e/y)							
Carbon sink potential - Mid - Increase							-190
retention of HWP (1000 tCO2e/y)							
Carbon sink potential - Mid - Increase							-1,834
trees outside forests (1000 tCO2e/y)							
Carbon sink potential - Mid - Reforest							-5,891
cropland (1000 tCO2e/y)							
Carbon sink potential - Mid - Reforest							-2,253
pasture (1000 tCO2e/y)							
Carbon sink potential - Mid - Restore							-288
productivity (1000 tCO2e/y)							

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

Item	2020	2025	2030	2035	2040	2045	2050
Land impacted for carbon sink potential -							40.5
High - Accelerate regeneration (1000							
hectares)							
Land impacted for carbon sink potential -							128
High - Avoid deforestation (over 30 years)							
(1000 hectares)							
Land impacted for carbon sink potential -							218
High - Extend rotation length (1000							
hectares)							
Land impacted for carbon sink potential -							17.3
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 -							258
High - Increase trees outside forests							
(1000 hectares)							
Land impacted for carbon sink potential -							519
High - Reforest cropland (1000 hectares)							017
Land impacted for carbon sink potential -							119
High - Reforest pasture (1000 hectares)							117
Land impacted for carbon sink potential -							143
							143
High - Restore productivity (1000 hectares)							
							1 / / 0
Land impacted for carbon sink potential -							1,443
High - Total impacted (over 30 years)							
(1000 hectares)							00.0
Land impacted for carbon sink potential -							20.2
Low - Accelerate regeneration (1000							
hectares)							
Land impacted for carbon sink potential -							120
Low - Avoid deforestation (over 30 years)							
(1000 hectares)							
Land impacted for carbon sink potential -							83.4
Low - Extend rotation length (1000							
hectares)							
Land impacted for carbon sink potential -							8.63
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 -							136
Low - Increase trees outside forests							
(1000 hectares)							
Land impacted for carbon sink potential -							260
Low - Reforest cropland (1000 hectares)							
Land impacted for carbon sink potential -							20.6
Low - Reforest pasture (1000 hectares)							
Land impacted for carbon sink potential -							86.4
Low - Restore productivity (1000							50.7
hectares)							
Land impacted for carbon sink potential -						+	735
Low - Total impacted (over 30 years)							130
(1000 hectares)							
Land impacted for carbon sink potential -							30.4
Mid - Accelerate regeneration (1000							30.4
hectares)							
HEGGAFES]							

				_	
Table 13. Ex	ccanario -	DIII $\Lambda D A \cdot$	Land sinks -	Enracte	lcontinuedl
Table 15. LT	occiiui iu -	FILLAN U.	Luiiu siiiks -	ו טו בטנט	lcontinucui

2020	2025	2030	2035	2040	2045	2050
						124
						151
						13
						0
						197
						390
						149
						174
						1,228
	2020	2020 2025	2020 2025 2030	2020 2025 2030 2035	2020 2025 2030 2035 2040	2020 2025 2030 2035 2040 2045

Table 14: E+ scenario - IMPACTS - Fossil fuel industries

Item	2020	2025	2030	2035	2040	2045	2050
Natural gas consumption - Annual (tcf)		144	121	97.3	73.2	46.1	32
Natural gas consumption - Cumulative							2,931
(tcf)							
Natural gas production - Annual (tcf)		0.529	0.5	0.435	0.368	0.292	0.227
Oil consumption - Annual (million bbls)		46.1	40.8	32.6	24.4	18	12.3
Oil consumption - Cumulative (million							991
bbls)							
Oil production - Annual (million bbls)		2.66	2.67	2.67	2.12	1.72	1.14

Table 15: E+ scenario - IMPACTS - Health

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal (million 2019\$)		125	0.122	0.115	0.092	0.061	0.001
Monetary damages from air pollution - Natural Gas (million 2019\$)		73.6	43.8	18.5	11.7	7.14	3.49
Monetary damages from air pollution - Transportation (million 2019\$)		195	183	140	81.3	37.2	14.7
Premature deaths from air pollution - Coal (deaths)		14.1	0.014	0.013	0.01	0.007	0
Premature deaths from air pollution - Natural Gas (deaths)		8.31	4.94	2.09	1.32	0.806	0.395
Premature deaths from air pollution - Transportation (deaths)		22	20.6	15.7	9.14	4.19	1.65

Table 16: E+ scenario - IMPACTS - Jobs

Item	2020	2025	2030	2035	2040	2045	2050
By economic sector - Agriculture (jobs)		3,679	3,685	3,623	2,083	1,054	3,462
By economic sector - Construction (jobs)		5,602	16,136	23,789	28,510	34,963	55,610
By economic sector - Manufacturing		6,180	7,502	9,750	9,262	8,469	13,621
(jobs)							
By economic sector - Mining (jobs)		1,054	702	481	303	184	105

Table 16: E+ scenario - IMPACTS - Jobs (continued)

Table 16: E+ scenario - IMPACTS - Jobs (co							
Item	2020	2025	2030	2035	2040	2045	2050
By economic sector - Other (jobs)		586	2,339	3,234	3,948	4,846	8,590
By economic sector - Pipeline (jobs)		199	349	315	105	99.8	425
By economic sector - Professional (jobs)		3,529	8,228	13,833	18,367	24,472	40,728
By economic sector - Trade (jobs)		3,206	5,632	8,311	10,371	13,345	21,991
By economic sector - Utilities (jobs)		5,243	10,308	17,535	21,910	28,841	47,111
By education level - All sectors -		8,127	16,530	25,051	30,079	37,368	61,009
Associates degree or some college (jobs)		-,	-,	,	,-	- ,	- ,
By education level - All sectors -		5,488	10,348	15,757	19,124	24,036	39,535
Bachelors degree (jobs)		3, .55	.5,5 .5	.07.01	.,,	2 .,000	07,000
By education level - All sectors - Doctoral		188	397	627	797	1,035	1,715
degree (jobs)		100	071	021	171	1,000	1,110
By education level - All sectors - High		14,142	25,005	35,392	39,857	47,457	78,860
school diploma or less (jobs)		14,142	23,003	33,372	37,031	41,431	10,000
By education level - All sectors - Masters		1,334	2,602	4,044	5,000	6,378	10,524
or professional degree (jobs)		1,334	2,602	4,044	5,000	0,310	10,524
		0.701	0.200	0.107	/. 070	/. 01/.	15,388
By resource sector - Biomass (jobs)		8,621	8,390	8,104	4,972	4,014	
By resource sector - CO2 (jobs)		0	1,453	1,457	14.1	247	3,162
By resource sector - Coal (jobs)		1,025	257	0	0	0	0
By resource sector - Grid (jobs)		7,621	16,428	30,894	41,013	53,982	87,725
By resource sector - Natural Gas (jobs)		1,577	1,420	1,280	1,070	1,313	1,251
By resource sector - Nuclear (jobs)		404	398	231	0.007	0.015	0.026
By resource sector - Oil (jobs)		2,295	1,889	1,433	1,005	703	450
By resource sector - Solar (jobs)		3,760	14,627	15,670	15,382	15,001	29,215
By resource sector - Wind (jobs)		3,975	10,020	21,801	31,402	41,013	54,454
Median wages - Annual - All (\$2019 per		53,898	55,469	57,289	58,995	60,632	61,479
iob)				, -			- ,
On-Site or In-Plant Training - Total jobs - 1		4,224	8,567	12,917	15,446	19,150	31,237
to 4 years (jobs)		.,	3,55.	,,	.5, 5	.,,	0.,_0.
On-Site or In-Plant Training - Total jobs - 4		1,641	3,637	5,562	6,755	8,490	13,771
to 10 years (jobs)		1,041	3,001	0,002	0,100	0,470	10,111
On-Site or In-Plant Training - Total jobs -		4,653	8,875	13,119	15,487	19,057	31,441
None (jobs)		4,000	0,013	13,117	13,401	17,031	31,441
On-Site or In-Plant Training - Total jobs -		0/./	7.00	707	0/0	10/0	1,729
		244	483	726	860	1,060	1,729
Over 10 years (jobs)		10.517	00.000	10511	F (010	(0.515	110 / / /
On-Site or In-Plant Training - Total jobs -		18,516	33,320	48,546	56,310	68,515	113,466
Up to 1 year (jobs)							
On-the-Job Training - All sectors - 1 to 4		5,243	10,903	16,590	19,991	24,911	40,519
years (jobs)							
On-the-Job Training - All sectors - 4 to 10		1,556	3,585	5,517	6,735	8,490	13,752
years (jobs)							
On-the-Job Training - All sectors - None		1,652	3,065	4,436	5,168	6,301	10,438
(jobs)							
On-the-Job Training - All sectors - Over 10		269	531	766	885	1,057	1,706
years (jobs)							
On-the-Job Training - All sectors - Up to 1		20,559	36,798	53,562	62,080	75,515	125,229
year (jobs)		.	.			.	•
Related work experience - All sectors - 1		9,814	18,898	28,302	33,735	41,852	68,915
to 4 years (jobs)		.,	,		55,155	.,,,,,,,	20,1
Related work experience - All sectors - 4		6,040	12,063	18,303	22,044	27,492	44,903
to 10 years (jobs)		0,040	12,000	10,000	22,044	21,772	44,700
Related work experience - All sectors -		4,504	8,224	11,928	13,773	16,748	27,786
		4,304	0,224	11,720	13,113	10,140	21,100
None (jobs)		1//5	0.150	1.7/1	E / 00	7.001	11,460
Related work experience - All sectors -		1,645	3,158	4,764	5,689	7,031	11,460
Over 10 years (jobs)		7.075	10.57.0	17.570	10 (1)	00.450	00.570
Related work experience - All sectors - Up		7,275	12,540	17,573	19,616	23,150	38,579
to 1 year (jobs)							
Wage income - All (million \$2019)		1,578	3,045	4,634	5,597	7,051	11,784

Table 17: E- scenario - PILLAR 1: Efficiency/Electrification - Commercial

Item	2020	2025	2030	2035	2040	2045	2050
Commercial HVAC investment in 2020s -		5,540	6,039				
Cumulative 5-yr (million \$2018)							
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
Sales of space heating units - Electric	3.92	6.69	9.32	17.9	38.6	64.5	79.7
Heat Pump (%)							
Sales of space heating units - Electric	6.31	5.58	5.85	6.72	8.6	10.7	11.9
Resistance (%)							
Sales of space heating units - Fossil (%)	0	2.1	1.98	1.48	0.719	0.234	0.062
Sales of space heating units - Gas Furnace	89.8	85.6	82.9	73.9	52.1	24.5	8.31
(%)							
Sales of water heating units - Electric	0.944	1.35	2.81	7.68	19.4	34.3	43
Heat Pump (%)							
Sales of water heating units - Electric	8.03	7.53	8.96	13.7	25.1	39.5	48
Resistance (%)							
Sales of water heating units - Gas Furnace	90.2	90.1	87.3	77.8	54.7	25.5	8.33
(%)							
Sales of water heating units - Other (%)	0.788	0.981	0.957	0.887	0.782	0.716	0.691

Table 18: E- scenario - PILLAR 1: Efficiency/Electrification - Electricity demand

Item	2020	2025	2030	2035	2040	2045	2050
Electricity distribution capital invested -		1.33	1.36	1.77	1.84	2.53	2.68
Cumulative 5-yr (billion \$2018)							

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

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Commercial (PJ)	70.8	69.4	67.5	65.7	63.5	60.8	58.1
Final energy use - Industry (PJ)	281	293	300	302	307	311	314
Final energy use - Residential (PJ)	86.4	82	78.8	75.5	71.4	65.8	59.3
Final energy use - Transportation (PJ)	182	171	156	144	135	124	111

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

Item	2020	2025	2030	2035	2040	2045	2050
Residential HVAC investment in 2020s vs.		1.78	2.27				
REF - Cumulative 5-yr (billion \$2018)							
Sales of cooking units - Electric	74.1	74.8	77.2	83.4	92.1	97.4	99.3
Resistance (%)							
Sales of cooking units - Gas (%)	25.9	25.2	22.8	16.6	7.91	2.55	0.687
Sales of space heating units - Electric	6.37	11	13.7	22.5	43.2	68.9	83.6
Heat Pump (%)							
Sales of space heating units - Electric	16.5	22.2	21.5	19.8	15.5	10.2	7.2
Resistance (%)							
Sales of space heating units - Fossil (%)	5.83	9.99	9.81	8.95	6.83	4.3	2.95
Sales of space heating units - Gas (%)	71.3	56.8	54.9	48.8	34.5	16.7	6.23
Sales of water heating units - Electric	0	0.395	1.48	5.1	13.9	24.9	31.5
Heat Pump (%)							
Sales of water heating units - Electric	35.5	51.4	51.8	53.2	56.8	61.3	64
Resistance (%)							
Sales of water heating units - Gas Furnace	64.5	48.2	46.7	41.7	29.3	13.7	4.47
(%)							
Sales of water heating units - Other (%)	0.03	0.032	0.032	0.032	0.032	0.032	0.032

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

Item	2020	2025	2030	2035	2040	2045	2050
Light-duty vehicle capital costs -		0	60.7	128	432	1,362	1,983
Cumulative 5-yr (million \$2018)							
Public EV charging plugs - DC Fast (1000	0.061		0.212		1.14		3.19
units)							
Public EV charging plugs - L2 (1000 units)	0.164		5.1		27.4		76.8
Vehicle sales - Heavy-duty - diesel (%)	97.4	96	91.3	79.8	58.2	32.1	13.7
Vehicle sales - Heavy-duty - EV (%)	0.498	1.45	4.11	10.8	23.6	39.5	51
Vehicle sales - Heavy-duty - gasoline (%)	0.228	0.236	0.239	0.225	0.179	0.109	0.051
Vehicle sales - Heavy-duty - hybrid (%)	0.083	0.094	0.104	0.107	0.092	0.06	0.03
Vehicle sales - Heavy-duty - hydrogen FC	0.332	0.969	2.74	7.17	15.7	26.3	34
(%)							
Vehicle sales - Heavy-duty - other (%)	1.5	1.28	1.46	1.95	2.25	1.96	1.14
Vehicle sales - Light-duty - diesel (%)	1.68	2.07	2.08	1.66	1.07	0.552	0.236
Vehicle sales - Light-duty - EV (%)	1.75	4.38	11.2	24.9	47.3	71.3	87.3
Vehicle sales - Light-duty - gasoline (%)	92.2	88	80.6	67.9	47.4	25.6	11.3
Vehicle sales - Light-duty - hybrid (%)	4.19	5.02	5.67	5.21	3.97	2.38	1.16
Vehicle sales - Light-duty - hydrogen FC	0.113	0.384	0.333	0.257	0.184	0.103	0.048
(%)							
Vehicle sales - Light-duty - other (%)	0.108	0.111	0.102	0.089	0.065	0.036	0.016
Vehicle sales - Medium-duty - diesel (%)	64.8	62.2	57.7	49.4	35.6	19.6	8.37
Vehicle sales - Medium-duty - EV (%)	0.664	1.94	5.49	14.3	31.4	52.6	68
Vehicle sales - Medium-duty - gasoline (%)	33.8	34.7	34.7	31.9	24.4	14.2	6.33
Vehicle sales - Medium-duty - hybrid (%)	0.363	0.418	0.464	0.478	0.414	0.275	0.141
Vehicle sales - Medium-duty - hydrogen	0.166	0.485	1.37	3.58	7.86	13.2	17
FC (%)							
Vehicle sales - Medium-duty - other (%)	0.253	0.266	0.279	0.286	0.258	0.184	0.102

Table 22: E- scenario - PILLAR 6: Land sinks - Agriculture

Item	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - Aggressive							-2,594
deployment - Corn-ethanol to energy							
grasses (1000 tCO2e/y)							
Carbon sink potential - Aggressive							-7,779
deployment - Cropland measures (1000							
tCO2e/y)							
Carbon sink potential - Aggressive							-286
deployment - Permanent conservation							
cover (1000 tCO2e/y)							
Carbon sink potential - Aggressive							-10,659
deployment - Total (1000 tCO2e/y)							
Carbon sink potential - Moderate							-2,594
deployment - Corn-ethanol to energy							
grasses (1000 tCO2e/y)							
Carbon sink potential - Moderate							-4,000
deployment - Cropland measures (1000							
tCO2e/y)							
Carbon sink potential - Moderate							-143
deployment - Permanent conservation							
cover (1000 tC02e/y)							
Carbon sink potential - Moderate							-6,737
deployment - Total (1000 tCO2e/y)							
Land impacted for carbon sink -							1,456
Aggressive deployment - Corn-ethanol to							
energy grasses (1000 hectares)							
Land impacted for carbon sink -							7,064
Aggressive deployment - Cropland							
measures (1000 hectares)							
Land impacted for carbon sink -							489
Aggressive deployment - Permanent							
conservation cover (1000 hectares)							

Table 22: E- scenario - PILLAR 6: Land sinks - Agriculture (continued)

Item	2020	2025	2030	2035	2040	2045	2050
Land impacted for carbon sink -							9,008
Aggressive deployment - Total (1000							
hectares)							
Land impacted for carbon sink - Moderate							1,456
deployment - Corn-ethanol to energy							
grasses (1000 hectares)							
Land impacted for carbon sink - Moderate							3,654
deployment - Cropland measures (1000							
hectares)							
Land impacted for carbon sink - Moderate							244
deployment - Permanent conservation							
cover (1000 hectares)							
Land impacted for carbon sink - Moderate							5,354
deployment - Total (1000 hectares)							

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

Item	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - High - Accelerate							-248
regeneration (1000 tC02e/y)							
Carbon sink potential - High - All (not							-17,146
counting overlap) (1000 tCO2e/y)							
Carbon sink potential - High - Avoid							-947
deforestation (1000 tCO2e/y)							
Carbon sink potential - High - Extend							-427
rotation length (1000 tCO2e/y)							
Carbon sink potential - High - Improve							-46.9
plantations (1000 tCO2e/y)							
Carbon sink potential - High - Increase							-285
retention of HWP (1000 tCO2e/y)							
Carbon sink potential - High - Increase							-2,717
trees outside forests (1000 tCO2e/y)							
Carbon sink potential - High - Reforest							-7,855
cropland (1000 tCO2e/y)							
Carbon sink potential - High - Reforest							-4,189
pasture (1000 tCO2e/y)							
Carbon sink potential - High - Restore							-431
productivity (1000 tCO2e/y)							
Carbon sink potential - Low - Accelerate							-124
regeneration (1000 tCO2e/y)							
Carbon sink potential - Low - All (not							-5,906
counting overlap) (1000 tCO2e/y)							
Carbon sink potential - Low - Avoid							-158
deforestation (1000 tCO2e/y)							
Carbon sink potential - Low - Extend							-164
rotation length (1000 tCO2e/y)							
Carbon sink potential - Low - Improve							-23.8
plantations (1000 tCO2e/y)							
Carbon sink potential - Low - Increase							-95
retention of HWP (1000 tCO2e/y)							
Carbon sink potential - Low - Increase							-951
trees outside forests (1000 tCO2e/y)							
Carbon sink potential - Low - Reforest							-3,928
cropland (1000 tCO2e/y)							
Carbon sink potential - Low - Reforest							-317
pasture (1000 tCO2e/y)							
Carbon sink potential - Low - Restore							-145
productivity (1000 tCO2e/y)							
Carbon sink potential - Mid - Accelerate							-186
regeneration (1000 tCO2e/y)							

Table 23: E- scenario - PILLAR 6: Land sinks - Forests (continued)

Item Carbon sink potential - Mid - All (not	2020	2025	2030	2035	2040	2045	2050 -11,52 <i>6</i>
counting overlap) (1000 tCO2e/y)							-11,020
Carbon sink potential - Mid - Avoid							-553
deforestation (1000 tC02e/y)							-555
Carbon sink potential - Mid - Extend							-296
rotation length (1000 tC02e/y)							-270
Carbon sink potential - Mid - Improve							-34.9
plantations (1000 tCO2e/y)							-34.7
Carbon sink potential - Mid - Increase							-190
retention of HWP (1000 tCO2e/y)							-170
Carbon sink potential - Mid - Increase							-1,834
trees outside forests (1000 tCO2e/y)							-1,034
Carbon sink potential - Mid - Reforest							-5,89
•							-5,69
cropland (1000 tC02e/y)							0.050
Carbon sink potential - Mid - Reforest							-2,253
pasture (1000 tC02e/y)							000
Carbon sink potential - Mid - Restore							-288
productivity (1000 tCO2e/y)							
Land impacted for carbon sink potential -							40.5
High - Accelerate regeneration (1000							
hectares)							
Land impacted for carbon sink potential -							128
High - Avoid deforestation (over 30 years)							
(1000 hectares)							
Land impacted for carbon sink potential -							218
High - Extend rotation length (1000							
hectares)							
Land impacted for carbon sink potential -							17.3
High - Improve plantations (1000							
hectares)							
Land impacted for carbon sink potential -							C
High - Increase retention of HWP (1000							
hectares)							
Land impacted for carbon sink potential -							258
High - Increase trees outside forests							
(1000 hectares)							
Land impacted for carbon sink potential -							519
High - Reforest cropland (1000 hectares)							
Land impacted for carbon sink potential -							119
High - Reforest pasture (1000 hectares)							
Land impacted for carbon sink potential -							143
High - Restore productivity (1000							
hectares)							
Land impacted for carbon sink potential -							1,443
High - Total impacted (over 30 years)							.,
(1000 hectares)							
Land impacted for carbon sink potential -							20.2
Low - Accelerate regeneration (1000							20.2
hectares)							
Land impacted for carbon sink potential -							120
Low - Avoid deforestation (over 30 years)							120
(1000 hectares)							
Land impacted for carbon sink potential -							83.4
Low - Extend rotation length (1000							03.4
= *							
hectares)							0.7
Land impacted for carbon sink potential -							8.6
Low - Improve plantations (1000							
hectares)							
Land impacted for carbon sink potential -							(
Low - Increase retention of HWP (1000							

Table 23: E- scenario - PILLAR 6: Land sinks - Forests (continued)

Land impacted for carbon sink potential -	Item	2020	2025	2030	2035	2040	2045	2050
1000 hectares 260	Land impacted for carbon sink potential -							136
Land impacted for carbon sink potential	Low - Increase trees outside forests							
Land impacted for carbon sink potential -								
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)								260
Low - Reforest pasture (1000 hectares) Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares) Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares) Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares) Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares) Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares) Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares) Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares) Land impacted for carbon sink potential - Mid - Increase retention of HWP (1000 hectares) Land impacted for carbon sink potential - Mid - Increase retention of HWP (1000 hectares) Land impacted for carbon sink potential - Mid - Increase trees outside forests (1000 hectares) Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares) Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares) Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares) Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares) Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares) Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares) Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares) Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares) Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares) Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares) Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares) Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)								
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Table 24: E- scenario - IMPACTS - Health

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal (million 2019\$)		125	0.122	0.115	0.092	0.061	0.001
Monetary damages from air pollution - Natural Gas (million 2019\$)		81.7	39.4	14.4	6.67	2.65	2.09
Monetary damages from air pollution - Transportation (million 2019\$)		198	202	197	179	143	98.4
Premature deaths from air pollution - Coal (deaths)		14.1	0.014	0.013	0.01	0.007	0
Premature deaths from air pollution - Natural Gas (deaths)		9.23	4.45	1.63	0.753	0.3	0.236
Premature deaths from air pollution - Transportation (deaths)		22.3	22.7	22.2	20.1	16.1	11.1

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

Item	2020	2025	2030	2035	2040	2045	2050
Commercial HVAC investment in 2020s -		5,541	6,031				
Cumulative 5-yr (million \$2018)							
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
Sales of space heating units - Electric	3.92	7.61	30.1	78	86.6	87.1	87.1
Heat Pump (%)							
Sales of space heating units - Electric	6.31	5.8	8.21	11.8	12.4	12.4	12.4
Resistance (%)							
Sales of space heating units - Fossil (%)	0	1.82	0.351	0.015	0	0	0
Sales of space heating units - Gas Furnace	89.8	84.8	61.3	10.2	1.03	0.454	0.456
(%)							
Sales of water heating units - Electric	0.944	1.84	14.5	42	47	47.3	47.3
Heat Pump (%)							
Sales of water heating units - Electric	8.03	8	20.3	47	51.8	52.1	52.1
Resistance (%)							
Sales of water heating units - Gas Furnace	90.2	89.2	64.5	10.3	0.61	0	0
(%)							
Sales of water heating units - Other (%)	0.788	0.941	0.732	0.684	0.681	0.683	0.683

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

Item	2020	2025	2030	2035	2040	2045	2050
Electricity distribution capital invested -		1.62	1.68	2.88	3.08	2.81	2.96
Cumulative 5-yr (billion \$2018)							

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

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Commercial (PJ)	70.8	69.4	66.6	62.4	57.8	54.2	52.1
Final energy use - Industry (PJ)	281	293	298	298	301	304	307
Final energy use - Residential (PJ)	86.4	81.9	77.8	69.7	60.5	53.3	48.7
Final energy use - Transportation (PJ)	182	170	150	125	103	89.2	83.4

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

Item	2020	2025	2030	2035	2040	2045	2050
Residential HVAC investment in 2020s vs.		1.79	2.3				
REF - Cumulative 5-yr (billion \$2018)							
Sales of cooking units - Electric	74.2	79.7	96.5	99.8	100	100	100
Resistance (%)							
Sales of cooking units - Gas (%)	25.8	20.3	3.47	0.175	0	0	0
Sales of space heating units - Electric	6.37	12.2	35.2	81.9	90.3	90.9	90.6
Heat Pump (%)							
Sales of space heating units - Electric	16.5	22	17.4	7.5	5.7	5.65	5.9
Resistance (%)							
Sales of space heating units - Fossil (%)	5.83	9.86	7.69	3.24	2.34	2.21	2.25
Sales of space heating units - Gas (%)	71.3	55.9	39.7	7.36	1.62	1.25	1.22
Sales of water heating units - Electric	0	0.739	10.1	30.7	34.4	34.6	34.6
Heat Pump (%)							
Sales of water heating units - Electric	35.5	51.5	55.3	63.7	65.3	65.4	65.3
Resistance (%)							
Sales of water heating units - Gas Furnace	64.5	47.7	34.5	5.53	0.326	0	0
(%)							
Sales of water heating units - Other (%)	0.03	0.032	0.032	0.032	0.032	0.032	0.032

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

Item	2020	2025	2030	2035	2040	2045	2050
Light-duty vehicle capital costs -		377	964	1,565	2,370	2,580	2,460
Cumulative 5-yr (million \$2018)							
Public EV charging plugs - DC Fast (1000	0.061		0.695		3.07		4.98
units)							
Public EV charging plugs - L2 (1000 units)	0.164		16.7		74		120
Vehicle sales - Heavy-duty - diesel (%)	97.2	92.1	67	23.3	4.22	0.628	0
Vehicle sales - Heavy-duty - EV (%)	0.588	3.81	19	45.6	57.4	59.6	60
Vehicle sales - Heavy-duty - gasoline (%)	0.227	0.227	0.176	0.066	0.013	0.002	0
Vehicle sales - Heavy-duty - hybrid (%)	0.082	0.09	0.077	0.031	0.007	0.001	0
Vehicle sales - Heavy-duty - hydrogen FC	0.392	2.54	12.7	30.4	38.2	39.7	40
(%)							
Vehicle sales - Heavy-duty - other (%)	1.5	1.23	1.07	0.568	0.163	0.038	0
Vehicle sales - Light-duty - diesel (%)	1.66	1.92	1.3	0.418	0.076	0.013	0
Vehicle sales - Light-duty - EV (%)	3.53	14	44.6	81.1	96.2	99.3	100
Vehicle sales - Light-duty - gasoline (%)	90.5	79.4	50.7	17.3	3.39	0.593	0
Vehicle sales - Light-duty - hybrid (%)	4.05	4.27	3.08	1.16	0.28	0.06	0
Vehicle sales - Light-duty - hydrogen FC	0.111	0.346	0.212	0.066	0.013	0.002	0
(%)							
Vehicle sales - Light-duty - other (%)	0.107	0.103	0.068	0.024	0.005	0.001	0
Vehicle sales - Medium-duty - diesel (%)	64.7	59.7	42.3	14.4	2.59	0.384	0
Vehicle sales - Medium-duty - EV (%)	0.784	5.07	25.3	60.8	76.5	79.5	80
Vehicle sales - Medium-duty - gasoline (%)	33.7	33.3	25.5	9.32	1.77	0.277	0
Vehicle sales - Medium-duty - hybrid (%)	0.363	0.402	0.341	0.14	0.03	0.005	0
Vehicle sales - Medium-duty - hydrogen	0.196	1.27	6.33	15.2	19.1	19.9	20
FC (%)							
Vehicle sales - Medium-duty - other (%)	0.253	0.255	0.205	0.083	0.019	0.004	0

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

Item	2020	2025	2030	2035	2040	2045	2050
Capital invested - Solar PV - Base (billion		0	15.6	12	14.6	12.2	52.8
\$2018)							
Capital invested - Wind - Base (billion		2.4	13.8	28.7	46.8	55.8	72.8
\$2018)							
Installed renewables - OffshoreWind -	0	0	0	0	0	0	0
Base land use assumptions (MW)							
Installed renewables - OffshoreWind -	0	0	0	0	0	0	0
Constrained land use assumptions (MW)							
Installed renewables - Solar - Base land	1.5	1.5	15,250	28,029	44,522	59,085	125,814
use assumptions (MW)							
Installed renewables - Solar -	3	3	35,378	57,933	83,708	117,763	210,296
Constrained land use assumptions (MW)							
Installed renewables - Wind - Base land	3,194	4,828	15,204	38,344	77,960	127,723	196,462
use assumptions (MW)							
Installed renewables - Wind - Constrained	6,388	21,123	47,262	93,890	162,682	247,616	382,508
land use assumptions (MW)							

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

Item	2020	2025	2030	2035	2040	2045	2050
OffshoreWind - Base land use	0	0	0	0	0	0	0
assumptions (GWh)							
OffshoreWind - Constrained land use	0	0	0	0	0	0	0
assumptions (GWh)							
Solar - Base land use assumptions (GWh)	3.05	3.05	24,916	46,102	73,931	98,534	214,569
Solar - Constrained land use assumptions	6.1	6.1	57,980	96,024	140,054	197,333	355,916
(GWh)							
Wind - Base land use assumptions (GWh)	13,033	18,764	54,815	134,543	267,937	435,076	661,392
Wind - Constrained land use assumptions	26,065	77,272	165,853	322,911	549,778	816,526	1,260,047
(GWh)							

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

Item	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - Aggressive							-2,594
deployment - Corn-ethanol to energy							
grasses (1000 tCO2e/y)							
Carbon sink potential - Aggressive							-7,779
deployment - Cropland measures (1000							-
tCO2e/y)							
Carbon sink potential - Aggressive							-286
deployment - Permanent conservation							
cover (1000 tC02e/y)							
Carbon sink potential - Aggressive							-10,659
deployment - Total (1000 tC02e/y)							,
Carbon sink potential - Moderate							-2,594
deployment - Corn-ethanol to energy							2,074
grasses (1000 tC02e/y)							
Carbon sink potential - Moderate							-4,000
deployment - Cropland measures (1000							-4,000
tCO2e/y)							
Carbon sink potential - Moderate							-143
deployment - Permanent conservation							-143
cover (1000 tC02e/y) Carbon sink potential - Moderate							-6,737
							-6,737
deployment - Total (1000 tC02e/y)							1/5/
Land impacted for carbon sink -							1,456
Aggressive deployment - Corn-ethanol to							
energy grasses (1000 hectares)							
Land impacted for carbon sink -							7,064
Aggressive deployment - Cropland							
measures (1000 hectares)							
Land impacted for carbon sink -							489
Aggressive deployment - Permanent							
conservation cover (1000 hectares)							
Land impacted for carbon sink -							9,008
Aggressive deployment - Total (1000							
hectares)							
Land impacted for carbon sink - Moderate							1,456
deployment - Corn-ethanol to energy							
grasses (1000 hectares)							
Land impacted for carbon sink - Moderate							3,654
deployment - Cropland measures (1000							
hectares)							
Land impacted for carbon sink - Moderate							244
deployment - Permanent conservation							
cover (1000 hectares)							
Land impacted for carbon sink - Moderate							5,354
deployment - Total (1000 hectares)							-,,
, ,,		1					

Table 33: E+RE+ scenario - PILLAR 6: Land sinks - Forests

Item	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - High - Accelerate							-248
regeneration (1000 tCO2e/y)							
Carbon sink potential - High - All (not							-17,146
counting overlap) (1000 tCO2e/y)							
Carbon sink potential - High - Avoid							-947
deforestation (1000 tCO2e/y)							
Carbon sink potential - High - Extend							-427
rotation length (1000 tCO2e/y)							
Carbon sink potential - High - Improve							-46.9
plantations (1000 tCO2e/y)							
Carbon sink potential - High - Increase							-285
retention of HWP (1000 tCO2e/y)							

Table 33: E+RE+ scenario - PILLAR 6: Land sinks - Forests (continued)

Item	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - High - Increase							-2,717
trees outside forests (1000 tCO2e/y)							
Carbon sink potential - High - Reforest cropland (1000 tC02e/y)							-7,855
Carbon sink potential - High - Reforest pasture (1000 tC02e/y)							-4,189
Carbon sink potential - High - Restore productivity (1000 tC02e/y)							-431
Carbon sink potential - Low - Accelerate regeneration (1000 tCO2e/y)							-124
Carbon sink potential - Low - All (not							-5,906
counting overlap) (1000 tCO2e/y) Carbon sink potential - Low - Avoid							-158
deforestation (1000 tCO2e/y) Carbon sink potential - Low - Extend							-164
rotation length (1000 tCO2e/y) Carbon sink potential - Low - Improve							-23.8
plantations (1000 tC02e/y) Carbon sink potential - Low - Increase							-95
retention of HWP (1000 tCO2e/y) Carbon sink potential - Low - Increase							-951
trees outside forests (1000 tC02e/y) Carbon sink potential - Low - Reforest							
cropland (1000 tCO2e/y)							-3,928
Carbon sink potential - Low - Reforest pasture (1000 tCO2e/y)							-317
Carbon sink potential - Low - Restore productivity (1000 tCO2e/y)							-145
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO2e/y)							-186
Carbon sink potential - Mid - All (not counting overlap) (1000 tC02e/y)							-11,526
Carbon sink potential - Mid - Avoid deforestation (1000 tC02e/y)							-553
Carbon sink potential - Mid - Extend rotation length (1000 tCO2e/y)							-296
Carbon sink potential - Mid - Improve							-34.9
plantations (1000 tCO2e/y) Carbon sink potential - Mid - Increase							-190
retention of HWP (1000 tCO2e/y) Carbon sink potential - Mid - Increase							-1,834
trees outside forests (1000 tC02e/y) Carbon sink potential - Mid - Reforest							-5,891
cropland (1000 tCO2e/y) Carbon sink potential - Mid - Reforest							-2,253
pasture (1000 tC02e/y) Carbon sink potential - Mid - Restore							-288
productivity (1000 tCO2e/y) Land impacted for carbon sink potential -							40.5
High - Accelerate regeneration (1000 hectares)							.0.0
Land impacted for carbon sink potential -	+	-	+				128
High - Avoid deforestation (over 30 years)							120
(1000 hectares) Land impacted for carbon sink potential -							218
High - Extend rotation length (1000 hectares)							218
Land impacted for carbon sink potential - High - Improve plantations (1000							17.3
hectares)							

Table 33: E+RE+ scenario - PILLAR 6: Land sinks - Forests (continued)

Item	2020	2025	2030	2035	2040	2045	2050
Land impacted for carbon sink potential - High - Increase retention of HWP (1000							0
hectares)							
Land impacted for carbon sink potential -							258
High - Increase trees outside forests							
(1000 hectares)							
Land impacted for carbon sink potential -							519
High - Reforest cropland (1000 hectares)							
Land impacted for carbon sink potential -							119
High - Reforest pasture (1000 hectares)							1/0
Land impacted for carbon sink potential -							143
High - Restore productivity (1000 hectares)							
Land impacted for carbon sink potential -							1,443
High - Total impacted (over 30 years)							1,443
(1000 hectares)							
Land impacted for carbon sink potential -							20.2
Low - Accelerate regeneration (1000							20.2
hectares)							
Land impacted for carbon sink potential -							120
Low - Avoid deforestation (over 30 years)							
(1000 hectares)							
Land impacted for carbon sink potential -							83.4
Low - Extend rotation length (1000							
hectares)							
Land impacted for carbon sink potential -							8.63
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 -							136
Low - Increase trees outside forests							
(1000 hectares)							260
Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares)							260
Land impacted for carbon sink potential -							20.6
Low - Reforest pasture (1000 hectares)							20.0
Land impacted for carbon sink potential -							86.4
Low - Restore productivity (1000							00. 1
hectares)							
Land impacted for carbon sink potential -							735
Low - Total impacted (over 30 years)							
(1000 hectares)							
Land impacted for carbon sink potential -							30.4
Mid - Accelerate regeneration (1000							
hectares)							
Land impacted for carbon sink potential -							124
Mid - Avoid deforestation (over 30 years)							
(1000 hectares)							
Land impacted for carbon sink potential -							151
Mid - Extend rotation length (1000							
hectares)							13
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)							13
Land impacted for carbon sink potential -							0
Mid - Increase retention of HWP (1000							U
hectares)							
Land impacted for carbon sink potential -							197
Mid - Increase trees outside forests (1000							171
11101 0000 ti 000 0010100 101 0010 (1000	Í.					1	

Table 33: E+RE+	. cronario -	DTII AD A.	I and cinke -	Forests	(continued)
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Item	2020	2025	2030	2035	2040	2045	2050
Land impacted for carbon sink potential -							390
Mid - Reforest cropland (1000 hectares)							
Land impacted for carbon sink potential -							149
Mid - Reforest pasture (1000 hectares)							
Land impacted for carbon sink potential -							174
Mid - Restore productivity (1000							
hectares)							
Land impacted for carbon sink potential -							1,228
Mid - Total impacted (over 30 years) (1000							
hectares)							

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

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution -		125	0.122	0.115	0.092	0.061	0.001
Coal (million 2019\$)							
Monetary damages from air pollution -		68.4	37.8	10.9	6.51	2.87	1.88
Natural Gas (million 2019\$)							
Monetary damages from air pollution -		195	183	140	81.3	37.2	14.7
Transportation (million 2019\$)							
Premature deaths from air pollution -		14.1	0.014	0.013	0.01	0.007	0
Coal (deaths)							
Premature deaths from air pollution -		7.72	4.27	1.24	0.735	0.324	0.212
Natural Gas (deaths)							
Premature deaths from air pollution -		22	20.6	15.7	9.14	4.19	1.65
Transportation (deaths)							

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

Item	2020	2025	2030	2035	2040	2045	2050
Commercial HVAC investment in 2020s -		5,541	6,031				
Cumulative 5-yr (million \$2018)							
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
Sales of space heating units - Electric	3.92	7.61	30.1	78	86.6	87.1	87.1
Heat Pump (%)							
Sales of space heating units - Electric	6.31	5.8	8.21	11.8	12.4	12.4	12.4
Resistance (%)							
Sales of space heating units - Fossil (%)	0	1.82	0.351	0.015	0	0	0
Sales of space heating units - Gas Furnace	89.8	84.8	61.3	10.2	1.03	0.454	0.456
(%)							
Sales of water heating units - Electric	0.944	1.84	14.5	42	47	47.3	47.3
Heat Pump (%)							
Sales of water heating units - Electric	8.03	8	20.3	47	51.8	52.1	52.1
Resistance (%)							
Sales of water heating units - Gas Furnace	90.2	89.2	64.5	10.3	0.61	0	0
(%)							
Sales of water heating units - Other (%)	0.788	0.941	0.732	0.684	0.681	0.683	0.683

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

Item	2020	2025	2030	2035	2040	2045	2050
Electricity distribution capital invested -		1.62	1.68	2.88	3.08	2.81	2.96
Cumulative 5-yr (billion \$2018)							

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

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Commercial (PJ)	70.8	69.4	66.6	62.4	57.8	54.2	52.1

Table 37: E+RE- scenario - PILLAR 1: Efficiency/Electrification - Overview (continued)

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Industry (PJ)	281	293	298	298	301	304	307
Final energy use - Residential (PJ)	86.4	81.9	77.8	69.7	60.5	53.3	48.7
Final energy use - Transportation (PJ)	182	170	150	125	103	89.2	83.4

Table 38: E+RE- scenario - PILLAR 1: Efficiency/Electrification - Residential

Item	2020	2025	2030	2035	2040	2045	2050
Residential HVAC investment in 2020s vs.		1.79	2.3				
REF - Cumulative 5-yr (billion \$2018)							
Sales of cooking units - Electric	74.2	79.7	96.5	99.8	100	100	100
Resistance (%)							
Sales of cooking units - Gas (%)	25.8	20.3	3.47	0.175	0	0	0
Sales of space heating units - Electric	6.37	12.2	35.2	81.9	90.3	90.9	90.6
Heat Pump (%)							
Sales of space heating units - Electric	16.5	22	17.4	7.5	5.7	5.65	5.9
Resistance (%)							
Sales of space heating units - Fossil (%)	5.83	9.86	7.69	3.24	2.34	2.21	2.25
Sales of space heating units - Gas (%)	71.3	55.9	39.7	7.36	1.62	1.25	1.22
Sales of water heating units - Electric	0	0.739	10.1	30.7	34.4	34.6	34.6
Heat Pump (%)							
Sales of water heating units - Electric	35.5	51.5	55.3	63.7	65.3	65.4	65.3
Resistance (%)							
Sales of water heating units - Gas Furnace	64.5	47.7	34.5	5.53	0.326	0	0
(%)							
Sales of water heating units - Other (%)	0.03	0.032	0.032	0.032	0.032	0.032	0.032

Table 39: E+RE- scenario - PILLAR 1: Efficiency/Electrification - Transportation

2020	2025	2030	2035	2040	2045	2050
	377	964	1,565	2,370	2,580	2,460
0.061		0.695		3.07		4.98
0.164		16.7		74		120
97.2	92.1	67	23.3	4.22	0.628	0
0.588	3.81	19	45.6	57.4	59.6	60
0.227	0.227	0.176	0.066	0.013	0.002	0
0.082	0.09	0.077	0.031	0.007	0.001	0
0.392	2.54	12.7	30.4	38.2	39.7	40
1.5	1.23	1.07	0.568	0.163	0.038	0
1.66	1.92	1.3	0.418	0.076	0.013	0
3.53	14	44.6	81.1	96.2	99.3	100
90.5	79.4	50.7	17.3	3.39	0.593	0
4.05	4.27	3.08	1.16	0.28	0.06	0
0.111	0.346	0.212	0.066	0.013	0.002	0
0.107	0.103	0.068	0.024	0.005	0.001	0
64.7	59.7	42.3	14.4	2.59	0.384	0
0.784	5.07	25.3	60.8	76.5	79.5	80
33.7	33.3	25.5	9.32	1.77	0.277	0
0.363	0.402	0.341	0.14	0.03	0.005	0
0.196	1.27	6.33	15.2	19.1	19.9	20
0.253	0.255	0.205	0.083	0.019	0.004	0
	0.061 0.164 97.2 0.588 0.227 0.082 0.392 1.5 1.66 3.53 90.5 4.05 0.111 0.107 64.7 0.784 33.7 0.363 0.196	0.061 0.164 97.2 92.1 0.588 3.81 0.227 0.082 0.09 0.392 2.54 1.5 1.66 1.92 3.53 14 90.5 79.4 4.05 4.05 4.27 0.111 0.346 0.107 0.103 64.7 59.7 0.784 5.07 33.7 33.3 0.363 0.402 0.196 1.27	0.061 0.695 0.164 16.7 97.2 92.1 67 0.588 3.81 19 0.227 0.227 0.176 0.082 0.09 0.077 0.392 2.54 12.7 1.5 1.23 1.07 1.66 1.92 1.3 3.53 14 44.6 90.5 79.4 50.7 4.05 4.27 3.08 0.111 0.346 0.212 0.107 0.103 0.068 64.7 59.7 42.3 0.784 5.07 25.3 33.7 33.3 25.5 0.363 0.402 0.341 0.196 1.27 6.33	0.061 0.695 0.164 16.7 97.2 92.1 67 23.3 0.588 3.81 19 45.6 0.227 0.227 0.176 0.066 0.082 0.09 0.077 0.031 0.392 2.54 12.7 30.4 1.5 1.23 1.07 0.568 1.66 1.92 1.3 0.418 3.53 14 44.6 81.1 90.5 79.4 50.7 17.3 4.05 4.27 3.08 1.16 0.111 0.346 0.212 0.066 0.107 0.103 0.068 0.024 64.7 59.7 42.3 14.4 0.784 5.07 25.3 60.8 33.7 33.3 25.5 9.32 0.363 0.402 0.341 0.14 0.196 1.27 6.33 15.2	377 964 1,565 2,370 0.061 0.695 3.07 0.164 16.7 74 97.2 92.1 67 23.3 4.22 0.588 3.81 19 45.6 57.4 0.227 0.227 0.176 0.066 0.013 0.082 0.09 0.077 0.031 0.007 0.392 2.54 12.7 30.4 38.2 1.5 1.23 1.07 0.568 0.163 1.66 1.92 1.3 0.418 0.076 3.53 14 44.6 81.1 96.2 90.5 79.4 50.7 17.3 3.39 4.05 4.27 3.08 1.16 0.28 0.111 0.346 0.212 0.066 0.013 0.107 0.103 0.068 0.024 0.005 64.7 59.7 42.3 14.4 2.59 0.784 5.07 25.3 </td <td>0.061 0.695 3.07 0.164 16.7 74 97.2 92.1 67 23.3 4.22 0.628 0.588 3.81 19 45.6 57.4 59.6 0.227 0.227 0.176 0.066 0.013 0.002 0.082 0.09 0.077 0.031 0.007 0.001 0.392 2.54 12.7 30.4 38.2 39.7 1.5 1.23 1.07 0.568 0.163 0.038 1.66 1.92 1.3 0.418 0.076 0.013 3.53 14 44.6 81.1 96.2 99.3 90.5 79.4 50.7 17.3 3.39 0.593 4.05 4.27 3.08 1.16 0.28 0.06 0.111 0.346 0.212 0.066 0.013 0.002 0.107 0.103 0.068 0.024 0.005 0.001 64.7</td>	0.061 0.695 3.07 0.164 16.7 74 97.2 92.1 67 23.3 4.22 0.628 0.588 3.81 19 45.6 57.4 59.6 0.227 0.227 0.176 0.066 0.013 0.002 0.082 0.09 0.077 0.031 0.007 0.001 0.392 2.54 12.7 30.4 38.2 39.7 1.5 1.23 1.07 0.568 0.163 0.038 1.66 1.92 1.3 0.418 0.076 0.013 3.53 14 44.6 81.1 96.2 99.3 90.5 79.4 50.7 17.3 3.39 0.593 4.05 4.27 3.08 1.16 0.28 0.06 0.111 0.346 0.212 0.066 0.013 0.002 0.107 0.103 0.068 0.024 0.005 0.001 64.7

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

Item	2020	2025	2030	2035	2040	2045	2050
Capital invested - Solar PV - Base (billion \$2018)		5.7	3.92	4.66	3.09	1.34	0
Capital invested - Solar PV - Constrained (billion \$2018)		2.15	3.06	7.09	4.01	1.27	0
Capital invested - Wind - Base (billion \$2018)		0	3.21	9.2	11.5	16.6	0.769
Capital invested - Wind - Constrained (billion \$2018)		2.45	9.77	10.6	13.1	16.1	0.65
Installed renewables - OffshoreWind - Base land use assumptions (MW)	0	0	0	0	0	0	0
Installed renewables - OffshoreWind - Constrained land use assumptions (MW)	0	0	0	0	0	0	0
Installed renewables - Solar - Base land use assumptions (MW)	384	5,368	9,201	14,151	17,633	19,230	19,230
Installed renewables - Solar - Constrained land use assumptions (MW)	215	2,094	5,086	12,618	17,141	18,653	18,653
Installed renewables - Wind - Base land use assumptions (MW)	3,194	3,194	5,602	13,020	22,791	37,561	38,287
Installed renewables - Wind - Constrained land use assumptions (MW)	3,194	4,861	12,201	20,755	31,810	46,209	46,823

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

Item	2020	2025	2030	2035	2040	2045	2050
OffshoreWind - Base land use	0	0	0	0	0	0	0
assumptions (GWh)							
OffshoreWind - Constrained land use	0	0	0	0	0	0	0
assumptions (GWh)							
Solar - Base land use assumptions (GWh)	622	8,751	15,039	23,132	28,859	31,458	31,458
Solar - Constrained land use assumptions	348	3,428	8,361	20,717	28,122	30,619	30,619
(GWh)							
Wind - Base land use assumptions (GWh)	13,033	13,033	21,498	47,321	81,119	131,906	134,361
Wind - Constrained land use assumptions	13,033	18,818	44,238	73,249	110,476	158,938	160,933
(GWh)							

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

Item	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - Aggressive							-2,594
deployment - Corn-ethanol to energy							
grasses (1000 tCO2e/y)							
Carbon sink potential - Aggressive							-7,779
deployment - Cropland measures (1000							
tCO2e/y)							
Carbon sink potential - Aggressive							-286
deployment - Permanent conservation							
cover (1000 tCO2e/y)							
Carbon sink potential - Aggressive							-10,659
deployment - Total (1000 tCO2e/y)							
Carbon sink potential - Moderate							-2,594
deployment - Corn-ethanol to energy							
grasses (1000 tCO2e/y)							
Carbon sink potential - Moderate							-4,000
deployment - Cropland measures (1000							
tCO2e/y)							
Carbon sink potential - Moderate							-143
deployment - Permanent conservation							
cover (1000 tCO2e/y)							
Carbon sink potential - Moderate							-6,737
deployment - Total (1000 tC02e/y)							

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

Item	2020	2025	2030	2035	2040	2045	2050
Land impacted for carbon sink -							1,456
Aggressive deployment - Corn-ethanol to							
energy grasses (1000 hectares)							
Land impacted for carbon sink -							7,064
Aggressive deployment - Cropland							
measures (1000 hectares)							
Land impacted for carbon sink -							489
Aggressive deployment - Permanent							
conservation cover (1000 hectares)							
Land impacted for carbon sink -							9,008
Aggressive deployment - Total (1000							
hectares)							
Land impacted for carbon sink - Moderate							1,456
deployment - Corn-ethanol to energy							
grasses (1000 hectares)							
Land impacted for carbon sink - Moderate							3,654
deployment - Cropland measures (1000							
hectares)							
Land impacted for carbon sink - Moderate							244
deployment - Permanent conservation							
cover (1000 hectares)							
Land impacted for carbon sink - Moderate							5,354
deployment - Total (1000 hectares)							

Table 43: E+RE- scenario - PILLAR 6: Land sinks - Forests

Item	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - High - Accelerate							-248
regeneration (1000 tCO2e/y)							
Carbon sink potential - High - All (not							-17,146
counting overlap) (1000 tCO2e/y)							
Carbon sink potential - High - Avoid							-947
deforestation (1000 tCO2e/y)							
Carbon sink potential - High - Extend							-427
rotation length (1000 tCO2e/y)							
Carbon sink potential - High - Improve							-46.9
plantations (1000 tCO2e/y)							
Carbon sink potential - High - Increase							-285
retention of HWP (1000 tCO2e/y)							
Carbon sink potential - High - Increase							-2,717
trees outside forests (1000 tCO2e/y)							
Carbon sink potential - High - Reforest							-7,855
cropland (1000 tCO2e/y)							
Carbon sink potential - High - Reforest							-4,189
pasture (1000 tCO2e/y)							
Carbon sink potential - High - Restore							-431
productivity (1000 tCO2e/y)							
Carbon sink potential - Low - Accelerate							-124
regeneration (1000 tCO2e/y)							
Carbon sink potential - Low - All (not							-5,906
counting overlap) (1000 tCO2e/y)							
Carbon sink potential - Low - Avoid							-158
deforestation (1000 tCO2e/y)							
Carbon sink potential - Low - Extend							-164
rotation length (1000 tCO2e/y)							
Carbon sink potential - Low - Improve							-23.8
plantations (1000 tCO2e/y)							
Carbon sink potential - Low - Increase							-95
retention of HWP (1000 tC02e/y)							
Carbon sink potential - Low - Increase							-951
trees outside forests (1000 tC02e/y)							

Table 43: E+RE- scenario - PILLAR 6: Land sinks - Forests (continued)

item	2020	2025	2030	2035	2040	2045	205
Carbon sink potential - Low - Reforest							-3,92
cropland (1000 tCO2e/y)							
Carbon sink potential - Low - Reforest pasture (1000 tCO2e/y)							-31
Carbon sink potential - Low - Restore							-14
productivity (1000 tCO2e/y)							-14
Carbon sink potential - Mid - Accelerate							-18
regeneration (1000 tCO2e/y)							
Carbon sink potential - Mid - All (not							-11,52
counting overlap) (1000 tCO2e/y)							
Carbon sink potential - Mid - Avoid							-55
deforestation (1000 tC02e/y)							
Carbon sink potential - Mid - Extend							-29
rotation length (1000 tC02e/y)							0.7
Carbon sink potential - Mid - Improve plantations (1000 tCO2e/y)							-34
Carbon sink potential - Mid - Increase							-19
retention of HWP (1000 tCO2e/y)							-17
Carbon sink potential - Mid - Increase							-1,83
rees outside forests (1000 tC02e/y)							-1,00
Carbon sink potential - Mid - Reforest							-5,8
cropland (1000 tCO2e/y)							0,0
Carbon sink potential - Mid - Reforest							-2,25
pasture (1000 tC02e/y)							_,
Carbon sink potential - Mid - Restore							-28
productivity (1000 tCO2e/y)							
and impacted for carbon sink potential -							40
ligh - Accelerate regeneration (1000							
nectares)							
and impacted for carbon sink potential -							12
High - Avoid deforestation (over 30 years)							
1000 hectares)							
and impacted for carbon sink potential -							2
High - Extend rotation length (1000							
nectares)							17
Land impacted for carbon sink potential -							17
High - Improve plantations (1000							
nectares) Land impacted for carbon sink potential -							
High - Increase retention of HWP (1000							
nectares)							
and impacted for carbon sink potential -							25
High - Increase trees outside forests							20
1000 hectares)							
and impacted for carbon sink potential -							5
ligh - Reforest cropland (1000 hectares)							
and impacted for carbon sink potential -							1
ligh - Reforest pasture (1000 hectares)							
and impacted for carbon sink potential -							14
High - Restore productivity (1000							
nectares)							
and impacted for carbon sink potential -							1,44
High - Total impacted (over 30 years)							
1000 hectares)							
and impacted for carbon sink potential -							20
Low - Accelerate regeneration (1000							
nectares)							
and impacted for carbon sink potential -							12
ow - Avoid deforestation (over 30 years)		I .					

Table 43: E+RE- scenario - PILLAR 6: Land sinks - Forests (continued)

Item	2020	2025	2030	2035	2040	2045	2050
Land impacted for carbon sink potential -							83.4
Low - Extend rotation length (1000							
hectares)							
Land impacted for carbon sink potential -							8.63
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 -							136
Low - Increase trees outside forests							
(1000 hectares)							
Land impacted for carbon sink potential -							260
Low - Reforest cropland (1000 hectares)							
Land impacted for carbon sink potential -							20.6
Low - Reforest pasture (1000 hectares)							
Land impacted for carbon sink potential -							86.4
Low - Restore productivity (1000							
hectares)							
Land impacted for carbon sink potential -		+					735
Low - Total impacted (over 30 years)							
(1000 hectares)							
Land impacted for carbon sink potential -							30.4
Mid - Accelerate regeneration (1000							00.1
hectares)							
Land impacted for carbon sink potential -		+					124
Mid - Avoid deforestation (over 30 years)							
(1000 hectares)							
Land impacted for carbon sink potential -		+					151
Mid - Extend rotation length (1000							101
hectares)							
Land impacted for carbon sink potential -							13
Mid - Improve plantations (1000 hectares)							10
Land impacted for carbon sink potential -		+					0
Mid - Increase retention of HWP (1000							U
hectares)							
Land impacted for carbon sink potential -		+					197
Mid - Increase trees outside forests (1000							171
hectares)							
Land impacted for carbon sink potential -		+					390
Mid - Reforest cropland (1000 hectares)							390
Land impacted for carbon sink potential -							149
·							149
Mid - Reforest pasture (1000 hectares)							471
Land impacted for carbon sink potential -							174
Mid - Restore productivity (1000							
hectares)							
Land impacted for carbon sink potential -							1,228
Mid - Total impacted (over 30 years) (1000							
hectares)							

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

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution -		125	0.122	0.115	0.092	0.061	0.001
Coal (million 2019\$)							
Monetary damages from air pollution -		75.3	34.1	42.7	25.1	10.1	4.54
Natural Gas (million 2019\$)							
Monetary damages from air pollution -		195	183	140	81.3	37.2	14.7
Transportation (million 2019\$)							
Premature deaths from air pollution -		14.1	0.014	0.013	0.01	0.007	0
Coal (deaths)							

Table 44: E+RE- scenario - IMPACTS - Health (continued)

Item	2020	2025	2030	2035	2040	2045	2050
Premature deaths from air pollution -		8.5	3.85	4.82	2.84	1.14	0.512
Natural Gas (deaths)							
Premature deaths from air pollution -		22	20.6	15.7	9.14	4.19	1.65
Transportation (deaths)							

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

Item	2020	2025	2030	2035	2040	2045	2050
Commercial HVAC investment in 2020s -		5,540	6,039				
Cumulative 5-yr (million \$2018)							
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
Sales of space heating units - Electric	3.92	6.69	9.32	17.9	38.6	64.5	79.7
Heat Pump (%)							
Sales of space heating units - Electric	6.31	5.58	5.85	6.72	8.6	10.7	11.9
Resistance (%)							
Sales of space heating units - Fossil (%)	0	2.1	1.98	1.48	0.719	0.234	0.062
Sales of space heating units - Gas Furnace	89.8	85.6	82.9	73.9	52.1	24.5	8.31
(%)							
Sales of water heating units - Electric	0.944	1.35	2.81	7.68	19.4	34.3	43
Heat Pump (%)							
Sales of water heating units - Electric	8.03	7.53	8.96	13.7	25.1	39.5	48
Resistance (%)							
Sales of water heating units - Gas Furnace	90.2	90.1	87.3	77.8	54.7	25.5	8.33
(%)							
Sales of water heating units - Other (%)	0.788	0.981	0.957	0.887	0.782	0.716	0.691

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

Item	2020	2025	2030	2035	2040	2045	2050
Electricity distribution capital invested -		1.33	1.36	1.77	1.84	2.53	2.68
Cumulative 5-yr (billion \$2018)							

Table 47: E-B+ scenario - PILLAR 1: Efficiency/Electrification - Overview

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Commercial (PJ)	70.8	69.4	67.5	65.7	63.5	60.8	58.1
Final energy use - Industry (PJ)	281	293	300	302	307	311	314
Final energy use - Residential (PJ)	86.4	82	78.8	75.5	71.4	65.8	59.3
Final energy use - Transportation (PJ)	182	171	156	144	135	124	111

Table 48: E-B+ scenario - PILLAR 1: Efficiency/Electrification - Residential

Item	2020	2025	2030	2035	2040	2045	2050
Residential HVAC investment in 2020s vs.		1.78	2.27				
REF - Cumulative 5-yr (billion \$2018)							
Sales of cooking units - Electric	74.1	74.8	77.2	83.4	92.1	97.4	99.3
Resistance (%)							
Sales of cooking units - Gas (%)	25.9	25.2	22.8	16.6	7.91	2.55	0.687
Sales of space heating units - Electric	6.37	11	13.7	22.5	43.2	68.9	83.6
Heat Pump (%)							
Sales of space heating units - Electric	16.5	22.2	21.5	19.8	15.5	10.2	7.2
Resistance (%)							
Sales of space heating units - Fossil (%)	5.83	9.99	9.81	8.95	6.83	4.3	2.95
Sales of space heating units - Gas (%)	71.3	56.8	54.9	48.8	34.5	16.7	6.23
Sales of water heating units - Electric	0	0.395	1.48	5.1	13.9	24.9	31.5
Heat Pump (%)							
Sales of water heating units - Electric	35.5	51.4	51.8	53.2	56.8	61.3	64
Resistance (%)							

Table 48: E-B+ scenario - PILLAR 1: Efficiency/Electrification - Residential (continued)

Item	2020	2025	2030	2035	2040	2045	2050
Sales of water heating units - Gas Furnace (%)	64.5	48.2	46.7	41.7	29.3	13.7	4.47
Sales of water heating units - Other (%)	0.03	0.032	0.032	0.032	0.032	0.032	0.032

Table 49: E-B+ scenario - PILLAR 1: Efficiency/Electrification - Transportation

2030 60.7 0.212	2035 128	2040 432	2045 1,362	2050 1,983
	128	432	1,362	1,983
0.212			I .	
0.212				
		1.14		3.19
5.1		27.4		76.8
91.3	79.8	58.2	32.1	13.7
4.11	10.8	23.6	39.5	51
0.239	0.225	0.179	0.109	0.051
0.104	0.107	0.092	0.06	0.03
2.74	7.17	15.7	26.3	34
1.46	1.95	2.25	1.96	1.14
2.08	1.66	1.07	0.552	0.236
11.2	24.9	47.3	71.3	87.3
80.6	67.9	47.4	25.6	11.3
5.67	5.21	3.97	2.38	1.16
0.333	0.257	0.184	0.103	0.048
0.102	0.089	0.065	0.036	0.016
57.7	49.4	35.6	19.6	8.37
5.49	14.3	31.4	52.6	68
34.7	31.9	24.4	14.2	6.33
0.464	0.478	0.414	0.275	0.141
1.37	3.58	7.86	13.2	17
0.279	0.286	0.258	0.184	0.102
	91.3 4.11 0.239 0.104 2.74 1.46 2.08 11.2 80.6 5.67 0.333 0.102 57.7 5.49 34.7 0.464 1.37	91.3 79.8 4.11 10.8 0.239 0.225 0.104 0.107 2.74 7.17 1.46 1.95 2.08 1.66 11.2 24.9 80.6 67.9 5.67 5.21 0.333 0.257 0.102 0.089 57.7 49.4 5.49 14.3 34.7 31.9 0.464 0.478 1.37 3.58	91.3 79.8 58.2 4.11 10.8 23.6 0.239 0.225 0.179 0.104 0.107 0.092 2.74 7.17 15.7 1.46 1.95 2.25 2.08 1.66 1.07 11.2 24.9 47.3 80.6 67.9 47.4 5.67 5.21 3.97 0.333 0.257 0.184 0.102 0.089 0.065 57.7 49.4 35.6 5.49 14.3 31.4 34.7 31.9 24.4 0.464 0.478 0.414 1.37 3.58 7.86	91.3 79.8 58.2 32.1 4.11 10.8 23.6 39.5 0.239 0.225 0.179 0.109 0.104 0.107 0.092 0.06 2.74 7.17 15.7 26.3 1.46 1.95 2.25 1.96 2.08 1.66 1.07 0.552 11.2 24.9 47.3 71.3 80.6 67.9 47.4 25.6 5.67 5.21 3.97 2.38 0.333 0.257 0.184 0.103 0.102 0.089 0.065 0.036 57.7 49.4 35.6 19.6 5.49 14.3 31.4 52.6 34.7 31.9 24.4 14.2 0.464 0.478 0.414 0.275 1.37 3.58 7.86 13.2

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

Item	2020	2025	2030	2035	2040	2045	2050
Capital invested - Biomass power plant	0	0.003	0.032	0	0	0	0
(billion \$2018)							
Capital invested - Biomass w/ccu allam	0	0	0	0.024	0.006	0.01	0
power plant (billion \$2018)							
Capital invested - Biomass w/ccu power	0	0	0	0.061	0.002	0.208	0.095
plant (billion \$2018)							

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

Item	2020	2025	2030	2035	2040	2045	2050
Biomass power plant (GWh)	0	5.4	67.8	67.8	67.8	67.8	67.8
Biomass w/ccu allam power plant (GWh)	0	0	0	24.1	30.2	40.1	40.1
Biomass w/ccu power plant (GWh)	0	0	0	68	69.9	303	410

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

Item	2020	2025	2030	2035	2040	2045	2050
Biomass purchases (million \$2018/year)		0.41	4.64	117	1,093	2,577	6,002
Conversion capital investment -		3.12	35.5	1,454	12,265	18,692	53,340
Cumulative 5-yr (million \$2018)							
Number of facilities - Allam power w ccu	0	0	0	1	2	3	3
(quantity)							

Table 52: <i>E-B+ scenario</i>	- PTI I AR 3º Clean tuels -	Rineneray (continued)

Item	2020	2025	2030	2035	2040	2045	2050
Number of facilities - Beccs hydrogen	0	0	0	1	15	35	41
(quantity)							
Number of facilities - Diesel (quantity)	0	0	0	1	1	2	3
Number of facilities - Diesel ccu (quantity)	0	0	0	1	2	3	4
Number of facilities - Power (quantity)	0	1	1	1	1	1	1
Number of facilities - Power ccu	0	0	0	1	2	3	3
(quantity)							
Number of facilities - Pyrolysis (quantity)	0	0	0	1	1	2	32
Number of facilities - Pyrolysis ccu	0	0	0	1	2	3	17
(quantity)							
Number of facilities - Sng (quantity)	0	1	1	1	1	2	2
Number of facilities - Sng ccu (quantity)	0	0	0	0	0	1	2

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

Item	2020	2025	2030	2035	2040	2045	2050
Annual - All (MMT)		0	0	1.79	17.5	41.5	57.6
Annual - BECCS (MMT)		0	0	1.79	17.5	41.5	57.6
Annual - Cement and lime (MMT)		0	0	0	0	0	0
Annual - NGCC (MMT)		0	0	0	0	0	0
Cumulative - All (MMT)		0	0	1.79	19.3	60.8	118
Cumulative - BECCS (MMT)		0	0	1.79	19.3	60.8	118
Cumulative - Cement and lime (MMT)		0	0	0	0	0	0
Cumulative - NGCC (MMT)		0	0	0	0	0	0

Table 54: E-B+ scenario - PILLAR 4: CCUS - CO2 pipelines

Item	2020	2025	2030	2035	2040	2045	2050
All (km)		0	276	573	1,503	2,642	3,732
Cumulative investment - All (million \$2018)		0	1,627	3,273	5,868	6,875	7,932
Cumulative investment - Spur (million \$2018)		0	0	17.9	986	1,993	3,050
Cumulative investment - Trunk (million \$2018)		0	1,627	3,255	4,882	4,882	4,882
Spur (km)		0	0	21.5	675	1,814	2,905
Trunk (km)		0	276	552	828	828	828

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

Item	2020	2025	2030	2035	2040	2045	2050
CO2 storage (MMT)		0	0	0	0	0	0
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 56: E-B+ scenario - PILLAR 6: Land sinks - Agriculture

Item	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - Aggressive							-2,881
deployment - Corn-ethanol to energy							
grasses (1000 tCO2e/y)							
Carbon sink potential - Aggressive							-7,608
deployment - Cropland measures (1000							
tCO2e/y)							
Carbon sink potential - Aggressive							0
deployment - Cropland to woody energy							
crops (1000 tCO2e/y)							

Table 56: E-B+ scenario - PILLAR 6: Land sinks - Agriculture (continued)

Item	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - Aggressive							0
deployment - Pasture to energy crops							
(1000 tC02e/y)							
Carbon sink potential - Aggressive							-273
deployment - Permanent conservation							
cover (1000 tC02e/y)							
Carbon sink potential - Aggressive							-10,762
deployment - Total (1000 tC02e/y)							
Carbon sink potential - Moderate							-2,881
deployment - Corn-ethanol to energy							
grasses (1000 tCO2e/y)							
Carbon sink potential - Moderate							-3,910
deployment - Cropland measures (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							-136
deployment - Permanent conservation							
cover (1000 tCO2e/y)							
Carbon sink potential - Moderate							-6,927
deployment - Total (1000 tCO2e/y)							
Land impacted for carbon sink -							1,679
Aggressive deployment - Corn-ethanol to							
energy grasses (1000 hectares)							
Land impacted for carbon sink -							16,939
Aggressive deployment - Cropland							
measures (1000 hectares)							
Land impacted for carbon sink -							15.7
Aggressive deployment - Cropland to							
woody energy crops (1000 hectares)							
Land impacted for carbon sink -							288
Aggressive deployment - Pasture to							
energy crops (1000 hectares)							
Land impacted for carbon sink -							466
Aggressive deployment - Permanent							
conservation cover (1000 hectares)							
Land impacted for carbon sink -							19,388
Aggressive deployment - Total (1000							,
hectares)							
Land impacted for carbon sink - Moderate							1,679
deployment - Corn-ethanol to energy							1,017
grasses (1000 hectares)							
Land impacted for carbon sink - Moderate							3,547
deployment - Cropland measures (1000							0,041
hectares)							
Land impacted for carbon sink - Moderate				+			15.7
deployment - Cropland to woody energy							10.1
crops (1000 hectares)							
Land impacted for carbon sink - Moderate							288
							200
deployment - Pasture to energy crops							
(1000 hectares)							000
Land impacted for carbon sink - Moderate							233
deployment - Permanent conservation							
cover (1000 hectares)							
Land impacted for carbon sink - Moderate							5,762
deployment - Total (1000 hectares)							

Table 57: E-B+ scenario - PILLAR 6: Land sinks - Forests

Iable 57: E-B+ scenario - PILLAR 6: Land 8 Item	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - High - Accelerate	2020	2020	2000	2000	2040	2040	-248
regeneration (1000 tCO2e/y)							2.0
Carbon sink potential - High - All (not							-17,146
counting overlap) (1000 tCO2e/y)							11,140
Carbon sink potential - High - Avoid							-947
deforestation (1000 tCO2e/y)							7-71
Carbon sink potential - High - Extend							-427
rotation length (1000 tCO2e/y)							-421
Carbon sink potential - High - Improve							-46.9
, , ,							-40.9
plantations (1000 tCO2e/y)							005
Carbon sink potential - High - Increase							-285
retention of HWP (1000 tCO2e/y)							
Carbon sink potential - High - Increase							-2,717
trees outside forests (1000 tCO2e/y)							
Carbon sink potential - High - Reforest							-7,855
cropland (1000 tCO2e/y)							
Carbon sink potential - High - Reforest							-4,189
pasture (1000 tCO2e/y)							
Carbon sink potential - High - Restore							-431
productivity (1000 tCO2e/y)							
Carbon sink potential - Low - Accelerate							-124
regeneration (1000 tC02e/y)							124
Carbon sink potential - Low - All (not							-5,906
							-5,906
counting overlap) (1000 tCO2e/y)							150
Carbon sink potential - Low - Avoid							-158
deforestation (1000 tCO2e/y)							
Carbon sink potential - Low - Extend							-164
rotation length (1000 tCO2e/y)							
Carbon sink potential - Low - Improve							-23.8
plantations (1000 tCO2e/y)							
Carbon sink potential - Low - Increase							-95
retention of HWP (1000 tCO2e/y)							
Carbon sink potential - Low - Increase							-951
trees outside forests (1000 tC02e/y)							,
Carbon sink potential - Low - Reforest							-3,928
cropland (1000 tCO2e/y)							0,720
Carbon sink potential - Low - Reforest							-317
							-317
pasture (1000 tC02e/y)							1/5
Carbon sink potential - Low - Restore							-145
productivity (1000 tCO2e/y)							
Carbon sink potential - Mid - Accelerate							-186
regeneration (1000 tCO2e/y)							
Carbon sink potential - Mid - All (not							-11,526
counting overlap) (1000 tCO2e/y)							
Carbon sink potential - Mid - Avoid							-553
deforestation (1000 tCO2e/y)							
Carbon sink potential - Mid - Extend							-296
rotation length (1000 tCO2e/y)							270
Carbon sink potential - Mid - Improve	+						-34.9
plantations (1000 tCO2e/y)							-54.7
							-190
Carbon sink potential - Mid - Increase							-190
retention of HWP (1000 tCO2e/y)							
Carbon sink potential - Mid - Increase							-1,834
trees outside forests (1000 tCO2e/y)							
Carbon sink potential - Mid - Reforest							-5,891
cropland (1000 tCO2e/y)							
Carbon sink potential - Mid - Reforest							-2,253
pasture (1000 tC02e/y)							
Carbon sink potential - Mid - Restore							-288

Table 57: E-B+ scenario - PILLAR 6: Land sinks - Forests (continued)

2020	2025	2030	2035	2040	2045	2050
						40.5
						400
						128
						010
						218
						17.3
						17.3
						0
						U
						258
						250
						519
						319
						119
						117
						143
						143
						1,443
						1,443
						20.2
						20.2
						120
						120
						83.4
						03.4
						8.63
						0.03
						0
						U
						136
						100
						260
						200
		+				20.6
						20.0
						86.4
						00.4
		+				735
						130
		-				30.4
						30.4
	l l	1	l l	1	1	
		2020 2025	2020 2025 2030	2020 2025 2030 2035	2020	2020 2025 2030 2035 2040 2045

<u>Table 57: E-B+ scenario - PILLAR 6: Land sinks - Forests (continued)</u>

Item	2020	2025	2030	2035	2040	2045	2050
Land impacted for carbon sink potential -							124
Mid - Avoid deforestation (over 30 years)							
(1000 hectares)							
Land impacted for carbon sink potential -							151
Mid - Extend rotation length (1000							
hectares)							
Land impacted for carbon sink potential -							13
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 -							197
Mid - Increase trees outside forests (1000							
hectares)							
Land impacted for carbon sink potential -							390
Mid - Reforest cropland (1000 hectares)							
Land impacted for carbon sink potential -							149
Mid - Reforest pasture (1000 hectares)							
Land impacted for carbon sink potential -							174
Mid - Restore productivity (1000							
hectares)							
Land impacted for carbon sink potential -							1,228
Mid - Total impacted (over 30 years) (1000							
hectares)							

Table 58: E-B+ scenario - IMPACTS - Health

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution -		125	0.122	0.115	0.092	0.061	0.001
Coal (million 2019\$)							
Monetary damages from air pollution -		82.7	34.5	17.3	10.8	4.35	2.21
Natural Gas (million 2019\$)							
Monetary damages from air pollution -		198	202	197	179	143	98.4
Transportation (million 2019\$)							
Premature deaths from air pollution -		14.1	0.014	0.013	0.01	0.007	0
Coal (deaths)							
Premature deaths from air pollution -		9.33	3.89	1.95	1.22	0.491	0.249
Natural Gas (deaths)							
Premature deaths from air pollution -		22.3	22.7	22.2	20.1	16.1	11.1
Transportation (deaths)							

Table 59: REF scenario - PILLAR 1: Efficiency/Electrification - Commercial

Item	2020	2025	2030	2035	2040	2045	2050
Commercial HVAC investment in 2020s -		5,476	5,633				
Cumulative 5-yr (million \$2018)							
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
Sales of space heating units - Electric	3.92	13	44.6	70.5	74.8	75.2	75.2
Heat Pump (%)							
Sales of space heating units - Electric	6.31	6.4	10.8	18.4	23.4	24.2	24.3
Resistance (%)							
Sales of space heating units - Fossil (%)	0	2.06	1.59	0.699	0.102	0.009	0
Sales of space heating units - Gas Furnace	89.8	78.5	43	10.4	1.69	0.518	0.457
(%)							
Sales of water heating units - Electric	0.944	0.821	0.817	0.818	0.814	0.81	0.81
Heat Pump (%)							
Sales of water heating units - Electric	8.03	7.01	7.03	7.01	7.01	7.01	7.01
Resistance (%)							

Table 59: REF scenario - PILLAR 1: Efficiency/Electrification - Commercial (continued)

	,.		•	,			
Item	2020	2025	2030	2035	2040	2045	2050
Sales of water heating units - Gas Furnace (%)	90.2	91.2	91.2	91.2	91.2	91.2	91.2
Sales of water heating units - Other (%)	0.788	0.989	0.989	0.988	0.987	0.991	0.991

Table 60: REF scenario - PILLAR 1: Efficiency/Electrification - Electricity demand

Item	2020	2025	2030	2035	2040	2045	2050
Electricity distribution capital invested -		1.36	1.39	1.46	1.5	1.63	1.69
Cumulative 5-yr (billion \$2018)							

Table 61: REF scenario - PILLAR 1: Efficiency/Electrification - Overview

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Commercial (PJ)	70.8	71	71	70.2	69.4	70	71.9
Final energy use - Industry (PJ)	281	297	305	312	321	329	340
Final energy use - Residential (PJ)	86.4	82.5	80.6	79.4	79.2	79.6	79.9
Final energy use - Transportation (PJ)	182	171	157	149	149	153	158

Table 62: REF scenario - PILLAR 1: Efficiency/Electrification - Residential

Item	2020	2025	2030	2035	2040	2045	2050
Residential HVAC investment in 2020s vs.		1.71	1.81				
REF - Cumulative 5-yr (billion \$2018)							
Sales of cooking units - Electric	73.9	73.9	73.9	73.9	73.9	73.9	73.9
Resistance (%)							
Sales of cooking units - Gas (%)	26.1	26.1	26.1	26.1	26.1	26.1	26.1
Sales of space heating units - Electric	5.61	14.1	14.5	15.1	15.7	16.4	17.4
Heat Pump (%)							
Sales of space heating units - Electric	16.7	21.4	21.2	20.9	20.5	19.8	18.9
Resistance (%)							
Sales of space heating units - Fossil (%)	5.95	9.38	9.47	9.46	9.32	9.23	9.3
Sales of space heating units - Gas (%)	71.7	55	54.8	54.5	54.5	54.6	54.4
Sales of water heating units - Electric	0	0	0	0	0	0	0
Heat Pump (%)							
Sales of water heating units - Electric	35.5	51.2	51.2	51.1	51.1	51	51
Resistance (%)							
Sales of water heating units - Gas Furnace	64.5	48.7	48.8	48.9	48.9	48.9	49
(%)							
Sales of water heating units - Other (%)	0.03	0.032	0.032	0.032	0.032	0.032	0.032

Table 63: REF scenario - PILLAR 1: Efficiency/Electrification - Transportation

Item	2020	2025	2030	2035	2040	2045	2050
Vehicle sales - Heavy-duty - diesel (%)	98.1	98.2	97.9	97	95.6	93.5	91.6
Vehicle sales - Heavy-duty - EV (%)	0	0	0	0	0	0	0
Vehicle sales - Heavy-duty - gasoline (%)	0.229	0.242	0.257	0.274	0.294	0.317	0.343
Vehicle sales - Heavy-duty - hybrid (%)	0.083	0.096	0.112	0.13	0.15	0.174	0.202
Vehicle sales - Heavy-duty - hydrogen FC	0.119	0.138	0.16	0.186	0.216	0.25	0.29
(%)							
Vehicle sales - Heavy-duty - other (%)	1.51	1.31	1.57	2.37	3.69	5.71	7.57
Vehicle sales - Light-duty - diesel (%)	1.67	2.06	2.2	2.05	1.85	1.72	1.64
Vehicle sales - Light-duty - EV (%)	3.18	5.11	5.84	7.15	8.75	10.2	11.4
Vehicle sales - Light-duty - gasoline (%)	90.9	87.4	85.4	83.7	81.8	79.8	78.2
Vehicle sales - Light-duty - hybrid (%)	4.06	4.93	6.05	6.62	7.22	7.85	8.38
Vehicle sales - Light-duty - hydrogen FC	0.111	0.381	0.353	0.315	0.313	0.314	0.325
(%)							
Vehicle sales - Light-duty - other (%)	0.107	0.111	0.108	0.108	0.108	0.107	0.11
Vehicle sales - Medium-duty - diesel (%)	65.2	63.5	61.6	59.6	58	56.5	55.2
Vehicle sales - Medium-duty - EV (%)	0.027	0.105	0.329	0.671	0.895	0.973	0.993
Vehicle sales - Medium-duty - gasoline (%)	34	35.5	37	38.5	39.7	40.8	41.7

Table 63: REF scenario - PILLAR 1: Efficiency/Electrification - Transportation (continued)

Item	2020	2025	2030	2035	2040	2045	2050
Vehicle sales - Medium-duty - hybrid (%)	0.365	0.427	0.496	0.577	0.674	0.793	0.929
Vehicle sales - Medium-duty - hydrogen FC (%)	0.175	0.208	0.242	0.285	0.339	0.409	0.487
Vehicle sales - Medium-duty - other (%)	0.255	0.271	0.298	0.345	0.42	0.528	0.671

Table 64: REF scenario - PILLAR 6: Land sinks - Forests

Thomas I Tho			0000	0005	00/0	00/5	0050
Item	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - High - Accelerate							-248
regeneration (1000 tC02e/y)							171//
Carbon sink potential - High - All (not							-17,146
counting overlap) (1000 tC02e/y)							0/7
Carbon sink potential - High - Avoid							-947
deforestation (1000 tC02e/y)							
Carbon sink potential - High - Extend							-427
rotation length (1000 tCO2e/y)							
Carbon sink potential - High - Improve							-46.9
plantations (1000 tCO2e/y)							
Carbon sink potential - High - Increase							-285
retention of HWP (1000 tCO2e/y)							
Carbon sink potential - High - Increase							-2,717
trees outside forests (1000 tC02e/y)							
Carbon sink potential - High - Reforest							-7,855
cropland (1000 tCO2e/y)							
Carbon sink potential - High - Reforest							-4,189
pasture (1000 tCO2e/y)							
Carbon sink potential - High - Restore							-431
productivity (1000 tCO2e/y)							
Carbon sink potential - Low - Accelerate							-124
regeneration (1000 tCO2e/y)							
Carbon sink potential - Low - All (not							-5,906
counting overlap) (1000 tCO2e/y)							
Carbon sink potential - Low - Avoid							-158
deforestation (1000 tCO2e/y)							
Carbon sink potential - Low - Extend							-164
rotation length (1000 tCO2e/y)							
Carbon sink potential - Low - Improve							-23.8
plantations (1000 tCO2e/y)							
Carbon sink potential - Low - Increase							-95
retention of HWP (1000 tCO2e/y)							
Carbon sink potential - Low - Increase							-951
trees outside forests (1000 tCO2e/y)							
Carbon sink potential - Low - Reforest							-3,928
cropland (1000 tCO2e/y)							
Carbon sink potential - Low - Reforest							-317
pasture (1000 tCO2e/y)							
Carbon sink potential - Low - Restore							-145
productivity (1000 tCO2e/y)							
Carbon sink potential - Mid - Accelerate							-186
regeneration (1000 tCO2e/y)							
Carbon sink potential - Mid - All (not							-11,526
counting overlap) (1000 tCO2e/y)							
Carbon sink potential - Mid - Avoid							-553
deforestation (1000 tCO2e/y)							
Carbon sink potential - Mid - Extend							-296
rotation length (1000 tCO2e/y)							
Carbon sink potential - Mid - Improve							-34.9
plantations (1000 tCO2e/y)							
Carbon sink potential - Mid - Increase							-190
retention of HWP (1000 tCO2e/y)							

Table 64: REF scenario - PILLAR 6: Land sinks - Forests (continued)

Table 04. KET Scenario - PILLAN O. Luna S		•	-	0005	00/0	00/5	0050
Item	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - Mid - Increase							-1,834
trees outside forests (1000 tC02e/y)							F 001
Carbon sink potential - Mid - Reforest							-5,891
cropland (1000 tCO2e/y)							0.050
Carbon sink potential - Mid - Reforest							-2,253
pasture (1000 tCO2e/y)							
Carbon sink potential - Mid - Restore							-288
productivity (1000 tCO2e/y)							
Land impacted for carbon sink potential -							40.5
High - Accelerate regeneration (1000							
hectares)							
Land impacted for carbon sink potential -							128
High - Avoid deforestation (over 30 years)							
(1000 hectares)							
Land impacted for carbon sink potential -							218
High - Extend rotation length (1000							
hectares)							
Land impacted for carbon sink potential -							17.3
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 -							258
High - Increase trees outside forests							
(1000 hectares)							
Land impacted for carbon sink potential -							519
High - Reforest cropland (1000 hectares)							
Land impacted for carbon sink potential -							119
High - Reforest pasture (1000 hectares)							
Land impacted for carbon sink potential -							143
High - Restore productivity (1000							
hectares)							
Land impacted for carbon sink potential -							1,443
High - Total impacted (over 30 years)							.,
(1000 hectares)							
Land impacted for carbon sink potential -						+	20.2
Low - Accelerate regeneration (1000							20.2
hectares)							
Land impacted for carbon sink potential -							120
Low - Avoid deforestation (over 30 years)							120
(1000 hectares)							
Land impacted for carbon sink potential -							83.4
Low - Extend rotation length (1000							00.4
hectares)							
Land impacted for carbon sink potential -							8.63
Low - Improve plantations (1000							0.00
hectares)							
Land impacted for carbon sink potential -							0
Low - Increase retention of HWP (1000							U
hectares)							
							136
Land impacted for carbon sink potential -							130
Low - Increase trees outside forests							
(1000 hectares)							0/0
Land impacted for carbon sink potential -							260
Low - Reforest cropland (1000 hectares)							
Land impacted for carbon sink potential -							20.6
Low - Reforest pasture (1000 hectares)							
Land impacted for carbon sink potential -							86.4
Low - Restore productivity (1000							
hectares)			'	1	I		

Table 64: REF scenario - PILLAR 6: Land sinks - Forests (continued)

Item	2020	2025	2030	2035	2040	2045	2050
Land impacted for carbon sink potential - Low - Total impacted (over 30 years)							735
(1000 hectares)							
Land impacted for carbon sink potential -							30.4
Mid - Accelerate regeneration (1000							
hectares)							
Land impacted for carbon sink potential -							124
Mid - Avoid deforestation (over 30 years)							
(1000 hectares)							4-4
Land impacted for carbon sink potential -							151
Mid - Extend rotation length (1000							
hectares)							13
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)							13
							0
Land impacted for carbon sink potential - Mid - Increase retention of HWP (1000							U
hectares)							
Land impacted for carbon sink potential -							197
Mid - Increase trees outside forests (1000							171
hectares)							
Land impacted for carbon sink potential -			+				390
Mid - Reforest cropland (1000 hectares)							370
Land impacted for carbon sink potential -			+				149
Mid - Reforest pasture (1000 hectares)							147
Land impacted for carbon sink potential -							174
Mid - Restore productivity (1000							
hectares)							
Land impacted for carbon sink potential -							1,228
Mid - Total impacted (over 30 years) (1000							, -
hectares)							

Table 65: 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)	-0.18		0.307				0.088
Business-as-usual carbon sink - Retained in Hardwood Products (Mt CO2e/y)	-0.078		-0.161				-0.17
Business-as-usual carbon sink - Total (Mt CO2e/y)	-0.258		0.146				-0.081

Table 66: REF scenario - IMPACTS - Health

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution -		368	190	123	96.5	83.6	81.5
Coal (million 2019\$)							
Monetary damages from air pollution -		95.6	78.3	89.6	56.8	32.9	29.7
Natural Gas (million 2019\$)							
Monetary damages from air pollution -		198	204	210	217	224	231
Transportation (million 2019\$)							
Premature deaths from air pollution -		41.6	21.4	13.9	10.9	9.45	9.2
Coal (deaths)							
Premature deaths from air pollution -		10.8	8.84	10.1	6.41	3.72	3.36
Natural Gas (deaths)							
Premature deaths from air pollution -		22.3	23	23.6	24.4	25.2	26
Transportation (deaths)							