Net-Zero America - vermont state report

Larson et al. 2020

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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	6
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	16
30	E+RE+ scenario - PILLAR 2: Clean Electricity - Generating capacity	16
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	17
34	E+RE+ scenario - IMPACTS - Health	19
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	20
38	E+RE- scenario - PILLAR 1: Efficiency/Electrification - Commercial	20
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	24
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	25
51	E-B+ scenario - PILLAR 2: Clean Electricity - Generation	25
52	E-B+ scenario - PILLAR 3: Clean fuels - Bioenergy	25
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	26
57	E-B+ scenario - PILLAR 6: Land sinks - Forests	27
58	REF scenario - PILLAR 1: Efficiency/Electrification - Residential	29

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	30
63	REF scenario - PILLAR 6: Land sinks - Forests	30
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	0.48	0.516	0	0	0	0
Cumulative 5-yr (billion \$2018)							
Sales of cooking units - Electric Resistance (%)	46.9	58.2	92.8	99.6	100	100	100
Sales of cooking units - Gas (%)	53.1	41.8	7.15	0.36	0	0	0
Sales of space heating units - Electric Heat Pump	3.07	12.1	61.6	90	93.8	94.1	94.1
(%)							
Sales of space heating units - Electric Resistance	1.43	1.61	1.3	0.591	0.438	0.433	0.475
(%)							
Sales of space heating units - Fossil (%)	77.8	76.6	30.1	8.25	5.56	5.39	5.36
Sales of space heating units - Gas (%)	17.8	9.73	6.95	1.18	0.152	0.087	0.086
Sales of water heating units - Electric Heat Pump	0	2.16	17	36.8	40.1	40.3	40.3
(%)							
Sales of water heating units - Electric Resistance	19.3	34	45.2	57.5	59.5	59.7	59.6
(%)							
Sales of water heating units - Gas Furnace (%)	54.1	47.8	34.7	5.56	0.327	0	0
Sales of water heating units - Other (%)	26.6	16	3.08	0.198	0.072	0.073	0.073

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

Item	2020	2025	2030	2035	2040	2045	2050
Light-duty vehicle capital costs - Cumulative 5-yr	0	118	306	489	743	806	770
(million \$2018)							
Public EV charging plugs - DC Fast (1000 units)	0.047	0	0.305	0	1.27	0	2.04
Public EV charging plugs - L2 (1000 units)	0.543	0	7.34	0	30.5	0	49.1
Vehicle sales - Heavy-duty - diesel (%)	97.2	92.1	67	23.3	4.22	0.628	0
Vehicle sales - Heavy-duty - EV (%)	0.588	3.81	19	45.6	57.4	59.6	60
Vehicle sales - Heavy-duty - gasoline (%)	0.227	0.227	0.176	0.066	0.013	0.002	0
Vehicle sales - Heavy-duty - hybrid (%)	0.082	0.09	0.077	0.031	0.007	0.001	0
Vehicle sales - Heavy-duty - hydrogen FC (%)	0.392	2.54	12.7	30.4	38.2	39.7	40
Vehicle sales - Heavy-duty - other (%)	1.5	1.23	1.07	0.568	0.163	0.038	0
Vehicle sales - Light-duty - diesel (%)	1.66	1.91	1.3	0.418	0.076	0.013	0
Vehicle sales - Light-duty - EV (%)	3.54	14	44.7	81.1	96.2	99.3	100
Vehicle sales - Light-duty - gasoline (%)	90.5	79.3	50.6	17.2	3.38	0.593	0
Vehicle sales - Light-duty - hybrid (%)	4.06	4.28	3.09	1.16	0.28	0.061	0
Vehicle sales - Light-duty - hydrogen FC (%)	0.111	0.346	0.212	0.066	0.013	0.002	0
Vehicle sales - Light-duty - other (%)	0.107	0.103	0.068	0.024	0.005	0.001	0
Vehicle sales - Medium-duty - diesel (%)	64.7	59.7	42.3	14.4	2.59	0.384	0
Vehicle sales - Medium-duty - EV (%)	0.784	5.07	25.3	60.8	76.5	79.5	80
Vehicle sales - Medium-duty - gasoline (%)	33.7	33.3	25.5	9.32	1.77	0.277	0
Vehicle sales - Medium-duty - hybrid (%)	0.363	0.402	0.341	0.14	0.03	0.005	0
Vehicle sales - Medium-duty - hydrogen 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)	18.9	17.7	16.9	15.8	14.7	13.9	13.5
Final energy use - Industry (PJ)	20.1	20.1	20.5	19.9	19.4	19.3	19.3
Final energy use - Residential (PJ)	33.2	29.9	26.5	22.3	18.3	15.4	13.7
Final energy use - Transportation (PJ)	51.8	48.3	42.1	34.2	27	22.5	20.5

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

Item	2020	2025	2030	2035	2040	2045	2050
Commercial HVAC investment in 2020s -	0	1,350	1,474	0	0	0	0
Cumulative 5-yr (million \$2018)							
Sales of cooking units - Electric Resistance (%)	36.9	49.9	81.2	87.4	87.7	87.7	87.7
Sales of cooking units - Gas (%)	63.1	50.1	18.8	12.6	12.3	12.3	12.3
Sales of space heating units - Electric Heat Pump (%)	2.16	10.9	39.6	72.4	77.6	77.8	77.9
Sales of space heating units - Electric Resistance (%)	1.2	4.38	16.6	21.3	22	22.2	22.1
Sales of space heating units - Fossil (%)	61.5	32.1	6.16	0.26	0	0	0

Table 4: E+ scenario -	PTI I AR 1. Efficiency	//Flectrification -	Commercial	(continued)
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Item	2020	2025	2030	2035	2040	2045	2050
Sales of space heating units - Gas Furnace (%)	35.1	52.6	37.6	6.02	0.358	0	0
Sales of water heating units - Electric Heat Pump (%)	2.07	3.51	16	41.2	45.7	46	46
Sales of water heating units - Electric Resistance (%)	10.3	12.2	23.9	48	52.2	52.5	52.5
Sales of water heating units - Gas Furnace (%)	79.6	80	58.2	9.28	0.549	0	0
Sales of water heating units - Other (%)	8.05	4.21	1.92	1.56	1.53	1.54	1.56

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

Item	2020	2025	2030	2035	2040	2045	2050
Electricity distribution capital invested -	0	0.313	0.322	0.616	0.66	0.557	0.583
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	0.03	0	0	0	0
\$2018)							
Capital invested - Biomass w/ccu allam power plant (billion \$2018)	0	0	0	0	0	0	0
Capital invested - Biomass w/ccu power plant (billion \$2018)	0	0	0	0	0	0	0
Capital invested - Solar PV - Base (billion \$2018)	0	0	0	0	0	1.03	4.22
Capital invested - Solar PV - Constrained (billion \$2018)	0	0.025	0.104	0	0	4.36	3.86
Capital invested - Wind - Base (billion \$2018)	0	0	2.03	0.534	0.524	0.425	0.362
Capital invested - Wind - Constrained (billion \$2018)	0	0	1.39	0.377	0.727	0.135	0.915

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

Item	2020	2025	2030	2035	2040	2045	2050
Biomass power plant (GWh)	0	0	59.4	59.4	59.4	59.4	59.4
Biomass w/ccu allam power plant (GWh)	0	0	0	0	0	0	0
Biomass w/ccu power plant (GWh)	0	0	0	0	0	0	0
Solar - Base land use assumptions (GWh)	60.7	0	0	0	0	1,823	7,865
Solar - Constrained land use assumptions (GWh)	0	0	0	0	0	4,415	4,449
Wind - Base land use assumptions (GWh)	604	0	3,243	927	964	822	726
Wind - Constrained land use assumptions (GWh)	604	0	2,204	650	1,310	242	1,804

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

Item	2020	2025	2030	2035	2040	2045	2050
Biomass purchases (million \$2018/year)	0	0.021	2.53	3.75	4.15	5.03	16.6
Conversion capital investment - Cumulative 5-yr	0	0.036	33.8	27.1	8.69	19	249
(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	0	0	0	0
Number of facilities - Diesel (quantity)	0	0	0	1	1	1	1
Number of facilities - Diesel ccu (quantity)	0	0	0	0	0	0	0
Number of facilities - Power (quantity)	0	0	1	1	1	1	1
Number of facilities - Power ccu (quantity)	0	0	0	0	0	0	0
Number of facilities - Pyrolysis (quantity)	0	0	0	1	1	1	1
Number of facilities - Pyrolysis ccu (quantity)	0	0	0	0	0	0	0
Number of facilities - Sng (quantity)	0	1	1	1	1	1	1
Number of facilities - Sng ccu (quantity)	0	0	0	0	0	0	0

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

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

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

Item	2020	2025	2030	2035	2040	2045	2050
CO2 storage (MMT)	0	0	0	0	0	0	0
Injection wells (wells)	0	0	0	0	0	0	0
Resource characterization, appraisal, permitting	0	0	0	0	0	0	0
costs (million \$2020)							
Wells and facilities construction costs (million	0	0	0	0	0	0	0
\$2020)							

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

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

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

Carbon sink potential - Aggressive deployment - Corn-ethanol to energy grasses (1000 tCO2e/y) Carbon sink potential - Aggressive deployment - Cropland measures (1000 tCO2e/y) Carbon sink potential - Aggressive deployment - Permanent conservation cover (1000 tCO2e/y) Carbon sink potential - Aggressive deployment - Permanent conservation cover (1000 tCO2e/y) Carbon sink potential - Aggressive deployment - Corn-ethanol to energy grasses (1000 tCO2e/y) Carbon sink potential - Moderate deployment - Cropland measures (1000 tCO2e/y) Carbon sink potential - Moderate deployment - Cropland measures (1000 tCO2e/y) Carbon sink potential - Moderate deployment - Cropland measures (1000 tCO2e/y) Carbon sink potential - Moderate deployment - Cropland measures (1000 tCO2e/y) Carbon sink potential - Moderate deployment - Conservation cover (1000 tCO2e/y) Carbon sink potential - Moderate deployment - Conservation cover (1000 tCO2e/y) Land impacted for carbon sink - Aggressive deployment - Corn-ethanol to energy grasses (1000 hectares) Land impacted for carbon sink - Aggressive deployment - Cropland measures (1000
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hectares)
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deployment - Permanent conservation cover
(1000 hectares)
Land impacted for carbon sink - Aggressive 0 0 194
deployment - Total (1000 hectares)
Land impacted for carbon sink - Moderate 0 0 0
deployment - Corn-ethanol to energy grasses
(1000 hectares)

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

Item	2020	2025	2050
Land impacted for carbon sink - Moderate	0	0	92.3
deployment - Cropland measures (1000			
hectares)			
Land impacted for carbon sink - Moderate	0	0	9.65
deployment - Permanent conservation cover			
(1000 hectares)			
Land impacted for carbon sink - Moderate	0	0	102
deployment - Total (1000 hectares)			

Item	2020	2025	2050
Carbon sink potential - High - Accelerate	0	0	14.3
regeneration (1000 tCO2e/y)			
Carbon sink potential - High - All (not counting overlap) (1000 tCO2e/y)	0	0	6,582
Carbon sink potential - High - Avoid deforestation (1000 tCO2e/y)	0	0	290
Carbon sink potential - High - Extend rotation length (1000 tC02e/y)	0	0	3,153
Carbon sink potential - High - Improve plantations (1000 tCO2e/y)	0	0	26.2
Carbon sink potential - High - Increase retention of HWP (1000 tCO2e/y)	0	0	1,532
Carbon sink potential - High - Increase trees outside forests (1000 tC02e/y)	0	0	113
Carbon sink potential - High - Reforest cropland (1000 tCO2e/y)	0	0	0
Carbon sink potential - High - Reforest pasture (1000 tC02e/y)	0	0	719
Carbon sink potential - High - Restore productivity (1000 tC02e/y)	0	0	734
Carbon sink potential - Low - Accelerate regeneration (1000 tC02e/y)	0	0	7.17
Carbon sink potential - Low - All (not counting overlap) (1000 tC02e/y)	0	0	2,132
Carbon sink potential - Low - Avoid deforestation (1000 tC02e/y)	0	0	48.3
Carbon sink potential - Low - Extend rotation length (1000 tC02e/y)	0	0	1,211
Carbon sink potential - Low - Improve plantations (1000 tC02e/y)	0	0	13.3
Carbon sink potential - Low - Increase retention of HWP (1000 tC02e/y)	0	0	511
Carbon sink potential - Low - Increase trees outside forests (1000 tC02e/y)	0	0	39.6
Carbon sink potential - Low - Reforest cropland (1000 tCO2e/y)	0	0	0
Carbon sink potential - Low - Reforest pasture (1000 tCO2e/y)	0	0	54.5
Carbon sink potential - Low - Restore productivity (1000 tCO2e/y)	0	0	248
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO2e/y)	0	0	10.7
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO2e/y)	0	0	4,357
Carbon sink potential - Mid - Avoid deforestation (1000 tCO2e/y)	0	0	169
Carbon sink potential - Mid - Extend rotation length (1000 tC02e/y)	0	0	2,182
Carbon sink potential - Mid - Improve plantations (1000 tCO2e/y)	0	0	19.5
Carbon sink potential - Mid - Increase retention of HWP (1000 tC02e/y)	0	0	1,021

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

Item	rests (contin 2020	2025	2050
Carbon sink potential - Mid - Increase trees	0	0	76.3
outside forests (1000 tCO2e/y)			
Carbon sink potential - Mid - Reforest cropland	0	0	0
(1000 tC02e/y)			
Carbon sink potential - Mid - Reforest pasture	0	0	387
(1000 tC02e/y)			
Carbon sink potential - Mid - Restore	0	0	491
productivity (1000 tCO2e/y)			
Land impacted for carbon sink potential - High -	0	0	2.34
Accelerate regeneration (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	39.2
Avoid deforestation (over 30 years) (1000		<u> </u>	07.2
hectares)			
Land impacted for carbon sink potential - High -	0	0	1,608
Extend rotation length (1000 hectares)	o	0	1,000
	0	0	9.65
Land impacted for carbon sink potential - High -	U	U	9.00
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	10.7
Increase trees outside forests (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	0
Reforest cropland (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	20.4
Reforest pasture (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	243
Restore productivity (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	1,934
Total impacted (over 30 years) (1000 hectares)			1,70
Land impacted for carbon sink potential - Low -	0	0	1.17
Accelerate regeneration (1000 hectares)	0	0	1.11
	0	0	36.8
Land impacted for carbon sink potential - Low -	0	0	30.0
Avoid deforestation (over 30 years) (1000			
hectares)			
Land impacted for carbon sink potential - Low -	0	0	616
Extend rotation length (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	4.83
Improve plantations (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	0
Increase retention of HWP (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	5.65
Increase trees outside forests (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	0
Reforest cropland (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	3.54
Reforest pasture (1000 hectares)			0.0 1
Land impacted for carbon sink potential - Low -	0	0	147
	o	0	141
Restore productivity (1000 hectares)	0	0	015
Land impacted for carbon sink potential - Low -	0	0	815
Total impacted (over 30 years) (1000 hectares)	_	_	
Land impacted for carbon sink potential - Mid -	0	0	1.76
Accelerate regeneration (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	38
Avoid deforestation (over 30 years) (1000			
hectares)			
Land impacted for carbon sink potential - Mid -	0	0	1,112
Extend rotation length (1000 hectares)			•
Land impacted for carbon sink potential - Mid -	0	0	7.26
Improve plantations (1000 hectares)	Ŭ	Ŭ	0
Land impacted for carbon sink potential - Mid -	0	0	0
Increase retention of HWP (1000 hectares)	5	5	U
Land impacted for carbon sink potential - Mid -	0	0	8.19
Increase trees outside forests (1000 hectares)	U	0	0.19
	1		

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

Item	2020	2025	2050
Land impacted for carbon sink potential - Mid -	0	0	0
Reforest cropland (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	25.6
Reforest pasture (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	297
Restore productivity (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	1,490
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	69.3	0.078	0.077	0.074	0.044	0.002
Monetary damages from air pollution - Natural Gas (million 2019\$)	0	17.1	9.51	5.84	5.31	3.26	1.32
Monetary damages from air pollution - Transportation (million 2019\$)	0	67	60.3	44.2	24.5	10.5	3.71
Premature deaths from air pollution - Coal (deaths)	0	7.77	0.009	0.009	0.008	0.005	0
Premature deaths from air pollution - Natural Gas (deaths)	0	1.93	1.07	0.66	0.6	0.368	0.149
Premature deaths from air pollution - Transportation (deaths)	0	7.53	6.78	4.97	2.75	1.19	0.418

Table 15: E+ scenario - IMPACTS - Jobs

Item	2020	2025	2030	2035	2040	2045	2050
By economic sector - Agriculture (jobs)	24.8	28.6	60.2	30.4	25.1	20.5	30.8
By economic sector - Construction (jobs)	1,167	944	992	1,021	1,024	1,747	4,857
By economic sector - Manufacturing (jobs)	427	646	1,155	1,069	1,170	1,656	2,609
By economic sector - Mining (jobs)	359	300	232	167	119	85.5	63
By economic sector - Other (jobs)	181	149	117	134	149	342	1,263
By economic sector - Pipeline (jobs)	41.5	41.9	38.4	33	27.9	23.4	20.4
By economic sector - Professional (jobs)	454	423	587	588	616	957	2,452
By economic sector - Trade (jobs)	428	385	411	406	410	645	1,766
By economic sector - Utilities (jobs)	142	208	570	615	635	1,086	2,760
By education level - All sectors - Associates	966	939	1,278	1,267	1,312	2,094	5,110
degree or some college (jobs)							
By education level - All sectors - Bachelors	668	655	872	843	862	1,316	3,086
degree (jobs)							
By education level - All sectors - Doctoral degree	25.9	23.8	30.2	29.5	30.2	46.2	116
(jobs)							
By education level - All sectors - High school	1,407	1,353	1,777	1,726	1,768	2,792	6,743
diploma or less (jobs)							
By education level - All sectors - Masters or	158	153	205	200	204	316	766
professional degree (jobs)							
By resource sector - Biomass (jobs)	103	123	166	86.6	75.6	74.8	132
By resource sector - CO2 (jobs)	0	0	0	0	0	0	0
By resource sector - Grid (jobs)	162	313	1,032	1,134	1,186	2,130	5,566
By resource sector - Natural Gas (jobs)	97.6	95.5	78	60.8	44.7	27.5	18.7
By resource sector - Nuclear (jobs)	0	0	0	0	0	0	0
By resource sector - Oil (jobs)	973	890	760	610	487	395	330
By resource sector - Solar (jobs)	1,771	1,563	1,147	930	1,133	2,665	7,894
By resource sector - Wind (jobs)	119	140	979	1,243	1,251	1,272	1,881
Median wages - Annual - All (\$2019 per job)	55,718	56,462	57,614	58,445	59,011	59,507	60,403
On-Site or In-Plant Training - Total jobs - 1 to 4	513	492	659	650	669	1,064	2,594
years (jobs)							
On-Site or In-Plant Training - Total jobs - 4 to 10	215	196	251	253	258	419	1,074
years (jobs)							
On-Site or In-Plant Training - Total jobs - None	539	520	688	670	690	1,083	2,608
(jobs)							

					- 13
Table 15:	E+ scenario -	IMPACIS	Inns	Lcontinue	:dI

Item	2020	2025	2030	2035	2040	2045	2050
On-Site or In-Plant Training - Total jobs - Over 10 years (jobs)	24.8	24	33.3	33.5	34.7	55.9	138
On-Site or In-Plant Training - Total jobs - Up to 1 year (jobs)	1,934	1,892	2,530	2,457	2,524	3,943	9,407
On-the-Job Training - All sectors - 1 to 4 years (jobs)	652	625	839	832	856	1,364	3,335
On-the-Job Training - All sectors - 4 to 10 years (jobs)	209	189	242	246	251	413	1,077
On-the-Job Training - All sectors - None (jobs)	192	182	229	223	228	359	884
On-the-Job Training - All sectors - Over 10 years (jobs)	35.2	33.7	43.3	42.2	43.6	67.9	158
On-the-Job Training - All sectors - Up to 1 year (jobs)	2,136	2,095	2,808	2,722	2,798	4,360	10,366
Related work experience - All sectors - 1 to 4 years (jobs)	1,155	1,120	1,492	1,456	1,494	2,340	5,637
Related work experience - All sectors - 4 to 10 years (jobs)	735	711	953	937	963	1,511	3,633
Related work experience - All sectors - None (jobs)	459	444	591	578	594	942	2,306
Related work experience - All sectors - Over 10 years (jobs)	193	192	263	257	265	411	955
Related work experience - All sectors - Up to 1 year (jobs)	683	658	863	837	861	1,361	3,290
Wage income - All (million \$2019)	180	176	240	238	247	391	956

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

Item	2020	2025	2030	2035	2040	2045	2050
Natural gas consumption - Annual (tcf)	10.5	10.6	8.98	7.2	5.42	3.41	2.37
Natural gas consumption - Cumulative (tcf)	0	0	0	0	0	0	217
Natural gas production - Annual (tcf)	0	0	0	0	0	0	0
Oil consumption - Annual (million bbls)	20	20	18.6	16.2	13.9	12.1	10.7
Oil consumption - Cumulative (million bbls)	0	0	0	0	0	0	496
Oil production - Annual (million bbls)	0	0	0	0	0	0	0

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

Item	2020	2025	2030	2035	2040	2045	2050
Residential HVAC investment in 2020s vs. REF -	0	0.481	0.555	0	0	0	0
Cumulative 5-yr (billion \$2018)							
Sales of cooking units - Electric Resistance (%)	46.7	48.1	52.9	65.8	83.7	94.7	98.6
Sales of cooking units - Gas (%)	53.3	51.9	47.1	34.2	16.3	5.26	1.42
Sales of space heating units - Electric Heat Pump	3.07	2.85	5.68	14	28.4	40.3	45.7
(%)							
Sales of space heating units - Electric Resistance	1.43	1.62	1.64	1.66	1.46	1.25	1.16
(%)							
Sales of space heating units - Fossil (%)	77.8	85.6	82.9	75	62.2	52	47.7
Sales of space heating units - Gas (%)	17.8	9.93	9.83	9.3	7.95	6.45	5.52
Sales of water heating units - Electric Heat Pump	0	0.306	1.16	3.82	9.35	15.4	18.6
(%)							
Sales of water heating units - Electric Resistance	19.3	32.3	32.8	34.8	38.7	42.6	44.7
(%)							
Sales of water heating units - Gas Furnace (%)	54.1	48.6	48	45.5	39.4	31.5	26.9
Sales of water heating units - Other (%)	26.6	18.8	18	15.8	12.6	10.5	9.75
Sales of water heating units - Other (%)	26.6	18.8	18	15.8	12.6	10.5	9.7

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	19.7	39.9	136	424	620
(million \$2018)							
Public EV charging plugs - DC Fast (1000 units)	0.047	0	0.104	0	0.478	0	1.31
Public EV charging plugs - L2 (1000 units)	0.543	0	2.49	0	11.5	0	31.4
Vehicle sales - Heavy-duty - diesel (%)	97.4	96	91.3	79.8	58.2	32.1	13.7

Table 18: E- scenario -	PTI I AR 1: Efficienc	v/Flectrification - `	Transnortation	(continued)

Item	2020	2025	2030	2035	2040	2045	2050
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 (%)	1.67	2.07	2.08	1.66	1.07	0.552	0.236
Vehicle sales - Light-duty - EV (%)	1.76	4.39	11.3	24.9	47.3	71.3	87.3
Vehicle sales - Light-duty - gasoline (%)	92.2	88	80.5	67.9	47.4	25.6	11.3
Vehicle sales - Light-duty - hybrid (%)	4.2	5.03	5.68	5.22	3.97	2.38	1.16
Vehicle sales - Light-duty - hydrogen FC (%)	0.113	0.383	0.332	0.256	0.183	0.102	0.047
Vehicle sales - Light-duty - other (%)	0.108	0.111	0.102	0.089	0.065	0.036	0.016
Vehicle sales - Medium-duty - diesel (%)	64.8	62.2	57.7	49.4	35.6	19.6	8.37
Vehicle sales - Medium-duty - EV (%)	0.664	1.94	5.49	14.3	31.4	52.6	68
Vehicle sales - Medium-duty - gasoline (%)	33.8	34.7	34.7	31.9	24.4	14.2	6.33
Vehicle sales - Medium-duty - hybrid (%)	0.363	0.418	0.464	0.478	0.414	0.275	0.141
Vehicle sales - Medium-duty - hydrogen 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)	18.9	17.8	17.3	16.8	16.3	15.9	15.6
Final energy use - Industry (PJ)	20.1	20.1	20.7	20.3	20	20	19.8
Final energy use - Residential (PJ)	33.2	30	27.8	25.9	24	22	20
Final energy use - Transportation (PJ)	51.9	48.7	44.2	40.3	37.2	33.7	29.5

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

Item	2020	2025	2030	2035	2040	2045	2050
Commercial HVAC investment in 2020s -	0	1,350	1,475	0	0	0	0
Cumulative 5-yr (million \$2018)							
Sales of cooking units - Electric Resistance (%)	36.9	40.7	44.7	56.5	72.7	82.9	86.4
Sales of cooking units - Gas (%)	63.1	59.3	55.3	43.5	27.3	17.1	13.6
Sales of space heating units - Electric Heat Pump	2.16	6.95	8.53	13.3	22.9	32.9	38.2
(%)							
Sales of space heating units - Electric Resistance	1.2	1.93	2.57	4.61	8	10.5	11.4
(%)							
Sales of space heating units - Fossil (%)	61.5	37.7	36.8	32.6	25.9	21.5	20.2
Sales of space heating units - Gas Furnace (%)	35.1	53.4	52.1	49.5	43.2	35.1	30.1
Sales of water heating units - Electric Heat Pump	2.07	2.63	3.32	5.68	11.3	18.2	22.2
(%)							
Sales of water heating units - Electric Resistance	10.3	11.4	11.8	14.3	19.6	26	29.9
(%)							
Sales of water heating units - Gas Furnace (%)	79.6	81.3	80.5	76	65.6	52.7	44.9
Sales of water heating units - Other (%)	8.05	4.66	4.38	4.02	3.56	3.09	2.97

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

Item	2020	2025	2030	2035	2040	2045	2050
Electricity distribution capital invested -	0	0.233	0.233	0.327	0.339	0.493	0.522
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	0
Corn-ethanol to energy grasses (1000 tCO2e/y)			
Carbon sink potential - Aggressive deployment -	0	0	-332
Cropland measures (1000 tCO2e/y)			
Carbon sink potential - Aggressive deployment -	0	0	-10.6
Permanent conservation cover (1000 tCO2e/y)			
Carbon sink potential - Aggressive deployment -	0	0	-343
Total (1000 tCO2e/y)			

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

Table 22. E Scenario I IEEAN O. Earla Sinks A	igi icaitai c (c	ontinacaj	
Item	2020	2025	2050
Carbon sink potential - Moderate deployment -	0	0	0
Corn-ethanol to energy grasses (1000 tCO2e/y)			
Carbon sink potential - Moderate deployment -	0	0	-175
Cropland measures (1000 tCO2e/y)			
Carbon sink potential - Moderate deployment -	0	0	-5.31
Permanent conservation cover (1000 tC02e/y)			
Carbon sink potential - Moderate deployment -	0	0	-181
Total (1000 tC02e/y)			
Land impacted for carbon sink - Aggressive	0	0	0
deployment - Corn-ethanol to energy grasses			
(1000 hectares)			
Land impacted for carbon sink - Aggressive	0	0	175
deployment - Cropland measures (1000			
hectares)			
Land impacted for carbon sink - Aggressive	0	0	19.3
deployment - Permanent conservation cover			
(1000 hectares)			
Land impacted for carbon sink - Aggressive	0	0	194
deployment - Total (1000 hectares)			
Land impacted for carbon sink - Moderate	0	0	0
deployment - Corn-ethanol to energy grasses			
(1000 hectares)			
Land impacted for carbon sink - Moderate	0	0	92.3
deployment - Cropland measures (1000			
hectares)			
Land impacted for carbon sink - Moderate	0	0	9.65
deployment - Permanent conservation cover			
(1000 hectares)			
Land impacted for carbon sink - Moderate	0	0	102
deployment - Total (1000 hectares)			

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

Item	2020	2025	2050
Carbon sink potential - High - Accelerate regeneration (1000 tCO2e/y)	0	0	14.3
Carbon sink potential - High - All (not counting overlap) (1000 tCO2e/y)	0	0	6,582
Carbon sink potential - High - Avoid deforestation (1000 tCO2e/y)	0	0	290
Carbon sink potential - High - Extend rotation length (1000 tCO2e/y)	0	0	3,153
Carbon sink potential - High - Improve plantations (1000 tCO2e/y)	0	0	26.2
Carbon sink potential - High - Increase retention of HWP (1000 tCO2e/y)	0	0	1,532
Carbon sink potential - High - Increase trees outside forests (1000 tCO2e/y)	0	0	113
Carbon sink potential - High - Reforest cropland (1000 tCO2e/y)	0	0	0
Carbon sink potential - High - Reforest pasture (1000 tCO2e/y)	0	0	719
Carbon sink potential - High - Restore productivity (1000 tC02e/y)	0	0	734
Carbon sink potential - Low - Accelerate regeneration (1000 tCO2e/y)	0	0	7.17
Carbon sink potential - Low - All (not counting overlap) (1000 tCO2e/y)	0	0	2,132
Carbon sink potential - Low - Avoid deforestation (1000 tCO2e/y)	0	0	48.3
Carbon sink potential - Low - Extend rotation length (1000 tCO2e/y)	0	0	1,211
Carbon sink potential - Low - Improve plantations (1000 tCO2e/y)	0	0	13.3

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

Table 23: <i>E- scenario - PILLAR 6: Land sinks - Fo</i> Item	2020	2025	2050
Carbon sink potential - Low - Increase retention	2020	0	2050 511
of HWP (1000 tCO2e/y)		0	311
Carbon sink potential - Low - Increase trees	0	0	39.6
outside forests (1000 tCO2e/y)			
Carbon sink potential - Low - Reforest cropland	0	0	0
(1000 tC02e/y)			
Carbon sink potential - Low - Reforest pasture	0	0	54.5
(1000 tC02e/y)			
Carbon sink potential - Low - Restore	0	0	248
productivity (1000 tCO2e/y)			
Carbon sink potential - Mid - Accelerate	0	0	10.7
regeneration (1000 tCO2e/y)			
Carbon sink potential - Mid - All (not counting	0	0	4,357
overlap) (1000 tC02e/y)			
Carbon sink potential - Mid - Avoid deforestation	0	0	169
(1000 tC02e/y)			0.100
Carbon sink potential - Mid - Extend rotation	0	0	2,182
length (1000 tC02e/y)			10.5
Carbon sink potential - Mid - Improve plantations	0	0	19.5
(1000 tCO2e/y)	0	0	1 001
Carbon sink potential - Mid - Increase retention	0	0	1,021
of HWP (1000 tC02e/y) Carbon sink potential - Mid - Increase trees	0	0	76.3
outside forests (1000 tC02e/y)	0	0	10.3
Carbon sink potential - Mid - Reforest cropland	0	0	0
(1000 tCO2e/y)		0	U
Carbon sink potential - Mid - Reforest pasture	0	0	387
(1000 tC02e/y)		0	301
Carbon sink potential - Mid - Restore	0	0	491
productivity (1000 tC02e/y)		0	771
Land impacted for carbon sink potential - High -	0	0	2.34
Accelerate regeneration (1000 hectares)			2.0 .
Land impacted for carbon sink potential - High -	0	0	39.2
Avoid deforestation (over 30 years) (1000			
hectares)			
Land impacted for carbon sink potential - High -	0	0	1,608
Extend rotation length (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	9.65
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	10.7
Increase trees outside forests (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	0
Reforest cropland (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	20.4
Reforest pasture (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	243
Restore productivity (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	1,934
Total impacted (over 30 years) (1000 hectares)			4 4 7
Land impacted for carbon sink potential - Low -	0	0	1.17
Accelerate regeneration (1000 hectares)			0/0
Land impacted for carbon sink potential - Low -	0	0	36.8
Avoid deforestation (over 30 years) (1000			
hectares)			/1/
Land impacted for carbon sink potential - Low -	0	0	616
Extend rotation length (1000 hectares)	0	0	/. 00
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)	0	U	4.83
Land impacted for carbon sink potential - Low -	0	0	0
	"	0	U
Increase retention of HWP (1000 hectares)	U	U	U

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

Item	2020	2025	2050
Land impacted for carbon sink potential - Low -	0	0	5.65
Increase trees outside forests (1000 hectares)	0	0	5.65
Land impacted for carbon sink potential - Low -	0	0	0
·	0	0	U
Reforest cropland (1000 hectares)	0		0.57
Land impacted for carbon sink potential - Low -	0	0	3.54
Reforest pasture (1000 hectares)			4.7
Land impacted for carbon sink potential - Low -	0	0	147
Restore productivity (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	815
Total impacted (over 30 years) (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	1.76
Accelerate regeneration (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	38
Avoid deforestation (over 30 years) (1000			
hectares)			
Land impacted for carbon sink potential - Mid -	0	0	1,112
Extend rotation length (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	7.26
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	8.19
Increase trees outside forests (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	0
Reforest cropland (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	25.6
Reforest pasture (1000 hectares)			_0.0
Land impacted for carbon sink potential - Mid -	0	0	297
Restore productivity (1000 hectares)		ŭ	-/-
Land impacted for carbon sink potential - Mid -	0	0	1,490
Total impacted (over 30 years) (1000 hectares)		٥	1,470
Total impacted (over 50 years) (1000 lieutal es)			

Table 24: E- scenario - IMPACTS - Health

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal	0	69.3	0.078	0.077	0.074	0.044	0.002
(million 2019\$)							
Monetary damages from air pollution - Natural	0	16.5	7.84	3.09	1.29	0.393	0.341
Gas (million 2019\$)							
Monetary damages from air pollution -	0	68.1	66.4	62.2	53.8	41.2	27.2
Transportation (million 2019\$)							
Premature deaths from air pollution - Coal	0	7.77	0.009	0.009	0.008	0.005	0
(deaths)							
Premature deaths from air pollution - Natural	0	1.87	0.885	0.349	0.146	0.044	0.038
Gas (deaths)							
Premature deaths from air pollution -	0	7.66	7.46	6.99	6.05	4.64	3.06
Transportation (deaths)							

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

Item	2020	2025	2030	2035	2040	2045	2050
Residential HVAC investment in 2020s vs. REF -	0	0.48	0.516	0	0	0	0
Cumulative 5-yr (billion \$2018)							
Sales of cooking units - Electric Resistance (%)	46.9	58.2	92.8	99.6	100	100	100
Sales of cooking units - Gas (%)	53.1	41.8	7.15	0.36	0	0	0
Sales of space heating units - Electric Heat Pump	3.07	12.1	61.6	90	93.8	94.1	94.1
(%)							
Sales of space heating units - Electric Resistance	1.43	1.61	1.3	0.591	0.438	0.433	0.475
(%)							
Sales of space heating units - Fossil (%)	77.8	76.6	30.1	8.25	5.56	5.39	5.36
Sales of space heating units - Gas (%)	17.8	9.73	6.95	1.18	0.152	0.087	0.086
Sales of water heating units - Electric Heat Pump	0	2.16	17	36.8	40.1	40.3	40.3
(%)							

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

Item	2020	2025	2030	2035	2040	2045	2050
Sales of water heating units - Electric Resistance	19.3	34	45.2	57.5	59.5	59.7	59.6
(%)							
Sales of water heating units - Gas Furnace (%)	54.1	47.8	34.7	5.56	0.327	0	0
Sales of water heating units - Other (%)	26.6	16	3.08	0.198	0.072	0.073	0.073

Table 26: 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	118	306	489	743	806	770
(million \$2018)							
Public EV charging plugs - DC Fast (1000 units)	0.047	0	0.305	0	1.27	0	2.04
Public EV charging plugs - L2 (1000 units)	0.543	0	7.34	0	30.5	0	49.1
Vehicle sales - Heavy-duty - diesel (%)	97.2	92.1	67	23.3	4.22	0.628	0
Vehicle sales - Heavy-duty - EV (%)	0.588	3.81	19	45.6	57.4	59.6	60
Vehicle sales - Heavy-duty - gasoline (%)	0.227	0.227	0.176	0.066	0.013	0.002	0
Vehicle sales - Heavy-duty - hybrid (%)	0.082	0.09	0.077	0.031	0.007	0.001	0
Vehicle sales - Heavy-duty - hydrogen FC (%)	0.392	2.54	12.7	30.4	38.2	39.7	40
Vehicle sales - Heavy-duty - other (%)	1.5	1.23	1.07	0.568	0.163	0.038	0
Vehicle sales - Light-duty - diesel (%)	1.66	1.91	1.3	0.418	0.076	0.013	0
Vehicle sales - Light-duty - EV (%)	3.54	14	44.7	81.1	96.2	99.3	100
Vehicle sales - Light-duty - gasoline (%)	90.5	79.3	50.6	17.2	3.38	0.593	0
Vehicle sales - Light-duty - hybrid (%)	4.06	4.28	3.09	1.16	0.28	0.061	0
Vehicle sales - Light-duty - hydrogen FC (%)	0.111	0.346	0.212	0.066	0.013	0.002	0
Vehicle sales - Light-duty - other (%)	0.107	0.103	0.068	0.024	0.005	0.001	0
Vehicle sales - Medium-duty - diesel (%)	64.7	59.7	42.3	14.4	2.59	0.384	0
Vehicle sales - Medium-duty - EV (%)	0.784	5.07	25.3	60.8	76.5	79.5	80
Vehicle sales - Medium-duty - gasoline (%)	33.7	33.3	25.5	9.32	1.77	0.277	0
Vehicle sales - Medium-duty - hybrid (%)	0.363	0.402	0.341	0.14	0.03	0.005	0
Vehicle sales - Medium-duty - hydrogen 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)	18.9	17.7	16.9	15.8	14.7	13.9	13.5
Final energy use - Industry (PJ)	20.1	20.1	20.5	19.9	19.4	19.3	19.3
Final energy use - Residential (PJ)	33.2	29.9	26.5	22.3	18.3	15.4	13.7
Final energy use - Transportation (PJ)	51.8	48.3	42.1	34.2	27	22.5	20.5

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

Item	2020	2025	2030	2035	2040	2045	2050
Commercial HVAC investment in 2020s -	0	1,350	1,474	0	0	0	0
Cumulative 5-yr (million \$2018)							
Sales of cooking units - Electric Resistance (%)	36.9	49.9	81.2	87.4	87.7	87.7	87.7
Sales of cooking units - Gas (%)	63.1	50.1	18.8	12.6	12.3	12.3	12.3
Sales of space heating units - Electric Heat Pump	2.16	10.9	39.6	72.4	77.6	77.8	77.9
(%)							
Sales of space heating units - Electric Resistance	1.2	4.38	16.6	21.3	22	22.2	22.1
(%)							
Sales of space heating units - Fossil (%)	61.5	32.1	6.16	0.26	0	0	0
Sales of space heating units - Gas Furnace (%)	35.1	52.6	37.6	6.02	0.358	0	0
Sales of water heating units - Electric Heat Pump	2.07	3.51	16	41.2	45.7	46	46
(%)							
Sales of water heating units - Electric Resistance	10.3	12.2	23.9	48	52.2	52.5	52.5
(%)							
Sales of water heating units - Gas Furnace (%)	79.6	80	58.2	9.28	0.549	0	0
Sales of water heating units - Other (%)	8.05	4.21	1.92	1.56	1.53	1.54	1.56

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

Item	2020	2025	2030	2035	2040	2045	2050
Electricity distribution capital invested -	0	0.313	0.322	0.616	0.66	0.557	0.583
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 - Solar PV - Base (billion \$2018)	0	0	0	0	1.64	7.68	8.43
Capital invested - Wind - Base (billion \$2018)	0	0	2.03	0.534	0.524	0.425	0.759

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

Item	2020	2025	2030	2035	2040	2045	2050
Solar - Base land use assumptions (GWh)	60.7	0	0	0	2,755	13,409	15,461
Solar - Constrained land use assumptions (GWh)	60.7	0	0	0	5,137	9,828	14,325
Wind - Base land use assumptions (GWh)	604	0	3,243	927	964	822	1,506
Wind - Constrained land use assumptions (GWh)	604	0	2,204	650	1,310	242	1,937

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

Table 32. LTNLT Scenario - FILLAN O. Lana Sinks	•		
Item	2020	2025	2050
Carbon sink potential - Aggressive deployment -	0	0	0
Corn-ethanol to energy grasses (1000 tCO2e/y)			
Carbon sink potential - Aggressive deployment -	0	0	-332
Cropland measures (1000 tCO2e/y)			
Carbon sink potential - Aggressive deployment -	0	0	-10.6
Permanent conservation cover (1000 tCO2e/y)			
Carbon sink potential - Aggressive deployment -	0	0	-343
Total (1000 tC02e/y)			
Carbon sink potential - Moderate deployment -	0	0	0
Corn-ethanol to energy grasses (1000 tCO2e/y)			
Carbon sink potential - Moderate deployment -	0	0	-175
Cropland measures (1000 tCO2e/y)			
Carbon sink potential - Moderate deployment -	0	0	-5.31
Permanent conservation cover (1000 tCO2e/y)			
Carbon sink potential - Moderate deployment -	0	0	-181
Total (1000 tC02e/y)			
Land impacted for carbon sink - Aggressive	0	0	0
deployment - Corn-ethanol to energy grasses			
(1000 hectares)			
Land impacted for carbon sink - Aggressive	0	0	175
deployment - Cropland measures (1000			
hectares)			
Land impacted for carbon sink - Aggressive	0	0	19.3
deployment - Permanent conservation cover			
(1000 hectares)			
Land impacted for carbon sink - Aggressive	0	0	194
deployment - Total (1000 hectares)			
Land impacted for carbon sink - Moderate	0	0	0
deployment - Corn-ethanol to energy grasses			
(1000 hectares)			
Land impacted for carbon sink - Moderate	0	0	92.3
deployment - Cropland measures (1000			
hectares)			
Land impacted for carbon sink - Moderate	0	0	9.65
deployment - Permanent conservation cover			
(1000 hectares)			
Land impacted for carbon sink - Moderate	0	0	102
deployment - Total (1000 hectares)			

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

Table 33: E+RE+ scenario - PILLAR 6: Land sinks - Fo	orests		
Item	2020	2025	2050
Carbon sink potential - High - Accelerate	0	0	14.3
regeneration (1000 tCO2e/y)			
Carbon sink potential - High - All (not counting	0	0	6,582
overlap) (1000 tC02e/y)			
Carbon sink potential - High - Avoid deforestation	0	0	290
(1000 tCO2e/y)			
Carbon sink potential - High - Extend rotation	0	0	3,153
length (1000 tC02e/y)			-,
Carbon sink potential - High - Improve	0	0	26.2
plantations (1000 tCO2e/y)			20.2
Carbon sink potential - High - Increase retention	0	0	1,532
of HWP (1000 tCO2e/y)	0	0	1,002
Carbon sink potential - High - Increase trees	0	0	113
outside forests (1000 tCO2e/y)	o	0	113
Carbon sink potential - High - Reforest cropland	0	0	0
(1000 tCO2e/y)	U	0	U
	0	0	719
Carbon sink potential - High - Reforest pasture	U	U	119
(1000 tC02e/y)	-		70./
Carbon sink potential - High - Restore	0	0	734
productivity (1000 tC02e/y)		_	
Carbon sink potential - Low - Accelerate	0	0	7.17
regeneration (1000 tCO2e/y)			
Carbon sink potential - Low - All (not counting	0	0	2,132
overlap) (1000 tCO2e/y)			
Carbon sink potential - Low - Avoid deforestation	0	0	48.3
(1000 tC02e/y)			
Carbon sink potential - Low - Extend rotation	0	0	1,211
length (1000 tC02e/y)			
Carbon sink potential - Low - Improve	0	0	13.3
plantations (1000 tC02e/y)			
Carbon sink potential - Low - Increase retention	0	0	511
of HWP (1000 tCO2e/y)			· · · ·
Carbon sink potential - Low - Increase trees	0	0	39.6
outside forests (1000 tCO2e/y)		9	07.0
Carbon sink potential - Low - Reforest cropland	0	0	0
(1000 tCO2e/y)	0	0	U
Carbon sink potential - Low - Reforest pasture	0	0	54.5
(1000 tCO2e/y)	U	0	54.5
	0	0	07.0
Carbon sink potential - Low - Restore	0	0	248
productivity (1000 tC02e/y)			40.7
Carbon sink potential - Mid - Accelerate	0	0	10.7
regeneration (1000 tC02e/y)		_	
Carbon sink potential - Mid - All (not counting	0	0	4,357
overlap) (1000 tC02e/y)			
Carbon sink potential - Mid - Avoid deforestation	0	0	169
(1000 tC02e/y)			
Carbon sink potential - Mid - Extend rotation	0	0	2,182
length (1000 tCO2e/y)			
Carbon sink potential - Mid - Improve plantations	0	0	19.5
(1000 tC02e/y)			
Carbon sink potential - Mid - Increase retention	0	0	1,021
of HWP (1000 tCO2e/y)			, -
Carbon sink potential - Mid - Increase trees	0	0	76.3
outside forests (1000 tCO2e/y)	J	0	10.0
Carbon sink potential - Mid - Reforest cropland	0	0	0
(1000 tC02e/y)	0	۱ '	U
	0	0	207
Carbon sink potential - Mid - Reforest pasture	U	υ	387
(1000 tC02e/y)	0		/ 04
Oonbon sink notantial Mid Destant	11 1	0	491
Carbon sink potential - Mid - Restore	0		
productivity (1000 tCO2e/y)			0.0.
	0	0	2.34

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

Table 33: E+RE+ scenario - PILLAR 6: Land sinks	•	Jiitiiiueuj	
Item	2020	2025	2050
Land impacted for carbon sink potential - High -	0	0	39.2
Avoid deforestation (over 30 years) (1000			
hectares)			
Land impacted for carbon sink potential - High -	0	0	1,608
Extend rotation length (1000 hectares)	o	0	1,000
	0	0	0.45
Land impacted for carbon sink potential - High -	0	0	9.65
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	10.7
Increase trees outside forests (1000 hectares)		-	
Land impacted for carbon sink potential - High -	0	0	0
Reforest cropland (1000 hectares)	0	0	O
	0	0	00.7
Land impacted for carbon sink potential - High -	0	0	20.4
Reforest pasture (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	243
Restore productivity (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	1,934
Total impacted (over 30 years) (1000 hectares)			, -
Land impacted for carbon sink potential - Low -	0	0	1.17
Accelerate regeneration (1000 hectares)	o	0	1.11
Land impacted for carbon sink potential - Low -	0	0	36.8
Avoid deforestation (over 30 years) (1000			
hectares)			
Land impacted for carbon sink potential - Low -	0	0	616
Extend rotation length (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	4.83
	U	0	4.03
Improve plantations (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	0
Increase retention of HWP (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	5.65
Increase trees outside forests (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	0
Reforest cropland (1000 hectares)			Ū
	0	0	3.54
Land impacted for carbon sink potential - Low -	U	U	3.54
Reforest pasture (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	147
Restore productivity (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	815
Total impacted (over 30 years) (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	1.76
	0	0	1.10
Accelerate regeneration (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	38
Avoid deforestation (over 30 years) (1000			
hectares)			
Land impacted for carbon sink potential - Mid -	0	0	1,112
Extend rotation length (1000 hectares)		-	-,
Land impacted for carbon sink potential - Mid -	0	0	7.26
	0	0	1.20
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	8.19
Increase trees outside forests (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	0
	0	0	O
Reforest cropland (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	25.6
Reforest pasture (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	297
Restore productivity (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	1,490
Total impacted (over 30 years) (1000 hectares)	0	5	1,470
rotar impacted (over 30 years) (1000 nectares)			

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

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal	0	69.3	0.078	0.077	0.074	0.044	0.002
(million 2019\$)							
Monetary damages from air pollution - Natural	0	15.7	8.4	4.38	3.21	1.12	0.31
Gas (million 2019\$)							
Monetary damages from air pollution -	0	67	60.3	44.2	24.5	10.5	3.71
Transportation (million 2019\$)							
Premature deaths from air pollution - Coal	0	7.77	0.009	0.009	0.008	0.005	0
(deaths)							
Premature deaths from air pollution - Natural	0	1.77	0.949	0.495	0.362	0.126	0.035
Gas (deaths)							
Premature deaths from air pollution -	0	7.53	6.78	4.97	2.75	1.19	0.418
Transportation (deaths)							

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	0.48	0.516	0	0	0	0
Cumulative 5-yr (billion \$2018)							
Sales of cooking units - Electric Resistance (%)	46.9	58.2	92.8	99.6	100	100	100
Sales of cooking units - Gas (%)	53.1	41.8	7.15	0.36	0	0	0
Sales of space heating units - Electric Heat Pump	3.07	12.1	61.6	90	93.8	94.1	94.1
(%)							
Sales of space heating units - Electric Resistance	1.43	1.61	1.3	0.591	0.438	0.433	0.475
(%)							
Sales of space heating units - Fossil (%)	77.8	76.6	30.1	8.25	5.56	5.39	5.36
Sales of space heating units - Gas (%)	17.8	9.73	6.95	1.18	0.152	0.087	0.086
Sales of water heating units - Electric Heat Pump	0	2.16	17	36.8	40.1	40.3	40.3
(%)							
Sales of water heating units - Electric Resistance	19.3	34	45.2	57.5	59.5	59.7	59.6
(%)							
Sales of water heating units - Gas Furnace (%)	54.1	47.8	34.7	5.56	0.327	0	0
Sales of water heating units - Other (%)	26.6	16	3.08	0.198	0.072	0.073	0.073

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

-rooti ijioati		or tation				
2020	2025	2030	2035	2040	2045	2050
0	118	306	489	743	806	770
0.047	0	0.305	0	1.27	0	2.04
0.543	0	7.34	0	30.5	0	49.1
97.2	92.1	67	23.3	4.22	0.628	0
0.588	3.81	19	45.6	57.4	59.6	60
0.227	0.227	0.176	0.066	0.013	0.002	0
0.082	0.09	0.077	0.031	0.007	0.001	0
0.392	2.54	12.7	30.4	38.2	39.7	40
1.5	1.23	1.07	0.568	0.163	0.038	0
1.66	1.91	1.3	0.418	0.076	0.013	0
3.54	14	44.7	81.1	96.2	99.3	100
90.5	79.3	50.6	17.2	3.38	0.593	0
4.06	4.28	3.09	1.16	0.28	0.061	0
0.111	0.346	0.212	0.066	0.013	0.002	0
0.107	0.103	0.068	0.024	0.005	0.001	0
64.7	59.7	42.3	14.4	2.59	0.384	0
0.784	5.07	25.3	60.8	76.5	79.5	80
33.7	33.3	25.5	9.32	1.77	0.277	0
0.363	0.402	0.341	0.14	0.03	0.005	0
0.196	1.27	6.33	15.2	19.1	19.9	20
0.253	0.255	0.205	0.083	0.019	0.004	0
	2020 0 0.047 0.543 97.2 0.588 0.227 0.082 0.392 1.5 1.66 3.54 90.5 4.06 0.111 0.107 64.7 0.784 33.7 0.363 0.196	2020 2025 0 118 0.047 0 0.543 0 97.2 92.1 0.588 3.81 0.227 0.227 0.082 0.09 0.392 2.54 1.5 1.23 1.66 1.91 3.54 14 90.5 79.3 4.06 4.28 0.111 0.346 0.107 0.103 64.7 59.7 0.784 5.07 33.7 33.3 0.363 0.402 0.196 1.27	0 118 306 0.047 0 0.305 0.543 0 7.34 97.2 92.1 67 0.588 3.81 19 0.227 0.227 0.176 0.082 0.09 0.077 0.392 2.54 12.7 1.5 1.23 1.07 1.66 1.91 1.3 3.54 14 44.7 90.5 79.3 50.6 4.06 4.28 3.09 0.111 0.346 0.212 0.107 0.103 0.068 64.7 59.7 42.3 0.784 5.07 25.3 33.7 33.3 25.5 0.363 0.402 0.341 0.196 1.27 6.33	2020 2025 2030 2035 0 118 306 489 0.047 0 0.305 0 0.543 0 7.34 0 97.2 92.1 67 23.3 0.588 3.81 19 45.6 0.227 0.227 0.176 0.066 0.082 0.09 0.077 0.031 0.392 2.54 12.7 30.4 1.5 1.23 1.07 0.568 1.66 1.91 1.3 0.418 3.54 14 44.7 81.1 90.5 79.3 50.6 17.2 4.06 4.28 3.09 1.16 0.111 0.346 0.212 0.066 0.107 0.103 0.068 0.024 64.7 59.7 42.3 14.4 0.784 5.07 25.3 60.8 33.7 33.3 25.5 9.32	2020 2025 2030 2035 2040 0 118 306 489 743 0.047 0 0.305 0 1.27 0.543 0 7.34 0 30.5 97.2 92.1 67 23.3 4.22 0.588 3.81 19 45.6 57.4 0.227 0.227 0.176 0.066 0.013 0.082 0.09 0.077 0.031 0.007 0.392 2.54 12.7 30.4 38.2 1.5 1.23 1.07 0.568 0.163 1.66 1.91 1.3 0.418 0.076 3.54 14 44.7 81.1 96.2 90.5 79.3 50.6 17.2 3.38 4.06 4.28 3.09 1.16 0.28 0.111 0.346 0.212 0.066 0.013 0.107 0.103 0.068 0.024	2020 2025 2030 2035 2040 2045 0 118 306 489 743 806 0.047 0 0.305 0 1.27 0 0.543 0 7.34 0 30.5 0 97.2 92.1 67 23.3 4.22 0.628 0.588 3.81 19 45.6 57.4 59.6 0.227 0.227 0.176 0.066 0.013 0.002 0.082 0.09 0.077 0.031 0.007 0.001 0.392 2.54 12.7 30.4 38.2 39.7 1.5 1.23 1.07 0.568 0.163 0.038 1.66 1.91 1.3 0.418 0.076 0.013 3.54 14 44.7 81.1 96.2 99.3 90.5 79.3 50.6 17.2 3.38 0.593 4.06 4.28 3.09 1.16

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

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Commercial (PJ)	18.9	17.7	16.9	15.8	14.7	13.9	13.5
Final energy use - Industry (PJ)	20.1	20.1	20.5	19.9	19.4	19.3	19.3
Final energy use - Residential (PJ)	33.2	29.9	26.5	22.3	18.3	15.4	13.7
Final energy use - Transportation (PJ)	51.8	48.3	42.1	34.2	27	22.5	20.5

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

Item	2020	2025	2030	2035	2040	2045	2050
Commercial HVAC investment in 2020s -	0	1,350	1,474	0	0	0	0
Cumulative 5-yr (million \$2018)							
Sales of cooking units - Electric Resistance (%)	36.9	49.9	81.2	87.4	87.7	87.7	87.7
Sales of cooking units - Gas (%)	63.1	50.1	18.8	12.6	12.3	12.3	12.3
Sales of space heating units - Electric Heat Pump (%)	2.16	10.9	39.6	72.4	77.6	77.8	77.9
Sales of space heating units - Electric Resistance (%)	1.2	4.38	16.6	21.3	22	22.2	22.1
Sales of space heating units - Fossil (%)	61.5	32.1	6.16	0.26	0	0	0
Sales of space heating units - Gas Furnace (%)	35.1	52.6	37.6	6.02	0.358	0	0
Sales of water heating units - Electric Heat Pump (%)	2.07	3.51	16	41.2	45.7	46	46
Sales of water heating units - Electric Resistance (%)	10.3	12.2	23.9	48	52.2	52.5	52.5
Sales of water heating units - Gas Furnace (%)	79.6	80	58.2	9.28	0.549	0	0
Sales of water heating units - Other (%)	8.05	4.21	1.92	1.56	1.53	1.54	1.56

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

Item	2020	2025	2030	2035	2040	2045	2050
Electricity distribution capital invested -	0	0.313	0.322	0.616	0.66	0.557	0.583
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	0	0	0	0
Capital invested - Solar PV - Constrained (billion \$2018)	0	0	0	0	0	0	0
Capital invested - Wind - Base (billion \$2018)	0	0	1.13	0	0	0	0.72
Capital invested - Wind - Constrained (billion \$2018)	0	0	0.479	0	0	0.166	0.571

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

Item	2020	2025	2030	2045	2050
Solar - Base land use assumptions (GWh)	60.7	0	0	0	0
Solar - Constrained land use assumptions (GWh)	60.7	0	0	0	0
Wind - Base land use assumptions (GWh)	604	0	1,821	0	1,422
Wind - Constrained land use assumptions (GWh)	604	0	762	309	1,132

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

Item	2020	2025	2050
Carbon sink potential - Aggressive deployment -	0	0	0
Corn-ethanol to energy grasses (1000 tCO2e/y)			
Carbon sink potential - Aggressive deployment -	0	0	-332
Cropland measures (1000 tCO2e/y)			
Carbon sink potential - Aggressive deployment -	0	0	-10.6
Permanent conservation cover (1000 tCO2e/y)			
Carbon sink potential - Aggressive deployment -	0	0	-343
Total (1000 tCO2e/y)			
Carbon sink potential - Moderate deployment -	0	0	0
Corn-ethanol to energy grasses (1000 tCO2e/y)			

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

Item	2020	2025	2050
Carbon sink potential - Moderate deployment -	0	0	-175
Cropland measures (1000 tCO2e/y)			
Carbon sink potential - Moderate deployment -	0	0	-5.31
Permanent conservation cover (1000 tCO2e/y)			
Carbon sink potential - Moderate deployment -	0	0	-181
Total (1000 tC02e/y)			
Land impacted for carbon sink - Aggressive	0	0	0
deployment - Corn-ethanol to energy grasses			
(1000 hectares)			
Land impacted for carbon sink - Aggressive	0	0	175
deployment - Cropland measures (1000			
hectares)			
Land impacted for carbon sink - Aggressive	0	0	19.3
deployment - Permanent conservation cover			
(1000 hectares)			
Land impacted for carbon sink - Aggressive	0	0	194
deployment - Total (1000 hectares)			
Land impacted for carbon sink - Moderate	0	0	0
deployment - Corn-ethanol to energy grasses			
(1000 hectares)			
Land impacted for carbon sink - Moderate	0	0	92.3
deployment - Cropland measures (1000			
hectares)			
Land impacted for carbon sink - Moderate	0	0	9.65
deployment - Permanent conservation cover			
(1000 hectares)			
Land impacted for carbon sink - Moderate	0	0	102
deployment - Total (1000 hectares)			

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

Item	2020	2025	2050
Carbon sink potential - High - Accelerate regeneration (1000 tCO2e/y)	0	0	14.3
Carbon sink potential - High - All (not counting overlap) (1000 tCO2e/y)	0	0	6,582
Carbon sink potential - High - Avoid deforestation (1000 tCO2e/y)	0	0	290
Carbon sink potential - High - Extend rotation length (1000 tCO2e/y)	0	0	3,153
Carbon sink potential - High - Improve plantations (1000 tCO2e/y)	0	0	26.2
Carbon sink potential - High - Increase retention of HWP (1000 tCO2e/y)	0	0	1,532
Carbon sink potential - High - Increase trees outside forests (1000 tCO2e/y)	0	0	113
Carbon sink potential - High - Reforest cropland (1000 tCO2e/y)	0	0	0
Carbon sink potential - High - Reforest pasture (1000 tCO2e/y)	0	0	719
Carbon sink potential - High - Restore productivity (1000 tCO2e/y)	0	0	734
Carbon sink potential - Low - Accelerate regeneration (1000 tCO2e/y)	0	0	7.17
Carbon sink potential - Low - All (not counting overlap) (1000 tCO2e/y)	0	0	2,132
Carbon sink potential - Low - Avoid deforestation (1000 tCO2e/y)	0	0	48.3
Carbon sink potential - Low - Extend rotation length (1000 tCO2e/y)	0	0	1,211
Carbon sink potential - Low - Improve plantations (1000 tCO2e/y)	0	0	13.3
Carbon sink potential - Low - Increase retention of HWP (1000 tCO2e/y)	0	0	511

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

Table 43: E+RE- scenario - PILLAR 6: Land sinks -	- Forests (co	ntinued)	
Item	2020	2025	2050
Carbon sink potential - Low - Increase trees	0	0	39.6
outside forests (1000 tCO2e/y)			
Carbon sink potential - Low - Reforest cropland	0	0	0
(1000 tC02e/y)			
Carbon sink potential - Low - Reforest pasture	0	0	54.5
(1000 tC02e/y)			
Carbon sink potential - Low - Restore	0	0	248
productivity (1000 tCO2e/y)			
Carbon sink potential - Mid - Accelerate	0	0	10.7
regeneration (1000 tCO2e/y)			
Carbon sink potential - Mid - All (not counting	0	0	4,357
overlap) (1000 tC02e/y)			
Carbon sink potential - Mid - Avoid deforestation	0	0	169
(1000 tC02e/y)			
Carbon sink potential - Mid - Extend rotation	0	0	2,182
length (1000 tC02e/y)			, -
Carbon sink potential - Mid - Improve plantations	0	0	19.5
(1000 tC02e/y)			
Carbon sink potential - Mid - Increase retention	0	0	1,021
of HWP (1000 tCO2e/y)	<u> </u>	Ŭ	1,021
Carbon sink potential - Mid - Increase trees	0	0	76.3
outside forests (1000 tC02e/y)	0	0	10.0
Carbon sink potential - Mid - Reforest cropland	0	0	0
(1000 tC02e/y)	0	0	U
Carbon sink potential - Mid - Reforest pasture	0	0	387
(1000 tCO2e/y)	0	0	301
Carbon sink potential - Mid - Restore	0	0	491
	U	0	471
productivity (1000 tC02e/y)	0	0	0.07
Land impacted for carbon sink potential - High -	0	0	2.34
Accelerate regeneration (1000 hectares)	0	0	00.0
Land impacted for carbon sink potential - High -	0	0	39.2
Avoid deforestation (over 30 years) (1000			
hectares)	0	0	1 / 00
Land impacted for carbon sink potential - High -	0	0	1,608
Extend rotation length (1000 hectares)			0.75
Land impacted for carbon sink potential - High -	0	0	9.65
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	10.7
Increase trees outside forests (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	0
Reforest cropland (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	20.4
Reforest pasture (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	243
Restore productivity (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	1,934
Total impacted (over 30 years) (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	1.17
Accelerate regeneration (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	36.8
Avoid deforestation (over 30 years) (1000			
hectares)			
Land impacted for carbon sink potential - Low -	0	0	616
Extend rotation length (1000 hectares)	Ĭ	Ĭ	0.0
Land impacted for carbon sink potential - Low -	0	0	4.83
	9	١ -	7.00
Improve plantations (1000 hectares)		0	0
Improve plantations (1000 hectares)	∩		
Land impacted for carbon sink potential - Low -	0	0	·
	0	0	5.65

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

Item	2020	2025	2050
Land impacted for carbon sink potential - Low -	0	0	2030
	U	U	U
Reforest cropland (1000 hectares)			0.57
Land impacted for carbon sink potential - Low -	0	0	3.54
Reforest pasture (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	147
Restore productivity (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	815
Total impacted (over 30 years) (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	1.76
Accelerate regeneration (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	38
Avoid deforestation (over 30 years) (1000			
hectares)			
Land impacted for carbon sink potential - Mid -	0	0	1,112
Extend rotation length (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	7.26
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	8.19
Increase trees outside forests (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	0
Reforest cropland (1000 hectares)		-	
Land impacted for carbon sink potential - Mid -	0	0	25.6
Reforest pasture (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	297
Restore productivity (1000 hectares)	3	0	271
Land impacted for carbon sink potential - Mid -	0	0	1,490
Total impacted (over 30 years) (1000 hectares)	9	0	1,470
Total impacted (over 30 years) (1000 fields es)			

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

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal	0	69.3	0.078	0.077	0.074	0.044	0.002
(million 2019\$)							
Monetary damages from air pollution - Natural	0	16.8	9.16	10.3	7.66	3.42	0.817
Gas (million 2019\$)							
Monetary damages from air pollution -	0	67	60.3	44.2	24.5	10.5	3.71
Transportation (million 2019\$)							
Premature deaths from air pollution - Coal	0	7.77	0.009	0.009	0.008	0.005	0
(deaths)							
Premature deaths from air pollution - Natural	0	1.89	1.04	1.16	0.866	0.386	0.092
Gas (deaths)							
Premature deaths from air pollution -	0	7.53	6.78	4.97	2.75	1.19	0.418
Transportation (deaths)							

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	0.481	0.555	0	0	0	0
Cumulative 5-yr (billion \$2018)							
Sales of cooking units - Electric Resistance (%)	46.7	48.1	52.9	65.8	83.7	94.7	98.6
Sales of cooking units - Gas (%)	53.3	51.9	47.1	34.2	16.3	5.26	1.42
Sales of space heating units - Electric Heat Pump	3.07	2.85	5.68	14	28.4	40.3	45.7
(%)							
Sales of space heating units - Electric Resistance	1.43	1.62	1.64	1.66	1.46	1.25	1.16
(%)							
Sales of space heating units - Fossil (%)	77.8	85.6	82.9	75	62.2	52	47.7
Sales of space heating units - Gas (%)	17.8	9.93	9.83	9.3	7.95	6.45	5.52
Sales of water heating units - Electric Heat Pump	0	0.306	1.16	3.82	9.35	15.4	18.6
(%)							
Sales of water heating units - Electric Resistance	19.3	32.3	32.8	34.8	38.7	42.6	44.7
(%)							

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

Item	2020	2025	2030	2035	2040	2045	2050
Sales of water heating units - Gas Furnace (%)	54.1	48.6	48	45.5	39.4	31.5	26.9
Sales of water heating units - Other (%)	26.6	18.8	18	15.8	12.6	10.5	9.75

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	19.7	39.9	136	424	620
(million \$2018)							
Public EV charging plugs - DC Fast (1000 units)	0.047	0	0.104	0	0.478	0	1.31
Public EV charging plugs - L2 (1000 units)	0.543	0	2.49	0	11.5	0	31.4
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 (%)	1.67	2.07	2.08	1.66	1.07	0.552	0.236
Vehicle sales - Light-duty - EV (%)	1.76	4.39	11.3	24.9	47.3	71.3	87.3
Vehicle sales - Light-duty - gasoline (%)	92.2	88	80.5	67.9	47.4	25.6	11.3
Vehicle sales - Light-duty - hybrid (%)	4.2	5.03	5.68	5.22	3.97	2.38	1.16
Vehicle sales - Light-duty - hydrogen FC (%)	0.113	0.383	0.332	0.256	0.183	0.102	0.047
Vehicle sales - Light-duty - other (%)	0.108	0.111	0.102	0.089	0.065	0.036	0.016
Vehicle sales - Medium-duty - diesel (%)	64.8	62.2	57.7	49.4	35.6	19.6	8.37
Vehicle sales - Medium-duty - EV (%)	0.664	1.94	5.49	14.3	31.4	52.6	68
Vehicle sales - Medium-duty - gasoline (%)	33.8	34.7	34.7	31.9	24.4	14.2	6.33
Vehicle sales - Medium-duty - hybrid (%)	0.363	0.418	0.464	0.478	0.414	0.275	0.141
Vehicle sales - Medium-duty - hydrogen 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 47: E-B+ scenario - PILLAR 1: Efficiency/Electrification - Overview

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Commercial (PJ)	18.9	17.8	17.3	16.8	16.3	15.9	15.6
Final energy use - Industry (PJ)	20.1	20.1	20.7	20.3	20	20	19.8
Final energy use - Residential (PJ)	33.2	30	27.8	25.9	24	22	20
Final energy use - Transportation (PJ)	51.9	48.7	44.2	40.3	37.2	33.7	29.5

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

Item	2020	2025	2030	2035	2040	2045	2050
Commercial HVAC investment in 2020s -	0	1,350	1,475	0	0	0	0
Cumulative 5-yr (million \$2018)							
Sales of cooking units - Electric Resistance (%)	36.9	40.7	44.7	56.5	72.7	82.9	86.4
Sales of cooking units - Gas (%)	63.1	59.3	55.3	43.5	27.3	17.1	13.6
Sales of space heating units - Electric Heat Pump	2.16	6.95	8.53	13.3	22.9	32.9	38.2
(%)							
Sales of space heating units - Electric Resistance	1.2	1.93	2.57	4.61	8	10.5	11.4
(%)							
Sales of space heating units - Fossil (%)	61.5	37.7	36.8	32.6	25.9	21.5	20.2
Sales of space heating units - Gas Furnace (%)	35.1	53.4	52.1	49.5	43.2	35.1	30.1
Sales of water heating units - Electric Heat Pump	2.07	2.63	3.32	5.68	11.3	18.2	22.2
(%)							
Sales of water heating units - Electric Resistance	10.3	11.4	11.8	14.3	19.6	26	29.9
(%)							
Sales of water heating units - Gas Furnace (%)	79.6	81.3	80.5	76	65.6	52.7	44.9
Sales of water heating units - Other (%)	8.05	4.66	4.38	4.02	3.56	3.09	2.97

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

11 7-	•		,				
Item	2020	2025	2030	2035	2040	2045	2050
Electricity distribution capital invested -	0	0.233	0.233	0.327	0.339	0.493	0.522
Cumulative 5-yr (billion \$2018)							

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

Item	2020	2025	2030	2035	2040	2045	2050
Capital invested - Biomass power plant (billion \$2018)	0	0	0.049	0	0	0	0
Capital invested - Biomass w/ccu allam power plant (billion \$2018)	0	0	0	0	0	0	0
Capital invested - Biomass w/ccu power plant (billion \$2018)	0	0	0	0	0	0	0

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

Item	2020	2025	2030	2035	2040	2045	2050
Biomass power plant (GWh)	0	0	95.9	95.9	95.9	95.9	95.9
Biomass w/ccu allam power plant (GWh)	0	0	0	0	0	0	0
Biomass w/ccu power plant (GWh)	0	0	0	0	0	0	0

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

Item	2020	2025	2030	2035	2040	2045	2050
Biomass purchases (million \$2018/year)	0	0.048	7.89	12	18.1	166	335
Conversion capital investment - Cumulative 5-yr	0	0.043	54.6	46.5	68	1,651	1,879
(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	0	0	0	0
Number of facilities - Diesel (quantity)	0	0	0	1	1	1	1
Number of facilities - Diesel ccu (quantity)	0	0	0	0	0	0	0
Number of facilities - Power (quantity)	0	0	1	1	1	1	1
Number of facilities - Power ccu (quantity)	0	0	0	0	0	0	0
Number of facilities - Pyrolysis (quantity)	0	0	0	1	1	2	4
Number of facilities - Pyrolysis ccu (quantity)	0	0	0	0	0	0	0
Number of facilities - Sng (quantity)	0	1	1	1	1	1	1
Number of facilities - Sng ccu (quantity)	0	0	0	0	0	0	0

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

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

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

Item	2020	2025	2030	2035	2040	2045	2050
CO2 storage (MMT)	0	0	0	0	0	0	0
Injection wells (wells)	0	0	0	0	0	0	0
Resource characterization, appraisal, permitting costs (million \$2020)	0	0	0	0	0	0	0
Wells and facilities construction costs (million \$2020)	0	0	0	0	0	0	0

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

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

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

Table 56: E-B+ scenario - PILLAR 6: Land sinks			
Item	2020	2025	2050
Carbon sink potential - Aggressive deployment -	0	0	0
Corn-ethanol to energy grasses (1000 tCO2e/y)			
Carbon sink potential - Aggressive deployment -	0	0	-332
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 tC02e/y)			
Carbon sink potential - Aggressive deployment -	0	0	-10.6
Permanent conservation cover (1000 tC02e/y)			
Carbon sink potential - Aggressive deployment -	0	0	-343
Total (1000 tC02e/y)			
Carbon sink potential - Moderate deployment -	0	0	0
Corn-ethanol to energy grasses (1000 tC02e/y)			_
Carbon sink potential - Moderate deployment -	0	0	-175
Cropland measures (1000 tC02e/y)			
Carbon sink potential - Moderate deployment -	0	0	0
Cropland to woody energy crops (1000 tCO2e/y)		•	Ü
Carbon sink potential - Moderate deployment -	0	0	0
Pasture to energy crops (1000 tCO2e/y)		0	J
Carbon sink potential - Moderate deployment -	0	0	-5.31
Permanent conservation cover (1000 tCO2e/y)		0	-5.51
Carbon sink potential - Moderate deployment -	0	0	-181
	"	U	-101
Total (1000 tC02e/y)	0	0	0
Land impacted for carbon sink - Aggressive	0	0	0
deployment - Corn-ethanol to energy grasses			
(1000 hectares)		0	/ 00
Land impacted for carbon sink - Aggressive	0	0	432
deployment - Cropland measures (1000			
hectares)		0	
Land impacted for carbon sink - Aggressive	0	0	0
deployment - Cropland to woody energy crops			
(1000 hectares)			4//
Land impacted for carbon sink - Aggressive	0	0	16.4
deployment - Pasture to energy crops (1000			
hectares)			
Land impacted for carbon sink - Aggressive	0	0	19.3
deployment - Permanent conservation cover			
(1000 hectares)			
Land impacted for carbon sink - Aggressive	0	0	468
deployment - Total (1000 hectares)			
Land impacted for carbon sink - Moderate	0	0	0
deployment - Corn-ethanol to energy grasses			
(1000 hectares)			
Land impacted for carbon sink - Moderate	0	0	92.3
deployment - Cropland measures (1000			
hectares)			
Land impacted for carbon sink - Moderate	0	0	0
deployment - Cropland to woody energy crops			
(1000 hectares)			
Land impacted for carbon sink - Moderate	0	0	16.4
deployment - Pasture to energy crops (1000			
hectares)			
Land impacted for carbon sink - Moderate	0	0	9.65
deployment - Permanent conservation cover		-	
(1000 hectares)			
Land impacted for carbon sink - Moderate	0	0	118
deployment - Total (1000 hectares)		-	

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

Table 57: <i>E-B+ scenario - PILLAR 6: Land sinks -</i> Item	2020	2025	2050
Carbon sink potential - High - Accelerate	0	0	14.3
regeneration (1000 tCO2e/y)			
Carbon sink potential - High - All (not counting	0	0	6,582
overlap) (1000 tC02e/y)			-,
Carbon sink potential - High - Avoid deforestation	0	0	290
(1000 tC02e/y)			
Carbon sink potential - High - Extend rotation	0	0	3,153
length (1000 tC02e/y)			·
Carbon sink potential - High - Improve	0	0	26.2
plantations (1000 tC02e/y)			
Carbon sink potential - High - Increase retention	0	0	1,532
of HWP (1000 tCO2e/y)			
Carbon sink potential - High - Increase trees	0	0	113
outside forests (1000 tCO2e/y)			
Carbon sink potential - High - Reforest cropland	0	0	0
(1000 tC02e/y)			
Carbon sink potential - High - Reforest pasture	0	0	719
(1000 tC02e/y)			
Carbon sink potential - High - Restore	0	0	734
productivity (1000 tCO2e/y)			
Carbon sink potential - Low - Accelerate	0	0	7.17
regeneration (1000 tCO2e/y)			
Carbon sink potential - Low - All (not counting	0	0	2,132
overlap) (1000 tCO2e/y)			
Carbon sink potential - Low - Avoid deforestation	0	0	48.3
(1000 tC02e/y)			
Carbon sink potential - Low - Extend rotation	0	0	1,211
length (1000 tCO2e/y)			
Carbon sink potential - Low - Improve	0	0	13.3
plantations (1000 tCO2e/y)			
Carbon sink potential - Low - Increase retention	0	0	511
of HWP (1000 tCO2e/y)			
Carbon sink potential - Low - Increase trees	0	0	39.6
outside forests (1000 tCO2e/y)			
Carbon sink potential - Low - Reforest cropland	0	0	0
(1000 tC02e/y)	_	_	
Carbon sink potential - Low - Reforest pasture	0	0	54.5
(1000 tC02e/y)			
Carbon sink potential - Low - Restore	0	0	248
productivity (1000 tCO2e/y)			
Carbon sink potential - Mid - Accelerate	0	0	10.7
regeneration (1000 tCO2e/y)			
Carbon sink potential - Mid - All (not counting	0	0	4,357
overlap) (1000 tC02e/y)			1/0
Carbon sink potential - Mid - Avoid deforestation	0	0	169
(1000 tC02e/y)			0.100
Carbon sink potential - Mid - Extend rotation	0	0	2,182
length (1000 tC02e/y)			10.5
Carbon sink potential - Mid - Improve plantations	0	0	19.5
(1000 tCO2e/y)	0		1 001
Carbon sink potential - Mid - Increase retention	0	0	1,021
of HWP (1000 tC02e/y)	0	0	7/ 0
Carbon sink potential - Mid - Increase trees	0	0	76.3
outside forests (1000 tC02e/y)	0	0	
Carbon sink potential - Mid - Reforest cropland	0	0	0
(1000 tC02e/y)			
Carbon sink potential - Mid - Reforest pasture	0	0	387
(1000 tC02e/y)			/ 01
Carbon sink potential - Mid - Restore	0	0	491
productivity (1000 tCO2e/y)			001
Land impacted for carbon sink potential - High -	0	0	2.34
Accelerate regeneration (1000 hectares)			

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

Table 57: E-B+ scenario - PILLAR 6: Land sinks	- Forests (cor		
Item	2020	2025	2050
Land impacted for carbon sink potential - High -	0	0	39.2
Avoid deforestation (over 30 years) (1000			
hectares)			
Land impacted for carbon sink potential - High -	0	0	1,608
Extend rotation length (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	9.65
Improve plantations (1000 hectares)			7.00
Land impacted for carbon sink potential - High -	0	0	0
Increase retention of HWP (1000 hectares)		0	O
Land impacted for carbon sink potential - High -	0	0	10.7
Increase trees outside forests (1000 hectares)		0	10.7
	0	0	
Land impacted for carbon sink potential - High -	0	0	0
Reforest cropland (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	20.4
Reforest pasture (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	243
Restore productivity (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	1,934
Total impacted (over 30 years) (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	1.17
Accelerate regeneration (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	36.8
Avoid deforestation (over 30 years) (1000		-	
hectares)			
Land impacted for carbon sink potential - Low -	0	0	616
Extend rotation length (1000 hectares)		0	010
Land impacted for carbon sink potential - Low -	0	0	/. 02
	0	U	4.83
Improve plantations (1000 hectares)		-	
Land impacted for carbon sink potential - Low -	0	0	0
Increase retention of HWP (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	5.65
Increase trees outside forests (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	0
Reforest cropland (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	3.54
Reforest pasture (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	147
Restore productivity (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	815
Total impacted (over 30 years) (1000 hectares)		•	0.0
Land impacted for carbon sink potential - Mid -	0	0	1.76
Accelerate regeneration (1000 hectares)		0	1.10
Land impacted for carbon sink potential - Mid -	0	0	38
	0	U	36
Avoid deforestation (over 30 years) (1000			
hectares)			
Land impacted for carbon sink potential - Mid -	0	0	1,112
Extend rotation length (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	7.26
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	8.19
Increase trees outside forests (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	0
Reforest cropland (1000 hectares)		9	J
Land impacted for carbon sink potential - Mid -	0	0	25.6
Reforest pasture (1000 hectares)		١ ٠	20.0
	0	0	007
Land impacted for carbon sink potential - Mid -	U	υ	297
Restore productivity (1000 hectares)			1 / 00
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)	0	0	1,490

Table 58: RFF scenario -	DTLLAD 1. Efficiency	//Electrification	Pacidontial
TADIE 58' REE SCENDING -	· PII I AR I' FIIII:12111.\	//FIRCHTIHICHHIDH :	- Resinentini

Item	2020	2025	2030	2035	2040	2045	2050
Residential HVAC investment in 2020s vs. REF -	0	0.472	0.488	0	0	0	0
Cumulative 5-yr (billion \$2018)							
Sales of cooking units - Electric Resistance (%)	46.2	46.2	46.2	46.2	46.2	46.2	46.2
Sales of cooking units - Gas (%)	53.8	53.8	53.8	53.8	53.8	53.8	53.8
Sales of space heating units - Electric Heat Pump	2.94	6.21	6.48	6.9	6.99	7.04	7.14
(%)							
Sales of space heating units - Electric Resistance	1.43	1.56	1.59	1.65	1.6	1.54	1.49
(%)							
Sales of space heating units - Fossil (%)	77.9	74.6	46.8	27.6	26.4	26.2	26.3
Sales of space heating units - Gas (%)	17.8	17.6	45.2	63.9	65.1	65.3	65.1
Sales of water heating units - Electric Heat Pump	0	0	0	0	0	0	0
(%)							
Sales of water heating units - Electric Resistance	19.3	32.1	31.9	31.9	31.9	31.8	31.7
(%)							
Sales of water heating units - Gas Furnace (%)	54.1	48.9	49.1	49.2	49.2	49.3	49.4
Sales of water heating units - Other (%)	26.6	19	19	18.9	18.9	18.9	18.9

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 (%)	1.67	2.06	2.2	2.05	1.85	1.72	1.64
Vehicle sales - Light-duty - EV (%)	3.19	5.12	5.86	7.18	8.77	10.2	11.4
Vehicle sales - Light-duty - gasoline (%)	90.9	87.4	85.4	83.7	81.7	79.8	78.2
Vehicle sales - Light-duty - hybrid (%)	4.07	4.94	6.06	6.64	7.23	7.86	8.39
Vehicle sales - Light-duty - hydrogen FC (%)	0.111	0.381	0.352	0.315	0.313	0.314	0.325
Vehicle sales - Light-duty - other (%)	0.107	0.111	0.108	0.108	0.108	0.107	0.11
Vehicle sales - Medium-duty - diesel (%)	65.2	63.5	61.6	59.6	58	56.5	55.2
Vehicle sales - Medium-duty - EV (%)	0.027	0.105	0.329	0.671	0.895	0.973	0.993
Vehicle sales - Medium-duty - gasoline (%)	34	35.5	37	38.5	39.7	40.8	41.7
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)	18.9	18.1	18	17.8	17.6	17.7	18.3
Final energy use - Industry (PJ)	20.1	20.9	22.3	22.8	23.6	24.9	26
Final energy use - Residential (PJ)	33.2	30.1	28.1	26.6	25.5	24.7	23.9
Final energy use - Transportation (PJ)	51.8	48.7	44.5	41.8	41.5	42.6	44

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

Item	2020	2025	2030	2035	2040	2045	2050
Commercial HVAC investment in 2020s -	0	1,333	1,370	0	0	0	0
Cumulative 5-yr (million \$2018)							
Sales of cooking units - Electric Resistance (%)	36.9	39	38.6	38.5	38.3	38.5	38.4
Sales of cooking units - Gas (%)	63.1	61	61.4	61.5	61.7	61.5	61.6
Sales of space heating units - Electric Heat Pump	2.16	12.9	41.1	64.2	67.8	68.1	68.2
(%)							
Sales of space heating units - Electric Resistance	1.2	2.59	7.38	19.7	30	31.8	31.8
(%)							
Sales of space heating units - Fossil (%)	61.5	35.8	25.1	9.79	1.41	0.111	0
Sales of space heating units - Gas Furnace (%)	35.1	48.7	26.4	6.27	0.795	0.043	0
Sales of water heating units - Electric Heat Pump	2.07	2.37	2.33	2.33	2.32	2.35	2.34
(%)							

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

Item	2020	2025	2030	2035	2040	2045	2050
Sales of water heating units - Electric Resistance	10.3	11.1	10.9	11.1	11.1	11	11
(%)							
Sales of water heating units - Gas Furnace (%)	79.6	81.8	82.2	82	82	82.3	82.3
Sales of water heating units - Other (%)	8.05	4.7	4.54	4.51	4.58	4.35	4.3

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

Item	2020	2025	2030	2035	2040	2045	2050
10111	2020				2040		2000
Electricity distribution capital invested -	0	0.265	0.269	0.352	0.366	0.338	0.346
Cumulative 5-yr (billion \$2018)							

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

Table 63: REF scenario - PILLAR 6: Land sinks - F				
Item	2020	2025	2030	2050
Business-as-usual carbon sink - Natural uptake (Mt CO2e/y)	4.2	0	-3.93	-3.51
Business-as-usual carbon sink - Retained in Hardwood Products (Mt CO2e/y)	-0.417	0	-0.75	-0.779
Business-as-usual carbon sink - Total (Mt CO2e/y)	3.78	0	-4.68	-4.29
Carbon sink potential - High - Accelerate	0	0	0	14.3
regeneration (1000 tC02e/y)				
Carbon sink potential - High - All (not counting overlap) (1000 tCO2e/y)	0	0	0	6,582
Carbon sink potential - High - Avoid deforestation (1000 tCO2e/y)	0	0	0	290
Carbon sink potential - High - Extend rotation length (1000 tCO2e/y)	0	0	0	3,153
Carbon sink potential - High - Improve plantations (1000 tCO2e/y)	0	0	0	26.2
Carbon sink potential - High - Increase retention of HWP (1000 tCO2e/y)	0	0	0	1,532
Carbon sink potential - High - Increase trees outside forests (1000 tCO2e/y)	0	0	0	113
Carbon sink potential - High - Reforest cropland (1000 tCO2e/y)	0	0	0	0
Carbon sink potential - High - Reforest pasture (1000 tCO2e/y)	0	0	0	719
Carbon sink potential - High - Restore productivity (1000 tCO2e/y)	0	0	0	734
Carbon sink potential - Low - Accelerate regeneration (1000 tCO2e/y)	0	0	0	7.17
Carbon sink potential - Low - All (not counting overlap) (1000 tCO2e/y)	0	0	0	2,132
Carbon sink potential - Low - Avoid deforestation (1000 tCO2e/y)	0	0	0	48.3
Carbon sink potential - Low - Extend rotation length (1000 tCO2e/y)	0	0	0	1,211
Carbon sink potential - Low - Improve plantations (1000 tCO2e/y)	0	0	0	13.3
Carbon sink potential - Low - Increase retention of HWP (1000 tC02e/y)	0	0	0	511
Carbon sink potential - Low - Increase trees outside forests (1000 tCO2e/y)	0	0	0	39.6
Carbon sink potential - Low - Reforest cropland (1000 tCO2e/y)	0	0	0	0
Carbon sink potential - Low - Reforest pasture (1000 tCO2e/y)	0	0	0	54.5
Carbon sink potential - Low - Restore productivity (1000 tC02e/y)	0	0	0	248
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO2e/y)	0	0	0	10.7
Carbon sink potential - Mid - All (not counting overlap) (1000 tC02e/y)	0	0	0	4,357

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

Table 63: REF scenario - PILLAR 6: Land sinks - H		ntinued)		
Item	2020	2025	2030	2050
Carbon sink potential - Mid - Avoid deforestation (1000 tCO2e/y)	0	0	0	169
Carbon sink potential - Mid - Extend rotation	0	0	0	2,182
length (1000 tCO2e/y)				
Carbon sink potential - Mid - Improve plantations (1000 tC02e/y)	0	0	0	19.5
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO2e/y)	0	0	0	1,021
Carbon sink potential - Mid - Increase trees	0	0	0	76.3
outside forests (1000 tCO2e/γ) Carbon sink potential - Mid - Reforest cropland	0	0	0	0
(1000 tCO2e/y) Carbon sink potential - Mid - Reforest pasture	0	0	0	387
(1000 tCO2e/y) Carbon sink potential - Mid - Restore	0	0	0	491
productivity (1000 tCO2e/y)				
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)	0	0	0	2.34
Land impacted for carbon sink potential - High -	0	0	0	39.2
Avoid deforestation (over 30 years) (1000 hectares)				
Land impacted for carbon sink potential - High -	0	0	0	1,608
Extend rotation length (1000 hectares)	0	0	0	0.75
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)	U	0	U	9.65
Land impacted for carbon sink potential - High - Increase retention of HWP (1000 hectares)	0	0	0	0
Land impacted for carbon sink potential - High -	0	0	0	10.7
Increase trees outside forests (1000 hectares)	0			
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)	0	0	0	0
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)	0	0	0	20.4
Land impacted for carbon sink potential - High -	0	0	0	243
Restore productivity (1000 hectares) Land impacted for carbon sink potential - High -	0	0	0	1,934
Total impacted (over 30 years) (1000 hectares) Land impacted for carbon sink potential - Low -	0	0	0	1.17
Accelerate regeneration (1000 hectares)	U	U	U	1.17
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000	0	0	0	36.8
hectares)	0		0	(1)
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)	0	0	0	616
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)	0	0	0	4.83
Land impacted for carbon sink potential - Low - Increase retention of HWP (1000 hectares)	0	0	0	0
Land impacted for carbon sink potential - Low -	0	0	0	5.65
Increase trees outside forests (1000 hectares) Land impacted for carbon sink potential - Low -	0	0	0	0
Reforest cropland (1000 hectares) Land impacted for carbon sink potential - Low -	0	0	0	3.54
Reforest pasture (1000 hectares)			-	
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)	0	0	0	147
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)	0	0	0	815
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)	0	0	0	1.76
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000	0	0	0	38
hectares)				

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

Thomas	0000	0005	0000	0050
Item	2020	2025	2030	2050
Land impacted for carbon sink potential - Mid -	0	0	0	1,112
Extend rotation length (1000 hectares)				
Land impacted for carbon sink potential - Mid -	0	0	0	7.26
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	8.19
Increase trees outside forests (1000 hectares)				
Land impacted for carbon sink potential - Mid -	0	0	0	0
Reforest cropland (1000 hectares)				
Land impacted for carbon sink potential - Mid -	0	0	0	25.6
Reforest pasture (1000 hectares)				
Land impacted for carbon sink potential - Mid -	0	0	0	297
Restore productivity (1000 hectares)				
Land impacted for carbon sink potential - Mid -	0	0	0	1,490
Total impacted (over 30 years) (1000 hectares)				

Table 64: REF scenario - IMPACTS - Health

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal (million 2019\$)	0	188	117	108	104	102	90.2
Monetary damages from air pollution - Natural Gas (million 2019\$)	0	12.7	10.5	12.7	12.2	11.7	11.1
Monetary damages from air pollution - Transportation (million 2019\$)	0	68	67.2	66.2	65.3	64.5	63.8
Premature deaths from air pollution - Coal (deaths)	0	21	13.2	12.1	11.7	11.4	10.1
Premature deaths from air pollution - Natural Gas (deaths)	0	1.44	1.19	1.43	1.38	1.33	1.25
Premature deaths from air pollution - Transportation (deaths)	0	7.65	7.56	7.44	7.35	7.26	7.18