

Net-Zero America - tennessee state report

2021-03-15

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.

Data by category and subcategory

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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 -		19,412	22,037				
Cumulative 5-yr (million \$2018)							
Sales of cooking units - Electric	43.5	55.3	83.4	88.9	89.2	89.2	89.1
Resistance (%)							
Sales of cooking units - Gas (%)	56.5	44.7	16.6	11.1	10.8	10.8	10.9
Sales of space heating units - Electric	9.56	30.6	77.3	90.8	91.9	92	92
Heat Pump (%)							
Sales of space heating units - Electric	4.81	4.61	4.92	6.26	6.57	6.58	6.55
Resistance (%)							
Sales of space heating units - Fossil (%)	0	2.83	0.549	0.023	0	0	0
Sales of space heating units - Gas Furnace	85.6	62	17.3	2.94	1.48	1.43	1.43
(%)							
Sales of water heating units - Electric	0.155	10.6	55.7	65.7	66.1	66.2	66.1
Heat Pump (%)							
Sales of water heating units - Electric	5.74	9.97	28	32.1	32.3	32.3	32.3
Resistance (%)							
Sales of water heating units - Gas Furnace	92.5	77.8	14.7	0.62	0	0	0
(%)							
Sales of water heating units - Other (%)	1.59	1.58	1.58	1.58	1.58	1.57	1.56

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

Item	2020	2025	2030	2035	2040	2045	2050
Electricity distribution capital invested -		4.81	4.94	6.83	7.17	5.85	5.99
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)	171	171	165	155	148	145	145
Final energy use - Industry (PJ)	755	838	888	904	913	905	904
Final energy use - Residential (PJ)	260	243	223	197	176	163	157
Final energy use - Transportation (PJ)	679	622	545	451	367	315	293

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

Item	2020	2025	2030	2035	2040	2045	2050
Residential HVAC investment in 2020s vs.		5.23	5.68				
REF - Cumulative 5-yr (billion \$2018)							
Sales of cooking units - Electric	83.2	86.7	97.7	99.9	100	100	100
Resistance (%)							
Sales of cooking units - Gas (%)	16.8	13.3	2.27	0.114	0	0	0
Sales of space heating units - Electric	32.2	47.8	80.2	87.5	87.8	87.7	87.7
Heat Pump (%)							
Sales of space heating units - Electric	31.3	29.8	12.5	8.63	8.46	8.57	8.59
Resistance (%)							
Sales of space heating units - Fossil (%)	4.13	4.49	1.84	1.23	1.19	1.17	1.17
Sales of space heating units - Gas (%)	32.4	17.9	5.43	2.67	2.55	2.52	2.52
Sales of water heating units - Electric	0	9.08	48.1	56.8	57.1	57.2	57.2
Heat Pump (%)							
Sales of water heating units - Electric	68.9	73.7	46.7	40.6	40.3	40.3	40.3
Resistance (%)							
Sales of water heating units - Gas Furnace	27.4	14.7	2.75	0.116	0	0	0
(%)							
Sales of water heating units - Other (%)	3.71	2.57	2.53	2.53	2.54	2.54	2.54

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

Item	2020	2025	2030	2035	2040	2045	2050
Light-duty vehicle capital costs -		1,105	2,839	4,591	6,958	7,569	7,219
Cumulative 5-yr (million \$2018)							
Public EV charging plugs - DC Fast (1000	0.165		2.15		9.36		15.1
units)							
Public EV charging plugs - L2 (1000 units)	0.888		51.7		225		363
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 (%)	1.55	1.81	1.26	0.402	0.074	0.013	0
Vehicle sales - Light-duty - EV (%)	3.92	15.2	46.5	81.8	96.3	99.3	100
Vehicle sales - Light-duty - gasoline (%)	89.9	78	48.8	16.5	3.29	0.59	0
Vehicle sales - Light-duty - hybrid (%)	4.42	4.54	3.21	1.19	0.291	0.064	0
Vehicle sales - Light-duty - hydrogen FC	0.11	0.34	0.203	0.063	0.013	0.002	0
(%)							
Vehicle sales - Light-duty - other (%)	0.102	0.098	0.064	0.022	0.004	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	0	0	0
Capital invested - Biomass w/ccu power plant (billion \$2018)	0	0	0	0	0	3.78	0
Capital invested - Solar PV - Base (billion \$2018)		0.364	0.667	1.41	2.88	6.84	11
Capital invested - Solar PV - Constrained (billion \$2018)		0.173	0	1.86	2.57	9.47	7
Capital invested - Wind - Base (billion \$2018)		0.069	0.052	0	0	0	0
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)	127	205	290	412	585	809	1,096
Installed renewables - Solar - Base land use assumptions (MW)	298	617	1,269	2,765	6,005	14,162	28,044
Installed renewables - Solar - Constrained land use assumptions (MW)	147	147	327	3,364	6,762	13,512	22,085
Installed renewables - Wind - Base land use assumptions (MW)	29	75.6	115	115	115	115	115
Installed renewables - Wind - Constrained land use assumptions (MW)	29	29	29	29	29	29	115

Table 7: E+ scenario - PILLAR 2: Clean Electricity - Generation

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

Table 7: E+ scenario - PILLAR 2: Clean Electricity - Generation (continued)

Item	2020	2025	2030	2035	2040	2045	2050
Biomass w/ccu power plant (GWh)	0	0	0	0	0	4,245	4,245
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)	538	1,056	2,116	4,533	9,759	22,749	44,773
Solar - Constrained land use assumptions	282	282	575	5,431	10,875	21,631	35,152
(GWh)							
Wind - Base land use assumptions (GWh)	106	245	361	361	361	361	361
Wind - Constrained land use assumptions	106	106	106	106	106	106	361
(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	170	170	506	506
Conversion capital investment -		0	0	3,213	0	6,799	0
Cumulative 5-yr (million \$2018)							
Number of facilities - Allam power w ccu	0	0	0	0	0	0	0
(quantity)							
Number of facilities - Beccs hydrogen	0	0	0	3	3	7	7
(quantity)							
Number of facilities - Diesel (quantity)	0	0	0	0	0	0	0
Number of facilities - Diesel ccu (quantity)	0	0	0	0	0	0	0
Number of facilities - Power (quantity)	0	0	0	0	0	0	0
Number of facilities - Power ccu	0	0	0	0	0	2	2
(quantity)							
Number of facilities - Pyrolysis (quantity)	0	0	0	0	0	0	0
Number of facilities - Pyrolysis ccu	0	0	0	0	0	0	0
(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	5.99	5.7	17.2	16.5
Annual - BECCS (MMT)		0	0	4.13	4.13	12.5	12.5
Annual - Cement and lime (MMT)		0	0	0	0	0	0
Annual - NGCC (MMT)		0	0	1.86	1.57	4.69	4.06
Cumulative - All (MMT)		0	0	5.99	11.7	28.9	45.4
Cumulative - BECCS (MMT)		0	0	4.13	8.26	20.7	33.2
Cumulative - Cement and lime (MMT)		0	0	0	0	0	0
Cumulative - NGCC (MMT)		0	0	1.86	3.43	8.12	12.2

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

Item	2020	2025	2030	2035	2040	2045	2050
All (km)		0	181	832	1,089	1,872	1,662
Cumulative investment - All (million \$2018)		0	1,110	2,685	2,984	3,656	3,492
Cumulative investment - Spur (million \$2018)		0	0	464	763	1,435	1,271
Cumulative investment - Trunk (million \$2018)		0	1,110	2,221	2,221	2,221	2,221
Spur (km)		0	0	470	727	1,511	1,301
Trunk (km)		0	181	362	362	362	362

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

Item	2020	2025	2030	2035	2040	2045	2050
CO2 storage (MMT)		0	0	0.88	1.81	2.58	3.73
Injection wells (wells)		0	1	2	4	7	8
Resource characterization, appraisal, permitting costs (million \$2020)		25.4	71.2	91.5	91.5	91.5	91.5
Wells and facilities construction costs (million \$2020)		0	16.9	66	118	197	244

Table 12: E+ scenario - PILLAR 6: Land sinks - Agriculture

Table 12: E+ Scenario - PILLAR 6: Land Sink			0000	0005	00/0	00/5	0050
Item	2020	2025	2030	2035	2040	2045	2050 -274
Carbon sink potential - Aggressive							-274
deployment - Corn-ethanol to energy							
grasses (1000 tC02e/y)							0.057
Carbon sink potential - Aggressive							-3,357
deployment - Cropland measures (1000							
tCO2e/y)							100
Carbon sink potential - Aggressive							-108
deployment - Permanent conservation							
cover (1000 tC02e/y)							0.700
Carbon sink potential - Aggressive							-3,739
deployment - Total (1000 tC02e/y)							
Carbon sink potential - Moderate							-274
deployment - Corn-ethanol to energy							
grasses (1000 tC02e/y)							
Carbon sink potential - Moderate							-1,769
deployment - Cropland measures (1000							
tCO2e/y)							
Carbon sink potential - Moderate							-54
deployment - Permanent conservation							
cover (1000 tCO2e/y)							
Carbon sink potential - Moderate							-2,097
deployment - Total (1000 tCO2e/y)							
Land impacted for carbon sink -							112
Aggressive deployment - Corn-ethanol to							
energy grasses (1000 hectares)							
Land impacted for carbon sink -							1,832
Aggressive deployment - Cropland							
measures (1000 hectares)							
Land impacted for carbon sink -							197
Aggressive deployment - Permanent							
conservation cover (1000 hectares)							
Land impacted for carbon sink -							2,141
Aggressive deployment - Total (1000							
hectares)							
Land impacted for carbon sink - Moderate							112
deployment - Corn-ethanol to energy							
grasses (1000 hectares)							
Land impacted for carbon sink - Moderate							965
deployment - Cropland measures (1000							
hectares)							
Land impacted for carbon sink - Moderate							98.3
deployment - Permanent conservation							,0.0
cover (1000 hectares)							
Land impacted for carbon sink - Moderate							1,176
deployment - Total (1000 hectares)							1,110
acproyment - rotar (1000 nectal es)							

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

Table 13: E+ scenario - PILLAR 6: Land sin	2020	2025	2030	2025	2040	2045	2050
Item Carbon sink potential - High - Accelerate	2020	2025	2030	2035	2040	2045	-116
regeneration (1000 tC02e/y)							-110
							01.077
Carbon sink potential - High - All (not							-31,364
counting overlap) (1000 tC02e/y)							0.170
Carbon sink potential - High - Avoid							-2,178
deforestation (1000 tCO2e/y)							F 700
Carbon sink potential - High - Extend							-5,783
rotation length (1000 tC02e/y)							
Carbon sink potential - High - Improve							-591
plantations (1000 tCO2e/y)							
Carbon sink potential - High - Increase							-6,834
retention of HWP (1000 tCO2e/y)							
Carbon sink potential - High - Increase							-928
trees outside forests (1000 tCO2e/y)							
Carbon sink potential - High - Reforest							-1,525
cropland (1000 tCO2e/y)							
Carbon sink potential - High - Reforest							-9,586
pasture (1000 tC02e/y)							
Carbon sink potential - High - Restore							-3,823
productivity (1000 tCO2e/y)							-,-
Carbon sink potential - Low - Accelerate							-57.9
regeneration (1000 tCO2e/y)							0
Carbon sink potential - Low - All (not							-8,323
counting overlap) (1000 tCO2e/y)							-0,525
Carbon sink potential - Low - Avoid							-363
deforestation (1000 tC02e/y)							-303
Carbon sink potential - Low - Extend							-2,221
·							-2,221
rotation length (1000 tC02e/y)							0.01
Carbon sink potential - Low - Improve							-301
plantations (1000 tC02e/y)							
Carbon sink potential - Low - Increase							-2,278
retention of HWP (1000 tCO2e/y)							
Carbon sink potential - Low - Increase							-325
trees outside forests (1000 tCO2e/y)							
Carbon sink potential - Low - Reforest							-763
cropland (1000 tCO2e/y)							
Carbon sink potential - Low - Reforest							-726
pasture (1000 tCO2e/y)							
Carbon sink potential - Low - Restore							-1,289
productivity (1000 tCO2e/y)							
Carbon sink potential - Mid - Accelerate							-86.8
regeneration (1000 tCO2e/y)							
Carbon sink potential - Mid - All (not							-19,839
counting overlap) (1000 tCO2e/y)							.,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,
Carbon sink potential - Mid - Avoid							-1,271
deforestation (1000 tC02e/y)							1,211
Carbon sink potential - Mid - Extend							-4,002
rotation length (1000 tCO2e/y)							-4,002
Carbon sink potential - Mid - Improve							-441
·							-441
plantations (1000 tCO2e/y)							, 557
Carbon sink potential - Mid - Increase							-4,556
retention of HWP (1000 tC02e/y)							
Carbon sink potential - Mid - Increase							-626
trees outside forests (1000 tC02e/y)							
Carbon sink potential - Mid - Reforest							-1,144
cropland (1000 tCO2e/y)							
Carbon sink potential - Mid - Reforest							-5,156
pasture (1000 tCO2e/y)							
Carbon sink potential - Mid - Restore							-2,556
productivity (1000 tCO2e/y)							

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

Table 13: E+ scenario - PILLAR 6: Land sink		·					
Item	2020	2025	2030	2035	2040	2045	2050
Land impacted for carbon sink potential -							18.9
High - Accelerate regeneration (1000							
hectares)							
Land impacted for carbon sink potential -							295
High - Avoid deforestation (over 30 years)							
(1000 hectares)							
Land impacted for carbon sink potential -							2,949
High - Extend rotation length (1000							
hectares)							
Land impacted for carbon sink potential -							218
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 -							88.2
High - Increase trees outside forests							
(1000 hectares)							
Land impacted for carbon sink potential -							101
High - Reforest cropland (1000 hectares)							
Land impacted for carbon sink potential -							272
High - Reforest pasture (1000 hectares)							
Land impacted for carbon sink potential -							1,267
High - Restore productivity (1000							•
hectares)							
Land impacted for carbon sink potential -							5,209
High - Total impacted (over 30 years)							,
(1000 hectares)							
Land impacted for carbon sink potential -							9.46
Low - Accelerate regeneration (1000							
hectares)							
Land impacted for carbon sink potential -	+						277
Low - Avoid deforestation (over 30 years)							
(1000 hectares)							
Land impacted for carbon sink potential -							1,130
Low - Extend rotation length (1000							1,100
hectares)							
Land impacted for carbon sink potential -							109
Low - Improve plantations (1000							107
hectares)							
Land impacted for carbon sink potential -	+						0
Low - Increase retention of HWP (1000							U
hectares)							
Land impacted for carbon sink potential -							46.4
Low - Increase trees outside forests							40.4
(1000 hectares)							
Land impacted for carbon sink potential -							50.4
							50.4
Low - Reforest cropland (1000 hectares)							47.2
Land impacted for carbon sink potential -							41.2
Low - Reforest pasture (1000 hectares)							7/7
Land impacted for carbon sink potential -							767
Low - Restore productivity (1000							
hectares)							0.10
Land impacted for carbon sink potential -							2,436
Low - Total impacted (over 30 years)							
(1000 hectares)							
Land impacted for carbon sink potential -							14.2
Mid - Accelerate regeneration (1000							
hectares)	I .						

Table 13: E+	econario -	DTIIAP 6.	I and cinke -	Enrocte	(continued)
1aule 15: <i>E+</i>	SCEHUITO -	PILLAR O:	LUIIU SIIIKS -	FULESTS	COMUNICEUM

286
200
039
164
0
67.3
' 5.6
341
544
532

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

Item	2020	2025	2030	2035	2040	2045	2050
Natural gas consumption - Annual (tcf)		303	256	205	154	97.1	67.4
Natural gas consumption - Cumulative							6,175
(tcf)							
Natural gas production - Annual (tcf)		4.04	3.82	3.33	2.81	2.23	1.73
Oil consumption - Annual (million bbls)		123	105	78.9	54.7	35.5	20.6
Oil consumption - Cumulative (million							2,449
bbls)							
Oil production - Annual (million bbls)		0.272	0.273	0.273	0.216	0.176	0.117

Table 15: E+ scenario - IMPACTS - Health

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal (million 2019\$)		678	0.89	0.865	0.635	0.43	0.035
Monetary damages from air pollution - Natural Gas (million 2019\$)		231	165	93.7	75.4	30.8	12.1
Monetary damages from air pollution - Transportation (million 2019\$)		1,540	1,435	1,091	632	291	118
Premature deaths from air pollution - Coal (deaths)		76.6	0.101	0.098	0.072	0.049	0.004
Premature deaths from air pollution - Natural Gas (deaths)		26.1	18.6	10.6	8.51	3.48	1.37
Premature deaths from air pollution - Transportation (deaths)		173	161	123	71.1	32.7	13.3

Table 16: E+ scenario - IMPACTS - Jobs

Item	2020	2025	2030	2035	2040	2045	2050
By economic sector - Agriculture (jobs)		446	511	765	539	791	630
By economic sector - Construction (jobs)		4,928	5,282	6,728	7,188	9,183	13,635
By economic sector - Manufacturing		8,493	10,165	13,466	12,832	10,500	13,560
(jobs)							
By economic sector - Mining (jobs)		2,237	1,603	1,043	637	388	238

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

Table 16: E+ scenario - IMPACTS - Jobs (co	ntinueaj						
Item	2020	2025	2030	2035	2040	2045	2050
By economic sector - Other (jobs)		336	393	622	971	1,757	3,311
By economic sector - Pipeline (jobs)		452	517	487	296	258	237
By economic sector - Professional (jobs)		2,680	2,460	3,173	3,387	4,784	6,907
By economic sector - Trade (jobs)		2,315	2,009	2,093	2,174	2,915	4,617
By economic sector - Utilities (jobs)		7,809	7,736	9,463	8,714	7,834	9,365
By education level - All sectors -		9,090	9,483	11,834	11,609	12,123	16,800
Associates degree or some college (jobs)							
By education level - All sectors -		6,373	6,380	7,650	7,345	7,571	10,227
Bachelors degree (jobs)							
By education level - All sectors - Doctoral		185	175	206	205	247	344
degree (jobs)							
By education level - All sectors - High		12,589	13,206	16,436	15,922	16,684	22,696
school diploma or less (jobs)							
By education level - All sectors - Masters		1,460	1,431	1,713	1,658	1,786	2,433
or professional degree (jobs)							
By resource sector - Biomass (jobs)		1,166	1,223	1,948	1,486	2,903	2,752
By resource sector - CO2 (jobs)		13.5	1,134	1,618	735	1,111	1,373
By resource sector - Coal (jobs)		519	20.5	17.8	15.6	14.1	12.5
By resource sector - Grid (jobs)		8,096	8,072	11,427	11,624	12,058	15,882
By resource sector - Natural Gas (jobs)		4,373	3,586	3,247	2,992	1,666	1,554
By resource sector - Nuclear (jobs)		2,514	2,474	2,435	1,914	956	349
By resource sector - Oil (jobs)		5,546	4,342	3,023	1,949	1,189	650
By resource sector - Solar (jobs)		4,257	5,307	8,129	10,534	14,614	25,062
By resource sector - Wind (jobs)		3,212	4,519	5,995	5,488	3,900	4,864
Median wages - Annual - All (\$2019 per		55,958	55,914	55,961	56,362	56,704	56,970
iob)		00,100		55,151	00,000		22/112
On-Site or In-Plant Training - Total jobs - 1		4,704	4,882	6,048	5,908	6,169	8,492
to 4 years (jobs)		.,	,,,,,	7,5 1.5	5,7.55	-,,,,,	-,
On-Site or In-Plant Training - Total jobs - 4		1,750	1,779	2,182	2,152	2,370	3,310
to 10 years (jobs)		,,,,,,	,,,,,	_,	_,	_,	5,515
On-Site or In-Plant Training - Total jobs -		4,817	4,982	6,159	6,000	6,318	8,666
None (jobs)		.,	.,	-,	,,,,,	,,,,,	5,555
On-Site or In-Plant Training - Total jobs -		237	247	311	305	323	448
Over 10 years (jobs)				J		020	
On-Site or In-Plant Training - Total jobs -		18,189	18,786	23,139	22,373	23,231	31,585
Up to 1 year (jobs)		.07.07	.57.55	20,.07	,	20,201	0.,000
On-the-Job Training - All sectors - 1 to 4		6,004	6,226	7,715	7,545	7,885	10,868
years (jobs)		0,001	0,220	1,1.10	.,0 .0	1,000	10,000
On-the-Job Training - All sectors - 4 to 10		1,653	1,689	2,093	2,083	2,328	3,281
years (jobs)		1,000	1,007	2,070	2,000	2,020	0,20.
On-the-Job Training - All sectors - None		1,614	1,643	1,994	1,944	2,077	2,876
(jobs)		1,014	1,040	1,774	1,7-1-1	2,011	2,010
On-the-Job Training - All sectors - Over 10		301	321	399	389	394	542
years (jobs)		001	021	377	007	074	042
On-the-Job Training - All sectors - Up to 1		20,125	20,797	25,639	24,778	25,726	34,932
year (jobs)		20,123	20,171	25,057	24,110	25,120	34,732
Related work experience - All sectors - 1		10,664	10,940	13,433	13,036	13,630	18,607
to 4 years (jobs)		10,004	10,740	10,400	13,030	13,030	10,001
Related work experience - All sectors - 4		6,833	7,017	8,616	8,377	8,719	11,940
to 10 years (jobs)		0,033	1,011	0,010	0,311	0,117	11,740
Related work experience - All sectors -		4,244	4,394	5,438	5,279	5,574	7,638
None (jobs)		4,244	4,374	5,450	0,217	5,514	1,030
Related work experience - All sectors -		1,936	2,007	0 /. / 7	2,384	0.207	3,245
		1,736	۷,001	2,467	2,384	2,396	3,245
Over 10 years (jobs) Related work experience - All sectors - Up		6,019	6,318	7,885	74/0	8,093	11,071
		0,019	0,318	1,085	7,662	0,093	11,071
to 1 year (jobs) Wage income - All (million \$2019)		1,662	1 715	2,118	0.071	0 170	2,991
vvage income - An (million \$2017)		1,002	1,715	۷,۱۱۵	2,071	2,178	۷,۶۶۱

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

Item	2020	2025	2030	2035	2040	2045	2050
Commercial HVAC investment in 2020s -		19,401	22,003				
Cumulative 5-yr (million \$2018)							
Sales of cooking units - Electric	43.5	47.1	51.3	61.6	76.1	85	88
Resistance (%)							
Sales of cooking units - Gas (%)	56.5	52.9	48.7	38.4	23.9	15	12
Sales of space heating units - Electric	9.56	21.7	26.9	42.4	66.6	83.3	89.7
Heat Pump (%)							
Sales of space heating units - Electric	4.81	4.61	4.65	4.78	5.23	5.91	6.33
Resistance (%)							
Sales of space heating units - Fossil (%)	0	3.27	3.09	2.34	1.17	0.379	0.099
Sales of space heating units - Gas Furnace	85.6	70.4	65.3	50.5	27	10.4	3.89
(%)							
Sales of water heating units - Electric	0.155	1.96	7.08	21.8	44.4	59.2	64.3
Heat Pump (%)							
Sales of water heating units - Electric	5.74	6.48	8.39	14.4	23.5	29.5	31.6
Resistance (%)							
Sales of water heating units - Gas Furnace	92.5	90	83	62.2	30.4	9.74	2.53
(%)							
Sales of water heating units - Other (%)	1.59	1.58	1.58	1.58	1.58	1.57	1.56

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

Item	2020	2025	2030	2035	2040	2045	2050
Electricity distribution capital invested -		4.14	4.18	4.77	4.88	5.83	6.04
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)	171	171	169	166	161	156	153
Final energy use - Industry (PJ)	755	838	889	910	921	912	909
Final energy use - Residential (PJ)	260	244	232	219	204	187	173
Final energy use - Transportation (PJ)	680	628	570	525	490	449	400

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

Item	2020	2025	2030	2035	2040	2045	2050
Residential HVAC investment in 2020s vs.		5.17	5.41				
REF - Cumulative 5-yr (billion \$2018)							
Sales of cooking units - Electric	83.1	83.5	85.1	89.2	94.8	98.3	99.6
Resistance (%)							
Sales of cooking units - Gas (%)	16.9	16.5	14.9	10.8	5.17	1.67	0.449
Sales of space heating units - Electric	32.2	41.6	45.3	56	72.3	82.8	86.5
Heat Pump (%)							
Sales of space heating units - Electric	31.3	33.1	31	25.2	16.6	11.1	9.21
Resistance (%)							
Sales of space heating units - Fossil (%)	4.13	5	4.74	3.81	2.44	1.57	1.28
Sales of space heating units - Gas (%)	32.4	20.3	18.9	14.9	8.67	4.49	3.04
Sales of water heating units - Electric	0	1.56	6	18.8	38.4	51.1	55.6
Heat Pump (%)							
Sales of water heating units - Electric	68.9	78.9	75.9	67	53.3	44.5	41.4
Resistance (%)							
Sales of water heating units - Gas Furnace	27.4	17	15.5	11.7	5.76	1.83	0.477
(%)							
Sales of water heating units - Other (%)	3.71	2.57	2.54	2.55	2.56	2.54	2.54

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

Item	2020	2025	2030	2035	2040	2045	2050
Light-duty vehicle capital costs -		0	180	376	1,271	3,991	5,817
Cumulative 5-yr (million \$2018)							
Public EV charging plugs - DC Fast (1000	0.165		0.677		3.48		9.69
units)							
Public EV charging plugs - L2 (1000 units)	0.888		16.3		83.7		233
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 (%)	1.56	1.97	2.06	1.64	1.05	0.537	0.23
Vehicle sales - Light-duty - EV (%)	1.89	4.68	11.9	25.9	48.4	72	87.6
Vehicle sales - Light-duty - gasoline (%)	91.7	87.5	79.6	66.7	46.2	24.9	11
Vehicle sales - Light-duty - hybrid (%)	4.59	5.39	6.05	5.51	4.13	2.44	1.18
Vehicle sales - Light-duty - hydrogen FC	0.113	0.38	0.326	0.249	0.177	0.098	0.046
(%)							
Vehicle sales - Light-duty - other (%)	0.103	0.106	0.097	0.084	0.061	0.033	0.015
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							-274
deployment - Corn-ethanol to energy							
grasses (1000 tCO2e/y)							
Carbon sink potential - Aggressive							-3,357
deployment - Cropland measures (1000							
tCO2e/y)							
Carbon sink potential - Aggressive							-108
deployment - Permanent conservation							
cover (1000 tCO2e/y)							
Carbon sink potential - Aggressive							-3,739
deployment - Total (1000 tCO2e/y)							
Carbon sink potential - Moderate							-274
deployment - Corn-ethanol to energy							
grasses (1000 tCO2e/y)							
Carbon sink potential - Moderate							-1,769
deployment - Cropland measures (1000							
tCO2e/y)							
Carbon sink potential - Moderate							-54
deployment - Permanent conservation							
cover (1000 tC02e/y)							
Carbon sink potential - Moderate							-2,097
deployment - Total (1000 tCO2e/y)							
Land impacted for carbon sink -							112
Aggressive deployment - Corn-ethanol to							
energy grasses (1000 hectares)							
Land impacted for carbon sink -							1,832
Aggressive deployment - Cropland							
measures (1000 hectares)							
Land impacted for carbon sink -							197
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 -							2,141
Aggressive deployment - Total (1000							
hectares)							
Land impacted for carbon sink - Moderate							112
deployment - Corn-ethanol to energy							
grasses (1000 hectares)							
Land impacted for carbon sink - Moderate							965
deployment - Cropland measures (1000							
hectares)							
Land impacted for carbon sink - Moderate							98.3
deployment - Permanent conservation							
cover (1000 hectares)							
Land impacted for carbon sink - Moderate							1,176
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							-116
regeneration (1000 tCO2e/y)							
Carbon sink potential - High - All (not							-31,364
counting overlap) (1000 tCO2e/y)							
Carbon sink potential - High - Avoid							-2,178
deforestation (1000 tCO2e/y)							
Carbon sink potential - High - Extend							-5,783
rotation length (1000 tCO2e/y)							
Carbon sink potential - High - Improve							-591
plantations (1000 tCO2e/y)							
Carbon sink potential - High - Increase							-6,834
retention of HWP (1000 tCO2e/y)							
Carbon sink potential - High - Increase							-928
trees outside forests (1000 tCO2e/y)							
Carbon sink potential - High - Reforest							-1,525
cropland (1000 tCO2e/y)							
Carbon sink potential - High - Reforest							-9,586
pasture (1000 tC02e/y)							
Carbon sink potential - High - Restore							-3,823
productivity (1000 tCO2e/y)							
Carbon sink potential - Low - Accelerate							-57.9
regeneration (1000 tCO2e/y)							
Carbon sink potential - Low - All (not							-8,323
counting overlap) (1000 tCO2e/y)							
Carbon sink potential - Low - Avoid							-363
deforestation (1000 tCO2e/y)							
Carbon sink potential - Low - Extend							-2,221
rotation length (1000 tCO2e/y)							
Carbon sink potential - Low - Improve							-301
plantations (1000 tCO2e/y)							
Carbon sink potential - Low - Increase							-2,278
retention of HWP (1000 tC02e/y)							
Carbon sink potential - Low - Increase							-325
trees outside forests (1000 tC02e/y)							
Carbon sink potential - Low - Reforest							-763
cropland (1000 tCO2e/y)							
Carbon sink potential - Low - Reforest							-726
pasture (1000 tC02e/y)							
Carbon sink potential - Low - Restore							-1,289
productivity (1000 tCO2e/y)							.,=0,
Carbon sink potential - Mid - Accelerate		+					-86.8
regeneration (1000 tCO2e/y)							00.0

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

Item Carbon sink potential - Mid - All (not	2020	2025	2030	2035	2040	2045	2050 -19,839
counting overlap) (1000 tCO2e/y)							•
Carbon sink potential - Mid - Avoid							-1,271
deforestation (1000 tC02e/y)							/ 000
Carbon sink potential - Mid - Extend rotation length (1000 tCO2e/y)							-4,002
Carbon sink potential - Mid - Improve							-441
plantations (1000 tCO2e/y)							
Carbon sink potential - Mid - Increase							-4,556
retention of HWP (1000 tCO2e/y)							
Carbon sink potential - Mid - Increase							-626
trees outside forests (1000 tC02e/y)							11//
Carbon sink potential - Mid - Reforest cropland (1000 tCO2e/y)							-1,144
Carbon sink potential - Mid - Reforest							-5,156
pasture (1000 tC02e/y)							0,100
Carbon sink potential - Mid - Restore							-2,556
productivity (1000 tCO2e/y)							
Land impacted for carbon sink potential -							18.9
High - Accelerate regeneration (1000							
hectares)							005
Land impacted for carbon sink potential - High - Avoid deforestation (over 30 years)							295
(1000 hectares)							
Land impacted for carbon sink potential -							2,949
High - Extend rotation length (1000							·
hectares)							
Land impacted for carbon sink potential -							218
High - Improve plantations (1000							
hectares) Land impacted for carbon sink potential -							0
High - Increase retention of HWP (1000							U
hectares)							
Land impacted for carbon sink potential -							88.2
High - Increase trees outside forests							
(1000 hectares)							
Land impacted for carbon sink potential -							101
High - Reforest cropland (1000 hectares) Land impacted for carbon sink potential -							272
High - Reforest pasture (1000 hectares)							212
Land impacted for carbon sink potential -							1,267
High - Restore productivity (1000							.,
hectares)							
Land impacted for carbon sink potential -							5,209
High - Total impacted (over 30 years)							
(1000 hectares) Land impacted for carbon sink potential -							0.77
Low - Accelerate regeneration (1000							9.46
hectares)							
Land impacted for carbon sink potential -							277
Low - Avoid deforestation (over 30 years)							
(1000 hectares)							
Land impacted for carbon sink potential -							1,130
Low - Extend rotation length (1000							
hectares) Land impacted for carbon sink potential -						+	109
Low - Improve plantations (1000							109
hectares)							
Land impacted for carbon sink potential -							0
Low - Increase retention of HWP (1000							
hectares)							

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

Item	2020	2025	2030	2035	2040	2045	2050
Land impacted for carbon sink potential -							46.4
Low - Increase trees outside forests							
(1000 hectares)							
Land impacted for carbon sink potential -							50.4
Low - Reforest cropland (1000 hectares)							
Land impacted for carbon sink potential -							47.2
Low - Reforest pasture (1000 hectares)							
Land impacted for carbon sink potential -							767
Low - Restore productivity (1000							
hectares)							
Land impacted for carbon sink potential -							2,436
Low - Total impacted (over 30 years)							
(1000 hectares)							
Land impacted for carbon sink potential -							14.2
Mid - Accelerate regeneration (1000							
hectares)							
Land impacted for carbon sink potential -							286
Mid - Avoid deforestation (over 30 years)							
(1000 hectares)							
Land impacted for carbon sink potential -							2,039
Mid - Extend rotation length (1000							
hectares)							
Land impacted for carbon sink potential -							164
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 -							67.3
Mid - Increase trees outside forests (1000							
hectares)							
Land impacted for carbon sink potential -							75.6
Mid - Reforest cropland (1000 hectares)							
Land impacted for carbon sink potential -							341
Mid - Reforest pasture (1000 hectares)							
Land impacted for carbon sink potential -							1,544
Mid - Restore productivity (1000							•
hectares)							
Land impacted for carbon sink potential -							4,532
Mid - Total impacted (over 30 years) (1000							
hectares)							

Table 24: E- scenario - IMPACTS - Health

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal (million 2019\$)		678	0.89	0.865	0.635	0.43	0.035
Monetary damages from air pollution - Natural Gas (million 2019\$)		175	109	45	18.5	6.58	4.21
Monetary damages from air pollution - Transportation (million 2019\$)		1,565	1,579	1,538	1,387	1,106	761
Premature deaths from air pollution - Coal (deaths)		76.6	0.101	0.098	0.072	0.049	0.004
Premature deaths from air pollution - Natural Gas (deaths)		19.8	12.3	5.08	2.09	0.743	0.475
Premature deaths from air pollution - Transportation (deaths)		176	178	173	156	124	85.5

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

Item	2020	2025	2030	2035	2040	2045	2050
Commercial HVAC investment in 2020s -		19,412	22,037				
Cumulative 5-yr (million \$2018)							
Sales of cooking units - Electric	43.5	55.3	83.4	88.9	89.2	89.2	89.1
Resistance (%)							
Sales of cooking units - Gas (%)	56.5	44.7	16.6	11.1	10.8	10.8	10.9
Sales of space heating units - Electric	9.56	30.6	77.3	90.8	91.9	92	92
Heat Pump (%)							
Sales of space heating units - Electric	4.81	4.61	4.92	6.26	6.57	6.58	6.55
Resistance (%)							
Sales of space heating units - Fossil (%)	0	2.83	0.549	0.023	0	0	0
Sales of space heating units - Gas Furnace	85.6	62	17.3	2.94	1.48	1.43	1.43
(%)							
Sales of water heating units - Electric	0.155	10.6	55.7	65.7	66.1	66.2	66.1
Heat Pump (%)							
Sales of water heating units - Electric	5.74	9.97	28	32.1	32.3	32.3	32.3
Resistance (%)							
Sales of water heating units - Gas Furnace	92.5	77.8	14.7	0.62	0	0	0
(%)							
Sales of water heating units - Other (%)	1.59	1.58	1.58	1.58	1.58	1.57	1.56

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

Item	2020	2025	2030	2035	2040	2045	2050
Electricity distribution capital invested -		4.81	4.94	6.83	7.17	5.85	5.99
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)	171	171	165	155	148	145	145
Final energy use - Industry (PJ)	755	838	888	904	913	905	904
Final energy use - Residential (PJ)	260	243	223	197	176	163	157
Final energy use - Transportation (PJ)	679	622	545	451	367	315	293

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

Item	2020	2025	2030	2035	2040	2045	2050
Residential HVAC investment in 2020s vs.		5.23	5.68				
REF - Cumulative 5-yr (billion \$2018)							
Sales of cooking units - Electric	83.2	86.7	97.7	99.9	100	100	100
Resistance (%)							
Sales of cooking units - Gas (%)	16.8	13.3	2.27	0.114	0	0	0
Sales of space heating units - Electric	32.2	47.8	80.2	87.5	87.8	87.7	87.7
Heat Pump (%)							
Sales of space heating units - Electric	31.3	29.8	12.5	8.63	8.46	8.57	8.59
Resistance (%)							
Sales of space heating units - Fossil (%)	4.13	4.49	1.84	1.23	1.19	1.17	1.17
Sales of space heating units - Gas (%)	32.4	17.9	5.43	2.67	2.55	2.52	2.52
Sales of water heating units - Electric	0	9.08	48.1	56.8	57.1	57.2	57.2
Heat Pump (%)							
Sales of water heating units - Electric	68.9	73.7	46.7	40.6	40.3	40.3	40.3
Resistance (%)							
Sales of water heating units - Gas Furnace	27.4	14.7	2.75	0.116	0	0	0
(%)							
Sales of water heating units - Other (%)	3.71	2.57	2.53	2.53	2.54	2.54	2.54

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

Item	2020	2025	2030	2035	2040	2045	2050
Light-duty vehicle capital costs -		1,105	2,839	4,591	6,958	7,569	7,219
Cumulative 5-yr (million \$2018)							
Public EV charging plugs - DC Fast (1000	0.165		2.15		9.36		15.1
units)							
Public EV charging plugs - L2 (1000 units)	0.888		51.7		225		363
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 (%)	1.55	1.81	1.26	0.402	0.074	0.013	0
Vehicle sales - Light-duty - EV (%)	3.92	15.2	46.5	81.8	96.3	99.3	100
Vehicle sales - Light-duty - gasoline (%)	89.9	78	48.8	16.5	3.29	0.59	0
Vehicle sales - Light-duty - hybrid (%)	4.42	4.54	3.21	1.19	0.291	0.064	0
Vehicle sales - Light-duty - hydrogen FC	0.11	0.34	0.203	0.063	0.013	0.002	0
(%)							
Vehicle sales - Light-duty - other (%)	0.102	0.098	0.064	0.022	0.004	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	1.82	5.34	15	16.4	37.2
\$2018)							
Capital invested - Wind - Base (billion		0.069	0.052	0	0	0	0
\$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	186	186	1,963	7,633	24,486	44,027	91,097
use assumptions (MW)							
Installed renewables - Solar -	551	551	2,531	13,579	41,479	80,336	155,216
Constrained land use assumptions (MW)							
Installed renewables - Wind - Base land	29	75.6	115	115	115	115	115
use assumptions (MW)							
Installed renewables - Wind - Constrained	58	58	58	58	58	58	229
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 assumptions (GWh)	0	0	0	0	0	0	0
Solar - Base land use assumptions (GWh)	355	355	3,227	12,251	39,100	70,108	144,501
Solar - Constrained land use assumptions (GWh)	1,002	1,002	4,184	21,860	66,347	127,856	246,439
Wind - Base land use assumptions (GWh)	106	245	361	361	361	361	361
Wind - Constrained land use assumptions (GWh)	212	212	212	212	212	212	721

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

Item	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - Aggressive							-274
deployment - Corn-ethanol to energy							
grasses (1000 tC02e/y)							
Carbon sink potential - Aggressive							-3,357
deployment - Cropland measures (1000							
tCO2e/y)							
Carbon sink potential - Aggressive							-108
deployment - Permanent conservation							
cover (1000 tC02e/y)							
Carbon sink potential - Aggressive							-3,739
deployment - Total (1000 tC02e/y)							
Carbon sink potential - Moderate							-274
deployment - Corn-ethanol to energy							
grasses (1000 tCO2e/y)							
Carbon sink potential - Moderate							-1,769
deployment - Cropland measures (1000							
tCO2e/y)							
Carbon sink potential - Moderate							-54
deployment - Permanent conservation							
cover (1000 tC02e/y)							
Carbon sink potential - Moderate							-2,097
deployment - Total (1000 tC02e/y)							
Land impacted for carbon sink -							112
Aggressive deployment - Corn-ethanol to							
energy grasses (1000 hectares)							
Land impacted for carbon sink -							1,832
Aggressive deployment - Cropland							•
measures (1000 hectares)							
Land impacted for carbon sink -							197
Aggressive deployment - Permanent							
conservation cover (1000 hectares)							
Land impacted for carbon sink -							2,141
Aggressive deployment - Total (1000							_,
hectares)							
Land impacted for carbon sink - Moderate							112
deployment - Corn-ethanol to energy							112
grasses (1000 hectares)							
Land impacted for carbon sink - Moderate							965
deployment - Cropland measures (1000							700
hectares)							
Land impacted for carbon sink - Moderate							98.3
deployment - Permanent conservation							70.0
cover (1000 hectares)							
Land impacted for carbon sink - Moderate							1,176
deployment - Total (1000 hectares)							1,170
deployment - rotal (1000 nectal es)							

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

Item	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - High - Accelerate							-116
regeneration (1000 tCO2e/y)							
Carbon sink potential - High - All (not							-31,364
counting overlap) (1000 tCO2e/y)							
Carbon sink potential - High - Avoid							-2,178
deforestation (1000 tCO2e/y)							
Carbon sink potential - High - Extend							-5,783
rotation length (1000 tCO2e/y)							
Carbon sink potential - High - Improve							-591
plantations (1000 tCO2e/y)							
Carbon sink potential - High - Increase							-6,834
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							-928
trees outside forests (1000 tCO2e/y)							
Carbon sink potential - High - Reforest cropland (1000 tCO2e/y)							-1,525
Carbon sink potential - High - Reforest pasture (1000 tC02e/y)							-9,586
Carbon sink potential - High - Restore productivity (1000 tC02e/y)							-3,823
Carbon sink potential - Low - Accelerate							-57.9
regeneration (1000 tCO2e/y) Carbon sink potential - Low - All (not							-8,323
counting overlap) (1000 tCO2e/y) Carbon sink potential - Low - Avoid							-363
deforestation (1000 tCO2e/y)							
Carbon sink potential - Low - Extend rotation length (1000 tCO2e/y)							-2,221
Carbon sink potential - Low - Improve plantations (1000 tCO2e/y)							-301
Carbon sink potential - Low - Increase							-2,278
retention of HWP (1000 tC02e/y)							205
Carbon sink potential - Low - Increase trees outside forests (1000 tC02e/y)							-325
Carbon sink potential - Low - Reforest							-763
cropland (1000 tCO2e/y)							70/
Carbon sink potential - Low - Reforest pasture (1000 tCO2e/y)							-726
Carbon sink potential - Low - Restore							-1,289
productivity (1000 tCO2e/y) Carbon sink potential - Mid - Accelerate							-86.8
regeneration (1000 tCO2e/y)							-00.0
Carbon sink potential - Mid - All (not counting overlap) (1000 tC02e/y)							-19,839
Carbon sink potential - Mid - Avoid deforestation (1000 tCO2e/y)							-1,271
Carbon sink potential - Mid - Extend							-4,002
rotation length (1000 tCO2e/y) Carbon sink potential - Mid - Improve							-441
plantations (1000 tCO2e/y)							
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO2e/y)							-4,556
Carbon sink potential - Mid - Increase trees outside forests (1000 tC02e/y)							-626
Carbon sink potential - Mid - Reforest cropland (1000 tCO2e/y)							-1,144
Carbon sink potential - Mid - Reforest							-5,156
pasture (1000 tCO2e/y) Carbon sink potential - Mid - Restore							-2,556
productivity (1000 tCO2e/y) Land impacted for carbon sink potential -							18.9
High - Accelerate regeneration (1000							10.7
hectares) Land impacted for carbon sink potential -							295
High - Avoid deforestation (over 30 years)							290
(1000 hectares)	+						2,949
Land impacted for carbon sink potential - High - Extend rotation length (1000							2,949
hectares) Land impacted for carbon sink potential -							218
High - Improve plantations (1000 hectares)							210

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

Item Land impacted for carbon sink potential -	2020	2025	2030	2035	2040	2045	2050 0
High - Increase retention of HWP (1000							U
hectares)							
Land impacted for carbon sink potential -							88.2
High - Increase trees outside forests							
(1000 hectares)							101
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)							101
Land impacted for carbon sink potential -							272
High - Reforest pasture (1000 hectares)							212
Land impacted for carbon sink potential -							1,267
High - Restore productivity (1000							1,201
hectares)							
Land impacted for carbon sink potential -							5,209
High - Total impacted (over 30 years)							
(1000 hectares)							
Land impacted for carbon sink potential -							9.46
Low - Accelerate regeneration (1000							
hectares)							
Land impacted for carbon sink potential -							277
Low - Avoid deforestation (over 30 years)							
(1000 hectares)							4400
Land impacted for carbon sink potential -							1,130
Low - Extend rotation length (1000							
hectares) Land impacted for carbon sink potential -							109
Low - Improve plantations (1000							107
hectares)							
Land impacted for carbon sink potential -							0
Low - Increase retention of HWP (1000							Ū
hectares)							
Land impacted for carbon sink potential -							46.4
Low - Increase trees outside forests							
(1000 hectares)							
Land impacted for carbon sink potential -							50.4
Low - Reforest cropland (1000 hectares)							
Land impacted for carbon sink potential -							47.2
Low - Reforest pasture (1000 hectares)							
Land impacted for carbon sink potential -							767
Low - Restore productivity (1000							
hectares)							0 / 0 /
Land impacted for carbon sink potential - Low - Total impacted (over 30 years)							2,436
(1000 hectares)							
Land impacted for carbon sink potential -							14.2
Mid - Accelerate regeneration (1000							14.2
hectares)							
Land impacted for carbon sink potential -							286
Mid - Avoid deforestation (over 30 years)							
(1000 hectares)							
Land impacted for carbon sink potential -							2,039
Mid - Extend rotation length (1000							
hectares)							
Land impacted for carbon sink potential -							164
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 -							67.3
Mid - Increase trees outside forests (1000							
hectares)							

Table 33: E+RE+	. cronaria -	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 -							75.6
Mid - Reforest cropland (1000 hectares)							
Land impacted for carbon sink potential -							341
Mid - Reforest pasture (1000 hectares)							
Land impacted for carbon sink potential -							1,544
Mid - Restore productivity (1000							
hectares)							
Land impacted for carbon sink potential -							4,532
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 -		678	0.89	0.865	0.635	0.43	0.035
Coal (million 2019\$)							
Monetary damages from air pollution -		188	134	70	43.8	12.3	4.63
Natural Gas (million 2019\$)							
Monetary damages from air pollution -		1,540	1,435	1,091	632	291	118
Transportation (million 2019\$)							
Premature deaths from air pollution -		76.6	0.101	0.098	0.072	0.049	0.004
Coal (deaths)							
Premature deaths from air pollution -		21.2	15.1	7.9	4.95	1.39	0.523
Natural Gas (deaths)							
Premature deaths from air pollution -		173	161	123	71.1	32.7	13.3
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 -		19,412	22,037				
Cumulative 5-yr (million \$2018)							
Sales of cooking units - Electric	43.5	55.3	83.4	88.9	89.2	89.2	89.1
Resistance (%)							
Sales of cooking units - Gas (%)	56.5	44.7	16.6	11.1	10.8	10.8	10.9
Sales of space heating units - Electric	9.56	30.6	77.3	90.8	91.9	92	92
Heat Pump (%)							
Sales of space heating units - Electric	4.81	4.61	4.92	6.26	6.57	6.58	6.55
Resistance (%)							
Sales of space heating units - Fossil (%)	0	2.83	0.549	0.023	0	0	0
Sales of space heating units - Gas Furnace	85.6	62	17.3	2.94	1.48	1.43	1.43
(%)							
Sales of water heating units - Electric	0.155	10.6	55.7	65.7	66.1	66.2	66.1
Heat Pump (%)							
Sales of water heating units - Electric	5.74	9.97	28	32.1	32.3	32.3	32.3
Resistance (%)							
Sales of water heating units - Gas Furnace	92.5	77.8	14.7	0.62	0	0	0
(%)							
Sales of water heating units - Other (%)	1.59	1.58	1.58	1.58	1.58	1.57	1.56

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

Item	2020	2025	2030	2035	2040	2045	2050
Electricity distribution capital invested -		4.81	4.94	6.83	7.17	5.85	5.99
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)	171	171	165	155	148	145	145

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

• •	-	•	•	-			
Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Industry (PJ)	755	838	888	904	913	905	904
Final energy use - Residential (PJ)	260	243	223	197	176	163	157
Final energy use - Transportation (PJ)	679	622	545	451	367	315	293

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

Item	2020	2025	2030	2035	2040	2045	2050
Residential HVAC investment in 2020s vs.		5.23	5.68				
REF - Cumulative 5-yr (billion \$2018)							
Sales of cooking units - Electric	83.2	86.7	97.7	99.9	100	100	100
Resistance (%)							
Sales of cooking units - Gas (%)	16.8	13.3	2.27	0.114	0	0	0
Sales of space heating units - Electric	32.2	47.8	80.2	87.5	87.8	87.7	87.7
Heat Pump (%)							
Sales of space heating units - Electric	31.3	29.8	12.5	8.63	8.46	8.57	8.59
Resistance (%)							
Sales of space heating units - Fossil (%)	4.13	4.49	1.84	1.23	1.19	1.17	1.17
Sales of space heating units - Gas (%)	32.4	17.9	5.43	2.67	2.55	2.52	2.52
Sales of water heating units - Electric	0	9.08	48.1	56.8	57.1	57.2	57.2
Heat Pump (%)							
Sales of water heating units - Electric	68.9	73.7	46.7	40.6	40.3	40.3	40.3
Resistance (%)							
Sales of water heating units - Gas Furnace	27.4	14.7	2.75	0.116	0	0	0
(%)							
Sales of water heating units - Other (%)	3.71	2.57	2.53	2.53	2.54	2.54	2.54

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

2020	2025	2030	2035	2040	2045	2050
	1,105	2,839	4,591	6,958	7,569	7,219
0.165		2.15		9.36		15.1
0.888		51.7		225		363
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
1.55	1.81	1.26	0.402	0.074	0.013	0
3.92	15.2	46.5	81.8	96.3	99.3	100
89.9	78	48.8	16.5	3.29	0.59	0
4.42	4.54	3.21	1.19	0.291	0.064	0
0.11	0.34	0.203	0.063	0.013	0.002	0
0.102	0.098	0.064	0.022	0.004	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
	0.165 0.888 97.2 0.588 0.227 0.082 0.392 1.5 1.55 3.92 89.9 4.42 0.11 0.102 64.7 0.784 33.7 0.363 0.196	0.165 0.888 97.2 92.1 0.588 3.81 0.227 0.082 0.09 0.392 2.54 1.5 1.55 1.81 3.92 15.2 89.9 4.42 4.54 0.11 0.34 0.102 0.098 64.7 59.7 0.784 5.07 33.7 33.3 0.363 0.402 0.196 1.27	0.165 2,839 0.165 2.15 0.888 51.7 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 1.55 1.81 1.26 3.92 15.2 46.5 89.9 78 48.8 4.42 4.54 3.21 0.11 0.34 0.203 0.102 0.098 0.064 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	1,105 2,839 4,591 0.165 2.15 0.888 51.7 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 1.55 1.81 1.26 0.402 3.92 15.2 46.5 81.8 89.9 78 48.8 16.5 4.42 4.54 3.21 1.19 0.11 0.34 0.203 0.063 0.102 0.098 0.064 0.022 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	1,105 2,839 4,591 6,958 0.165 2.15 9.36 0.888 51.7 225 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 1.55 1.81 1.26 0.402 0.074 3.92 15.2 46.5 81.8 96.3 89.9 78 48.8 16.5 3.29 4.42 4.54 3.21 1.19 0.291 0.11 0.34 0.203 0.063 0.013 0.102 0.098 0.064 0.022 0.004 64.7 59.7 42.3 14.4 2.59 0.784 5.07 25	1,105 2,839 4,591 6,958 7,569 0.165 2.15 9.36 0.888 51.7 225 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 1.55 1.81 1.26 0.402 0.074 0.013 3.92 15.2 46.5 81.8 96.3 99.3 89.9 78 48.8 16.5 3.29 0.59 4.42 4.54 3.21 1.19 0.291 0.064 0.11 0.34 0.203 0.063 0.013 0.002 0.102 0.098

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)		0	0	0	1.03	1.06	0.107
Capital invested - Solar PV - Constrained (billion \$2018)		0	0	0.233	0.639	1.71	0
Capital invested - Wind - Base (billion \$2018)		0.069	0	0	0.046	0	0
Capital invested - Wind - Constrained (billion \$2018)		0	0	0	0	0	0
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)	602	602	602	602	1,761	3,021	3,156
Installed renewables - Solar - Constrained land use assumptions (MW)	276	276	276	523	1,243	3,279	3,279
Installed renewables - Wind - Base land use assumptions (MW)	29	75.6	75.6	75.6	115	115	115
Installed renewables - Wind - Constrained land use assumptions (MW)	29	29	29	29	29	29	29

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)	1,029	1,029	1,029	1,029	2,901	4,915	5,134
Solar - Constrained land use assumptions	501	501	501	902	2,052	5,309	5,309
(GWh)							
Wind - Base land use assumptions (GWh)	106	245	245	245	361	361	361
Wind - Constrained land use assumptions	106	106	106	106	106	106	106
(GWh)							

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

Item	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - Aggressive							-274
deployment - Corn-ethanol to energy							
grasses (1000 tCO2e/y)							
Carbon sink potential - Aggressive							-3,357
deployment - Cropland measures (1000							
tCO2e/y)							
Carbon sink potential - Aggressive							-108
deployment - Permanent conservation							
cover (1000 tCO2e/y)							
Carbon sink potential - Aggressive							-3,739
deployment - Total (1000 tC02e/y)							
Carbon sink potential - Moderate							-274
deployment - Corn-ethanol to energy							
grasses (1000 tCO2e/y)							
Carbon sink potential - Moderate							-1,769
deployment - Cropland measures (1000							
tCO2e/y)							
Carbon sink potential - Moderate							-54
deployment - Permanent conservation							
cover (1000 tCO2e/y)							
Carbon sink potential - Moderate							-2,097
deployment - Total (1000 tCO2e/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 -							112
Aggressive deployment - Corn-ethanol to							
energy grasses (1000 hectares)							
Land impacted for carbon sink -							1,832
Aggressive deployment - Cropland							
measures (1000 hectares)							
Land impacted for carbon sink -							197
Aggressive deployment - Permanent							
conservation cover (1000 hectares)							
Land impacted for carbon sink -							2,141
Aggressive deployment - Total (1000							
hectares)							
Land impacted for carbon sink - Moderate							112
deployment - Corn-ethanol to energy							
grasses (1000 hectares)							
Land impacted for carbon sink - Moderate							965
deployment - Cropland measures (1000							
hectares)							
Land impacted for carbon sink - Moderate							98.3
deployment - Permanent conservation							
cover (1000 hectares)							
Land impacted for carbon sink - Moderate							1,176
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							-116
regeneration (1000 tCO2e/y)							
Carbon sink potential - High - All (not							-31,364
counting overlap) (1000 tCO2e/y)							
Carbon sink potential - High - Avoid							-2,178
deforestation (1000 tCO2e/y)							
Carbon sink potential - High - Extend							-5,783
rotation length (1000 tCO2e/y)							
Carbon sink potential - High - Improve							-591
plantations (1000 tCO2e/y)							
Carbon sink potential - High - Increase							-6,834
retention of HWP (1000 tCO2e/y)							
Carbon sink potential - High - Increase							-928
trees outside forests (1000 tCO2e/y)							
Carbon sink potential - High - Reforest							-1,525
cropland (1000 tCO2e/y)							
Carbon sink potential - High - Reforest							-9,586
pasture (1000 tCO2e/y)							
Carbon sink potential - High - Restore							-3,823
productivity (1000 tCO2e/y)							
Carbon sink potential - Low - Accelerate							-57.9
regeneration (1000 tCO2e/y)							
Carbon sink potential - Low - All (not							-8,323
counting overlap) (1000 tCO2e/y)							
Carbon sink potential - Low - Avoid							-363
deforestation (1000 tCO2e/y)							
Carbon sink potential - Low - Extend							-2,221
rotation length (1000 tCO2e/y)							
Carbon sink potential - Low - Improve							-301
plantations (1000 tCO2e/y)							
Carbon sink potential - Low - Increase							-2,278
retention of HWP (1000 tC02e/y)							•
Carbon sink potential - Low - Increase							-325
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							-76
cropland (1000 tCO2e/y)							70
Carbon sink potential - Low - Reforest							-72
pasture (1000 tCO2e/y)							
Carbon sink potential - Low - Restore							-1,28
productivity (1000 tCO2e/y)							
Carbon sink potential - Mid - Accelerate							-86.
regeneration (1000 tCO2e/y)							
Carbon sink potential - Mid - All (not							-19,83
counting overlap) (1000 tCO2e/y)							
Carbon sink potential - Mid - Avoid							-1,2
deforestation (1000 tCO2e/y)							
Carbon sink potential - Mid - Extend							-4,00
rotation length (1000 tCO2e/y)							
Carbon sink potential - Mid - Improve							-44
plantations (1000 tCO2e/y)							
Carbon sink potential - Mid - Increase							-4,55
retention of HWP (1000 tCO2e/y)							
Carbon sink potential - Mid - Increase							-62
rees outside forests (1000 tC02e/y)							
Carbon sink potential - Mid - Reforest							-1,14
cropland (1000 tCO2e/y)							
Carbon sink potential - Mid - Reforest							-5,15
pasture (1000 tCO2e/y)							•
Carbon sink potential - Mid - Restore							-2,55
productivity (1000 tCO2e/y)							,-
and impacted for carbon sink potential -							18
High - Accelerate regeneration (1000							
nectares)							
Land impacted for carbon sink potential -							29
High - Avoid deforestation (over 30 years)							
(1000 hectares)							
Land impacted for carbon sink potential -							2,94
High - Extend rotation length (1000							2,7-
hectares)							
Land impacted for carbon sink potential -						+	21
High - Improve plantations (1000							
nectares)							
Land impacted for carbon sink potential -	+					-	
High - Increase retention of HWP (1000							
nectares)							
-							0.0
Land impacted for carbon sink potential -							88
High - Increase trees outside forests							
(1000 hectares)							4.
and impacted for carbon sink potential -							1
High - Reforest cropland (1000 hectares)							
Land impacted for carbon sink potential -							2
High - Reforest pasture (1000 hectares)							
and impacted for carbon sink potential -							1,2
High - Restore productivity (1000							
nectares)							
and impacted for carbon sink potential -							5,20
ligh - Total impacted (over 30 years)							
1000 hectares)							
and impacted for carbon sink potential -							9.4
ow - Accelerate regeneration (1000							
nectares)							
and impacted for carbon sink potential -							2
ow - Avoid deforestation (over 30 years)							
1000 hectares)							

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 -	T	Т	T				1,130
Low - Extend rotation length (1000							
hectares)							
Land impacted for carbon sink potential -							109
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 -							46.4
Low - Increase trees outside forests							
(1000 hectares)							
Land impacted for carbon sink potential -							50.4
Low - Reforest cropland (1000 hectares)							
Land impacted for carbon sink potential -							47.2
Low - Reforest pasture (1000 hectares)							71.2
Land impacted for carbon sink potential -		+					767
Low - Restore productivity (1000							101
hectares)							
							0.607
Land impacted for carbon sink potential -							2,436
Low - Total impacted (over 30 years)							
(1000 hectares)							11.0
Land impacted for carbon sink potential -							14.2
Mid - Accelerate regeneration (1000							
hectares)							
Land impacted for carbon sink potential -							286
Mid - Avoid deforestation (over 30 years)							
(1000 hectares)							
Land impacted for carbon sink potential -							2,039
Mid - Extend rotation length (1000							
hectares)							
Land impacted for carbon sink potential -							164
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 -							67.3
Mid - Increase trees outside forests (1000							
hectares)							
Land impacted for carbon sink potential -							75.6
Mid - Reforest cropland (1000 hectares)							10.0
Land impacted for carbon sink potential -							341
Mid - Reforest pasture (1000 hectares)							041
Land impacted for carbon sink potential -							1,544
Mid - Restore productivity (1000							1,344
hectares)							/ 500
Land impacted for carbon sink potential -							4,532
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 -		678	0.89	0.865	0.635	0.43	0.035
Coal (million 2019\$)							
Monetary damages from air pollution -		214	151	156	120	41.1	13.4
Natural Gas (million 2019\$)							
Monetary damages from air pollution -		1,540	1,435	1,091	632	291	118
Transportation (million 2019\$)							
Premature deaths from air pollution -		76.6	0.101	0.098	0.072	0.049	0.004
Coal (deaths)							

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

Item	2020	2025	2030	2035	2040	2045	2050
Premature deaths from air pollution - Natural Gas (deaths)		24.1	17	17.6	13.5	4.64	1.51
Premature deaths from air pollution - Transportation (deaths)		173	161	123	71.1	32.7	13.3

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

Item	2020	2025	2030	2035	2040	2045	2050
Commercial HVAC investment in 2020s -		19,401	22,003				
Cumulative 5-yr (million \$2018)							
Sales of cooking units - Electric	43.5	47.1	51.3	61.6	76.1	85	88
Resistance (%)							
Sales of cooking units - Gas (%)	56.5	52.9	48.7	38.4	23.9	15	12
Sales of space heating units - Electric	9.56	21.7	26.9	42.4	66.6	83.3	89.7
Heat Pump (%)							
Sales of space heating units - Electric	4.81	4.61	4.65	4.78	5.23	5.91	6.33
Resistance (%)							
Sales of space heating units - Fossil (%)	0	3.27	3.09	2.34	1.17	0.379	0.099
Sales of space heating units - Gas Furnace	85.6	70.4	65.3	50.5	27	10.4	3.89
(%)							
Sales of water heating units - Electric	0.155	1.96	7.08	21.8	44.4	59.2	64.3
Heat Pump (%)							
Sales of water heating units - Electric	5.74	6.48	8.39	14.4	23.5	29.5	31.6
Resistance (%)							
Sales of water heating units - Gas Furnace	92.5	90	83	62.2	30.4	9.74	2.53
(%)							
Sales of water heating units - Other (%)	1.59	1.58	1.58	1.58	1.58	1.57	1.56

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

Item	2020	2025	2030	2035	2040	2045	2050
Electricity distribution capital invested -		4.14	4.18	4.77	4.88	5.83	6.04
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)	171	171	169	166	161	156	153
Final energy use - Industry (PJ)	755	838	889	910	921	912	909
Final energy use - Residential (PJ)	260	244	232	219	204	187	173
Final energy use - Transportation (PJ)	680	628	570	525	490	449	400

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

Item	2020	2025	2030	2035	2040	2045	2050
Residential HVAC investment in 2020s vs.		5.17	5.41				
REF - Cumulative 5-yr (billion \$2018)							
Sales of cooking units - Electric	83.1	83.5	85.1	89.2	94.8	98.3	99.6
Resistance (%)							
Sales of cooking units - Gas (%)	16.9	16.5	14.9	10.8	5.17	1.67	0.449
Sales of space heating units - Electric	32.2	41.6	45.3	56	72.3	82.8	86.5
Heat Pump (%)							
Sales of space heating units - Electric	31.3	33.1	31	25.2	16.6	11.1	9.21
Resistance (%)							
Sales of space heating units - Fossil (%)	4.13	5	4.74	3.81	2.44	1.57	1.28
Sales of space heating units - Gas (%)	32.4	20.3	18.9	14.9	8.67	4.49	3.04
Sales of water heating units - Electric	0	1.56	6	18.8	38.4	51.1	55.6
Heat Pump (%)							
Sales of water heating units - Electric	68.9	78.9	75.9	67	53.3	44.5	41.4
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 (%)	27.4	17	15.5	11.7	5.76	1.83	0.477
Sales of water heating units - Other (%)	3.71	2.57	2.54	2.55	2.56	2.54	2.54

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

•••	, .		•				
Item	2020	2025	2030	2035	2040	2045	2050
Light-duty vehicle capital costs -		0	180	376	1,271	3,991	5,817
Cumulative 5-yr (million \$2018)							
Public EV charging plugs - DC Fast (1000	0.165		0.677		3.48		9.69
units)							
Public EV charging plugs - L2 (1000 units)	0.888		16.3		83.7		233
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 (%)	1.56	1.97	2.06	1.64	1.05	0.537	0.23
Vehicle sales - Light-duty - EV (%)	1.89	4.68	11.9	25.9	48.4	72	87.6
Vehicle sales - Light-duty - gasoline (%)	91.7	87.5	79.6	66.7	46.2	24.9	11
Vehicle sales - Light-duty - hybrid (%)	4.59	5.39	6.05	5.51	4.13	2.44	1.18
Vehicle sales - Light-duty - hydrogen FC	0.113	0.38	0.326	0.249	0.177	0.098	0.046
(%)							
Vehicle sales - Light-duty - other (%)	0.103	0.106	0.097	0.084	0.061	0.033	0.015
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 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	0	0	0	0	0
(billion \$2018)							
Capital invested - Biomass w/ccu allam	0	0	0	0.046	0	0	0
power plant (billion \$2018)							
Capital invested - Biomass w/ccu power	0	0	2.97	0.004	6.62	0	0
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	0	0	0	0	0	0
Biomass w/ccu allam power plant (GWh)	0	0	0	45.5	45.5	45.5	45.5
Biomass w/ccu power plant (GWh)	0	0	3,332	3,337	10,762	10,762	10,762

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

Item	2020	2025	2030	2035	2040	2045	2050
1(6)))	2020	2025	2030	2033	2040	2045	2000
Biomass purchases (million \$2018/year)		0	214	575	1,886	2,174	2,174
Conversion capital investment -		0	2,724	4,018	15,288	3,181	0
Cumulative 5-yr (million \$2018)							
Number of facilities - Allam power w ccu	0	0	0	1	1	1	1
(quantity)							

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Table 52: E-B+ scenario -	PILLAR 3: Clean fuels -	Bioeneray Icontinued I

Item	2020	2025	2030	2035	2040	2045	2050
Number of facilities - Beccs hydrogen	0	0	0	4	15	18	18
(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	2	3	9	9	9
(quantity)							
Number of facilities - Pyrolysis (quantity)	0	0	0	0	0	0	0
Number of facilities - Pyrolysis ccu	0	0	0	0	0	0	0
(quantity)							
Number of facilities - Sng (quantity)	0	0	0	0	0	0	0
Number of facilities - Sng ccu (quantity)	0	0	1	1	1	1	1

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

Item	2020	2025	2030	2035	2040	2045	2050
Annual - All (MMT)		0	3.3	8.41	27.6	31.7	31.7
Annual - BECCS (MMT)		0	3.3	8.41	27.6	31.7	31.7
Annual - Cement and lime (MMT)		0	0	0	0	0	0
Annual - NGCC (MMT)		0	0	0	0	0	0.01
Cumulative - All (MMT)		0	3.3	11.7	39.3	71	103
Cumulative - BECCS (MMT)		0	3.3	11.7	39.3	71	103
Cumulative - Cement and lime (MMT)		0	0	0	0	0	0
Cumulative - NGCC (MMT)		0	0	0	0	0	0.01

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

Item	2020	2025	2030	2035	2040	2045	2050
All (km)		0	499	1,390	2,745	2,186	2,944
Cumulative investment - All (million \$2018)		0	1,603	3,872	6,641	6,309	6,854
Cumulative investment - Spur (million \$2018)		0	310	1,287	2,763	2,431	2,976
Cumulative investment - Trunk (million \$2018)		0	1,293	2,585	3,878	3,878	3,878
Spur (km)		0	318	1,029	2,203	1,644	2,401
Trunk (km)		0	181	362	543	543	543

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

Item	2020	2025	2030	2035	2040	2045	2050
CO2 storage (MMT)		0	0.92	3.21	7.13	9.85	10
Injection wells (wells)		0	2	7	12	20	24
Resource characterization, appraisal, permitting costs (million \$2020)		25.4	112	173	173	173	173
Wells and facilities construction costs (million \$2020)		0	50.8	198	353	590	732

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

Item	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - Aggressive							-652
deployment - Corn-ethanol to energy							
grasses (1000 tCO2e/y)							
Carbon sink potential - Aggressive							-3,109
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)							07.0
Carbon sink potential - Aggressive							-97.8
deployment - Permanent conservation							
cover (1000 tC02e/y)							
Carbon sink potential - Aggressive							-3,859
deployment - Total (1000 tC02e/y)							
Carbon sink potential - Moderate							-652
deployment - Corn-ethanol to energy							
grasses (1000 tCO2e/y)							
Carbon sink potential - Moderate							-1,638
deployment - Cropland measures (1000							
tCO2e/y)							
Carbon sink potential - Moderate							0
deployment - Cropland to woody energy							
crops (1000 tC02e/y)							
Carbon sink potential - Moderate							0
deployment - Pasture to energy crops							
(1000 tC02e/y)							
Carbon sink potential - Moderate							-48.9
deployment - Permanent conservation							
cover (1000 tCO2e/y)							
Carbon sink potential - Moderate							-2,339
deployment - Total (1000 tCO2e/y)							
Land impacted for carbon sink -							292
Aggressive deployment - Corn-ethanol to							
energy grasses (1000 hectares)							
Land impacted for carbon sink -							4,110
Aggressive deployment - Cropland							
measures (1000 hectares)							
Land impacted for carbon sink -							110
Aggressive deployment - Cropland to							
woody energy crops (1000 hectares)							
Land impacted for carbon sink -							442
Aggressive deployment - Pasture to							
energy crops (1000 hectares)							
Land impacted for carbon sink -							178
Aggressive deployment - Permanent							
conservation cover (1000 hectares)							
Land impacted for carbon sink -							5,132
Aggressive deployment - Total (1000							
hectares)							
Land impacted for carbon sink - Moderate							292
deployment - Corn-ethanol to energy							
grasses (1000 hectares)							
Land impacted for carbon sink - Moderate							877
deployment - Cropland measures (1000							• • • • • • • • • • • • • • • • • • • •
hectares)							
Land impacted for carbon sink - Moderate							110
deployment - Cropland to woody energy							
crops (1000 hectares)							
Land impacted for carbon sink - Moderate							442
deployment - Pasture to energy crops							772
(1000 hectares)							
Land impacted for carbon sink - Moderate							89
deployment - Permanent conservation							09
cover (1000 hectares)							
Land impacted for carbon sink - Moderate							1,810
							1,010
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	2023	2030	2033	2040	2040	-116
regeneration (1000 tC02e/y)							110
Carbon sink potential - High - All (not		+					-31,364
counting overlap) (1000 tCO2e/y)							-01,004
Carbon sink potential - High - Avoid		+					-2,178
deforestation (1000 tCO2e/y)							-2,110
Carbon sink potential - High - Extend							-5,783
rotation length (1000 tCO2e/y)							-5,165
Carbon sink potential - High - Improve							-591
plantations (1000 tCO2e/y)							-591
Carbon sink potential - High - Increase							-6,834
retention of HWP (1000 tCO2e/y)							
Carbon sink potential - High - Increase							-928
trees outside forests (1000 tC02e/y)							
Carbon sink potential - High - Reforest							-1,525
cropland (1000 tCO2e/y)							
Carbon sink potential - High - Reforest							-9,586
pasture (1000 tCO2e/y)							
Carbon sink potential - High - Restore							-3,823
productivity (1000 tCO2e/y)							
Carbon sink potential - Low - Accelerate							-57.9
regeneration (1000 tCO2e/y)							
Carbon sink potential - Low - All (not							-8,323
counting overlap) (1000 tCO2e/y)							-,-
Carbon sink potential - Low - Avoid							-363
deforestation (1000 tCO2e/y)							
Carbon sink potential - Low - Extend							-2,221
rotation length (1000 tC02e/y)							2,221
Carbon sink potential - Low - Improve							-301
plantations (1000 tCO2e/y)							-301
							0.070
Carbon sink potential - Low - Increase							-2,278
retention of HWP (1000 tC02e/y)							005
Carbon sink potential - Low - Increase							-325
trees outside forests (1000 tC02e/y)							
Carbon sink potential - Low - Reforest							-763
cropland (1000 tCO2e/y)							
Carbon sink potential - Low - Reforest							-726
pasture (1000 tCO2e/y)							
Carbon sink potential - Low - Restore							-1,289
productivity (1000 tCO2e/y)							
Carbon sink potential - Mid - Accelerate							-86.8
regeneration (1000 tCO2e/y)							
Carbon sink potential - Mid - All (not							-19,839
counting overlap) (1000 tCO2e/y)							
Carbon sink potential - Mid - Avoid							-1,271
deforestation (1000 tC02e/y)							•
Carbon sink potential - Mid - Extend							-4,002
rotation length (1000 tCO2e/y)							.,002
Carbon sink potential - Mid - Improve							-441
plantations (1000 tCO2e/y)							7-71
Carbon sink potential - Mid - Increase							-4,556
retention of HWP (1000 tCO2e/y)							-4,556
							/0/
Carbon sink potential - Mid - Increase							-626
trees outside forests (1000 tC02e/y)							
Carbon sink potential - Mid - Reforest							-1,144
cropland (1000 tCO2e/y)							
Carbon sink potential - Mid - Reforest	T						-5,156
pasture (1000 tCO2e/y)							
Carbon sink potential - Mid - Restore							-2,556
productivity (1000 tCO2e/y)							

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

Item	2020	2025	2030	2035	2040	2045	2050
Land impacted for carbon sink potential -	2020	2020	2000	2000	2040	2040	18.9
High - Accelerate regeneration (1000							
hectares)							
Land impacted for carbon sink potential -							295
High - Avoid deforestation (over 30 years)							
(1000 hectares)							
Land impacted for carbon sink potential -							2,949
High - Extend rotation length (1000							
hectares)							
Land impacted for carbon sink potential -							218
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 -							88.2
High - Increase trees outside forests							
(1000 hectares)							101
Land impacted for carbon sink potential -							101
High - Reforest cropland (1000 hectares)							070
Land impacted for carbon sink potential -							272
High - Reforest pasture (1000 hectares)							4.0.
Land impacted for carbon sink potential -							1,267
High - Restore productivity (1000							
hectares)							F 000
Land impacted for carbon sink potential -							5,209
High - Total impacted (over 30 years)							
(1000 hectares) Land impacted for carbon sink potential -							9.46
Low - Accelerate regeneration (1000							9.40
hectares)							
Land impacted for carbon sink potential -							277
Low - Avoid deforestation (over 30 years)							211
(1000 hectares)							
Land impacted for carbon sink potential -							1,130
Low - Extend rotation length (1000							1,130
hectares)							
Land impacted for carbon sink potential -							109
Low - Improve plantations (1000							107
hectares)							
Land impacted for carbon sink potential -							0
Low - Increase retention of HWP (1000							·
hectares)							
Land impacted for carbon sink potential -							46.4
Low - Increase trees outside forests							
(1000 hectares)							
Land impacted for carbon sink potential -							50.4
Low - Reforest cropland (1000 hectares)							
Land impacted for carbon sink potential -							47.2
Low - Reforest pasture (1000 hectares)							
Land impacted for carbon sink potential -							767
Low - Restore productivity (1000							
hectares)							
Land impacted for carbon sink potential -							2,436
Low - Total impacted (over 30 years)							
(1000 hectares)							
Land impacted for carbon sink potential -							14.2
Mid - Accelerate regeneration (1000							
hectares)						[

<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 -							286
Mid - Avoid deforestation (over 30 years)							
(1000 hectares)							
Land impacted for carbon sink potential -							2,039
Mid - Extend rotation length (1000							
hectares)							
Land impacted for carbon sink potential -							164
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 -							67.3
Mid - Increase trees outside forests (1000							
hectares)							
Land impacted for carbon sink potential -							75.6
Mid - Reforest cropland (1000 hectares)							
Land impacted for carbon sink potential -							341
Mid - Reforest pasture (1000 hectares)							
Land impacted for carbon sink potential -							1,544
Mid - Restore productivity (1000							
hectares)							
Land impacted for carbon sink potential -							4,532
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 -		678	0.89	0.865	0.635	0.43	0.035
Coal (million 2019\$)							
Monetary damages from air pollution -		200	118	59.1	37.9	19.1	8.1
Natural Gas (million 2019\$)							
Monetary damages from air pollution -		1,565	1,579	1,538	1,387	1,106	761
Transportation (million 2019\$)							
Premature deaths from air pollution -		76.6	0.101	0.098	0.072	0.049	0.004
Coal (deaths)							
Premature deaths from air pollution -		22.6	13.3	6.67	4.27	2.16	0.915
Natural Gas (deaths)							
Premature deaths from air pollution -		176	178	173	156	124	85.5
Transportation (deaths)							

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

Item	2020	2025	2030	2035	2040	2045	2050
Commercial HVAC investment in 2020s -		19,056	19,846				
Cumulative 5-yr (million \$2018)							
Sales of cooking units - Electric	43.5	45.6	45.9	45.7	46	45.9	45.7
Resistance (%)							
Sales of cooking units - Gas (%)	56.5	54.4	54.1	54.3	54	54.1	54.3
Sales of space heating units - Electric	9.56	27.5	56.9	76.1	79	79.4	79.4
Heat Pump (%)							
Sales of space heating units - Electric	4.81	5.67	10	15.4	18.7	19.2	19.2
Resistance (%)							
Sales of space heating units - Fossil (%)	0	2.93	1.3	0.192	0.019	0	0
Sales of space heating units - Gas Furnace	85.6	63.9	31.8	8.33	2.28	1.48	1.43
(%)							
Sales of water heating units - Electric	0.155	0.153	0.147	0.149	0.149	0.146	0.148
Heat Pump (%)							
Sales of water heating units - Electric	5.74	5.75	5.58	5.66	5.62	5.56	5.61
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 (%)	92.5	92.5	92.7	92.6	92.7	92.7	92.7
Sales of water heating units - Other (%)	1.59	1.58	1.58	1.58	1.58	1.57	1.56

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

Item	2020	2025	2030	2035	2040	2045	2050
Electricity distribution capital invested -		4.86	5	5.95	6.18	5.74	5.89
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)	171	174	176	176	177	181	190
Final energy use - Industry (PJ)	755	847	903	938	959	961	976
Final energy use - Residential (PJ)	260	244	236	230	227	228	229
Final energy use - Transportation (PJ)	680	628	576	545	545	562	584

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

Item	2020	2025	2030	2035	2040	2045	2050
Residential HVAC investment in 2020s vs.		5.15	4.97				
REF - Cumulative 5-yr (billion \$2018)							
Sales of cooking units - Electric	82.9	82.9	82.9	82.9	82.9	82.9	82.9
Resistance (%)							
Sales of cooking units - Gas (%)	17.1	17.1	17.1	17.1	17.1	17.1	17.1
Sales of space heating units - Electric	30.6	53.8	54.6	55.9	57.2	58.9	61.6
Heat Pump (%)							
Sales of space heating units - Electric	32	27.2	26.7	25.9	24.9	23.3	20.6
Resistance (%)							
Sales of space heating units - Fossil (%)	4.21	3.29	3.32	3.27	3.22	3.18	3.2
Sales of space heating units - Gas (%)	33.2	15.8	15.4	14.9	14.7	14.6	14.6
Sales of water heating units - Electric	0	0	0	0	0	0	0
Heat Pump (%)							
Sales of water heating units - Electric	68.9	80	80.1	80	79.9	79.9	79.9
Resistance (%)							
Sales of water heating units - Gas Furnace	27.4	17.5	17.3	17.5	17.6	17.5	17.6
(%)							
Sales of water heating units - Other (%)	3.71	2.57	2.54	2.55	2.57	2.56	2.57

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 (%)	1.55	1.97	2.18	2.03	1.83	1.71	1.62
Vehicle sales - Light-duty - EV (%)	3.56	5.6	6.38	7.84	9.55	11.1	12.2
Vehicle sales - Light-duty - gasoline (%)	90.2	86.7	84.5	82.7	80.6	78.7	77.1
Vehicle sales - Light-duty - hybrid (%)	4.44	5.28	6.47	7.04	7.6	8.18	8.63
Vehicle sales - Light-duty - hydrogen FC	0.111	0.377	0.346	0.307	0.304	0.305	0.315
(%)							
Vehicle sales - Light-duty - other (%)	0.102	0.106	0.102	0.103	0.102	0.101	0.104
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

Table 64: REF scenario - PILLAR 6: Land si							
Item	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - High - Accelerate						T	-116
regeneration (1000 tCO2e/y)							
Carbon sink potential - High - All (not							-31,364
counting overlap) (1000 tCO2e/y)							
Carbon sink potential - High - Avoid							-2,178
deforestation (1000 tCO2e/y)							
Carbon sink potential - High - Extend							-5,783
rotation length (1000 tCO2e/y)							
Carbon sink potential - High - Improve							-591
plantations (1000 tCO2e/y)							
Carbon sink potential - High - Increase							-6,834
retention of HWP (1000 tCO2e/y)							-,
Carbon sink potential - High - Increase							-928
trees outside forests (1000 tC02e/y)							
Carbon sink potential - High - Reforest						-	-1,525
cropland (1000 tCO2e/y)							.,020
Carbon sink potential - High - Reforest						-	-9,586
pasture (1000 tCO2e/y)							7,000
Carbon sink potential - High - Restore							-3,823
productivity (1000 tC02e/y)							-0,020
Carbon sink potential - Low - Accelerate							-57.9
regeneration (1000 tC02e/y)							-51.9
Carbon sink potential - Low - All (not							-8,323
							-0,323
counting overlap) (1000 tC02e/y)							070
Carbon sink potential - Low - Avoid							-363
deforestation (1000 tC02e/y)							0.001
Carbon sink potential - Low - Extend							-2,221
rotation length (1000 tCO2e/y)							0.04
Carbon sink potential - Low - Improve							-301
plantations (1000 tCO2e/y)							
Carbon sink potential - Low - Increase							-2,278
retention of HWP (1000 tCO2e/y)							
Carbon sink potential - Low - Increase							-325
trees outside forests (1000 tCO2e/y)							
Carbon sink potential - Low - Reforest							-763
cropland (1000 tCO2e/y)							
Carbon sink potential - Low - Reforest							-726
pasture (1000 tCO2e/y)							
Carbon sink potential - Low - Restore							-1,289
productivity (1000 tCO2e/y)							
Carbon sink potential - Mid - Accelerate							-86.8
regeneration (1000 tC02e/y)							
Carbon sink potential - Mid - All (not							-19,839
counting overlap) (1000 tCO2e/y)							
Carbon sink potential - Mid - Avoid							-1,271
deforestation (1000 tCO2e/y)							,
Carbon sink potential - Mid - Extend						+	-4,002
rotation length (1000 tCO2e/y)							.,002
Carbon sink potential - Mid - Improve						+	-441
plantations (1000 tCO2e/y)							
Carbon sink potential - Mid - Increase				+		\longrightarrow	-4,556
retention of HWP (1000 tCO2e/y)							-4,000
TOTAL							

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

Item	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - Mid - Increase trees outside forests (1000 tCO2e/y)							-626
Carbon sink potential - Mid - Reforest							-1,144
cropland (1000 tCO2e/y)							.,
Carbon sink potential - Mid - Reforest							-5,156
pasture (1000 tCO2e/y)							
Carbon sink potential - Mid - Restore							-2,556
productivity (1000 tC02e/y)							10.0
Land impacted for carbon sink potential - High - Accelerate regeneration (1000							18.9
hectares)							
Land impacted for carbon sink potential -							295
High - Avoid deforestation (over 30 years)							270
(1000 hectares)							
Land impacted for carbon sink potential -							2,949
High - Extend rotation length (1000							
hectares)							
Land impacted for carbon sink potential -							218
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 -							88.2
High - Increase trees outside forests							00.2
(1000 hectares)							
Land impacted for carbon sink potential -							101
High - Reforest cropland (1000 hectares)							
Land impacted for carbon sink potential -							272
High - Reforest pasture (1000 hectares)							
Land impacted for carbon sink potential -							1,267
High - Restore productivity (1000							
hectares)							F 000
Land impacted for carbon sink potential -							5,209
High - Total impacted (over 30 years) (1000 hectares)							
Land impacted for carbon sink potential -							9.46
Low - Accelerate regeneration (1000							7.40
hectares)							
Land impacted for carbon sink potential -							277
Low - Avoid deforestation (over 30 years)							
(1000 hectares)							
Land impacted for carbon sink potential -							1,130
Low - Extend rotation length (1000							
hectares)							100
Land impacted for carbon sink potential -							109
Low - Improve plantations (1000 hectares)							
Land impacted for carbon sink potential -							0
Low - Increase retention of HWP (1000							Ü
hectares)							
Land impacted for carbon sink potential -							46.4
Low - Increase trees outside forests							
(1000 hectares)							
Land impacted for carbon sink potential -							50.4
Low - Reforest cropland (1000 hectares)							
Land impacted for carbon sink potential -							47.2
Low - Reforest pasture (1000 hectares)							7/7
Land impacted for carbon sink potential -							767
Low - Restore productivity (1000					1		

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) (1000 hectares)							2,436
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)							14.2
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)							286
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)							2,039
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)							164
Land impacted for carbon sink potential - Mid - Increase retention of HWP (1000 hectares)							0
Land impacted for carbon sink potential - Mid - Increase trees outside forests (1000 hectares)							67.3
Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares)							75.6
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)							341
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)							1,544
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)							4,532

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)	-8.29		-10.7				-8.71
Business-as-usual carbon sink - Retained in Hardwood Products (Mt CO2e/y)	-1.86		-3.1				-3.26
Business-as-usual carbon sink - Total (Mt CO2e/y)	-10.1		-13.8				-12

Table 66: REF scenario - IMPACTS - Health

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution -		2,413	1,652	1,307	1,127	1,062	1,052
Coal (million 2019\$)							
Monetary damages from air pollution -		191	205	222	261	220	209
Natural Gas (million 2019\$)							
Monetary damages from air pollution -		1,564	1,601	1,639	1,685	1,732	1,780
Transportation (million 2019\$)							
Premature deaths from air pollution -		273	187	148	127	120	119
Coal (deaths)							
Premature deaths from air pollution -		21.5	23.2	25.1	29.4	24.8	23.6
Natural Gas (deaths)							
Premature deaths from air pollution -		176	180	184	190	195	200
Transportation (deaths)							