Net-Zero America - alabama state report

Larson et al. 2020

February 2021

These data underlie graphs and tables presented in the Princeton Net-Zero America study (E. Larson, C. Greig, J. Jenkins, E. Mayfield, A. Pascale, C. Zhang, J. Drossman, R. Williams, S. Pacala, R. Socolow, EJ Baik, R. Birdsey, R. Duke, R. Jones, B. Haley, E. Leslie, K. Paustian, and A. Swan, Net-Zero America: Potential Pathways, Infrastructure, and Impacts, interim report, Princeton University, Princeton, NJ, December 15, 2020. Report available at https://netzeroamerica.princeton.edu.)

Notes

- These data are a subset of all data from the study available at https://netzeroamerica.princeton.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 state-level 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.)
- Some results are not model outputs, but rather they are limits that apply across all scenarios (e.g., maximum carbon storage potential in agricultural soils).

List of Tables

1	E+ scenario - PILLAR 1: Efficiency/Electrification - Residential	4
2	E+ scenario - PILLAR 1: Efficiency/Electrification - Transportation	4
3	E+ scenario - PILLAR 1: Efficiency/Electrification - Overview	4
4	E+ scenario - PILLAR 1: Efficiency/Electrification - Commercial	4
5	E+ scenario - PILLAR 1: Efficiency/Electrification - Electricity demand	5
6	E+ scenario - PILLAR 2: Clean Electricity - Generating capacity	5
7	E+ scenario - PILLAR 2: Clean Electricity - Generation	5
8	E+ scenario - PILLAR 3: Clean fuels - Bioenergy	5
9	E+ scenario - PILLAR 4: CCUS - CO2 capture	5
10	E+ scenario - PILLAR 4: CCUS - CO2 storage	6
11	E+ scenario - PILLAR 4: CCUS - CO2 pipelines	6
12	E+ scenario - PILLAR 6: Land sinks - Agriculture	6
13	E+ scenario - PILLAR 6: Land sinks - Forests	7
14	E+ scenario - IMPACTS - Health	9
15	E+ scenario - IMPACTS - Jobs	9
16	E+ scenario - IMPACTS - Fossil fuel industries	10
17	E- scenario - PILLAR 1: Efficiency/Electrification - Residential	10

18	E- scenario - PILLAR 1: Efficiency/Electrification - Transportation	10
19	E- scenario - PILLAR 1: Efficiency/Electrification - Overview	11
20	E- scenario - PILLAR 1: Efficiency/Electrification - Commercial	11
21	E- scenario - PILLAR 1: Efficiency/Electrification - Electricity demand	11
22	E- scenario - PILLAR 6: Land sinks - Agriculture	11
23	E- scenario - PILLAR 6: Land sinks - Forests	12
24	E- scenario - IMPACTS - Health	14
25	E+RE+ scenario - PILLAR 1: Efficiency/Electrification - Residential	14
26	E+RE+ scenario - PILLAR 1: Efficiency/Electrification - Transportation	15
27	E+RE+ scenario - PILLAR 1: Efficiency/Electrification - Overview	15
28	E+RE+ scenario - PILLAR 1: Efficiency/Electrification - Commercial	15
29	E+RE+ scenario - PILLAR 1: Efficiency/Electrification - Electricity demand	15
30	E+RE+ scenario - PILLAR 2: Clean Electricity - Generating capacity	15
31	E+RE+ scenario - PILLAR 2: Clean Electricity - Generation	16
32	E+RE+ scenario - PILLAR 6: Land sinks - Agriculture	16
33	E+RE+ scenario - PILLAR 6: Land sinks - Forests	16
34	E+RE+ scenario - IMPACTS - Health	18
35	E+RE- scenario - PILLAR 1: Efficiency/Electrification - Residential	19
36	E+RE- scenario - PILLAR 1: Efficiency/Electrification - Transportation	19
37	E+RE- scenario - PILLAR 1: Efficiency/Electrification - Overview	19
38	E+RE- scenario - PILLAR 1: Efficiency/Electrification - Commercial	19
39	E+RE- scenario - PILLAR 1: Efficiency/Electrification - Electricity demand	20
40	E+RE- scenario - PILLAR 2: Clean Electricity - Generating capacity	20
41	E+RE- scenario - PILLAR 2: Clean Electricity - Generation	20
42	E+RE- scenario - PILLAR 6: Land sinks - Agriculture	20
43	E+RE- scenario - PILLAR 6: Land sinks - Forests	21
44	E+RE- scenario - IMPACTS - Health	23
45	E-B+ scenario - PILLAR 1: Efficiency/Electrification - Residential	23
46	E-B+ scenario - PILLAR 1: Efficiency/Electrification - Transportation	23
47	E-B+ scenario - PILLAR 1: Efficiency/Electrification - Overview	24
48	E-B+ scenario - PILLAR 1: Efficiency/Electrification - Commercial	24
49	E-B+ scenario - PILLAR 1: Efficiency/Electrification - Electricity demand	24
50	E-B+ scenario - PILLAR 2: Clean Electricity - Generating capacity	24
51	E-B+ scenario - PILLAR 2: Clean Electricity - Generation	24
52	E-B+ scenario - PILLAR 3: Clean fuels - Bioenergy	24
53	E-B+ scenario - PILLAR 4: CCUS - CO2 capture	25
54	E-B+ scenario - PILLAR 4: CCUS - CO2 storage	25
55	E-B+ scenario - PILLAR 4: CCUS - CO2 pipelines	25
56	E-B+ scenario - PILLAR 6: Land sinks - Agriculture	25
57	E-B+ scenario - PILLAR 6: Land sinks - Forests	26
58	REF scenario - PILLAR 1: Efficiency/Electrification - Residential	28

59	REF scenario - PILLAR 1: Efficiency/Electrification - Transportation	29
60	REF scenario - PILLAR 1: Efficiency/Electrification - Overview	29
61	REF scenario - PILLAR 1: Efficiency/Electrification - Commercial	29
62	REF scenario - PILLAR 1: Efficiency/Electrification - Electricity demand	29
63	REF scenario - PILLAR 6: Land sinks - Forests	29
64	REF scenario - IMPACTS - Health	32

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

Item	2020	2025	2030	2035	2040	2045	2050
Residential HVAC investment in 2020s vs. REF -	0	3.86	4.57	0	0	0	0
Cumulative 5-yr (billion \$2018)							
Sales of cooking units - Electric Resistance (%)	83.7	87.1	97.8	99.9	100	100	100
Sales of cooking units - Gas (%)	16.3	12.9	2.2	0.111	0	0	0
Sales of space heating units - Electric Heat Pump	34.1	48.8	80.6	87.8	88.1	88	88
(%)							
Sales of space heating units - Electric Resistance	32.6	30.4	12.8	8.81	8.63	8.75	8.76
(%)							
Sales of space heating units - Fossil (%)	6.33	6.33	2.2	1.25	1.2	1.18	1.18
Sales of space heating units - Gas (%)	27	14.4	4.38	2.16	2.08	2.05	2.05
Sales of water heating units - Electric Heat Pump	0	12.1	64.3	75.9	76.4	76.4	76.4
(%)							
Sales of water heating units - Electric Resistance	72.5	72.8	30.8	21.4	21	21	21
(%)							
Sales of water heating units - Gas Furnace (%)	23.5	12.5	2.34	0.099	0	0	0
Sales of water heating units - Other (%)	3.93	2.64	2.61	2.62	2.63	2.63	2.64

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

Table 2. 2. deciral to 1 122, in 1. 2 [[reletion, 2 leed.	Table 2. 2. Bootharie Tierra in Efficiency, Electrification Transportation										
Item	2020	2025	2030	2035	2040	2045	2050				
Light-duty vehicle capital costs - Cumulative 5-yr	0	1,020	2,605	4,234	6,409	6,981	6,653				
(million \$2018)											
Public EV charging plugs - DC Fast (1000 units)	0.07	0	2.03	0	9.05	0	14.7				
Public EV charging plugs - L2 (1000 units)	0.285	0	48.9	0	217	0	352				
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 (%)	1.51	1.78	1.24	0.397	0.074	0.013	0				
Vehicle sales - Light-duty - EV (%)	4.04	15.6	47	82	96.4	99.3	100				
Vehicle sales - Light-duty - gasoline (%)	89.7	77.6	48.2	16.3	3.26	0.589	0				
Vehicle sales - Light-duty - hybrid (%)	4.55	4.63	3.26	1.2	0.294	0.064	0				
Vehicle sales - Light-duty - hydrogen FC (%)	0.11	0.337	0.2	0.062	0.012	0.002	0				
Vehicle sales - Light-duty - other (%)	0.1	0.096	0.062	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 FC (%)	0.196	1.27	6.33	15.2	19.1	19.9	20				
Vehicle sales - Medium-duty - other (%)	0.253	0.255	0.205	0.083	0.019	0.004	0				

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

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Commercial (PJ)	116	116	112	106	101	99.4	100
Final energy use - Industry (PJ)	551	582	615	609	632	649	656
Final energy use - Residential (PJ)	163	153	141	126	114	108	105
Final energy use - Transportation (PJ)	546	508	443	365	294	250	232

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

Item	2020	2025	2030	2035	2040	2045	2050
Commercial HVAC investment in 2020s -	0	13,557	15,391	0	0	0	0
Cumulative 5-yr (million \$2018)							
Sales of cooking units - Electric Resistance (%)	43.5	55.3	83.4	88.9	89.2	89.2	89.1
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 Heat Pump (%)	11.7	29.4	77	90.8	91.9	92	92
Sales of space heating units - Electric Resistance (%)	5.83	4.63	4.92	6.27	6.62	6.6	6.56
Sales of space heating units - Fossil (%)	0	2.9	0.562	0.024	0	0	0

Table 4: E+ scenario - PILLAR 1: Efficiency/Electrification - Commercial (continued)

Item	2020	2025	2030	2035	2040	2045	2050
Sales of space heating units - Gas Furnace (%)	82.5	63.1	17.5	2.95	1.48	1.44	1.44
Sales of water heating units - Electric Heat Pump (%)	0.191	10.6	55.6	65.6	66.1	66.1	66.1
Sales of water heating units - Electric Resistance (%)	7.05	10.1	28.1	32.2	32.3	32.3	32.3
Sales of water heating units - Gas Furnace (%)	90.8	77.7	14.7	0.619	0	0	0
Sales of water heating units - Other (%)	1.97	1.59	1.58	1.59	1.59	1.58	1.57

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

Item	2020	2025	2030	2035	2040	2045	2050
Electricity distribution capital invested -	0	3.72	3.8	5.83	6.14	5	5.13
Cumulative 5-yr (billion \$2018)							

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

Item	2020	2025	2030	2035	2040	2045	2050
Capital invested - Biomass power plant (billion	0	0	0	0	0	0	0
\$2018)							
Capital invested - Biomass w/ccu allam power	0	0	0	0	0.009	0	0
plant (billion \$2018)							
Capital invested - Biomass w/ccu power plant	0	0	0	0	11.9	0	0
(billion \$2018)							
Capital invested - Solar PV - Base (billion \$2018)	0	0	8.49	8.3	8.81	17.6	21.6
Capital invested - Solar PV - Constrained (billion	0	0.546	5.41	8.67	9.99	17.4	20.8
\$2018)							

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	8.94	8.94	8.94
Biomass w/ccu power plant (GWh)	0	0	0	0	13,376	13,376	13,376
Solar - Base land use assumptions (GWh)	762	0	13,661	14,509	16,301	34,459	44,765
Solar - Constrained land use assumptions (GWh)	762	0	7,675	14,889	15,552	40,275	45,687

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

Item	2020	2025	2030	2035	2040	2045	2050
Biomass purchases (million \$2018/year)	0	0	0	184	681	1,049	1,049
Conversion capital investment - Cumulative 5-yr	0	0	0	3,509	10,945	7,022	0
(million \$2018)							
Number of facilities - Allam power w ccu	0	0	0	0	1	1	1
(quantity)							
Number of facilities - Beccs hydrogen (quantity)	0	0	0	4	4	11	11
Number of facilities - Diesel (quantity)	0	0	0	0	0	0	0
Number of facilities - Diesel ccu (quantity)	0	0	0	0	1	1	1
Number of facilities - Power (quantity)	0	0	0	0	0	0	0
Number of facilities - Power ccu (quantity)	0	0	0	0	10	10	10
Number of facilities - Pyrolysis (quantity)	0	0	0	0	0	0	0
Number of facilities - Pyrolysis ccu (quantity)	0	0	0	0	0	0	0
Number of facilities - Sng (quantity)	0	0	0	0	0	0	0
Number of facilities - Sng ccu (quantity)	0	0	0	0	0	0	0

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

Item	2020	2025	2030	2035	2040	2045	2050
Annual - All (MMT)	0	0	3.24	10.3	22.7	36	37.5
Annual - BECCS (MMT)	0	0	0	4.51	17.3	26.4	26.3
Annual - Cement and lime (MMT)	0	0	3.24	3.35	3.32	6.84	7.07
Annual - NGCC (MMT)	0	0	0	2.46	2.07	2.77	4.1
Cumulative - All (MMT)	0	0	3.24	13.6	36.2	72.2	110

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

Item	2020	2025	2030	2035	2040	2045	2050
Cumulative - BECCS (MMT)	0	0	0	4.51	21.8	48.2	74.5
Cumulative - Cement and lime (MMT)	0	0	3.24	6.59	9.91	16.8	23.8
Cumulative - NGCC (MMT)	0	0	0	2.46	4.53	7.3	11.4

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

Item	2020	2025	2030	2035	2040	2045	2050
CO2 storage (MMT)	0	0	2.19	8.81	16.3	27.5	35.4
Injection wells (wells)	0	0	2	10	18	32	38
Resource characterization, appraisal, permitting	0	14.6	263	417	417	417	417
costs (million \$2020)							
Wells and facilities construction costs (million	0	0	80.8	315	561	938	1,164
\$2020)							

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

Item	2020	2025	2030	2035	2040	2045	2050
All (km)	0	0	648	2,591	3,732	4,532	4,874
Cumulative investment - All (million \$2018)	0	0	2,094	4,991	6,149	6,901	7,104
Cumulative investment - Spur (million \$2018)	0	0	222	1,248	2,405	3,157	3,361
Cumulative investment - Trunk (million \$2018)	0	0	1,872	3,743	3,743	3,743	3,743
Spur (km)	0	0	313	1,922	3,063	3,862	4,205
Trunk (km)	0	0	335	669	669	669	669

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

Item	2020	2025	2050
Carbon sink potential - Aggressive deployment -	0	0	-57.1
Corn-ethanol to energy grasses (1000 tC02e/y)			
Carbon sink potential - Aggressive deployment -	0	0	-2,225
Cropland measures (1000 tCO2e/y)			
Carbon sink potential - Aggressive deployment -	0	0	-58.1
Permanent conservation cover (1000 tCO2e/y)			
Carbon sink potential - Aggressive deployment -	0	0	-2,340
Total (1000 tC02e/y)			
Carbon sink potential - Moderate deployment -	0	0	-57.1
Corn-ethanol to energy grasses (1000 tC02e/y)			
Carbon sink potential - Moderate deployment -	0	0	-1,171
Cropland measures (1000 tCO2e/y)			
Carbon sink potential - Moderate deployment -	0	0	-29.1
Permanent conservation cover (1000 tCO2e/y)			
Carbon sink potential - Moderate deployment -	0	0	-1,257
Total (1000 tC02e/y)			
Land impacted for carbon sink - Aggressive	0	0	33
deployment - Corn-ethanol to energy grasses			
(1000 hectares)			
Land impacted for carbon sink - Aggressive	0	0	1,003
deployment - Cropland measures (1000			
hectares)			
Land impacted for carbon sink - Aggressive	0	0	106
deployment - Permanent conservation cover			
(1000 hectares)			
Land impacted for carbon sink - Aggressive	0	0	1,142
deployment - Total (1000 hectares)			
Land impacted for carbon sink - Moderate	0	0	33
deployment - Corn-ethanol to energy grasses			
(1000 hectares)			
Land impacted for carbon sink - Moderate	0	0	528
deployment - Cropland measures (1000			
hectares)			
Land impacted for carbon sink - Moderate	0	0	52.8
deployment - Permanent conservation cover			
(1000 hectares)			

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

Item	2020	2025	2050
Land impacted for carbon sink - Moderate	0	0	614
deployment - Total (1000 hectares)			

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

Table 13: E+ scenario - PILLAR 6: Land sinks - Fo			
Item	2020	2025	2050
Carbon sink potential - High - Accelerate	0	0	340
regeneration (1000 tCO2e/y)			
Carbon sink potential - High - All (not counting	0	0	58,635
overlap) (1000 tCO2e/y)			
Carbon sink potential - High - Avoid deforestation	0	0	1,902
(1000 tC02e/y)		-	.,
Carbon sink potential - High - Extend rotation	0	0	11,580
length (1000 tCO2e/y)		0	11,500
Carbon sink potential - High - Improve	0	0	6,158
		0	0,130
plantations (1000 tCO2e/y)			00 / 50
Carbon sink potential - High - Increase retention	0	0	22,452
of HWP (1000 tC02e/y)			
Carbon sink potential - High - Increase trees	0	0	592
outside forests (1000 tCO2e/y)			
Carbon sink potential - High - Reforest cropland	0	0	3,048
(1000 tCO2e/y)			
Carbon sink potential - High - Reforest pasture	0	0	7,006
(1000 tCO2e/y)			
Carbon sink potential - High - Restore	0	0	5,558
productivity (1000 tCO2e/y)			-,
Carbon sink potential - Low - Accelerate	0	0	170
regeneration (1000 tC02e/y)		ı ı	110
Carbon sink potential - Low - All (not counting	0	0	19,687
overlap) (1000 tCO2e/y)		0	17,001
		0	017
Carbon sink potential - Low - Avoid deforestation	0	0	317
(1000 tC02e/y)			
Carbon sink potential - Low - Extend rotation	0	0	4,448
length (1000 tC02e/y)			
Carbon sink potential - Low - Improve	0	0	3,133
plantations (1000 tCO2e/y)			
Carbon sink potential - Low - Increase retention	0	0	7,484
of HWP (1000 tCO2e/y)			
Carbon sink potential - Low - Increase trees	0	0	207
outside forests (1000 tCO2e/y)			_
Carbon sink potential - Low - Reforest cropland	0	0	1,524
(1000 tC02e/y)		0	1,024
Carbon sink potential - Low - Reforest pasture	0	0	531
(1000 tC02e/y)		0	551
		0	1.070
Carbon sink potential - Low - Restore	0	0	1,873
productivity (1000 tC02e/y)			
Carbon sink potential - Mid - Accelerate	0	0	255
regeneration (1000 tCO2e/y)			
Carbon sink potential - Mid - All (not counting	0	0	39,107
overlap) (1000 tCO2e/y)			
Carbon sink potential - Mid - Avoid deforestation	0	0	1,110
(1000 tC02e/y)			
Carbon sink potential - Mid - Extend rotation	0	0	8,014
length (1000 tC02e/y)		-	-,
Carbon sink potential - Mid - Improve plantations	0	0	4,591
(1000 tC02e/y)		١ -	7,071
Carbon sink potential - Mid - Increase retention	0	0	14,968
	0	υ	14,700
of HWP (1000 tCO2e/y)			
Carbon sink potential - Mid - Increase trees	0	0	400
outside forests (1000 tCO2e/y)			
Carbon sink potential - Mid - Reforest cropland	0	0	2,286
(1000 tC02e/y)			
Carbon sink potential - Mid - Reforest pasture	0	0	3,768
(1000 tCO2e/y)			
·			

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

Table 13: E+ scenario - PILLAR 6: Land sinks - Fo	2020	2025	2050
Carbon sink potential - Mid - Restore	0	0	3,715
productivity (1000 tCO2e/y)			0,110
Land impacted for carbon sink potential - High -	0	0	55.6
Accelerate regeneration (1000 hectares)			00.0
Land impacted for carbon sink potential - High -	0	0	258
Avoid deforestation (over 30 years) (1000		•	200
hectares)			
Land impacted for carbon sink potential - High -	0	0	5,905
Extend rotation length (1000 hectares)		0	3,703
Land impacted for carbon sink potential - High -	0	0	2,269
Improve plantations (1000 hectares)	0	0	2,209
	0	0	
Land impacted for carbon sink potential - High -	U	U	0
Increase retention of HWP (1000 hectares)	0	0	F/ 0
Land impacted for carbon sink potential - High -	0	0	56.3
Increase trees outside forests (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	201
Reforest cropland (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	199
Reforest pasture (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	1,842
Restore productivity (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	10,786
Total impacted (over 30 years) (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	27.8
Accelerate regeneration (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	242
Avoid deforestation (over 30 years) (1000			
hectares)			
Land impacted for carbon sink potential - Low -	0	0	2,262
Extend rotation length (1000 hectares)			, -
Land impacted for carbon sink potential - Low -	0	0	1,134
Improve plantations (1000 hectares)		-	.,
Land impacted for carbon sink potential - Low -	0	0	0
Increase retention of HWP (1000 hectares)		•	J
Land impacted for carbon sink potential - Low -	0	0	29.6
Increase trees outside forests (1000 hectares)		•	27.0
Land impacted for carbon sink potential - Low -	0	0	101
Reforest cropland (1000 hectares)		0	101
	0	0	34.5
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)	0	0	34.5
	0	0	1115
Land impacted for carbon sink potential - Low -	0	0	1,115
Restore productivity (1000 hectares)			1.01.7
Land impacted for carbon sink potential - Low -	0	0	4,946
Total impacted (over 30 years) (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	41.7
Accelerate regeneration (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	250
Avoid deforestation (over 30 years) (1000			
hectares)			
Land impacted for carbon sink potential - Mid -	0	0	4,084
Extend rotation length (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	1,707
Improve plantations (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	0
Increase retention of HWP (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	42.9
Increase trees outside forests (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	151
Reforest cropland (1000 hectares)	"	0	101
Land impacted for carbon sink potential - Mid -	0	0	249
Reforest pasture (1000 hectares)		U	247
	0	0	0.07.5
Land impacted for carbon sink potential - Mid -	U	U	2,245
Restore productivity (1000 hectares)			

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

Item	2020	2025	2050
Land impacted for carbon sink potential - Mid -	0	0	8,770
Total impacted (over 30 years) (1000 hectares)			

Table 14: E+ scenario - IMPACTS - Health

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal (million 2019\$)	0	356	0.484	0.438	0.28	0.172	0.012
Monetary damages from air pollution - Natural Gas (million 2019\$)	0	178	152	88.5	71.5	32.5	11.9
Monetary damages from air pollution - Transportation (million 2019\$)	0	985	912	688	394	178	68.5
Premature deaths from air pollution - Coal (deaths)	0	39.9	0.054	0.049	0.031	0.019	0.001
Premature deaths from air pollution - Natural Gas (deaths)	0	20.1	17.2	9.99	8.07	3.67	1.34
Premature deaths from air pollution - Transportation (deaths)	0	111	103	77.4	44.4	20	7.7

Table 15: E+ scenario - IMPACTS - Jobs

Item	2020	2025	2030	2035	2040	2045	2050
By economic sector - Agriculture (jobs)	180	207	421	539	1,339	1,627	1,339
By economic sector - Construction (jobs)	5,969	5,929	12,364	14,210	16,054	22,563	29,736
By economic sector - Manufacturing (jobs)	5,035	8,956	10,678	13,714	13,720	12,169	15,204
By economic sector - Mining (jobs)	6,890	5,168	3,824	2,875	1,979	1,428	977
By economic sector - Other (jobs)	319	292	1,573	1,918	2,529	4,410	6,741
By economic sector - Pipeline (jobs)	673	667	817	856	628	561	568
By economic sector - Professional (jobs)	4,180	3,843	5,608	6,120	7,886	11,430	14,822
By economic sector - Trade (jobs)	3,610	2,898	3,909	4,098	4,796	7,083	9,798
By economic sector - Utilities (jobs)	10,843	10,656	12,382	13,961	15,065	18,246	22,436
By education level - All sectors - Associates	11,511	11,930	16,253	18,586	20,354	25,339	32,663
degree or some college (jobs)							
By education level - All sectors - Bachelors	8,165	8,305	10,434	11,479	12,440	15,350	19,570
degree (jobs)							
By education level - All sectors - Doctoral degree	265	252	333	350	404	549	706
(jobs)							
By education level - All sectors - High school	15,785	16,182	22,092	25,197	27,829	34,487	43,830
diploma or less (jobs)							
By education level - All sectors - Masters or	1,971	1,950	2,464	2,680	2,970	3,792	4,853
professional degree (jobs)							
By resource sector - Biomass (jobs)	746	890	1,161	1,535	4,031	5,935	5,718
By resource sector - CO2 (jobs)	0	5.69	2,217	3,546	2,622	3,152	3,827
By resource sector - Coal (jobs)	5,625	3,136	1,714	1,496	1,309	1,185	1,051
By resource sector - Grid (jobs)	10,196	10,559	13,544	18,082	21,853	29,969	39,050
By resource sector - Natural Gas (jobs)	9,255	9,132	8,036	6,638	7,116	5,084	3,801
By resource sector - Nuclear (jobs)	2,704	2,660	2,383	1,365	252	0	0
By resource sector - Oil (jobs)	6,987	6,244	5,177	4,041	2,741	1,846	1,054
By resource sector - Solar (jobs)	1,595	3,090	13,258	16,139	19,083	28,813	42,414
By resource sector - Wind (jobs)	591	2,900	4,086	5,449	4,989	3,533	4,707
Median wages - Annual - All (\$2019 per job)	57,022	57,323	56,551	56,786	57,256	57,935	58,613
On-Site or In-Plant Training - Total jobs - 1 to 4	6,067	6,220	8,438	9,583	10,455	13,005	16,678
years (jobs)							
On-Site or In-Plant Training - Total jobs - 4 to 10	2,409	2,371	3,380	3,808	4,205	5,428	6,975
years (jobs)							
On-Site or In-Plant Training - Total jobs - None	5,913	6,146	8,318	9,388	10,349	12,900	16,536
(jobs)							
On-Site or In-Plant Training - Total jobs - Over 10	293	307	431	500	554	698	898
years (jobs)							
On-Site or In-Plant Training - Total jobs - Up to 1	23,016	23,574	31,009	35,013	38,434	47,485	60,535
year (jobs)							
On-the-Job Training - All sectors - 1 to 4 years	7,787	7,977	10,848	12,314	13,422	16,716	21,450
(jobs)							

Table 15:	E+ scenario	- IMPACTS -	.Inhs I	continuedi

Item	2020	2025	2030	2035	2040	2045	2050
On-the-Job Training - All sectors - 4 to 10 years	2,303	2,256	3,298	3,738	4,156	5,414	6,983
(jobs)							
On-the-Job Training - All sectors - None (jobs)	2,004	2,034	2,755	3,068	3,371	4,287	5,544
On-the-Job Training - All sectors - Over 10 years (jobs)	335	370	518	589	627	759	978
On-the-Job Training - All sectors - Up to 1 year (jobs)	25,270	25,981	34,158	38,582	42,421	52,341	66,667
Related work experience - All sectors - 1 to 4 years (jobs)	13,923	14,113	18,576	20,886	22,874	28,378	36,218
Related work experience - All sectors - 4 to 10 years (jobs)	8,750	8,971	11,929	13,442	14,648	18,180	23,272
Related work experience - All sectors - None (jobs)	5,299	5,446	7,402	8,425	9,341	11,688	14,944
Related work experience - All sectors - Over 10 years (jobs)	2,380	2,509	3,246	3,662	3,929	4,760	6,084
Related work experience - All sectors - Up to 1 year (jobs)	7,347	7,580	10,422	11,877	13,204	16,511	21,105
Wage income - All (million \$2019)	2,150	2,214	2,917	3,310	3,665	4,607	5,957

Table 16: E+ scenario - IMPACTS - Fossil fuel industries

Item	2020	2025	2030	2035	2040	2045	2050
Natural gas consumption - Annual (tcf)	572	580	489	392	295	186	129
Natural gas consumption - Cumulative (tcf)	0	0	0	0	0	0	11,820
Natural gas production - Annual (tcf)	149	165	156	136	115	91.3	70.9
Oil consumption - Annual (million bbls)	93.4	87.1	73.9	54.9	37.3	23.4	12.6
Oil consumption - Cumulative (million bbls)	0	0	0	0	0	0	1,701
Oil production - Annual (million bbls)	9.74	10.5	10.6	10.6	8.36	6.8	4.52

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

2020	2025	2030	2035	2040	2045	2050
0	3.81	4.31	0	0	0	0
83.6	84	85.5	89.5	95	98.4	99.6
16.4	16	14.5	10.5	5.01	1.62	0.435
34.1	42.7	46.3	56.9	72.9	83.2	86.8
32.6	33.8	31.7	25.8	17	11.4	9.4
6.33	7.13	6.71	5.24	3.12	1.79	1.34
27	16.4	15.2	12.1	7.04	3.65	2.47
0	2.09	8.02	25.1	51.3	68.4	74.3
72.5	80.9	76.2	62.3	41.2	27.4	22.6
23.5	14.4	13.2	9.97	4.91	1.56	0.408
3.93	2.64	2.61	2.64	2.65	2.64	2.64
	83.6 16.4 34.1 32.6 6.33 27 0 72.5	0 3.81 83.6 84 16.4 16 34.1 42.7 32.6 33.8 6.33 7.13 27 16.4 0 2.09 72.5 80.9	0 3.81 4.31 83.6 84 85.5 16.4 16 14.5 34.1 42.7 46.3 32.6 33.8 31.7 6.33 7.13 6.71 27 16.4 15.2 0 2.09 8.02 72.5 80.9 76.2 23.5 14.4 13.2	0 3.81 4.31 0 83.6 84 85.5 89.5 16.4 16 14.5 10.5 34.1 42.7 46.3 56.9 32.6 33.8 31.7 25.8 6.33 7.13 6.71 5.24 27 16.4 15.2 12.1 0 2.09 8.02 25.1 72.5 80.9 76.2 62.3 23.5 14.4 13.2 9.97	0 3.81 4.31 0 0 83.6 84 85.5 89.5 95 16.4 16 14.5 10.5 5.01 34.1 42.7 46.3 56.9 72.9 32.6 33.8 31.7 25.8 17 6.33 7.13 6.71 5.24 3.12 27 16.4 15.2 12.1 7.04 0 2.09 8.02 25.1 51.3 72.5 80.9 76.2 62.3 41.2 23.5 14.4 13.2 9.97 4.91	0 3.81 4.31 0 0 0 83.6 84 85.5 89.5 95 98.4 16.4 16 14.5 10.5 5.01 1.62 34.1 42.7 46.3 56.9 72.9 83.2 32.6 33.8 31.7 25.8 17 11.4 6.33 7.13 6.71 5.24 3.12 1.79 27 16.4 15.2 12.1 7.04 3.65 0 2.09 8.02 25.1 51.3 68.4 72.5 80.9 76.2 62.3 41.2 27.4 23.5 14.4 13.2 9.97 4.91 1.56

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

Item	2020	2025	2030	2035	2040	2045	2050
Light-duty vehicle capital costs - Cumulative 5-yr	0	0	163	347	1,168	3,685	5,365
(million \$2018)							
Public EV charging plugs - DC Fast (1000 units)	0.07	0	0.612	0	3.34	0	9.39
Public EV charging plugs - L2 (1000 units)	0.285	0	14.7	0	80.3	0	225
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 (%)	1.52	1.94	2.05	1.63	1.04	0.533	0.228

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

Item	2020	2025	2030	2035	2040	2045	2050
Vehicle sales - Light-duty - EV (%)	1.93	4.78	12.1	26.2	48.7	72.3	87.7
Vehicle sales - Light-duty - gasoline (%)	91.6	87.3	79.3	66.3	45.8	24.6	10.9
Vehicle sales - Light-duty - hybrid (%)	4.72	5.51	6.18	5.61	4.18	2.46	1.19
Vehicle sales - Light-duty - hydrogen FC (%)	0.113	0.379	0.324	0.246	0.174	0.097	0.045
Vehicle sales - Light-duty - other (%)	0.101	0.105	0.095	0.083	0.059	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 FC (%)	0.166	0.485	1.37	3.58	7.86	13.2	17
Vehicle sales - Medium-duty - other (%)	0.253	0.266	0.279	0.286	0.258	0.184	0.102

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

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Commercial (PJ)	116	116	115	113	110	107	105
Final energy use - Industry (PJ)	551	582	616	613	638	655	660
Final energy use - Residential (PJ)	163	154	147	140	131	121	113
Final energy use - Transportation (PJ)	546	513	465	427	397	363	322

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

**	•						
Item	2020	2025	2030	2035	2040	2045	2050
Commercial HVAC investment in 2020s -	0	13,551	15,374	0	0	0	0
Cumulative 5-yr (million \$2018)							
Sales of cooking units - Electric Resistance (%)	43.5	47.1	51.3	61.6	76.1	85	88
Sales of cooking units - Gas (%)	56.5	52.9	48.7	38.4	23.9	15	12
Sales of space heating units - Electric Heat Pump	11.7	20.3	25.7	41.5	66.1	83.2	89.6
(%)							
Sales of space heating units - Electric Resistance	5.83	4.63	4.65	4.79	5.28	5.94	6.33
(%)							
Sales of space heating units - Fossil (%)	0	3.35	3.16	2.4	1.19	0.387	0.102
Sales of space heating units - Gas Furnace (%)	82.5	71.7	66.5	51.3	27.4	10.5	3.93
Sales of water heating units - Electric Heat Pump	0.191	1.96	7.08	21.8	44.4	59.2	64.3
(%)							
Sales of water heating units - Electric Resistance	7.05	6.58	8.46	14.5	23.6	29.5	31.6
(%)							
Sales of water heating units - Gas Furnace (%)	90.8	89.9	82.9	62.1	30.4	9.73	2.53
Sales of water heating units - Other (%)	1.97	1.59	1.58	1.59	1.59	1.58	1.57

Table 21: E- scenario - PILLAR 1: Efficiency/Electrification - Electricity demand

11	- 1	/					
Item	2020	2025	2030	2035	2040	2045	2050
Electricity distribution capital invested -	0	3.04	3.04	3.84	3.93	5.22	5.46
Cumulative 5-yr (billion \$2018)							

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

Item	2020	2025	2050
Carbon sink potential - Aggressive deployment -	0	0	-57.1
Corn-ethanol to energy grasses (1000 tCO2e/y)			
Carbon sink potential - Aggressive deployment -	0	0	-2,225
Cropland measures (1000 tCO2e/y)			
Carbon sink potential - Aggressive deployment -	0	0	-58.1
Permanent conservation cover (1000 tCO2e/y)			
Carbon sink potential - Aggressive deployment -	0	0	-2,340
Total (1000 tC02e/y)			
Carbon sink potential - Moderate deployment -	0	0	-57.1
Corn-ethanol to energy grasses (1000 tCO2e/y)			
Carbon sink potential - Moderate deployment -	0	0	-1,171
Cropland measures (1000 tCO2e/y)			
Carbon sink potential - Moderate deployment -	0	0	-29.1
Permanent conservation cover (1000 tCO2e/y)			

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

Item	2020	2025	2050
Carbon sink potential - Moderate deployment -	0	0	-1,257
Total (1000 tCO2e/y)			
Land impacted for carbon sink - Aggressive	0	0	33
deployment - Corn-ethanol to energy grasses			
(1000 hectares)			
Land impacted for carbon sink - Aggressive	0	0	1,003
deployment - Cropland measures (1000			
hectares)			
Land impacted for carbon sink - Aggressive	0	0	106
deployment - Permanent conservation cover			
(1000 hectares)			
Land impacted for carbon sink - Aggressive	0	0	1,142
deployment - Total (1000 hectares)			
Land impacted for carbon sink - Moderate	0	0	33
deployment - Corn-ethanol to energy grasses			
(1000 hectares)			
Land impacted for carbon sink - Moderate	0	0	528
deployment - Cropland measures (1000			
hectares)			
Land impacted for carbon sink - Moderate	0	0	52.8
deployment - Permanent conservation cover			
(1000 hectares)			
Land impacted for carbon sink - Moderate	0	0	614
deployment - Total (1000 hectares)			

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

rests		
2020	2025	2050
0	0	340
		F0 /0F
U	U	58,635
		1000
U	0	1,902
0	0	11,580
U	0	11,560
0	0	6,158
0	0	22,452
0	0	592
0	0	3,048
0	0	7,006
0	0	5,558
0	0	170
0	0	19,687
0	0	317
0	0	4,448
0	0	3,133
0	0	7,484
0	0	207
0	0	1,524
	2020 0 0 0 0 0 0 0 0 0 0 0 0 0	2020 2025 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

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

Table 23: E- scenario - PILLAR 6: Land sinks - Fo	orests (contin	uedJ	
Item	2020	2025	2050
Carbon sink potential - Low - Reforest pasture	0	0	531
(1000 tCO2e/y)			
Carbon sink potential - Low - Restore	0	0	1,873
productivity (1000 tCO2e/y)			
Carbon sink potential - Mid - Accelerate	0	0	255
regeneration (1000 tC02e/y)			
Carbon sink potential - Mid - All (not counting	0	0	39,107
overlap) (1000 tC02e/y)			07,101
Carbon sink potential - Mid - Avoid deforestation	0	0	1,110
(1000 tC02e/y)			1,1.10
Carbon sink potential - Mid - Extend rotation	0	0	8,014
length (1000 tC02e/y)		0	0,014
Carbon sink potential - Mid - Improve plantations	0	0	4,591
	0	0	4,371
(1000 tC02e/y)	0	0	1/ 0/ 0
Carbon sink potential - Mid - Increase retention	0	0	14,968
of HWP (1000 tC02e/y)			
Carbon sink potential - Mid - Increase trees	0	0	400
outside forests (1000 tCO2e/y)			
Carbon sink potential - Mid - Reforest cropland	0	0	2,286
(1000 tC02e/y)			
Carbon sink potential - Mid - Reforest pasture	0	0	3,768
(1000 tCO2e/y)			
Carbon sink potential - Mid - Restore	0	0	3,715
productivity (1000 tCO2e/y)			
Land impacted for carbon sink potential - High -	0	0	55.6
Accelerate regeneration (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	258
Avoid deforestation (over 30 years) (1000			
hectares)			
Land impacted for carbon sink potential - High -	0	0	5,905
Extend rotation length (1000 hectares)		0	0,700
Land impacted for carbon sink potential - High -	0	0	2,269
Improve plantations (1000 hectares)		0	2,207
Land impacted for carbon sink potential - High -	0	0	0
Increase retention of HWP (1000 hectares)		0	U
	0	0	E/ 0
Land impacted for carbon sink potential - High -	0	U	56.3
Increase trees outside forests (1000 hectares)		-	001
Land impacted for carbon sink potential - High -	0	0	201
Reforest cropland (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	199
Reforest pasture (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	1,842
Restore productivity (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	10,786
Total impacted (over 30 years) (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	27.8
Accelerate regeneration (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	242
Avoid deforestation (over 30 years) (1000			
hectares)			
Land impacted for carbon sink potential - Low -	0	0	2,262
Extend rotation length (1000 hectares)		0	2,202
Land impacted for carbon sink potential - Low -	0	0	1,134
Improve plantations (1000 hectares)		0	1,154
	0	0	0
Land impacted for carbon sink potential - Low -	0	U	U
Increase retention of HWP (1000 hectares)		-	00.7
Land impacted for carbon sink potential - Low -	0	0	29.6
Increase trees outside forests (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	101
Reforest cropland (1000 hectares)			
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)	0	0	34.5

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

Item	2020	2025	2050
Land impacted for carbon sink potential - Low -	0	0	1,115
Restore productivity (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	4,946
Total impacted (over 30 years) (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	41.7
Accelerate regeneration (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	250
Avoid deforestation (over 30 years) (1000			
hectares)			
Land impacted for carbon sink potential - Mid -	0	0	4,084
Extend rotation length (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	1,707
Improve plantations (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	0
Increase retention of HWP (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	42.9
Increase trees outside forests (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	151
Reforest cropland (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	249
Reforest pasture (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	2,245
Restore productivity (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	8,770
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\$)	0	356	0.484	0.438	0.28	0.172	0.012
Monetary damages from air pollution - Natural Gas (million 2019\$)	0	173	114	47.2	18.7	6	3.52
Monetary damages from air pollution - Transportation (million 2019\$)	0	1,002	1,004	970	869	687	468
Premature deaths from air pollution - Coal (deaths)	0	39.9	0.054	0.049	0.031	0.019	0.001
Premature deaths from air pollution - Natural Gas (deaths)	0	19.5	12.9	5.33	2.12	0.677	0.397
Premature deaths from air pollution - Transportation (deaths)	0	113	113	109	97.7	77.3	52.6

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

•						
2020	2025	2030	2035	2040	2045	2050
0	3.86	4.57	0	0	0	0
83.7	87.1	97.8	99.9	100	100	100
16.3	12.9	2.2	0.111	0	0	0
34.1	48.8	80.6	87.8	88.1	88	88
32.6	30.4	12.8	8.81	8.63	8.75	8.76
6.33	6.33	2.2	1.25	1.2	1.18	1.18
27	14.4	4.38	2.16	2.08	2.05	2.05
0	12.1	64.3	75.9	76.4	76.4	76.4
72.5	72.8	30.8	21.4	21	21	21
23.5	12.5	2.34	0.099	0	0	0
3.93	2.64	2.61	2.62	2.63	2.63	2.64
	0 83.7 16.3 34.1 32.6 6.33 27 0 72.5	0 3.86 83.7 87.1 16.3 12.9 34.1 48.8 32.6 30.4 6.33 6.33 27 14.4 0 12.1 72.5 72.8 23.5 12.5	0 3.86 4.57 83.7 87.1 97.8 16.3 12.9 2.2 34.1 48.8 80.6 32.6 30.4 12.8 6.33 6.33 2.2 27 14.4 4.38 0 12.1 64.3 72.5 72.8 30.8 23.5 12.5 2.34	0 3.86 4.57 0 83.7 87.1 97.8 99.9 16.3 12.9 2.2 0.111 34.1 48.8 80.6 87.8 32.6 30.4 12.8 8.81 6.33 6.33 2.2 1.25 27 14.4 4.38 2.16 0 12.1 64.3 75.9 72.5 72.8 30.8 21.4 23.5 12.5 2.34 0.099	0 3.86 4.57 0 0 83.7 87.1 97.8 99.9 100 16.3 12.9 2.2 0.111 0 34.1 48.8 80.6 87.8 88.1 32.6 30.4 12.8 8.81 8.63 6.33 6.33 2.2 1.25 1.2 27 14.4 4.38 2.16 2.08 0 12.1 64.3 75.9 76.4 72.5 72.8 30.8 21.4 21 23.5 12.5 2.34 0.099 0	0 3.86 4.57 0 0 0 83.7 87.1 97.8 99.9 100 100 16.3 12.9 2.2 0.111 0 0 34.1 48.8 80.6 87.8 88.1 88 32.6 30.4 12.8 8.81 8.63 8.75 6.33 6.33 2.2 1.25 1.2 1.18 27 14.4 4.38 2.16 2.08 2.05 0 12.1 64.3 75.9 76.4 76.4 72.5 72.8 30.8 21.4 21 21 23.5 12.5 2.34 0.099 0 0

Table 26: E+RE+ scenario -	PILLAR 1: Efficienc	v/Flectrification -	Transportation
Table 20. LTNL Taccitatio	I ILLAN I. LIIICICIIC	V/ L 10011 1110411011	ii aiioboi tatioii

Item	2020	2025	2030	2035	2040	2045	2050
Light-duty vehicle capital costs - Cumulative 5-yr	0	1,020	2,605	4,234	6,409	6,981	6,653
(million \$2018)							
Public EV charging plugs - DC Fast (1000 units)	0.07	0	2.03	0	9.05	0	14.7
Public EV charging plugs - L2 (1000 units)	0.285	0	48.9	0	217	0	352
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 (%)	1.51	1.78	1.24	0.397	0.074	0.013	0
Vehicle sales - Light-duty - EV (%)	4.04	15.6	47	82	96.4	99.3	100
Vehicle sales - Light-duty - gasoline (%)	89.7	77.6	48.2	16.3	3.26	0.589	0
Vehicle sales - Light-duty - hybrid (%)	4.55	4.63	3.26	1.2	0.294	0.064	0
Vehicle sales - Light-duty - hydrogen FC (%)	0.11	0.337	0.2	0.062	0.012	0.002	0
Vehicle sales - Light-duty - other (%)	0.1	0.096	0.062	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 FC (%)	0.196	1.27	6.33	15.2	19.1	19.9	20
Vehicle sales - Medium-duty - other (%)	0.253	0.255	0.205	0.083	0.019	0.004	0

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

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Commercial (PJ)	116	116	112	106	101	99.4	100
Final energy use - Industry (PJ)	551	582	615	609	632	649	656
Final energy use - Residential (PJ)	163	153	141	126	114	108	105
Final energy use - Transportation (PJ)	546	508	443	365	294	250	232

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

Item	2020	2025	2030	2035	2040	2045	2050
Commercial HVAC investment in 2020s -	0	13,557	15,391	0	0	0	0
Cumulative 5-yr (million \$2018)							
Sales of cooking units - Electric Resistance (%)	43.5	55.3	83.4	88.9	89.2	89.2	89.1
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 Heat Pump	11.7	29.4	77	90.8	91.9	92	92
(%)							
Sales of space heating units - Electric Resistance	5.83	4.63	4.92	6.27	6.62	6.6	6.56
(%)							
Sales of space heating units - Fossil (%)	0	2.9	0.562	0.024	0	0	0
Sales of space heating units - Gas Furnace (%)	82.5	63.1	17.5	2.95	1.48	1.44	1.44
Sales of water heating units - Electric Heat Pump	0.191	10.6	55.6	65.6	66.1	66.1	66.1
(%)							
Sales of water heating units - Electric Resistance	7.05	10.1	28.1	32.2	32.3	32.3	32.3
(%)							
Sales of water heating units - Gas Furnace (%)	90.8	77.7	14.7	0.619	0	0	0
Sales of water heating units - Other (%)	1.97	1.59	1.58	1.59	1.59	1.58	1.57

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

Item	2020	2025	2030	2035	2040	2045	2050
Electricity distribution capital invested -	0	3.72	3.8	5.83	6.14	5	5.13
Cumulative 5-yr (billion \$2018)							

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

Item	2020	2025	2030	2035	2040	2045	2050
Capital invested - Offshore Wind - Base (billion \$2018)	0	0	0	0	0	0	3.29
Capital invested - Solar PV - Base (billion \$2018)	0	2.39	5.53	18.1	24.6	35.5	53.9

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

Item	2020	2025	2030	2035	2040	2045	2050
OffshoreWind - Base land use assumptions (GWh)	0	0	0	0	0	0	7,836
OffshoreWind - Constrained land use	0	0	0	0	0	0	6,693
assumptions (GWh)							
Solar - Base land use assumptions (GWh)	762	3,444	8,876	31,714	45,342	69,442	111,553
Solar - Constrained land use assumptions (GWh)	762	0	12,019	30,122	48,067	62,644	110,750

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

Table 32: E+RE+ Scenario - PILLAR 6: Lunu Sinks			
Item	2020	2025	2050
Carbon sink potential - Aggressive deployment -	0	0	-57.1
Corn-ethanol to energy grasses (1000 tCO2e/y)			
Carbon sink potential - Aggressive deployment -	0	0	-2,225
Cropland measures (1000 tCO2e/y)			
Carbon sink potential - Aggressive deployment -	0	0	-58.1
Permanent conservation cover (1000 tCO2e/y)			
Carbon sink potential - Aggressive deployment -	0	0	-2,340
Total (1000 tC02e/y)			
Carbon sink potential - Moderate deployment -	0	0	-57.1
Corn-ethanol to energy grasses (1000 tCO2e/y)			
Carbon sink potential - Moderate deployment -	0	0	-1,171
Cropland measures (1000 tCO2e/y)			
Carbon sink potential - Moderate deployment -	0	0	-29.1
Permanent conservation cover (1000 tCO2e/y)			
Carbon sink potential - Moderate deployment -	0	0	-1,257
Total (1000 tC02e/y)			
Land impacted for carbon sink - Aggressive	0	0	33
deployment - Corn-ethanol to energy grasses			
(1000 hectares)			
Land impacted for carbon sink - Aggressive	0	0	1,003
deployment - Cropland measures (1000			
hectares)			
Land impacted for carbon sink - Aggressive	0	0	106
deployment - Permanent conservation cover			
(1000 hectares)			
Land impacted for carbon sink - Aggressive	0	0	1,142
deployment - Total (1000 hectares)			
Land impacted for carbon sink - Moderate	0	0	33
deployment - Corn-ethanol to energy grasses			
(1000 hectares)			
Land impacted for carbon sink - Moderate	0	0	528
deployment - Cropland measures (1000			
hectares)			
Land impacted for carbon sink - Moderate	0	0	52.8
deployment - Permanent conservation cover			
(1000 hectares)			
Land impacted for carbon sink - Moderate	0	0	614
deployment - Total (1000 hectares)			

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

Item	2020	2025	2050
Carbon sink potential - High - Accelerate	0	0	340
regeneration (1000 tCO2e/y)			
Carbon sink potential - High - All (not counting	0	0	58,635
overlap) (1000 tCO2e/y)			
Carbon sink potential - High - Avoid deforestation	0	0	1,902
(1000 tCO2e/y)			
Carbon sink potential - High - Extend rotation	0	0	11,580
length (1000 tCO2e/y)			
Carbon sink potential - High - Improve	0	0	6,158
plantations (1000 tCO2e/y)			
Carbon sink potential - High - Increase retention	0	0	22,452
of HWP (1000 tCO2e/y)			

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

Table 33: E+RE+ scenario - PILLAR 6: Land sinks	- Furests (เน	пипиеиј	
Item	2020	2025	2050
Carbon sink potential - High - Increase trees	0	0	592
outside forests (1000 tCO2e/y)			3. -
Carbon sink potential - High - Reforest cropland	0	0	3,048
(1000 tCO2e/y)	ŭ		3,040
Carbon sink potential - High - Reforest pasture	0	0	7,006
(1000 tCO2e/y)	0	0	1,000
Carbon sink potential - High - Restore	0	0	5,558
productivity (1000 tCO2e/y)	0	0	3,336
Carbon sink potential - Low - Accelerate	0	0	170
regeneration (1000 tCO2e/y)	U	0	170
Carbon sink potential - Low - All (not counting	0	0	10 / 07
	0	0	19,687
overlap) (1000 tC02e/y)	0		017
Carbon sink potential - Low - Avoid deforestation	0	0	317
(1000 tC02e/y)			
Carbon sink potential - Low - Extend rotation	0	0	4,448
length (1000 tC02e/y)			
Carbon sink potential - Low - Improve	0	0	3,133
plantations (1000 tCO2e/y)			
Carbon sink potential - Low - Increase retention	0	0	7,484
of HWP (1000 tCO2e/y)			
Carbon sink potential - Low - Increase trees	0	0	207
outside forests (1000 tCO2e/y)			
Carbon sink potential - Low - Reforest cropland	0	0	1,524
(1000 tC02e/y)			
Carbon sink potential - Low - Reforest pasture	0	0	531
(1000 tC02e/y)			
Carbon sink potential - Low - Restore	0	0	1,873
productivity (1000 tCO2e/y)			•
Carbon sink potential - Mid - Accelerate	0	0	255
regeneration (1000 tCO2e/y)			200
Carbon sink potential - Mid - All (not counting	0	0	39,107
overlap) (1000 tC02e/y)	0	0	07,101
Carbon sink potential - Mid - Avoid deforestation	0	0	1,110
(1000 tCO2e/y)	0	0	1,110
Carbon sink potential - Mid - Extend rotation	0	0	8,014
length (1000 tCO2e/y)	0	0	0,014
Carbon sink potential - Mid - Improve plantations	0	0	4,591
	U	0	4,591
(1000 tC02e/y)	0	0	1/ 0/ 0
Carbon sink potential - Mid - Increase retention	0	0	14,968
of HWP (1000 tC02e/y)			
Carbon sink potential - Mid - Increase trees	0	0	400
outside forests (1000 tCO2e/y)			
Carbon sink potential - Mid - Reforest cropland	0	0	2,286
(1000 tC02e/y)			
Carbon sink potential - Mid - Reforest pasture	0	0	3,768
(1000 tC02e/y)			
Carbon sink potential - Mid - Restore	0	0	3,715
productivity (1000 tCO2e/y)			
Land impacted for carbon sink potential - High -	0	0	55.6
Accelerate regeneration (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	258
Avoid deforestation (over 30 years) (1000			
hectares)			
Land impacted for carbon sink potential - High -	0	0	5,905
Extend rotation length (1000 hectares)			-,,
Land impacted for carbon sink potential - High -	0	0	2,269
Improve plantations (1000 hectares)	9	0	2,207
Land impacted for carbon sink potential - High -	0	0	0
Increase retention of HWP (1000 hectares)	o	U	U
	0	0	E/ 0
Land impacted for carbon sink potential - High -	0	0	56.3
Increase trees outside forests (1000 hectares)			001
Land impacted for carbon sink potential - High -	0	0	201
Reforest cropland (1000 hectares)	l l		

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

Item	s - Forests (6 2020	2025	2050
			199
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)	0	0	
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)	0	0	1,842
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)	0	0	10,786
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)	0	0	27.8
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000	0	0	242
hectares) Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)	0	0	2,262
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)	0	0	1,134
Land impacted for carbon sink potential - Low - Increase retention of HWP (1000 hectares)	0	0	0
Land impacted for carbon sink potential - Low - Increase trees outside forests (1000 hectares)	0	0	29.6
Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares)	0	0	101
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)	0	0	34.5
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)	0	0	1,115
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)	0	0	4,946
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)	0	0	41.7
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)	0	0	250
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)	0	0	4,084
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)	0	0	1,707
Land impacted for carbon sink potential - Mid - Increase retention of HWP (1000 hectares)	0	0	0
Land impacted for carbon sink potential - Mid - Increase trees outside forests (1000 hectares)	0	0	42.9
Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares)	0	0	151
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)	0	0	249
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)	0	0	2,245
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)	0	0	8,770

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

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal (million 2019\$)	0	356	0.484	0.438	0.28	0.172	0.012
Monetary damages from air pollution - Natural Gas (million 2019\$)	0	207	156	86.3	52.2	11.5	3.94
Monetary damages from air pollution - Transportation (million 2019\$)	0	985	912	688	394	178	68.5
Premature deaths from air pollution - Coal (deaths)	0	39.9	0.054	0.049	0.031	0.019	0.001
Premature deaths from air pollution - Natural Gas (deaths)	0	23.4	17.6	9.74	5.9	1.29	0.446
Premature deaths from air pollution - Transportation (deaths)	0	111	103	77.4	44.4	20	7.7

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

Item	2020	2025	2030	2035	2040	2045	2050
Residential HVAC investment in 2020s vs. REF -	0	3.86	4.57	0	0	0	0
Cumulative 5-yr (billion \$2018)							
Sales of cooking units - Electric Resistance (%)	83.7	87.1	97.8	99.9	100	100	100
Sales of cooking units - Gas (%)	16.3	12.9	2.2	0.111	0	0	0
Sales of space heating units - Electric Heat Pump	34.1	48.8	80.6	87.8	88.1	88	88
(%)							
Sales of space heating units - Electric Resistance	32.6	30.4	12.8	8.81	8.63	8.75	8.76
(%)							
Sales of space heating units - Fossil (%)	6.33	6.33	2.2	1.25	1.2	1.18	1.18
Sales of space heating units - Gas (%)	27	14.4	4.38	2.16	2.08	2.05	2.05
Sales of water heating units - Electric Heat Pump	0	12.1	64.3	75.9	76.4	76.4	76.4
(%)							
Sales of water heating units - Electric Resistance	72.5	72.8	30.8	21.4	21	21	21
(%)							
Sales of water heating units - Gas Furnace (%)	23.5	12.5	2.34	0.099	0	0	0
Sales of water heating units - Other (%)	3.93	2.64	2.61	2.62	2.63	2.63	2.64

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

Item	2020	2025	2030	2035	2040	2045	2050
Light-duty vehicle capital costs - Cumulative 5-yr	0	1,020	2,605	4,234	6,409	6,981	6,653
(million \$2018)							
Public EV charging plugs - DC Fast (1000 units)	0.07	0	2.03	0	9.05	0	14.7
Public EV charging plugs - L2 (1000 units)	0.285	0	48.9	0	217	0	352
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 (%)	1.51	1.78	1.24	0.397	0.074	0.013	0
Vehicle sales - Light-duty - EV (%)	4.04	15.6	47	82	96.4	99.3	100
Vehicle sales - Light-duty - gasoline (%)	89.7	77.6	48.2	16.3	3.26	0.589	0
Vehicle sales - Light-duty - hybrid (%)	4.55	4.63	3.26	1.2	0.294	0.064	0
Vehicle sales - Light-duty - hydrogen FC (%)	0.11	0.337	0.2	0.062	0.012	0.002	0
Vehicle sales - Light-duty - other (%)	0.1	0.096	0.062	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 FC (%)	0.196	1.27	6.33	15.2	19.1	19.9	20
Vehicle sales - Medium-duty - other (%)	0.253	0.255	0.205	0.083	0.019	0.004	0

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

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Commercial (PJ)	116	116	112	106	101	99.4	100
Final energy use - Industry (PJ)	551	582	615	609	632	649	656
Final energy use - Residential (PJ)	163	153	141	126	114	108	105
Final energy use - Transportation (PJ)	546	508	443	365	294	250	232

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

Item	2020	2025	2030	2035	2040	2045	2050
Commercial HVAC investment in 2020s -	0	13,557	15,391	0	0	0	0
Cumulative 5-yr (million \$2018)							
Sales of cooking units - Electric Resistance (%)	43.5	55.3	83.4	88.9	89.2	89.2	89.1
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 Heat Pump (%)	11.7	29.4	77	90.8	91.9	92	92
Sales of space heating units - Electric Resistance (%)	5.83	4.63	4.92	6.27	6.62	6.6	6.56
Sales of space heating units - Fossil (%)	0	2.9	0.562	0.024	0	0	0

Table 38: E+RE- scenario - PILLAR 1: Efficiency/Electrification - Commercial (continued)

Item	2020	2025	2030	2035	2040	2045	2050
Sales of space heating units - Gas Furnace (%)	82.5	63.1	17.5	2.95	1.48	1.44	1.44
Sales of water heating units - Electric Heat Pump (%)	0.191	10.6	55.6	65.6	66.1	66.1	66.1
Sales of water heating units - Electric Resistance (%)	7.05	10.1	28.1	32.2	32.3	32.3	32.3
Sales of water heating units - Gas Furnace (%)	90.8	77.7	14.7	0.619	0	0	0
Sales of water heating units - Other (%)	1.97	1.59	1.58	1.59	1.59	1.58	1.57

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

Item	2020	2025	2030	2035	2040	2045	2050
Electricity distribution capital invested -	0	3.72	3.8	5.83	6.14	5	5.13
Cumulative 5-yr (billion \$2018)							

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	0.69	3.37	4.54	3.65	0
Capital invested - Solar PV - Constrained (billion	0	0	0.748	2.12	3.82	3.34	1.22
\$2018)							

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

Item	2020	2025	2030	2035	2040	2045	2050
Solar - Base land use assumptions (GWh)	762	0	1,102	5,883	8,447	7,128	0
Solar - Constrained land use assumptions (GWh)	762	0	1,194	3,677	7,039	6,575	2,533

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

Table 42. ETRE Section 11 TEE/TK S. Earla Sinks	rigiricartar		
Item	2020	2025	2050
Carbon sink potential - Aggressive deployment -	0	0	-57.1
Corn-ethanol to energy grasses (1000 tC02e/y)			
Carbon sink potential - Aggressive deployment -	0	0	-2,225
Cropland measures (1000 tCO2e/y)			
Carbon sink potential - Aggressive deployment -	0	0	-58.1
Permanent conservation cover (1000 tCO2e/y)			
Carbon sink potential - Aggressive deployment -	0	0	-2,340
Total (1000 tCO2e/y)			
Carbon sink potential - Moderate deployment -	0	0	-57.1
Corn-ethanol to energy grasses (1000 tC02e/y)			
Carbon sink potential - Moderate deployment -	0	0	-1,171
Cropland measures (1000 tC02e/y)			
Carbon sink potential - Moderate deployment -	0	0	-29.1
Permanent conservation cover (1000 tC02e/y)			
Carbon sink potential - Moderate deployment -	0	0	-1,257
Total (1000 tC02e/y)			
Land impacted for carbon sink - Aggressive	0	0	33
deployment - Corn-ethanol to energy grasses			
(1000 hectares)			
Land impacted for carbon sink - Aggressive	0	0	1,003
deployment - Cropland measures (1000			
hectares)			
Land impacted for carbon sink - Aggressive	0	0	106
deployment - Permanent conservation cover			
(1000 hectares)			
Land impacted for carbon sink - Aggressive	0	0	1,142
deployment - Total (1000 hectares)			
Land impacted for carbon sink - Moderate	0	0	33
deployment - Corn-ethanol to energy grasses			
(1000 hectares)			
Land impacted for carbon sink - Moderate	0	0	528
deployment - Cropland measures (1000			
hectares)			
		I	

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

Item	2020	2025	2050
Land impacted for carbon sink - Moderate	0	0	52.8
deployment - Permanent conservation cover			
(1000 hectares)			
Land impacted for carbon sink - Moderate	0	0	614
deployment - Total (1000 hectares)			

Item	2020	2025	2050
Carbon sink potential - High - Accelerate regeneration (1000 tC02e/y)	0	0	340
Carbon sink potential - High - All (not counting overlap) (1000 tC02e/y)	0	0	58,635
Carbon sink potential - High - Avoid deforestation (1000 tC02e/y)	0	0	1,902
Carbon sink potential - High - Extend rotation length (1000 tCO2e/y)	0	0	11,580
Carbon sink potential - High - Improve plantations (1000 tC02e/y)	0	0	6,158
Carbon sink potential - High - Increase retention of HWP (1000 tCO2e/y)	0	0	22,452
Carbon sink potential - High - Increase trees outside forests (1000 tCO2e/y)	0	0	592
Carbon sink potential - High - Reforest cropland (1000 tC02e/y)	0	0	3,048
Carbon sink potential - High - Reforest pasture (1000 tC02e/y)	0	0	7,006
Carbon sink potential - High - Restore productivity (1000 tC02e/y)	0	0	5,558
Carbon sink potential - Low - Accelerate regeneration (1000 tC02e/y)	0	0	170
Carbon sink potential - Low - All (not counting overlap) (1000 tCO2e/y)	0	0	19,687
Carbon sink potential - Low - Avoid deforestation (1000 tC02e/y)	0	0	317
Carbon sink potential - Low - Extend rotation length (1000 tCO2e/y)	0	0	4,448
Carbon sink potential - Low - Improve plantations (1000 tCO2e/y)	0	0	3,133
Carbon sink potential - Low - Increase retention of HWP (1000 tC02e/y)	0	0	7,484
Carbon sink potential - Low - Increase trees outside forests (1000 tCO2e/y)	0	0	207
Carbon sink potential - Low - Reforest cropland (1000 tCO2e/y)	0	0	1,524
Carbon sink potential - Low - Reforest pasture (1000 tC02e/y)	0	0	531
Carbon sink potential - Low - Restore productivity (1000 tC02e/y)	0	0	1,873
Carbon sink potential - Mid - Accelerate regeneration (1000 tC02e/y)	0	0	255
Carbon sink potential - Mid - All (not counting overlap) (1000 tC02e/y)	0	0	39,107
Carbon sink potential - Mid - Avoid deforestation (1000 tCO2e/y)	0	0	1,110
Carbon sink potential - Mid - Extend rotation length (1000 tC02e/y)	0	0	8,014
Carbon sink potential - Mid - Improve plantations (1000 tC02e/y)	0	0	4,591
Carbon sink potential - Mid - Increase retention of HWP (1000 tC02e/y)	0	0	14,968
Carbon sink potential - Mid - Increase trees outside forests (1000 tCO2e/y)	0	0	400

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

Item Carbon sink potential - Mid - Reforest cropland (1000 tCO2e/y) Carbon sink potential - Mid - Reforest pasture (1000 tCO2e/y) Carbon sink potential - Mid - Restore productivity (1000 tCO2e/y)	2020 0 0	2025	2050 2,286
(1000 tCO2e/y) Carbon sink potential - Mid - Reforest pasture (1000 tCO2e/y) Carbon sink potential - Mid - Restore			2,286
(1000 tCO2e/y) Carbon sink potential - Mid - Reforest pasture (1000 tCO2e/y) Carbon sink potential - Mid - Restore	0		
(1000 tCO2e/y) Carbon sink potential - Mid - Restore	0		
Carbon sink potential - Mid - Restore		0	3,768
	0	0	3,715
1,			•
Land impacted for carbon sink potential - High -	0	0	55.6
Accelerate regeneration (1000 hectares)			00.0
Land impacted for carbon sink potential - High -	0	0	258
Avoid deforestation (over 30 years) (1000		•	200
hectares)			
Land impacted for carbon sink potential - High -	0	0	5,905
Extend rotation length (1000 hectares)	0	0	3,703
Land impacted for carbon sink potential - High -	0	0	2,269
Improve plantations (1000 hectares)	U	0	2,207
Land impacted for carbon sink potential - High -	0	0	0
	U	U	U
Increase retention of HWP (1000 hectares)	0		F/ 0
Land impacted for carbon sink potential - High -	0	0	56.3
Increase trees outside forests (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	201
Reforest cropland (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	199
Reforest pasture (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	1,842
Restore productivity (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	10,786
Total impacted (over 30 years) (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	27.8
Accelerate regeneration (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	242
Avoid deforestation (over 30 years) (1000			
hectares)			
Land impacted for carbon sink potential - Low -	0	0	2,262
Extend rotation length (1000 hectares)			, -
Land impacted for carbon sink potential - Low -	0	0	1,134
Improve plantations (1000 hectares)			.,
Land impacted for carbon sink potential - Low -	0	0	0
Increase retention of HWP (1000 hectares)	0	0	U
Land impacted for carbon sink potential - Low -	0	0	29.6
Increase trees outside forests (1000 hectares)	0	0	27.0
	0		101
Land impacted for carbon sink potential - Low -	U	0	101
Reforest cropland (1000 hectares)	0		0/ 5
Land impacted for carbon sink potential - Low -	0	0	34.5
Reforest pasture (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	1,115
Restore productivity (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	4,946
Total impacted (over 30 years) (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	41.7
Accelerate regeneration (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	250
Avoid deforestation (over 30 years) (1000			
hectares)			
Land impacted for carbon sink potential - Mid -	0	0	4,084
Extend rotation length (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	1,707
Improve plantations (1000 hectares)	-	-	,
Land impacted for carbon sink potential - Mid -	0	0	0
Increase retention of HWP (1000 hectares)	J	٦	J
Land impacted for carbon sink potential - Mid -	0	0	42.9
Increase trees outside forests (1000 hectares)	U	U	42.7
	0		151
Land impacted for carbon sink potential - Mid -	0	0	151
Reforest cropland (1000 hectares)	1	1	

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

Item	2020	2025	2050
Land impacted for carbon sink potential - Mid -	0	0	249
Reforest pasture (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	2,245
Restore productivity (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	8,770
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 - Coal (million 2019\$)	0	356	0.484	0.438	0.28	0.172	0.012
Monetary damages from air pollution - Natural Gas (million 2019\$)	0	160	144	133	103	36	12.3
Monetary damages from air pollution - Transportation (million 2019\$)	0	985	912	688	394	178	68.5
Premature deaths from air pollution - Coal (deaths)	0	39.9	0.054	0.049	0.031	0.019	0.001
Premature deaths from air pollution - Natural Gas (deaths)	0	18.1	16.3	15	11.6	4.07	1.39
Premature deaths from air pollution - Transportation (deaths)	0	111	103	77.4	44.4	20	7.7

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

Item	2020	2025	2030	2035	2040	2045	2050
Residential HVAC investment in 2020s vs. REF -	0	3.81	4.31	0	0	0	0
Cumulative 5-yr (billion \$2018)							
Sales of cooking units - Electric Resistance (%)	83.6	84	85.5	89.5	95	98.4	99.6
Sales of cooking units - Gas (%)	16.4	16	14.5	10.5	5.01	1.62	0.435
Sales of space heating units - Electric Heat Pump	34.1	42.7	46.3	56.9	72.9	83.2	86.8
(%)							
Sales of space heating units - Electric Resistance	32.6	33.8	31.7	25.8	17	11.4	9.4
(%)							
Sales of space heating units - Fossil (%)	6.33	7.13	6.71	5.24	3.12	1.79	1.34
Sales of space heating units - Gas (%)	27	16.4	15.2	12.1	7.04	3.65	2.47
Sales of water heating units - Electric Heat Pump	0	2.09	8.02	25.1	51.3	68.4	74.3
(%)							
Sales of water heating units - Electric Resistance	72.5	80.9	76.2	62.3	41.2	27.4	22.6
(%)							
Sales of water heating units - Gas Furnace (%)	23.5	14.4	13.2	9.97	4.91	1.56	0.408
Sales of water heating units - Other (%)	3.93	2.64	2.61	2.64	2.65	2.64	2.64

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

Item	2020	2025	2030	2035	2040	2045	2050
Light-duty vehicle capital costs - Cumulative 5-yr	0	0	163	347	1,168	3,685	5,365
(million \$2018)							
Public EV charging plugs - DC Fast (1000 units)	0.07	0	0.612	0	3.34	0	9.39
Public EV charging plugs - L2 (1000 units)	0.285	0	14.7	0	80.3	0	225
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 (%)	1.52	1.94	2.05	1.63	1.04	0.533	0.228
Vehicle sales - Light-duty - EV (%)	1.93	4.78	12.1	26.2	48.7	72.3	87.7
Vehicle sales - Light-duty - gasoline (%)	91.6	87.3	79.3	66.3	45.8	24.6	10.9
Vehicle sales - Light-duty - hybrid (%)	4.72	5.51	6.18	5.61	4.18	2.46	1.19
Vehicle sales - Light-duty - hydrogen FC (%)	0.113	0.379	0.324	0.246	0.174	0.097	0.045
Vehicle sales - Light-duty - other (%)	0.101	0.105	0.095	0.083	0.059	0.033	0.015
Vehicle sales - Medium-duty - diesel (%)	64.8	62.2	57.7	49.4	35.6	19.6	8.37

Table 46: E-B+ scenario - PILLAR 1: Efficiency/Ela					00/0	00/5	0050
Item	2020	2025	2030	2035	2040	2045	2050
Vehicle sales - Medium-duty - EV (%)	0.664	1.94	5.49	14.3	31.4	52.6	68
Vehicle sales - Medium-duty - gasoline (%) Vehicle sales - Medium-duty - hybrid (%)	33.8 0.363	34.7 0.418	34.7 0.464	31.9 0.478	24.4 0.414	14.2 0.275	6.33 0.141
Vehicle sales - Medium-duty - hydrogen FC (%)	0.363	0.485	1.37	3.58	7.86	13.2	17
Vehicle sales - Medium-duty - Hydrogen FC (%)	0.166	0.465	0.279	0.286	0.258	0.184	0.102
,	'		'	0.200	0.200	0.104	0.102
Table 47: E-B+ scenario - PILLAR 1: Efficiency/Ele	•			2227	2212	2215	
Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Commercial (PJ)	116	116	115	113	110	107	105
Final energy use - Industry (PJ)	551	582	616	613	638	655	660
Final energy use - Residential (PJ) Final energy use - Transportation (PJ)	163 546	154 513	147 465	140 427	131 397	121 363	113 322
			<u>'</u>	121	9		
Table 48: <i>E-B+ scenario - PILLAR 1: Efficiency/El</i> Item	2020	2025	2030	2035	2040	2045	2050
Commercial HVAC investment in 2020s -	0	13,551	15,374	0	0	0	2030
Cumulative 5-yr (million \$2018) Sales of cooking units - Electric Resistance (%)	43.5	47.1	51.3	61.6	76.1	85	88
Sales of cooking units - Electric Resistance (%)	56.5	52.9	48.7	38.4	23.9	15	12
Sales of space heating units - Electric Heat Pump	11.7	20.3	25.7	41.5	66.1	83.2	89.6
(%) Sales of space heating units - Electric Resistance	5.83	4.63	4.65	4.79	5.28	5.94	6.33
(%)	5.65	4.03	4.65	4.19	5.20	5.94	0.33
Sales of space heating units - Fossil (%)	0	3.35	3.16	2.4	1.19	0.387	0.102
Sales of space heating units - Gas Furnace (%)	82.5	71.7	66.5	51.3	27.4	10.5	3.93
Sales of water heating units - Electric Heat Pump (%)	0.191	1.96	7.08	21.8	44.4	59.2	64.3
Sales of water heating units - Electric Resistance (%)	7.05	6.58	8.46	14.5	23.6	29.5	31.6
Sales of water heating units - Gas Furnace (%)	90.8	89.9	82.9	62.1	30.4	9.73	2.53
Sales of water heating units - Other (%)	1.97	1.59	1.58	1.59	1.59	1.58	1.57
Table 49: E-B+ scenario - PILLAR 1: Efficiency/Ele Item	ectrificatior 2020			2035	2040	2045	2050
Electricity distribution capital invested -	0	3.04	3.04	3.84	3.93	5.22	5.46
Cumulative 5-yr (billion \$2018)		0.0 1	0.01	0.01	0.70	0.22	0.10
Table 50: E-B+ scenario - PILLAR 2: Clean Electr	<u> </u>	<u> </u>	•				
Item Capital invested - Biomass power plant (billion	2020	2025	2030	2035	2040	2045	2050
\$2018)	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	7.01	16.4	0	0
Table 51: E-B+ scenario - PILLAR 2: Clean Electri							
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
Biomass w/ccu power plant (GWh)	0	0	0	7,863	26,215	26,215	26,215
Table 52: E-B+ scenario - PILLAR 3: Clean fuels -		2005	0000	0005	00/0	0015	2053
Item	2020	2025	2030	2035	2040	2045	2050
Biomass purchases (million \$2018/year)	0	0	0	479	2,220	3,039	3,039

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

Item	2020	2025	2030	2035	2040	2045	2050
Conversion capital investment - Cumulative 5-yr	0	0	0	6,531	22,561	9,661	0
(million \$2018)							
Number of facilities - Allam power w ccu	0	0	0	0	0	0	0
(quantity)							
Number of facilities - Beccs hydrogen (quantity)	0	0	0	1	10	21	21
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 (quantity)	0	0	0	6	20	20	20
Number of facilities - Pyrolysis (quantity)	0	0	0	0	0	0	0
Number of facilities - Pyrolysis ccu (quantity)	0	0	0	1	2	2	2
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 53: E-B+ scenario - PILLAR 4: CCUS - CO2 capture

Item	2020	2025	2030	2035	2040	2045	2050
Annual - All (MMT)	0	0	3.24	11.2	39.1	55	55.8
Annual - BECCS (MMT)	0	0	0	7.89	35.8	48.2	48.1
Annual - Cement and lime (MMT)	0	0	3.24	3.35	3.32	6.84	7.07
Annual - NGCC (MMT)	0	0	0	0	0	0	0.69
Cumulative - All (MMT)	0	0	3.24	14.5	53.6	109	164
Cumulative - BECCS (MMT)	0	0	0	7.89	43.6	91.8	140
Cumulative - Cement and lime (MMT)	0	0	3.24	6.59	9.91	16.8	23.8
Cumulative - NGCC (MMT)	0	0	0	0	0	0	0.69

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

Item	2020	2025	2030	2035	2040	2045	2050
CO2 storage (MMT)	0	0	3.69	15	30.9	43.3	46.8
Injection wells (wells)	0	0	4	14	26	44	56
Resource characterization, appraisal, permitting costs (million \$2020)	0	14.6	361	580	580	580	580
Wells and facilities construction costs (million \$2020)	0	0	114	446	795	1,330	1,651

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

Item	2020	2025	2030	2035	2040	2045	2050
All (km)	0	0	648	2,004	2,846	4,113	4,308
Cumulative investment - All (million \$2018)	0	0	2,093	5,131	6,675	7,991	8,051
Cumulative investment - Spur (million \$2018)	0	0	221	1,388	2,806	4,123	4,183
Cumulative investment - Trunk (million \$2018)	0	0	1,872	3,743	3,869	3,869	3,869
Spur (km)	0	0	313	1,335	2,177	3,443	3,639
Trunk (km)	0	0	335	669	669	669	669

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

Item	2020	2025	2050
Carbon sink potential - Aggressive deployment -	0	0	-216
Corn-ethanol to energy grasses (1000 tCO2e/y)			
Carbon sink potential - Aggressive deployment -	0	0	-2,063
Cropland measures (1000 tCO2e/y)			
Carbon sink potential - Aggressive deployment -	0	0	0
Cropland to woody energy crops (1000 tCO2e/y)			
Carbon sink potential - Aggressive deployment -	0	0	0
Pasture to energy crops (1000 tCO2e/y)			
Carbon sink potential - Aggressive deployment -	0	0	-53.1
Permanent conservation cover (1000 tCO2e/y)			
Carbon sink potential - Aggressive deployment -	0	0	-2,332
Total (1000 tC02e/y)			
Carbon sink potential - Moderate deployment -	0	0	-216
Corn-ethanol to energy grasses (1000 tCO2e/y)			
Carbon sink potential - Moderate deployment -	0	0	-216

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

Table 56: E-B+ Scenario - PILLAR 6: Lana Sinks -	•	•	•
Item	2020	2025	2050
Carbon sink potential - Moderate deployment -	0	0	-1,085
Cropland measures (1000 tCO2e/y)			
Carbon sink potential - Moderate deployment -	0	0	0
Cropland to woody energy crops (1000 tCO2e/y)			
Carbon sink potential - Moderate deployment -	0	0	0
Pasture to energy crops (1000 tC02e/y)			
Carbon sink potential - Moderate deployment -	0	0	-26.6
Permanent conservation cover (1000 tC02e/y)			
Carbon sink potential - Moderate deployment -	0	0	-1,328
Total (1000 tC02e/y)			
Land impacted for carbon sink - Aggressive	0	0	118
deployment - Corn-ethanol to energy grasses			
(1000 hectares)			
Land impacted for carbon sink - Aggressive	0	0	2,276
deployment - Cropland measures (1000			
hectares)			
Land impacted for carbon sink - Aggressive	0	0	45.6
deployment - Cropland to woody energy crops			
(1000 hectares)			
Land impacted for carbon sink - Aggressive	0	0	327
deployment - Pasture to energy crops (1000			
hectares)			
Land impacted for carbon sink - Aggressive	0	0	96.7
deployment - Permanent conservation cover			
(1000 hectares)			
Land impacted for carbon sink - Aggressive	0	0	2,863
deployment - Total (1000 hectares)			
Land impacted for carbon sink - Moderate	0	0	118
deployment - Corn-ethanol to energy grasses			
(1000 hectares)			
Land impacted for carbon sink - Moderate	0	0	485
deployment - Cropland measures (1000			
hectares)			
Land impacted for carbon sink - Moderate	0	0	45.6
deployment - Cropland to woody energy crops			
(1000 hectares)			
Land impacted for carbon sink - Moderate	0	0	327
deployment - Pasture to energy crops (1000			
hectares)			
Land impacted for carbon sink - Moderate	0	0	48.3
deployment - Permanent conservation cover			
(1000 hectares)			
Land impacted for carbon sink - Moderate	0	0	1,024
deployment - Total (1000 hectares)			

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

Item	2020	2025	2050
Carbon sink potential - High - Accelerate	0	0	340
regeneration (1000 tCO2e/y)			
Carbon sink potential - High - All (not counting	0	0	58,635
overlap) (1000 tCO2e/y)			
Carbon sink potential - High - Avoid deforestation	0	0	1,902
(1000 tC02e/y)			
Carbon sink potential - High - Extend rotation	0	0	11,580
length (1000 tCO2e/y)			
Carbon sink potential - High - Improve	0	0	6,158
plantations (1000 tCO2e/y)			
Carbon sink potential - High - Increase retention	0	0	22,452
of HWP (1000 tCO2e/y)			
Carbon sink potential - High - Increase trees	0	0	592
outside forests (1000 tCO2e/y)			
Carbon sink potential - High - Reforest cropland	0	0	3,048
(1000 tCO2e/y)			

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

Table 57: E-B+ scenario - PILLAR 6: Land sinks -	Forests (con	tinued)	
Item	2020	2025	2050
Carbon sink potential - High - Reforest pasture	0	0	7,006
(1000 tC02e/y)			
Carbon sink potential - High - Restore	0	0	5,558
productivity (1000 tCO2e/y)			
Carbon sink potential - Low - Accelerate	0	0	170
regeneration (1000 tCO2e/y)			
Carbon sink potential - Low - All (not counting	0	0	19,687
overlap) (1000 tCO2e/y)			
Carbon sink potential - Low - Avoid deforestation	0	0	317
(1000 tCO2e/y)			
Carbon sink potential - Low - Extend rotation	0	0	4,448
length (1000 tCO2e/y)			
Carbon sink potential - Low - Improve	0	0	3,133
plantations (1000 tCO2e/y)			
Carbon sink potential - Low - Increase retention	0	0	7,484
of HWP (1000 tCO2e/y)			
Carbon sink potential - Low - Increase trees	0	0	207
outside forests (1000 tCO2e/y)			
Carbon sink potential - Low - Reforest cropland	0	0	1,524
(1000 tCO2e/y)			.,
Carbon sink potential - Low - Reforest pasture	0	0	531
(1000 tCO2e/y)			001
Carbon sink potential - Low - Restore	0	0	1,873
productivity (1000 tC02e/y)		0	1,010
Carbon sink potential - Mid - Accelerate	0	0	255
regeneration (1000 tC02e/y)		0	200
Carbon sink potential - Mid - All (not counting	0	0	39,107
overlap) (1000 tC02e/y)		0	39,101
Carbon sink potential - Mid - Avoid deforestation	0	0	1,110
(1000 tC02e/y)	0	0	1,110
Carbon sink potential - Mid - Extend rotation	0	0	8,014
	0	0	8,014
length (1000 tC02e/y)	0	0	/ 501
Carbon sink potential - Mid - Improve plantations	0	0	4,591
(1000 tC02e/y)	0	0	1/ 0/0
Carbon sink potential - Mid - Increase retention	0	0	14,968
of HWP (1000 tCO2e/y)			
Carbon sink potential - Mid - Increase trees	0	0	400
outside forests (1000 tC02e/y)			0.007
Carbon sink potential - Mid - Reforest cropland	0	0	2,286
(1000 tC02e/y)			
Carbon sink potential - Mid - Reforest pasture	0	0	3,768
(1000 tC02e/y)			
Carbon sink potential - Mid - Restore	0	0	3,715
productivity (1000 tCO2e/y)			
Land impacted for carbon sink potential - High -	0	0	55.6
Accelerate regeneration (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	258
Avoid deforestation (over 30 years) (1000			
hectares)			
Land impacted for carbon sink potential - High -	0	0	5,905
Extend rotation length (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	2,269
Improve plantations (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	0
Increase retention of HWP (1000 hectares)	-	-	-
Land impacted for carbon sink potential - High -	0	0	56.3
Increase trees outside forests (1000 hectares)		ŭ	55.5
Land impacted for carbon sink potential - High -	0	0	201
Reforest cropland (1000 hectares)	"	١	201
Land impacted for carbon sink potential - High -	0	0	199
Reforest pasture (1000 hectares)	"	U	177
Land impacted for carbon sink potential - High -	0	0	1,842
Restore productivity (1000 hectares)	"	U	1,042
restore bi odderivity (1000 Hectal es)			

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

Item	2020	2025	2050
Land impacted for carbon sink potential - High -	2020	2025	10,786
Total impacted (over 30 years) (1000 hectares)	"	U	10,766
Land impacted for carbon sink potential - Low -	0	0	27.8
Accelerate regeneration (1000 hectares)		U	21.0
Land impacted for carbon sink potential - Low -	0	0	242
Avoid deforestation (over 30 years) (1000	0	U	242
hectares)			
Land impacted for carbon sink potential - Low -	0	0	2,262
Extend rotation length (1000 hectares)	0	U	2,262
	0	0	1107
Land impacted for carbon sink potential - Low -	0	0	1,134
Improve plantations (1000 hectares)		0	0
Land impacted for carbon sink potential - Low -	0	0	0
Increase retention of HWP (1000 hectares)			20. (
Land impacted for carbon sink potential - Low -	0	0	29.6
Increase trees outside forests (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	101
Reforest cropland (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	34.5
Reforest pasture (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	1,115
Restore productivity (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	4,946
Total impacted (over 30 years) (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	41.7
Accelerate regeneration (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	250
Avoid deforestation (over 30 years) (1000			
hectares)			
Land impacted for carbon sink potential - Mid -	0	0	4,084
Extend rotation length (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	1,707
Improve plantations (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	0
Increase retention of HWP (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	42.9
Increase trees outside forests (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	151
Reforest cropland (1000 hectares)		_	
Land impacted for carbon sink potential - Mid -	0	0	249
Reforest pasture (1000 hectares)		•	,
Land impacted for carbon sink potential - Mid -	0	0	2,245
Restore productivity (1000 hectares)		U	2,240
Land impacted for carbon sink potential - Mid -	0	0	8,770
Total impacted (over 30 years) (1000 hectares)		5	5,110
rotal impactor (over oo year of (1000 fielda es)			

 ${\it Table 58: REF \, scenario - PILLAR \, 1: \, Efficiency/Electrification - \, Residential}$

Item	2020	2025	2030	2035	2040	2045	2050
Residential HVAC investment in 2020s vs. REF -	0	3.76	3.8	0	0	0	0
Cumulative 5-yr (billion \$2018)							
Sales of cooking units - Electric Resistance (%)	83.5	83.5	83.5	83.5	83.5	83.5	83.5
Sales of cooking units - Gas (%)	16.5	16.5	16.5	16.5	16.5	16.5	16.5
Sales of space heating units - Electric Heat Pump	32.1	57	57.8	59.1	60.4	62.1	64.7
(%)							
Sales of space heating units - Electric Resistance	33.6	26.8	26.4	25.6	24.5	23	20.3
(%)							
Sales of space heating units - Fossil (%)	6.48	4.04	4.09	4.01	3.92	3.88	3.9
Sales of space heating units - Gas (%)	27.8	12.1	11.7	11.3	11.2	11.1	11.1
Sales of water heating units - Electric Heat Pump	0	0	0	0	0	0	0
(%)							
Sales of water heating units - Electric Resistance	72.5	82.6	82.7	82.5	82.4	82.4	82.3
(%)							
Sales of water heating units - Gas Furnace (%)	23.5	14.8	14.7	14.9	15	15	15
Sales of water heating units - Other (%)	3.93	2.64	2.61	2.64	2.66	2.66	2.66

Table 59: 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 (%)	1.52	1.94	2.18	2.03	1.82	1.7	1.62
Vehicle sales - Light-duty - EV (%)	3.69	5.76	6.55	8.07	9.81	11.3	12.5
Vehicle sales - Light-duty - gasoline (%)	90	86.4	84.2	82.3	80.2	78.3	76.7
Vehicle sales - Light-duty - hybrid (%)	4.56	5.4	6.6	7.17	7.73	8.29	8.72
Vehicle sales - Light-duty - hydrogen FC (%)	0.111	0.375	0.344	0.305	0.301	0.302	0.312
Vehicle sales - Light-duty - other (%)	0.1	0.104	0.101	0.101	0.1	0.099	0.102
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
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 60: REF scenario - PILLAR 1: Efficiency/Electrification - Overview

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Commercial (PJ)	116	118	119	119	120	124	129
Final energy use - Industry (PJ)	551	594	623	639	664	684	709
Final energy use - Residential (PJ)	163	154	151	149	149	150	153
Final energy use - Transportation (PJ)	546	512	468	441	440	453	469

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

Item	2020	2025	2030	2035	2040	2045	2050
Commercial HVAC investment in 2020s -	0	13,308	13,855	0	0	0	0
Cumulative 5-yr (million \$2018)							
Sales of cooking units - Electric Resistance (%)	43.5	45.6	45.9	45.7	46	45.9	45.7
Sales of cooking units - Gas (%)	56.5	54.4	54.1	54.3	54	54.1	54.3
Sales of space heating units - Electric Heat Pump	11.7	32	71.2	79	79.3	79.3	79.4
(%)							
Sales of space heating units - Electric Resistance	5.83	6.42	12	15.8	18.7	19.2	19.2
(%)							
Sales of space heating units - Fossil (%)	0	2.68	0.471	0.024	0	0	0
Sales of space heating units - Gas Furnace (%)	82.5	58.9	16.3	5.24	1.95	1.49	1.44
Sales of water heating units - Electric Heat Pump	0.191	0.157	0.15	0.153	0.152	0.148	0.15
(%)							
Sales of water heating units - Electric Resistance	7.05	5.85	5.67	5.75	5.7	5.62	5.68
(%)							
Sales of water heating units - Gas Furnace (%)	90.8	92.4	92.6	92.5	92.6	92.7	92.6
Sales of water heating units - Other (%)	1.97	1.59	1.58	1.59	1.59	1.58	1.57

Table 62: REF scenario - PILLAR 1: Efficiency/Electrification - Electricity demand

Item	2020	2025	2030	2035	2040	2045	2050
Electricity distribution capital invested -	0	4.01	4.13	5.56	5.83	5.01	5.15
Cumulative 5-yr (billion \$2018)							

Table 63: REF scenario - PILLAR 6: Land sinks - Forests

Item	2020	2025	2030	2050
Business-as-usual carbon sink - Natural uptake	-56.9	0	-17.8	-14.4
(Mt CO2e/y)				
Business-as-usual carbon sink - Retained in	-6.11	0	-10.2	-10.7
Hardwood Products (Mt CO2e/y)				
Business-as-usual carbon sink - Total (Mt CO2e/y)	-63	0	-28	-25.1
Carbon sink potential - High - Accelerate	0	0	0	340
regeneration (1000 tCO2e/y)				

Table 63: REF scenario - PILLAR 6: Land sinks - Forests (continued)

Table 63: REF scenario - PILLAR 6: Land sinks - F	orests (con	ntinued)		
Item	2020	2025	2030	2050
Carbon sink potential - High - All (not counting	0	0	0	58,635
overlap) (1000 tCO2e/y)				
Carbon sink potential - High - Avoid deforestation	0	0	0	1,902
(1000 tCO2e/y)				
Carbon sink potential - High - Extend rotation	0	0	0	11,580
length (1000 tCO2e/y)				
Carbon sink potential - High - Improve	0	0	0	6,158
plantations (1000 tCO2e/y)				
Carbon sink potential - High - Increase retention	0	0	0	22,452
of HWP (1000 tC02e/y)				,
Carbon sink potential - High - Increase trees	0	0	0	592
outside forests (1000 tCO2e/y)			J	
Carbon sink potential - High - Reforest cropland	0	0	0	3,048
(1000 tC02e/y)			J	0,0.0
Carbon sink potential - High - Reforest pasture	0	0	0	7,006
(1000 tCO2e/y)	Ŭ		Ü	1,000
Carbon sink potential - High - Restore	0	0	0	5,558
productivity (1000 tCO2e/y)	0	0	O	0,000
Carbon sink potential - Low - Accelerate	0	0	0	170
regeneration (1000 tCO2e/y)	o	0	U	170
Carbon sink potential - Low - All (not counting	0		0	10 / 07
overlap) (1000 tCO2e/y)	0	0	0	19,687
	0	0	0	017
Carbon sink potential - Low - Avoid deforestation	0	0	0	317
(1000 tC02e/y)				
Carbon sink potential - Low - Extend rotation	0	0	0	4,448
length (1000 tC02e/y)				2.122
Carbon sink potential - Low - Improve	0	0	0	3,133
plantations (1000 tCO2e/y)				
Carbon sink potential - Low - Increase retention	0	0	0	7,484
of HWP (1000 tC02e/y)				
Carbon sink potential - Low - Increase trees	0	0	0	207
outside forests (1000 tCO2e/y)				
Carbon sink potential - Low - Reforest cropland	0	0	0	1,524
(1000 tC02e/y)				
Carbon sink potential - Low - Reforest pasture	0	0	0	531
(1000 tC02e/y)				
Carbon sink potential - Low - Restore	0	0	0	1,873
productivity (1000 tCO2e/y)				
Carbon sink potential - Mid - Accelerate	0	0	0	255
regeneration (1000 tCO2e/y)				
Carbon sink potential - Mid - All (not counting	0	0	0	39,107
overlap) (1000 tC02e/y)				
Carbon sink potential - Mid - Avoid deforestation	0	0	0	1,110
(1000 tC02e/y)				,
Carbon sink potential - Mid - Extend rotation	0	0	0	8,014
length (1000 tC02e/y)			J	, 5,5
Carbon sink potential - Mid - Improve plantations	0	0	0	4,591
(1000 tCO2e/y)			J	1,071
Carbon sink potential - Mid - Increase retention	0	0	0	14,968
of HWP (1000 tCO2e/y)	o	0	O	14,700
Carbon sink potential - Mid - Increase trees	0	0	0	400
outside forests (1000 tC02e/y)	o	0	U	400
	0	0	0	0.007
Carbon sink potential - Mid - Reforest cropland	0	0	0	2,286
(1000 tC02e/y)	0			0.7/0
Carbon sink potential - Mid - Reforest pasture	0	0	0	3,768
(1000 tC02e/y)		_		
Carbon sink potential - Mid - Restore	0	0	0	3,715
productivity (1000 tCO2e/y)				
Land impacted for carbon sink potential - High -	0	0	0	55.6
Accelerate regeneration (1000 hectares)				
Land impacted for carbon sink potential - High -	0	0	0	258
Avoid deforestation (over 30 years) (1000				
hectares)				
1100 car 00)				

Table 63: REF scenario - PILLAR 6: Land sinks - Forests (continued)

Table 63: REF scenario - PILLAR 6: Land sinks - I	-orests (con			
Item	2020	2025	2030	2050
Land impacted for carbon sink potential - High -	0	0	0	5,905
Extend rotation length (1000 hectares)				
Land impacted for carbon sink potential - High -	0	0	0	2,269
Improve plantations (1000 hectares)				
Land impacted for carbon sink potential - High -	0	0	0	0
Increase retention of HWP (1000 hectares)				
Land impacted for carbon sink potential - High -	0	0	0	56.3
Increase trees outside forests (1000 hectares)				
Land impacted for carbon sink potential - High -	0	0	0	201
Reforest cropland (1000 hectares)				
Land impacted for carbon sink potential - High -	0	0	0	199
Reforest pasture (1000 hectares)				
Land impacted for carbon sink potential - High -	0	0	0	1,842
Restore productivity (1000 hectares)				, -
Land impacted for carbon sink potential - High -	0	0	0	10,786
Total impacted (over 30 years) (1000 hectares)				10,100
Land impacted for carbon sink potential - Low -	0	0	0	27.8
Accelerate regeneration (1000 hectares)		0	0	21.0
Land impacted for carbon sink potential - Low -	0	0	0	242
Avoid deforestation (over 30 years) (1000	U	0	0	242
hectares)				
Land impacted for carbon sink potential - Low -	0	0	0	2,262
Extend rotation length (1000 hectares)	U	0	0	2,202
Land impacted for carbon sink potential - Low -	0	0	0	1,134
	U	0	U	1,134
Improve plantations (1000 hectares)	0	0	0	0
Land impacted for carbon sink potential - Low -	0	0	0	0
Increase retention of HWP (1000 hectares)	0	-	0	00.4
Land impacted for carbon sink potential - Low -	0	0	0	29.6
Increase trees outside forests (1000 hectares)				101
Land impacted for carbon sink potential - Low -	0	0	0	101
Reforest cropland (1000 hectares)				
Land impacted for carbon sink potential - Low -	0	0	0	34.5
Reforest pasture (1000 hectares)				
Land impacted for carbon sink potential - Low -	0	0	0	1,115
Restore productivity (1000 hectares)				
Land impacted for carbon sink potential - Low -	0	0	0	4,946
Total impacted (over 30 years) (1000 hectares)				
Land impacted for carbon sink potential - Mid -	0	0	0	41.7
Accelerate regeneration (1000 hectares)				
Land impacted for carbon sink potential - Mid -	0	0	0	250
Avoid deforestation (over 30 years) (1000				
hectares)				
Land impacted for carbon sink potential - Mid -	0	0	0	4,084
Extend rotation length (1000 hectares)				
Land impacted for carbon sink potential - Mid -	0	0	0	1,707
Improve plantations (1000 hectares)				
Land impacted for carbon sink potential - Mid -	0	0	0	0
Increase retention of HWP (1000 hectares)				
Land impacted for carbon sink potential - Mid -	0	0	0	42.9
Increase trees outside forests (1000 hectares)		-	-	
Land impacted for carbon sink potential - Mid -	0	0	0	151
Reforest cropland (1000 hectares)		-	-	
Land impacted for carbon sink potential - Mid -	0	0	0	249
Reforest pasture (1000 hectares)	" "	"	·	2-7
Land impacted for carbon sink potential - Mid -	0	0	0	2,245
Restore productivity (1000 hectares)	" "	"	·	2,2-0
Land impacted for carbon sink potential - Mid -	0	0	0	8,770
Total impacted (over 30 years) (1000 hectares)		٦	١	0,110
Total impacted (over 50 years) (1000 ficetal 68)				

Table 64: REF scenario - IMPACTS - Health

14515 5 11 1121 5551141 15 21 11 11 15 15 11 11 11							
Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal	0	1,451	984	751	659	622	618
(million 2019\$)							
Monetary damages from air pollution - Natural	0	206	214	221	247	242	262
Gas (million 2019\$)							
Monetary damages from air pollution -	0	1,001	1,017	1,034	1,055	1,077	1,099
Transportation (million 2019\$)							
Premature deaths from air pollution - Coal	0	163	110	84.2	74	69.8	69.4
(deaths)							
Premature deaths from air pollution - Natural	0	23.3	24.2	25	27.9	27.4	29.6
Gas (deaths)							
Premature deaths from air pollution -	0	113	114	116	119	121	124
Transportation (deaths)							