# Net-Zero America - illinois state report

Larson et al. 2020

#### February 2021

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

#### **Notes**

- These data are a subset of all data from the study available at https://netzeroamerica.princeton.edu.
- The Net-Zero America study describes five pathways to reach net-zero emissions and one "no new policies" reference scenario. In this document, state-level results are grouped by scenario. For some scenarios, the study generated national, but not state-level results.
- Within results for a given scenario, data tables are organized into corresponding sections of the full net-zero study (e.g., Pillar 1, Pillar 2, etc.)
- Some results are not model outputs, but rather they are limits that apply across all scenarios (e.g., maximum carbon storage potential in agricultural soils).

#### **List of Tables**

1	E+ scenario - PILLAR 1: Efficiency/Electrification - Residential	4
2	E+ scenario - PILLAR 1: Efficiency/Electrification - Transportation	4
3	E+ scenario - PILLAR 1: Efficiency/Electrification - Overview	4
4	E+ scenario - PILLAR 1: Efficiency/Electrification - Commercial	4
5	E+ scenario - PILLAR 1: Efficiency/Electrification - Electricity demand	5
6	E+ scenario - PILLAR 2: Clean Electricity - Generating capacity	5
7	E+ scenario - PILLAR 2: Clean Electricity - Generation	5
8	E+ scenario - PILLAR 3: Clean fuels - Bioenergy	5
9	E+ scenario - PILLAR 4: CCUS - CO2 capture	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	10.8	14.4	0	0	0	0
Cumulative 5-yr (billion \$2018)							
Sales of cooking units - Electric Resistance (%)	50.8	61.3	93.4	99.7	100	100	100
Sales of cooking units - Gas (%)	49.2	38.7	6.63	0.334	0	0	0
Sales of space heating units - Electric Heat Pump	3.5	10.7	39.6	85.8	93.9	94.4	94.2
(%)							
Sales of space heating units - Electric Resistance	12.7	18.4	13.8	6.17	4.76	4.69	4.9
(%)							
Sales of space heating units - Fossil (%)	2.45	4.48	3.17	1.07	0.718	0.695	0.671
Sales of space heating units - Gas (%)	81.4	66.5	43.4	6.93	0.605	0.212	0.217
Sales of water heating units - Electric Heat Pump	0	1.85	15.9	37.3	41	41.2	41.2
(%)							
Sales of water heating units - Electric Resistance	22.7	38.5	43.9	56.3	58.6	58.7	58.6
(%)							
Sales of water heating units - Gas Furnace (%)	77.3	59.6	40	6.28	0.367	0	0
Sales of water heating units - Other (%)	0.046	0.112	0.113	0.113	0.111	0.111	0.112

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	2,022	5,214	8,399	12,743	13,847	13,214
(million \$2018)							
Public EV charging plugs - DC Fast (1000 units)	0.299	0	3.24	0	13.9	0	22.4
Public EV charging plugs - L2 (1000 units)	1.41	0	78	0	334	0	539
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 (%)	1.4	1.68	1.2	0.382	0.072	0.013	0
Vehicle sales - Light-duty - EV (%)	4.42	16.7	48.8	82.7	96.4	99.3	100
Vehicle sales - Light-duty - gasoline (%)	89.1	76.3	46.4	15.6	3.17	0.586	0
Vehicle sales - Light-duty - hybrid (%)	4.91	4.9	3.38	1.24	0.304	0.067	0
Vehicle sales - Light-duty - hydrogen FC (%)	0.11	0.331	0.191	0.059	0.012	0.002	0
Vehicle sales - Light-duty - other (%)	0.095	0.091	0.058	0.02	0.004	0.001	0
Vehicle sales - Medium-duty - diesel (%)	64.7	59.7	42.3	14.4	2.59	0.384	0
Vehicle sales - Medium-duty - EV (%)	0.784	5.07	25.3	60.8	76.5	79.5	80
Vehicle sales - Medium-duty - gasoline (%)	33.7	33.3	25.5	9.32	1.77	0.277	0
Vehicle sales - Medium-duty - hybrid (%)	0.363	0.402	0.341	0.14	0.03	0.005	0
Vehicle sales - Medium-duty - hydrogen FC (%)	0.196	1.27	6.33	15.2	19.1	19.9	20
Vehicle sales - Medium-duty - other (%)	0.253	0.255	0.205	0.083	0.019	0.004	0

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

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Commercial (PJ)	441	434	415	383	346	319	305
Final energy use - Industry (PJ)	634	660	671	671	678	686	694
Final energy use - Residential (PJ)	591	551	512	443	367	307	269
Final energy use - Transportation (PJ)	1,043	977	873	748	634	562	530

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

Item	2020	2025	2030	2035	2040	2045	2050
Commercial HVAC investment in 2020s -	0	40,927	44,680	0	0	0	0
Cumulative 5-yr (million \$2018)							
Sales of cooking units - Electric Resistance (%)	41	54.2	82.9	88.6	88.9	88.9	88.9
Sales of cooking units - Gas (%)	59	45.8	17.1	11.4	11.1	11.1	11.1
Sales of space heating units - Electric Heat Pump (%)	0.751	8.27	35.3	81	89	89.5	89.5
Sales of space heating units - Electric Resistance (%)	2.86	3.5	5.34	9.38	10.1	10.2	10.2
Sales of space heating units - Fossil (%)	0	2.07	0.402	0.017	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 (%)	96.4	86.2	59	9.63	0.906	0.363	0.363
Sales of water heating units - Electric Heat Pump (%)	0.271	2.48	19.4	46.1	50.7	51	51
Sales of water heating units - Electric Resistance (%)	2.65	4.62	18.3	44	48.5	48.8	48.8
Sales of water heating units - Gas Furnace (%)	96.9	92.7	62.2	9.74	0.572	0	0
Sales of water heating units - Other (%)	0.154	0.185	0.186	0.187	0.186	0.187	0.187

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

Item	2020	2025	2030	2035	2040	2045	2050
Electricity distribution capital invested -	0	6.63	6.83	11.6	12.4	12.3	13
Cumulative 5-yr (billion \$2018)							

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

Item	2020	2025	2030	2035	2040	2045	2050
Capital invested - Biomass power plant (billion \$2018)	0	0	0	0	0	0	0
Capital invested - Biomass w/ccu allam power plant (billion \$2018)	0	0	0	0.024	0	0	0
Capital invested - Biomass w/ccu power plant (billion \$2018)	0	0	0.199	0	0	0	0
Capital invested - Solar PV - Base (billion \$2018)	0	2.64	1.73	5.31	8.41	4.98	2.34
Capital invested - Solar PV - Constrained (billion \$2018)	0	1.16	2.5	7.75	8.56	5.43	1.47
Capital invested - Wind - Base (billion \$2018)	0	10.1	29	25.6	30.1	28	30.8
Capital invested - Wind - Constrained (billion \$2018)	0	3.55	6.59	4.41	2.68	0.201	66

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

Item	2020	2025	2030	2035	2040	2045	2050
Biomass power plant (GWh)	0	0	0	0	0	0	0
Biomass w/ccu allam power plant (GWh)	0	0	0	24.2	24.2	24.2	24.2
Biomass w/ccu power plant (GWh)	0	0	224	224	224	224	224
Solar - Base land use assumptions (GWh)	650	3,663	2,607	8,856	14,766	8,959	4,440
Solar - Constrained land use assumptions (GWh)	770	1,890	4,260	8,627	12,881	11,258	2,947
Wind - Base land use assumptions (GWh)	22,788	22,093	70,431	65,330	79,992	77,614	88,212
Wind - Constrained land use assumptions (GWh)	23,175	7,399	15,480	10,759	6,967	407	178,172

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

Item	2020	2025	2030	2035	2040	2045	2050
Biomass purchases (million \$2018/year)	0	0	11.3	2,030	3,353	3,754	3,754
Conversion capital investment - Cumulative 5-yr	0	0	183	29,262	19,141	5,818	0
(million \$2018)							
Number of facilities - Allam power w ccu	0	0	0	1	1	1	1
(quantity)							
Number of facilities - Beccs hydrogen (quantity)	0	0	0	33	56	63	63
Number of facilities - Diesel (quantity)	0	0	0	0	0	0	0
Number of facilities - Diesel ccu (quantity)	0	0	0	1	1	1	1
Number of facilities - Power (quantity)	0	0	0	0	0	0	0
Number of facilities - Power ccu (quantity)	0	0	2	2	2	2	2
Number of facilities - Pyrolysis (quantity)	0	0	0	0	0	0	0
Number of facilities - Pyrolysis ccu (quantity)	0	0	0	1	1	1	1
Number of facilities - Sng (quantity)	0	0	0	0	0	0	0
Number of facilities - Sng ccu (quantity)	0	0	2	2	2	2	2

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

Item	2020	2025	2030	2035	2040	2045	2050
Annual - All (MMT)	0	0	0.24	41.5	66.8	74.1	74.8
Annual - BECCS (MMT)	0	0	0.22	37.8	62.4	69.9	69.9
Annual - Cement and lime (MMT)	0	0	0	3.35	3.32	3.42	3.53
Annual - NGCC (MMT)	0	0	0.02	0.38	1.08	0.81	1.38
Cumulative - All (MMT)	0	0	0.24	41.8	109	183	257
Cumulative - BECCS (MMT)	0	0	0.22	38	100	170	240
Cumulative - Cement and lime (MMT)	0	0	0	3.35	6.67	10.1	13.6
Cumulative - NGCC (MMT)	0	0	0.02	0.4	1.48	2.29	3.67

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

Item	2020	2025	2030	2035	2040	2045	2050
CO2 storage (MMT)	0	0	1.1	3.52	7.23	11.2	14.9
Injection wells (wells)	0	0	2	9	15	26	32
Resource characterization, appraisal, permitting	0	100	281	361	361	361	361
costs (million \$2020)							
Wells and facilities construction costs (million	0	0	66.8	260	464	776	963
\$2020)							

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

Item	2020	2025	2030	2035	2040	2045	2050
All (km)	0	0	1,464	3,167	4,446	5,778	6,621
Cumulative investment - All (million \$2018)	0	0	6,204	9,975	10,943	12,504	13,165
Cumulative investment - Spur (million \$2018)	0	0	304	1,825	2,792	4,354	5,015
Cumulative investment - Trunk (million \$2018)	0	0	5,900	8,150	8,150	8,150	8,150
Spur (km)	0	0	507	1,842	3,122	4,454	5,297
Trunk (km)	0	0	958	1,324	1,324	1,324	1,324

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

ential - Aggressive deployment - 0 0 -3,8	0	Carbon sink potential - Aggressive deployment -
energy grasses (1000 tCO2e/y)		Corn-ethanol to energy grasses (1000 tCO2e/y)
ential - Aggressive deployment - 0 0 -17,54	0	Carbon sink potential - Aggressive deployment -
res (1000 tCO2e/y)		Cropland measures (1000 tCO2e/y)
ential - Aggressive deployment - 0 0 -49	0	Carbon sink potential - Aggressive deployment -
ervation cover (1000 tCO2e/y)		Permanent conservation cover (1000 tCO2e/y)
ential - Aggressive deployment - 0 0 -21,80	0	Carbon sink potential - Aggressive deployment -
e/y)		Total (1000 tCO2e/y)
ential - Moderate deployment - 0 0 -3,8	0	Carbon sink potential - Moderate deployment -
energy grasses (1000 tCO2e/y)		Corn-ethanol to energy grasses (1000 tCO2e/y)
ential - Moderate deployment - 0 0 -9,24	0	Carbon sink potential - Moderate deployment -
res (1000 tC02e/y)		Cropland measures (1000 tCO2e/y)
ential - Moderate deployment - 0 0 -2	0	Carbon sink potential - Moderate deployment -
ervation cover (1000 tCO2e/y)		Permanent conservation cover (1000 tCO2e/y)
ential - Moderate deployment - 0 0 -13,2	0	Carbon sink potential - Moderate deployment -
e/y)		Total (1000 tC02e/y)
or carbon sink - Aggressive 0 0 1,73	0	Land impacted for carbon sink - Aggressive
rn-ethanol to energy grasses		deployment - Corn-ethanol to energy grasses
		(1000 hectares)
or carbon sink - Aggressive 0 0 7,20	0	Land impacted for carbon sink - Aggressive
opland measures (1000		deployment - Cropland measures (1000
		hectares)
or carbon sink - Aggressive 0 0 7	0	Land impacted for carbon sink - Aggressive
rmanent conservation cover		deployment - Permanent conservation cover
		(1000 hectares)
or carbon sink - Aggressive 0 0,77	0	Land impacted for carbon sink - Aggressive
al (1000 hectares)		deployment - Total (1000 hectares)
or carbon sink - Moderate 0 0 1,7%	0	Land impacted for carbon sink - Moderate
rn-ethanol to energy grasses		deployment - Corn-ethanol to energy grasses
		(1000 hectares)
e/y) ential - Moderate deployment - energy grasses (1000 tC02e/y) ential - Moderate deployment - res (1000 tC02e/y) ential - Moderate deployment - res (1000 tC02e/y) ential - Moderate deployment - ervation cover (1000 tC02e/y) ential - Moderate deployment - ervation sink - Aggressive or carbon sink - Moderate or carbon sink - Aggressive	0 0 0 0 0	Total (1000 tCO2e/y)  Carbon sink potential - Moderate deployment - Corn-ethanol to energy grasses (1000 tCO2e/y)  Carbon sink potential - Moderate deployment - Cropland measures (1000 tCO2e/y)  Carbon sink potential - Moderate deployment - Permanent conservation cover (1000 tCO2e/y)  Carbon sink potential - Moderate deployment - Total (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 hectares)  Land impacted for carbon sink - Aggressive deployment - Permanent conservation cover (1000 hectares)  Land impacted for carbon sink - Aggressive deployment - Total (1000 hectares)  Land impacted for carbon sink - Moderate deployment - Total (1000 hectares)  Land impacted for carbon sink - Moderate deployment - Corn-ethanol to energy grasses

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

Item	2020	2025	2050
Land impacted for carbon sink - Moderate	0	0	3,799
deployment - Cropland measures (1000			
hectares)			
Land impacted for carbon sink - Moderate	0	0	389
deployment - Permanent conservation cover			
(1000 hectares)			
Land impacted for carbon sink - Moderate	0	0	5,922
deployment - Total (1000 hectares)			

Item	ests 2020	2025	2050
Carbon sink potential - High - Accelerate	0	0	95.6
regeneration (1000 tC02e/y)			
Carbon sink potential - High - All (not counting	0	0	21,662
overlap) (1000 tC02e/y)  Carbon sink potential - High - Avoid deforestation	0	0	2 402
(1000 tC02e/y)	U	0	2,692
Carbon sink potential - High - Extend rotation	0	0	2,426
length (1000 tC02e/y) Carbon sink potential - High - Improve	0	0	108
plantations (1000 tCO2e/y)	U	0	100
Carbon sink potential - High - Increase retention	0	0	1,364
of HWP (1000 tCO2e/y)			
Carbon sink potential - High - Increase trees	0	0	3,477
outside forests (1000 tC02e/y)			
Carbon sink potential - High - Reforest cropland	0	0	5,430
(1000 tC02e/y)  Carbon sink potential - High - Reforest pasture	0	0	4,831
(1000 tCO2e/y)	U	0	4,031
Carbon sink potential - High - Restore	0	0	1,239
productivity (1000 tCO2e/y)			
Carbon sink potential - Low - Accelerate	0	0	47.9
regeneration (1000 tCO2e/y)			
Carbon sink potential - Low - All (not counting	0	0	6,654
overlap) (1000 tC02e/y)			
Carbon sink potential - Low - Avoid deforestation	0	0	449
(1000 tCO2e/y)  Carbon sink potential - Low - Extend rotation	0	0	932
length (1000 tC02e/y)	0	0	702
Carbon sink potential - Low - Improve	0	0	55.1
plantations (1000 tCO2e/y)			-
Carbon sink potential - Low - Increase retention	0	0	455
of HWP (1000 tCO2e/y)			
Carbon sink potential - Low - Increase trees	0	0	1,217
outside forests (1000 tC02e/y)			
Carbon sink potential - Low - Reforest cropland (1000 tCO2e/y)	0	0	2,715
Carbon sink potential - Low - Reforest pasture	0	0	366
(1000 tCO2e/y)			000
Carbon sink potential - Low - Restore	0	0	418
productivity (1000 tC02e/y)			
Carbon sink potential - Mid - Accelerate	0	0	71.7
regeneration (1000 tCO2e/y)			
Carbon sink potential - Mid - All (not counting	0	0	14,157
overlap) (1000 tCO2e/y)		_	
Carbon sink potential - Mid - Avoid deforestation (1000 tCO2e/y)	0	0	1,570
Carbon sink potential - Mid - Extend rotation	0	0	1,679
length (1000 tC02e/y)	0	0	1,017
Carbon sink potential - Mid - Improve plantations	0	0	80.8
(1000 tCO2e/y)			22.0
Carbon sink potential - Mid - Increase retention	0	0	909
of HWP (1000 tCO2e/y)			

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

Tem	Table 13: E+ scenario - PILLAR 6: Land sinks - Fo	rests (contin	ued)	
Dutside forests (1000 tC02e/y)   Carbon sink potential - Mid - Reforest cropland   0		2020	2025	2050
Carbon sink potential - Mid - Reforest cropland   0		0	0	2,347
(1000 tCO2e/y)   Carbon sink potential - Mid - Reforest pasture   0	outside forests (1000 tCO2e/y)			
Carbon sink potential - Mid - Reforest pasture   0	Carbon sink potential - Mid - Reforest cropland	0	0	4,073
Carbon sink potential - Mid - Restore				
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Department   Company   C	Carbon sink potential - Mid - Restore	0	0	828
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Increase retention of HWP (1000 hectares)  Land impacted for carbon sink potential - Low -	Improve plantations (1000 hectares)			
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Reforest cropland (1000 hectares)  Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)  Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)  Land impacted for carbon sink potential - Low - OOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOO	Increase trees outside forests (1000 hectares)			
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Reforest pasture (1000 hectares)  Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)  Land impacted for carbon sink potential - Low - O O O O O O O O O O O O O O O O O O	Reforest cropland (1000 hectares)			
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Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)  Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)  Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)  Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)  Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)  Land impacted for carbon sink potential - Mid - Increase retention of HWP (1000 hectares)  Land impacted for carbon sink potential - Mid - Increase retention of HWP (1000 hectares)  Land impacted for carbon sink potential - Mid - Increase retention of HWP (1000 hectares)  Land impacted for carbon sink potential - Mid - Increase retention of HWP (1000 hectares)	·			
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hectares)  Land impacted for carbon sink potential - Mid - 0 0 855  Extend rotation length (1000 hectares)  Land impacted for carbon sink potential - Mid - 0 0 30  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 0 252			0	333
Land impacted for carbon sink potential - Mid - 0 0 855  Extend rotation length (1000 hectares)  Land impacted for carbon sink potential - Mid - 0 0 30  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 0 252				
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Land impacted for carbon sink potential - Mid - 0 0 252		0	U	U
				050
THE THE SET THE SOUTSIDE TO PESTS ( IUUU NECTA PES )		U	U	252
	increase trees outside forests (1000 hectares)			

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

Item	2020	2025	2050
Land impacted for carbon sink potential - Mid -	0	0	269
Reforest cropland (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	172
Reforest pasture (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	500
Restore productivity (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	2,444
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	0	967	0.82	0.798	0.692	0.487	0.034
(million 2019\$)							
Monetary damages from air pollution - Natural	0	406	285	214	182	104	45
Gas (million 2019\$)							
Monetary damages from air pollution -	0	4,899	4,586	3,504	2,047	963	413
Transportation (million 2019\$)							
Premature deaths from air pollution - Coal	0	109	0.092	0.089	0.078	0.055	0.004
(deaths)							
Premature deaths from air pollution - Natural	0	45.8	32.2	24.1	20.6	11.8	5.09
Gas (deaths)							
Premature deaths from air pollution -	0	551	516	394	230	108	46.5
Transportation (deaths)							

# Table 15: E+ scenario - IMPACTS - Jobs

Item	2020	2025	2030	2035	2040	2045	2050
By economic sector - Agriculture (jobs)	2,965	2,969	3,009	6,027	6,096	4,421	3,486
By economic sector - Construction (jobs)	12,370	17,402	25,542	34,708	42,720	45,856	51,094
By economic sector - Manufacturing (jobs)	11,251	19,745	23,393	31,660	31,381	26,513	32,791
By economic sector - Mining (jobs)	11,564	7,211	4,726	3,490	2,423	1,769	1,288
By economic sector - Other (jobs)	737	1,357	1,979	3,434	5,038	5,493	6,239
By economic sector - Pipeline (jobs)	1,070	1,058	1,601	1,066	632	556	657
By economic sector - Professional (jobs)	8,626	10,710	15,142	24,613	32,319	36,422	40,856
By economic sector - Trade (jobs)	8,227	8,059	9,493	12,933	16,399	18,501	21,341
By economic sector - Utilities (jobs)	20,127	21,944	26,956	32,994	38,326	40,915	46,284
By education level - All sectors - Associates	22,609	27,319	34,622	46,468	54,488	56,651	64,674
degree or some college (jobs)							
By education level - All sectors - Bachelors	15,947	18,781	23,004	30,907	36,166	37,734	42,706
degree (jobs)							
By education level - All sectors - Doctoral degree	526	621	798	1,160	1,442	1,570	1,749
(jobs)							
By education level - All sectors - High school	34,002	39,240	47,835	64,703	74,038	74,717	83,892
diploma or less (jobs)							
By education level - All sectors - Masters or	3,853	4,493	5,582	7,687	9,200	9,776	11,014
professional degree (jobs)							
By resource sector - Biomass (jobs)	7,202	7,011	6,882	15,395	17,314	16,261	15,366
By resource sector - CO2 (jobs)	0	53.1	5,823	3,018	974	1,978	3,799
By resource sector - Coal (jobs)	11,281	4,620	1,584	1,162	1,004	900	796
By resource sector - Grid (jobs)	20,170	24,329	31,296	49,021	61,863	71,240	83,397
By resource sector - Natural Gas (jobs)	10,580	10,687	8,662	7,320	7,749	4,221	3,147
By resource sector - Nuclear (jobs)	6,369	6,266	5,516	3,870	2,680	1,368	0
By resource sector - Oil (jobs)	13,013	11,530	9,557	7,423	5,282	3,774	2,521
By resource sector - Solar (jobs)	3,308	9,777	10,623	18,308	23,642	20,303	23,475
By resource sector - Wind (jobs)	5,014	16,180	31,897	45,408	54,826	60,402	71,532
Median wages - Annual - All (\$2019 per job)	64,497	64,977	66,411	67,018	68,533	70,362	71,320
On-Site or In-Plant Training - Total jobs - 1 to 4	11,921	14,200	17,888	23,892	27,925	28,977	32,936
years (jobs)							
On-Site or In-Plant Training - Total jobs - 4 to 10	4,645	5,518	7,215	9,578	11,448	12,172	13,775
years (jobs)							
On-Site or In-Plant Training - Total jobs - None	12,029	14,546	18,152	24,767	28,922	29,763	33,601
(jobs)							

Table 15.	E+ scenario	- IMPACTS -	. Johs I	(continued)

Item	2020	2025	2030	2035	2040	2045	2050
On-Site or In-Plant Training - Total jobs - Over 10	591	732	953	1,277	1,501	1,573	1,799
years (jobs)							
On-Site or In-Plant Training - Total jobs - Up to 1	47,751	55,458	67,632	91,410	105,538	107,963	121,924
year (jobs)							
On-the-Job Training - All sectors - 1 to 4 years	15,116	18,106	22,978	30,637	35,933	37,435	42,598
(jobs)					44.05/	10.011	
On-the-Job Training - All sectors - 4 to 10 years	4,422	5,281	6,999	9,347	11,254	12,014	13,607
(jobs)	/ 10/	/ 00/	/ 000	0.107	0.770	0.707	10.0/1
On-the-Job Training - All sectors - None (jobs)	4,184	4,926	6,033	8,107	9,440	9,734	10,961
On-the-Job Training - All sectors - Over 10 years	681	879	1,109	1,459	1,659	1,669	1,899
(jobs)				101.07	11= 0 / 0	110 =01	
On-the-Job Training - All sectors - Up to 1 year	52,534	61,261	74,721	101,374	117,048	119,594	134,970
(jobs)							
Related work experience - All sectors - 1 to 4	27,689	32,202	39,725	53,657	62,656	64,815	73,283
years (jobs)	1=101						
Related work experience - All sectors - 4 to 10	17,121	20,469	25,716	34,424	40,324	42,009	47,740
years (jobs)							
Related work experience - All sectors - None	11,045	13,011	16,120	21,780	25,262	25,904	29,229
(jobs)							
Related work experience - All sectors - Over 10	4,670	5,658	7,001	9,294	10,723	11,039	12,597
_years (jobs)							
Related work experience - All sectors - Up to 1	16,412	19,114	23,279	31,769	36,369	36,680	41,185
year (jobs)							
Wage income - All (million \$2019)	4,962	5,878	7,428	10,115	12,017	12,698	14,553

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

Item	2020	2025	2030	2035	2040	2045	2050
Natural gas consumption - Annual (tcf)	846	858	723	580	437	275	191
Natural gas consumption - Cumulative (tcf)	0	0	0	0	0	0	17,474
Natural gas production - Annual (tcf)	2.62	2.9	2.75	2.39	2.02	1.6	1.25
Oil consumption - Annual (million bbls)	215	204	179	143	108	81.3	59.6
Oil consumption - Cumulative (million bbls)	0	0	0	0	0	0	4,405
Oil production - Annual (million bbls)	10.1	10.9	10.9	10.9	8.66	7.04	4.69

# 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	10.7	14.3	0	0	0	0
Cumulative 5-yr (billion \$2018)							
Sales of cooking units - Electric Resistance (%)	50.6	51.9	56.4	68.3	84.9	95.1	98.7
Sales of cooking units - Gas (%)	49.4	48.1	43.6	31.7	15.1	4.87	1.31
Sales of space heating units - Electric Heat Pump	3.5	8.23	11.6	22.2	45.5	72.3	87.2
(%)							
Sales of space heating units - Electric Resistance	12.7	18.7	18.1	16.4	12.5	8.16	5.9
(%)							
Sales of space heating units - Fossil (%)	2.45	4.6	4.47	3.97	2.93	1.72	1.01
Sales of space heating units - Gas (%)	81.4	68.5	65.9	57.4	39	17.8	5.87
Sales of water heating units - Electric Heat Pump	0	0.582	2.2	7.34	18.4	30.9	37.9
(%)							
Sales of water heating units - Electric Resistance	22.7	38.3	38.8	40.9	46.2	52.8	56.7
(%)							
Sales of water heating units - Gas Furnace (%)	77.3	61	58.9	51.7	35.3	16.1	5.22
Sales of water heating units - Other (%)	0.046	0.112	0.113	0.113	0.113	0.113	0.112

# 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	333	687	2,331	7,297	10,644
(million \$2018)							
Public EV charging plugs - DC Fast (1000 units)	0.299	0	1.05	0	5.19	0	14.3
Public EV charging plugs - L2 (1000 units)	1.41	0	25.2	0	125	0	345
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 (%)	1.41	1.85	2.03	1.61	1.02	0.519	0.223
Vehicle sales - Light-duty - EV (%)	2.06	5.07	12.6	27.1	49.7	72.9	87.9
Vehicle sales - Light-duty - gasoline (%)	91.2	86.7	78.4	65.1	44.7	23.9	10.6
Vehicle sales - Light-duty - hybrid (%)	5.1	5.88	6.55	5.89	4.34	2.52	1.21
Vehicle sales - Light-duty - hydrogen FC (%)	0.112	0.376	0.317	0.239	0.168	0.092	0.043
Vehicle sales - Light-duty - other (%)	0.096	0.1	0.09	0.078	0.056	0.03	0.014
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)	441	434	424	414	399	379	356
Final energy use - Industry (PJ)	634	660	674	680	693	701	708
Final energy use - Residential (PJ)	591	552	524	495	458	408	352
Final energy use - Transportation (PJ)	1,044	984	908	847	798	740	672

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

Item	2020	2025	2030	2035	2040	2045	2050
Commercial HVAC investment in 2020s -	0	40,922	44,666	0	0	0	0
Cumulative 5-yr (million \$2018)							
Sales of cooking units - Electric Resistance (%)	41	45.8	49.8	60.5	75.4	84.5	87.7
Sales of cooking units - Gas (%)	59	54.2	50.2	39.5	24.6	15.5	12.3
Sales of space heating units - Electric Heat Pump	0.751	6.2	9.31	19.3	41.6	67.6	82.4
(%)							
Sales of space heating units - Electric Resistance	2.86	3.43	3.64	4.33	6.04	8.25	9.53
(%)							
Sales of space heating units - Fossil (%)	0	2.4	2.27	1.73	0.88	0.287	0.075
Sales of space heating units - Gas Furnace (%)	96.4	88	84.8	74.6	51.5	23.8	7.97
Sales of water heating units - Electric Heat Pump	0.271	1.04	2.99	9.2	22.7	38.2	46.9
(%)							
Sales of water heating units - Electric Resistance	2.65	3.78	5.32	10.5	22.3	36.6	44.8
(%)							
Sales of water heating units - Gas Furnace (%)	96.9	95	91.5	80.1	54.8	25	8.1
Sales of water heating units - Other (%)	0.154	0.185	0.186	0.187	0.186	0.187	0.187

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

Item	2020	2025	2030	2035	2040	2045	2050
Electricity distribution capital invested -	0	5.41	5.46	7.27	7.54	10.4	11
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	-3,836
Corn-ethanol to energy grasses (1000 tCO2e/y)			
Carbon sink potential - Aggressive deployment -	0	0	-17,544
Cropland measures (1000 tCO2e/y)			
Carbon sink potential - Aggressive deployment -	0	0	-428
Permanent conservation cover (1000 tCO2e/y)			
Carbon sink potential - Aggressive deployment -	0	0	-21,808
Total (1000 tCO2e/y)			

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

Table 22. E Section of Telan of Earla Siliks	igi icaitai c (c	ontinacaj	
Item	2020	2025	2050
Carbon sink potential - Moderate deployment -	0	0	-3,836
Corn-ethanol to energy grasses (1000 tCO2e/y)			
Carbon sink potential - Moderate deployment -	0	0	-9,245
Cropland measures (1000 tCO2e/y)			
Carbon sink potential - Moderate deployment -	0	0	-214
Permanent conservation cover (1000 tC02e/y)			
Carbon sink potential - Moderate deployment -	0	0	-13,295
Total (1000 tC02e/y)			
Land impacted for carbon sink - Aggressive	0	0	1,734
deployment - Corn-ethanol to energy grasses			
(1000 hectares)			
Land impacted for carbon sink - Aggressive	0	0	7,209
deployment - Cropland measures (1000			
hectares)			
Land impacted for carbon sink - Aggressive	0	0	779
deployment - Permanent conservation cover			
(1000 hectares)			
Land impacted for carbon sink - Aggressive	0	0	9,721
deployment - Total (1000 hectares)			
Land impacted for carbon sink - Moderate	0	0	1,734
deployment - Corn-ethanol to energy grasses			
(1000 hectares)			
Land impacted for carbon sink - Moderate	0	0	3,799
deployment - Cropland measures (1000			•
hectares)			
Land impacted for carbon sink - Moderate	0	0	389
deployment - Permanent conservation cover			
(1000 hectares)			
Land impacted for carbon sink - Moderate	0	0	5,922
deployment - Total (1000 hectares)			
- <u> </u>			

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

1able 23: E- scenario - PILLAR 6: Lana sinks - For			
Item	2020	2025	2050
Carbon sink potential - High - Accelerate	0	0	95.6
regeneration (1000 tCO2e/y)			
Carbon sink potential - High - All (not counting	0	0	21,662
overlap) (1000 tCO2e/y)			
Carbon sink potential - High - Avoid deforestation	0	0	2,692
(1000 tC02e/y)			
Carbon sink potential - High - Extend rotation	0	0	2,426
length (1000 tCO2e/y)			
Carbon sink potential - High - Improve	0	0	108
plantations (1000 tCO2e/y)			
Carbon sink potential - High - Increase retention	0	0	1,364
of HWP (1000 tCO2e/y)			
Carbon sink potential - High - Increase trees	0	0	3,477
outside forests (1000 tCO2e/y)			
Carbon sink potential - High - Reforest cropland	0	0	5,430
(1000 tC02e/y)			
Carbon sink potential - High - Reforest pasture	0	0	4,831
(1000 tC02e/y)			
Carbon sink potential - High - Restore	0	0	1,239
productivity (1000 tCO2e/y)			
Carbon sink potential - Low - Accelerate	0	0	47.9
regeneration (1000 tCO2e/y)			
Carbon sink potential - Low - All (not counting	0	0	6,654
overlap) (1000 tCO2e/y)			
Carbon sink potential - Low - Avoid deforestation	0	0	449
(1000 tCO2e/y)			
Carbon sink potential - Low - Extend rotation	0	0	932
length (1000 tCO2e/y)			
Carbon sink potential - Low - Improve	0	0	55.1
plantations (1000 tCO2e/y)			

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

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0	0	2,894
0	0	7.82
0	0	342
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Table 23: E- scenario - PILLAR 6: Land sinks - Forests (continued)

Item	2020	2025	2050
Land impacted for carbon sink potential - Low -	0	0	174
Increase trees outside forests (1000 hectares)		•	
Land impacted for carbon sink potential - Low -	0	0	180
Reforest cropland (1000 hectares)		•	100
Land impacted for carbon sink potential - Low -	0	0	23.8
Reforest pasture (1000 hectares)			20.0
Land impacted for carbon sink potential - Low -	0	0	248
Restore productivity (1000 hectares)			210
Land impacted for carbon sink potential - Low -	0	0	1,469
Total impacted (over 30 years) (1000 hectares)			.,
Land impacted for carbon sink potential - Mid -	0	0	11.7
Accelerate regeneration (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	353
Avoid deforestation (over 30 years) (1000		-	
hectares)			
Land impacted for carbon sink potential - Mid -	0	0	855
Extend rotation length (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	30
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	252
Increase trees outside forests (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	269
Reforest cropland (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	172
Reforest pasture (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	500
Restore productivity (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	2,444
Total impacted (over 30 years) (1000 hectares)			

Table 24: E- scenario - IMPACTS - Health

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal	0	967	0.82	0.798	0.692	0.487	0.034
(million 2019\$)							
Monetary damages from air pollution - Natural	0	440	300	127	55.5	18.5	13.4
Gas (million 2019\$)							
Monetary damages from air pollution -	0	4,985	5,062	4,958	4,497	3,605	2,497
Transportation (million 2019\$)							
Premature deaths from air pollution - Coal	0	109	0.092	0.089	0.078	0.055	0.004
(deaths)							
Premature deaths from air pollution - Natural	0	49.7	33.9	14.4	6.27	2.09	1.52
Gas (deaths)							
Premature deaths from air pollution -	0	561	569	558	506	405	281
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	10.8	14.4	0	0	0	0
Cumulative 5-yr (billion \$2018)							
Sales of cooking units - Electric Resistance (%)	50.8	61.3	93.4	99.7	100	100	100
Sales of cooking units - Gas (%)	49.2	38.7	6.63	0.334	0	0	0
Sales of space heating units - Electric Heat Pump	3.5	10.7	39.6	85.8	93.9	94.4	94.2
(%)							
Sales of space heating units - Electric Resistance	12.7	18.4	13.8	6.17	4.76	4.69	4.9
(%)							
Sales of space heating units - Fossil (%)	2.45	4.48	3.17	1.07	0.718	0.695	0.671
Sales of space heating units - Gas (%)	81.4	66.5	43.4	6.93	0.605	0.212	0.217
Sales of water heating units - Electric Heat Pump	0	1.85	15.9	37.3	41	41.2	41.2
(%)							

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	22.7	38.5	43.9	56.3	58.6	58.7	58.6
(%)							
Sales of water heating units - Gas Furnace (%)	77.3	59.6	40	6.28	0.367	0	0
Sales of water heating units - Other (%)	0.046	0.112	0.113	0.113	0.111	0.111	0.112

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 (million \$2018)	0	2,022	5,214	8,399	12,743	13,847	13,214
Public EV charging plugs - DC Fast (1000 units)	0.299	0	3.24	0	13.9	0	22.4
Public EV charging plugs - L2 (1000 units)	1.41	0	78	0	334	0	539
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 (%)	1.4	1.68	1.2	0.382	0.072	0.013	0
Vehicle sales - Light-duty - EV (%)	4.42	16.7	48.8	82.7	96.4	99.3	100
Vehicle sales - Light-duty - gasoline (%)	89.1	76.3	46.4	15.6	3.17	0.586	0
Vehicle sales - Light-duty - hybrid (%)	4.91	4.9	3.38	1.24	0.304	0.067	0
Vehicle sales - Light-duty - hydrogen FC (%)	0.11	0.331	0.191	0.059	0.012	0.002	0
Vehicle sales - Light-duty - other (%)	0.095	0.091	0.058	0.02	0.004	0.001	0
Vehicle sales - Medium-duty - diesel (%)	64.7	59.7	42.3	14.4	2.59	0.384	0
Vehicle sales - Medium-duty - EV (%)	0.784	5.07	25.3	60.8	76.5	79.5	80
Vehicle sales - Medium-duty - gasoline (%)	33.7	33.3	25.5	9.32	1.77	0.277	0
Vehicle sales - Medium-duty - hybrid (%)	0.363	0.402	0.341	0.14	0.03	0.005	0
Vehicle sales - Medium-duty - hydrogen FC (%)	0.196	1.27	6.33	15.2	19.1	19.9	20
Vehicle sales - Medium-duty - other (%)	0.253	0.255	0.205	0.083	0.019	0.004	0

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

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Commercial (PJ)	441	434	415	383	346	319	305
Final energy use - Industry (PJ)	634	660	671	671	678	686	694
Final energy use - Residential (PJ)	591	551	512	443	367	307	269
Final energy use - Transportation (PJ)	1,043	977	873	748	634	562	530

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

Item	2020	2025	2030	2035	2040	2045	2050
Commercial HVAC investment in 2020s -	0	40,927	44,680	0	0	0	0
Cumulative 5-yr (million \$2018)							
Sales of cooking units - Electric Resistance (%)	41	54.2	82.9	88.6	88.9	88.9	88.9
Sales of cooking units - Gas (%)	59	45.8	17.1	11.4	11.1	11.1	11.1
Sales of space heating units - Electric Heat Pump	0.751	8.27	35.3	81	89	89.5	89.5
(%)							
Sales of space heating units - Electric Resistance	2.86	3.5	5.34	9.38	10.1	10.2	10.2
(%)							
Sales of space heating units - Fossil (%)	0	2.07	0.402	0.017	0	0	0
Sales of space heating units - Gas Furnace (%)	96.4	86.2	59	9.63	0.906	0.363	0.363
Sales of water heating units - Electric Heat Pump	0.271	2.48	19.4	46.1	50.7	51	51
(%)							
Sales of water heating units - Electric Resistance	2.65	4.62	18.3	44	48.5	48.8	48.8
(%)							
Sales of water heating units - Gas Furnace (%)	96.9	92.7	62.2	9.74	0.572	0	0
Sales of water heating units - Other (%)	0.154	0.185	0.186	0.187	0.186	0.187	0.187

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

Item	2020	2025	2030	2035	2040	2045	2050
Electricity distribution capital invested -	0	6.63	6.83	11.6	12.4	12.3	13
Cumulative 5-yr (billion \$2018)							

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

Item	2020	2025	2030	2035	2040	2045	2050
Capital invested - Solar PV - Base (billion \$2018)	0	1.93	6.22	10.7	7.78	9.39	13.6
Capital invested - Wind - Base (billion \$2018)	0	10.5	29.9	38.8	42.7	38.7	18.6

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

Item	2020	2025	2030	2035	2040	2045	2050
Solar - Base land use assumptions (GWh)	650	2,685	9,605	17,415	13,767	17,465	26,717
Solar - Constrained land use assumptions (GWh)	650	3,869	8,165	17,245	13,051	17,936	29,931
Wind - Base land use assumptions (GWh)	22,788	22,969	72,467	98,809	112,813	104,504	50,957
Wind - Constrained land use assumptions (GWh)	23,175	7,399	15,587	17,489	537	99.8	380,451

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	-3,836
Corn-ethanol to energy grasses (1000 tCO2e/y)			
Carbon sink potential - Aggressive deployment -	0	0	-17,544
Cropland measures (1000 tCO2e/y)			
Carbon sink potential - Aggressive deployment -	0	0	-428
Permanent conservation cover (1000 tCO2e/y)			
Carbon sink potential - Aggressive deployment -	0	0	-21,808
Total (1000 tC02e/y)			
Carbon sink potential - Moderate deployment -	0	0	-3,836
Corn-ethanol to energy grasses (1000 tCO2e/y)			
Carbon sink potential - Moderate deployment -	0	0	-9,245
Cropland measures (1000 tCO2e/y)			
Carbon sink potential - Moderate deployment -	0	0	-214
Permanent conservation cover (1000 tCO2e/y)			
Carbon sink potential - Moderate deployment -	0	0	-13,295
Total (1000 tC02e/y)			
Land impacted for carbon sink - Aggressive	0	0	1,734
deployment - Corn-ethanol to energy grasses			
(1000 hectares)			
Land impacted for carbon sink - Aggressive	0	0	7,209
deployment - Cropland measures (1000			
hectares)			
Land impacted for carbon sink - Aggressive	0	0	779
deployment - Permanent conservation cover			
(1000 hectares)			
Land impacted for carbon sink - Aggressive	0	0	9,721
deployment - Total (1000 hectares)			
Land impacted for carbon sink - Moderate	0	0	1,734
deployment - Corn-ethanol to energy grasses			
(1000 hectares)			
Land impacted for carbon sink - Moderate	0	0	3,799
deployment - Cropland measures (1000			
hectares)			
Land impacted for carbon sink - Moderate	0	0	389
deployment - Permanent conservation cover			
(1000 hectares)			
Land impacted for carbon sink - Moderate	0	0	5,922
deployment - Total (1000 hectares)			

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

Table 33: E+RE+ scenario - PILLAR 6: Land sinks	- Forests		
Item	2020	2025	2050
Carbon sink potential - High - Accelerate	0	0	95.6
regeneration (1000 tCO2e/y)			
Carbon sink potential - High - All (not counting	0	0	21,662
overlap) (1000 tCO2e/y)			
Carbon sink potential - High - Avoid deforestation	0	0	2,692
(1000 tC02e/y)			
Carbon sink potential - High - Extend rotation	0	0	2,426
length (1000 tCO2e/y)			_,
Carbon sink potential - High - Improve	0	0	108
plantations (1000 tC02e/y)		•	100
Carbon sink potential - High - Increase retention	0	0	1,364
of HWP (1000 tCO2e/y)	0	0	1,004
Carbon sink potential - High - Increase trees	0	0	3,477
outside forests (1000 tCO2e/y)	0	0	3,411
Carbon sink potential - High - Reforest cropland	0	0	5,430
	U	0	5,430
(1000 tC02e/y)	0	0	/ 001
Carbon sink potential - High - Reforest pasture	0	0	4,831
(1000 tC02e/y)			
Carbon sink potential - High - Restore	0	0	1,239
productivity (1000 tCO2e/y)			
Carbon sink potential - Low - Accelerate	0	0	47.9
regeneration (1000 tCO2e/y)			
Carbon sink potential - Low - All (not counting	0	0	6,654
overlap) (1000 tCO2e/y)			
Carbon sink potential - Low - Avoid deforestation	0	0	449
(1000 tC02e/y)			
Carbon sink potential - Low - Extend rotation	0	0	932
length (1000 tC02e/y)			
Carbon sink potential - Low - Improve	0	0	55.1
plantations (1000 tCO2e/y)			
Carbon sink potential - Low - Increase retention	0	0	455
of HWP (1000 tC02e/y)	0	ŭ	400
Carbon sink potential - Low - Increase trees	0	0	1,217
outside forests (1000 tCO2e/y)	0	0	1,211
Carbon sink potential - Low - Reforest cropland	0	0	2,715
(1000 tC02e/y)	o	0	2,113
	0	0	0//
Carbon sink potential - Low - Reforest pasture	0	0	366
(1000 tC02e/y)			/10
Carbon sink potential - Low - Restore	0	0	418
productivity (1000 tCO2e/y)			
Carbon sink potential - Mid - Accelerate	0	0	71.7
regeneration (1000 tCO2e/y)			
Carbon sink potential - Mid - All (not counting	0	0	14,157
overlap) (1000 tCO2e/y)			
Carbon sink potential - Mid - Avoid deforestation	0	0	1,570
(1000 tC02e/y)			
Carbon sink potential - Mid - Extend rotation	0	0	1,679
length (1000 tCO2e/y)			
Carbon sink potential - Mid - Improve plantations	0	0	80.8
(1000 tC02e/y)		•	00.0
Carbon sink potential - Mid - Increase retention	0	0	909
of HWP (1000 tC02e/y)	0	Ŭ	,,,
Carbon sink potential - Mid - Increase trees	0	0	2,347
outside forests (1000 tCO2e/y)	U	0	2,341
	0		/. 070
Carbon sink potential - Mid - Reforest cropland	0	0	4,073
(1000 tC02e/y)			0 = 0 =
Carbon sink potential - Mid - Reforest pasture	0	0	2,599
(1000 tC02e/y)			
Conhan sink notantial Mid Dostons	0	0	828
Carbon sink potential - Mid - Restore	0	1	
productivity (1000 tCO2e/y)			
	0	0	15.6

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

Table 33: E+RE+ scenario - PILLAR 6: Land sinks	•		
Item	2020	2025	2050
Land impacted for carbon sink potential - High -	0	0	364
Avoid deforestation (over 30 years) (1000			
hectares)			
Land impacted for carbon sink potential - High -	0	0	1,237
Extend rotation length (1000 hectares)	o	0	1,201
	0	0	00.0
Land impacted for carbon sink potential - High -	0	0	39.9
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	330
Increase trees outside forests (1000 hectares)		-	
Land impacted for carbon sink potential - High -	0	0	359
Reforest cropland (1000 hectares)	o	0	007
			107
Land impacted for carbon sink potential - High -	0	0	137
Reforest pasture (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	411
Restore productivity (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	2,894
Total impacted (over 30 years) (1000 hectares)		-	_,-,-
Land impacted for carbon sink potential - Low -	0	0	7.82
	U	١	1.02
Accelerate regeneration (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	342
Avoid deforestation (over 30 years) (1000			
hectares)			
Land impacted for carbon sink potential - Low -	0	0	474
Extend rotation length (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	20
	U	١	20
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	174
Increase trees outside forests (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	180
Reforest cropland (1000 hectares)			.00
	0	0	23.8
Land impacted for carbon sink potential - Low -	U	U	23.0
Reforest pasture (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	248
Restore productivity (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	1,469
Total impacted (over 30 years) (1000 hectares)			·
Land impacted for carbon sink potential - Mid -	0	0	11.7
	o	١	11.1
Accelerate regeneration (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	353
Avoid deforestation (over 30 years) (1000			
hectares)			
Land impacted for carbon sink potential - Mid -	0	0	855
Extend rotation length (1000 hectares)		-	
Land impacted for carbon sink potential - Mid -	0	0	30
	o	١	30
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	252
Increase trees outside forests (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	269
	5	٦	207
Reforest cropland (1000 hectares)			470
Land impacted for carbon sink potential - Mid -	0	0	172
Reforest pasture (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	500
Restore productivity (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	2,444
Total impacted (over 30 years) (1000 hectares)		ŭ	_,
rotar impacted (over 30 years) (1000 Hectares)			

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

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal	0	967	0.82	0.798	0.692	0.487	0.034
(million 2019\$)							
Monetary damages from air pollution - Natural	0	432	286	165	110	39.2	10.8
Gas (million 2019\$)							
Monetary damages from air pollution -	0	4,899	4,586	3,504	2,047	963	413
Transportation (million 2019\$)							
Premature deaths from air pollution - Coal	0	109	0.092	0.089	0.078	0.055	0.004
(deaths)							
Premature deaths from air pollution - Natural	0	48.7	32.3	18.6	12.5	4.43	1.22
Gas (deaths)							
Premature deaths from air pollution -	0	551	516	394	230	108	46.5
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	10.8	14.4	0	0	0	0
Cumulative 5-yr (billion \$2018)							
Sales of cooking units - Electric Resistance (%)	50.8	61.3	93.4	99.7	100	100	100
Sales of cooking units - Gas (%)	49.2	38.7	6.63	0.334	0	0	0
Sales of space heating units - Electric Heat Pump	3.5	10.7	39.6	85.8	93.9	94.4	94.2
(%)							
Sales of space heating units - Electric Resistance	12.7	18.4	13.8	6.17	4.76	4.69	4.9
(%)							
Sales of space heating units - Fossil (%)	2.45	4.48	3.17	1.07	0.718	0.695	0.671
Sales of space heating units - Gas (%)	81.4	66.5	43.4	6.93	0.605	0.212	0.217
Sales of water heating units - Electric Heat Pump	0	1.85	15.9	37.3	41	41.2	41.2
(%)							
Sales of water heating units - Electric Resistance	22.7	38.5	43.9	56.3	58.6	58.7	58.6
(%)							
Sales of water heating units - Gas Furnace (%)	77.3	59.6	40	6.28	0.367	0	0
Sales of water heating units - Other (%)	0.046	0.112	0.113	0.113	0.111	0.111	0.112

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

	on manap	0				
2020	2025	2030	2035	2040	2045	2050
0	2,022	5,214	8,399	12,743	13,847	13,214
0.299	0	3.24	0	13.9	0	22.4
1.41	0	78	0	334	0	539
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
1.4	1.68	1.2	0.382	0.072	0.013	0
4.42	16.7	48.8	82.7	96.4	99.3	100
89.1	76.3	46.4	15.6	3.17	0.586	0
4.91	4.9	3.38	1.24	0.304	0.067	0
0.11	0.331	0.191	0.059	0.012	0.002	0
0.095	0.091	0.058	0.02	0.004	0.001	0
64.7	59.7	42.3	14.4	2.59	0.384	0
0.784	5.07	25.3	60.8	76.5	79.5	80
33.7	33.3	25.5	9.32	1.77	0.277	0
0.363	0.402	0.341	0.14	0.03	0.005	0
0.196	1.27	6.33	15.2	19.1	19.9	20
0.253	0.255	0.205	0.083	0.019	0.004	0
	2020 0 0.299 1.41 97.2 0.588 0.227 0.082 0.392 1.5 1.4 4.42 89.1 4.91 0.11 0.095 64.7 0.784 33.7 0.363 0.196	2020         2025           0         2,022           0.299         0           1.41         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           1.4         1.68           4.42         16.7           89.1         76.3           4.91         4.9           0.11         0.331           0.095         0.091           64.7         59.7           0.784         5.07           33.7         33.3           0.363         0.402           0.196         1.27	2020         2025         2030           0         2,022         5,214           0.299         0         3.24           1.41         0         78           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           1.4         1.68         1.2           4.42         16.7         48.8           89.1         76.3         46.4           4.91         4.9         3.38           0.11         0.331         0.191           0.095         0.091         0.058           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         2,022         5,214         8,399           0.299         0         3.24         0           1.41         0         78         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           1.4         1.68         1.2         0.382           4.42         16.7         48.8         82.7           89.1         76.3         46.4         15.6           4.91         4.9         3.38         1.24           0.11         0.331         0.191         0.059           0.095         0.091         0.058         0.02           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         2,022         5,214         8,399         12,743           0.299         0         3.24         0         13.9           1.41         0         78         0         334           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           1.4         1.68         1.2         0.382         0.072           4.42         16.7         48.8         82.7         96.4           89.1         76.3         46.4         15.6         3.17           4.91         4.9         3.38         1.24         0.304           0.11         0.331         0.191         0.059         0.012           0.095         0.091         0.058         0.02         <	2020         2025         2030         2035         2040         2045           0         2,022         5,214         8,399         12,743         13,847           0.299         0         3.24         0         13.9         0           1.41         0         78         0         334         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           1.4         1.68         1.2         0.382         0.072         0.013           4.42         16.7         48.8         82.7         96.4         99.3           89.1         76.3         46.4         15.6         3.17         0.586           4.91         4.9         3.38         <

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

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Commercial (PJ)	441	434	415	383	346	319	305
Final energy use - Industry (PJ)	634	660	671	671	678	686	694
Final energy use - Residential (PJ)	591	551	512	443	367	307	269
Final energy use - Transportation (PJ)	1,043	977	873	748	634	562	530

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

Item	2020	2025	2030	2035	2040	2045	2050
Commercial HVAC investment in 2020s -	0	40,927	44,680	0	0	0	0
Cumulative 5-yr (million \$2018)							
Sales of cooking units - Electric Resistance (%)	41	54.2	82.9	88.6	88.9	88.9	88.9
Sales of cooking units - Gas (%)	59	45.8	17.1	11.4	11.1	11.1	11.1
Sales of space heating units - Electric Heat Pump	0.751	8.27	35.3	81	89	89.5	89.5
(%)							
Sales of space heating units - Electric Resistance	2.86	3.5	5.34	9.38	10.1	10.2	10.2
(%)							
Sales of space heating units - Fossil (%)	0	2.07	0.402	0.017	0	0	0
Sales of space heating units - Gas Furnace (%)	96.4	86.2	59	9.63	0.906	0.363	0.363
Sales of water heating units - Electric Heat Pump	0.271	2.48	19.4	46.1	50.7	51	51
(%)							
Sales of water heating units - Electric Resistance	2.65	4.62	18.3	44	48.5	48.8	48.8
(%)							
Sales of water heating units - Gas Furnace (%)	96.9	92.7	62.2	9.74	0.572	0	0
Sales of water heating units - Other (%)	0.154	0.185	0.186	0.187	0.186	0.187	0.187

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

Item	2020	2025	2030	2035	2040	2045	2050
Electricity distribution capital invested -	0	6.63	6.83	11.6	12.4	12.3	13
Cumulative 5-yr (billion \$2018)							

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

Item	2020	2025	2030	2035	2040	2045	2050
Capital invested - Solar PV - Base (billion \$2018)	0	2.75	6.89	3.69	4.13	1.86	0
Capital invested - Solar PV - Constrained (billion \$2018)	0	2.5	5.3	4.21	4.26	1.14	0
Capital invested - Wind - Base (billion \$2018)	0	7.65	9.8	0	7.4	12.2	24
Capital invested - Wind - Constrained (billion \$2018)	0	3.22	3.5	0.04	1.89	2.27	4.57

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

Item	2020	2025	2030	2035	2040	2045	2050
Solar - Base land use assumptions (GWh)	650	3,834	10,723	6,208	7,362	3,470	0
Solar - Constrained land use assumptions (GWh)	650	3,470	8,244	7,050	7,618	2,139	0
Wind - Base land use assumptions (GWh)	22,788	16,823	24,209	0	19,958	34,467	71,885
Wind - Constrained land use assumptions (GWh)	22,788	6,911	8,515	107	4,977	6,191	12,646

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

Item	2020	2025	2050
Carbon sink potential - Aggressive deployment -	0	0	-3,836
Corn-ethanol to energy grasses (1000 tCO2e/y)			
Carbon sink potential - Aggressive deployment -	0	0	-17,544
Cropland measures (1000 tCO2e/y)			
Carbon sink potential - Aggressive deployment -	0	0	-428
Permanent conservation cover (1000 tCO2e/y)			
Carbon sink potential - Aggressive deployment -	0	0	-21,808
Total (1000 tC02e/y)			
Carbon sink potential - Moderate deployment -	0	0	-3,836
Corn-ethanol to energy grasses (1000 tC02e/y)			

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

Table 12. ETAE Geenarie Tieerik e. Earla en ke	, ig. rourea.	o (comema	caj
Item	2020	2025	2050
Carbon sink potential - Moderate deployment -	0	0	-9,245
Cropland measures (1000 tCO2e/y)			
Carbon sink potential - Moderate deployment -	0	0	-214
Permanent conservation cover (1000 tCO2e/y)			
Carbon sink potential - Moderate deployment -	0	0	-13,295
Total (1000 tC02e/y)			
Land impacted for carbon sink - Aggressive	0	0	1,734
deployment - Corn-ethanol to energy grasses			
(1000 hectares)			
Land impacted for carbon sink - Aggressive	0	0	7,209
deployment - Cropland measures (1000			
hectares)			
Land impacted for carbon sink - Aggressive	0	0	779
deployment - Permanent conservation cover			
(1000 hectares)			
Land impacted for carbon sink - Aggressive	0	0	9,721
deployment - Total (1000 hectares)			
Land impacted for carbon sink - Moderate	0	0	1,734
deployment - Corn-ethanol to energy grasses			
(1000 hectares)			
Land impacted for carbon sink - Moderate	0	0	3,799
deployment - Cropland measures (1000			
hectares)			
Land impacted for carbon sink - Moderate	0	0	389
deployment - Permanent conservation cover			
(1000 hectares)			
Land impacted for carbon sink - Moderate	0	0	5,922
deployment - Total (1000 hectares)			

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

Table 43. LTRL- Scenario - FILLAN O. Lana Sinks			
Item	2020	2025	2050
Carbon sink potential - High - Accelerate	0	0	95.6
regeneration (1000 tCO2e/y)			
Carbon sink potential - High - All (not counting	0	0	21,662
overlap) (1000 tCO2e/y)			
Carbon sink potential - High - Avoid deforestation	0	0	2,692
(1000 tCO2e/y)			
Carbon sink potential - High - Extend rotation	0	0	2,426
length (1000 tCO2e/y)			
Carbon sink potential - High - Improve	0	0	108
plantations (1000 tCO2e/y)			
Carbon sink potential - High - Increase retention	0	0	1,364
of HWP (1000 tCO2e/y)			
Carbon sink potential - High - Increase trees	0	0	3,477
outside forests (1000 tCO2e/y)			
Carbon sink potential - High - Reforest cropland	0	0	5,430
(1000 tCO2e/y)			
Carbon sink potential - High - Reforest pasture	0	0	4,831
(1000 tCO2e/y)			
Carbon sink potential - High - Restore	0	0	1,239
productivity (1000 tCO2e/y)			
Carbon sink potential - Low - Accelerate	0	0	47.9
regeneration (1000 tCO2e/y)			
Carbon sink potential - Low - All (not counting	0	0	6,654
overlap) (1000 tCO2e/y)			
Carbon sink potential - Low - Avoid deforestation	0	0	449
(1000 tCO2e/y)			
Carbon sink potential - Low - Extend rotation	0	0	932
length (1000 tCO2e/y)			
Carbon sink potential - Low - Improve	0	0	55.1
plantations (1000 tCO2e/y)			
Carbon sink potential - Low - Increase retention	0	0	455
of HWP (1000 tCO2e/y)			
·			

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

Table 43: E+RE- scenario - PILLAR 6: Land sinks	- Forests (cc	ntinueaj	
Item	2020	2025	2050
Carbon sink potential - Low - Increase trees	0	0	1,217
outside forests (1000 tCO2e/y)			
Carbon sink potential - Low - Reforest cropland	0	0	2,715
(1000 tC02e/y)			•
Carbon sink potential - Low - Reforest pasture	0	0	366
(1000 tC02e/y)			
Carbon sink potential - Low - Restore	0	0	418
productivity (1000 tCO2e/y)	o	0	710
Carbon sink potential - Mid - Accelerate	0	0	71.7
regeneration (1000 tC02e/y)	o	0	1 1.1
Carbon sink potential - Mid - All (not counting	0	0	1/. 157
	U	U	14,157
overlap) (1000 tC02e/y)	0		1 570
Carbon sink potential - Mid - Avoid deforestation	0	0	1,570
(1000 tC02e/y)			4 (70
Carbon sink potential - Mid - Extend rotation	0	0	1,679
length (1000 tC02e/y)			
Carbon sink potential - Mid - Improve plantations	0	0	80.8
(1000 tC02e/y)			
Carbon sink potential - Mid - Increase retention	0	0	909
of HWP (1000 tCO2e/y)			
Carbon sink potential - Mid - Increase trees	0	0	2,347
outside forests (1000 tC02e/y)			
Carbon sink potential - Mid - Reforest cropland	0	0	4,073
(1000 tC02e/y)			,
Carbon sink potential - Mid - Reforest pasture	0	0	2,599
(1000 tC02e/y)			2,077
Carbon sink potential - Mid - Restore	0	0	828
productivity (1000 tCO2e/y)	o	0	020
Land impacted for carbon sink potential - High -	0	0	15.6
Accelerate regeneration (1000 hectares)	U	0	13.6
Land impacted for carbon sink potential - High -	0	0	277
	0	0	364
Avoid deforestation (over 30 years) (1000			
hectares)	0		1.007
Land impacted for carbon sink potential - High -	0	0	1,237
Extend rotation length (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	39.9
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	330
Increase trees outside forests (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	359
Reforest cropland (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	137
Reforest pasture (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	411
Restore productivity (1000 hectares)	Ŭ	•	711
Land impacted for carbon sink potential - High -	0	0	2,894
Total impacted (over 30 years) (1000 hectares)	U	0	2,074
	0	0	7.00
Land impacted for carbon sink potential - Low -	0	0	7.82
Accelerate regeneration (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	342
Avoid deforestation (over 30 years) (1000			
hectares)			
Land impacted for carbon sink potential - Low -	0	0	474
Extend rotation length (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	20
Improve plantations (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	0
Increase retention of HWP (1000 hectares)	-	Ŭ	J
Land impacted for carbon sink potential - Low -	0	0	174
Increase trees outside forests (1000 hectares)	U	١ '	114

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

Item	2020	2025	2050
Land impacted for carbon sink potential - Low -	0	0	180
Reforest cropland (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	23.8
Reforest pasture (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	248
Restore productivity (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	1,469
Total impacted (over 30 years) (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	11.7
Accelerate regeneration (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	353
Avoid deforestation (over 30 years) (1000			
hectares)			
Land impacted for carbon sink potential - Mid -	0	0	855
Extend rotation length (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	30
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	252
Increase trees outside forests (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	269
Reforest cropland (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	172
Reforest pasture (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	500
Restore productivity (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	2,444
Total impacted (over 30 years) (1000 hectares)			

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

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal	0	967	0.82	0.798	0.692	0.487	0.034
(million 2019\$)							
Monetary damages from air pollution - Natural	0	368	198	317	227	91	29.4
Gas (million 2019\$)							
Monetary damages from air pollution -	0	4,899	4,586	3,504	2,047	963	413
Transportation (million 2019\$)							
Premature deaths from air pollution - Coal	0	109	0.092	0.089	0.078	0.055	0.004
(deaths)							
Premature deaths from air pollution - Natural	0	41.6	22.4	35.8	25.6	10.3	3.32
Gas (deaths)							
Premature deaths from air pollution -	0	551	516	394	230	108	46.5
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	10.7	14.3	0	0	0	0
Cumulative 5-yr (billion \$2018)							
Sales of cooking units - Electric Resistance (%)	50.6	51.9	56.4	68.3	84.9	95.1	98.7
Sales of cooking units - Gas (%)	49.4	48.1	43.6	31.7	15.1	4.87	1.31
Sales of space heating units - Electric Heat Pump	3.5	8.23	11.6	22.2	45.5	72.3	87.2
(%)							
Sales of space heating units - Electric Resistance	12.7	18.7	18.1	16.4	12.5	8.16	5.9
(%)							
Sales of space heating units - Fossil (%)	2.45	4.6	4.47	3.97	2.93	1.72	1.01
Sales of space heating units - Gas (%)	81.4	68.5	65.9	57.4	39	17.8	5.87
Sales of water heating units - Electric Heat Pump	0	0.582	2.2	7.34	18.4	30.9	37.9
(%)							
Sales of water heating units - Electric Resistance	22.7	38.3	38.8	40.9	46.2	52.8	56.7
(%)							

# 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 (%)	77.3	61	58.9	51.7	35.3	16.1	5.22
Sales of water heating units - Other (%)	0.046	0.112	0.113	0.113	0.113	0.113	0.112

#### 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	333	687	2,331	7,297	10,644
(million \$2018)							
Public EV charging plugs - DC Fast (1000 units)	0.299	0	1.05	0	5.19	0	14.3
Public EV charging plugs - L2 (1000 units)	1.41	0	25.2	0	125	0	345
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 (%)	1.41	1.85	2.03	1.61	1.02	0.519	0.223
Vehicle sales - Light-duty - EV (%)	2.06	5.07	12.6	27.1	49.7	72.9	87.9
Vehicle sales - Light-duty - gasoline (%)	91.2	86.7	78.4	65.1	44.7	23.9	10.6
Vehicle sales - Light-duty - hybrid (%)	5.1	5.88	6.55	5.89	4.34	2.52	1.21
Vehicle sales - Light-duty - hydrogen FC (%)	0.112	0.376	0.317	0.239	0.168	0.092	0.043
Vehicle sales - Light-duty - other (%)	0.096	0.1	0.09	0.078	0.056	0.03	0.014
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)	441	434	424	414	399	379	356
Final energy use - Industry (PJ)	634	660	674	680	693	701	708
Final energy use - Residential (PJ)	591	552	524	495	458	408	352
Final energy use - Transportation (PJ)	1,044	984	908	847	798	740	672

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

Item	2020	2025	2030	2035	2040	2045	2050
Commercial HVAC investment in 2020s -	0	40,922	44,666	0	0	0	0
Cumulative 5-yr (million \$2018)							
Sales of cooking units - Electric Resistance (%)	41	45.8	49.8	60.5	75.4	84.5	87.7
Sales of cooking units - Gas (%)	59	54.2	50.2	39.5	24.6	15.5	12.3
Sales of space heating units - Electric Heat Pump	0.751	6.2	9.31	19.3	41.6	67.6	82.4
(%)							
Sales of space heating units - Electric Resistance	2.86	3.43	3.64	4.33	6.04	8.25	9.53
(%)							
Sales of space heating units - Fossil (%)	0	2.4	2.27	1.73	0.88	0.287	0.075
Sales of space heating units - Gas Furnace (%)	96.4	88	84.8	74.6	51.5	23.8	7.97
Sales of water heating units - Electric Heat Pump	0.271	1.04	2.99	9.2	22.7	38.2	46.9
(%)							
Sales of water heating units - Electric Resistance	2.65	3.78	5.32	10.5	22.3	36.6	44.8
(%)							
Sales of water heating units - Gas Furnace (%)	96.9	95	91.5	80.1	54.8	25	8.1
Sales of water heating units - Other (%)	0.154	0.185	0.186	0.187	0.186	0.187	0.187

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

	•		•				
Item	2020	2025	2030	2035	2040	2045	2050
Electricity distribution capital invested -	0	5.41	5.46	7.27	7.54	10.4	11
Cumulative 5-yr (billion \$2018)							

Table 50. F-R+ scenar	ים אווזם הו	· Cloan Ela	atnicity Co	nonatina oa	nanitu

Item	2020	2025	2030	2035	2040	2045	2050
Capital invested - Biomass power plant (billion	0	0	0	0	0	0	0
\$2018)							
Capital invested - Biomass w/ccu allam power	0	0	0	0.075	0	0	0
plant (billion \$2018)							
Capital invested - Biomass w/ccu power plant	0	0	1.9	1.4	0	0	0
(billion \$2018)							

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

Item	2020	2025	2030	2035	2040	2045	2050
Biomass power plant (GWh)	0	0	0	0	0	0	0
Biomass w/ccu allam power plant (GWh)	0	0	0	74.6	74.6	74.6	74.6
Biomass w/ccu power plant (GWh)	0	0	2,136	3,710	3,710	3,710	3,710

#### 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	151	6,164	10,720	10,720	10,720
Conversion capital investment - Cumulative 5-yr	0	0	1,746	60,802	45,876	0	0
(million \$2018)							
Number of facilities - Allam power w ccu	0	0	0	2	2	2	2
(quantity)							
Number of facilities - Beccs hydrogen (quantity)	0	0	0	70	124	124	124
Number of facilities - Diesel (quantity)	0	0	0	0	0	0	0
Number of facilities - Diesel ccu (quantity)	0	0	0	2	2	2	2
Number of facilities - Power (quantity)	0	0	0	0	0	0	0
Number of facilities - Power ccu (quantity)	0	0	2	4	4	4	4
Number of facilities - Pyrolysis (quantity)	0	0	0	0	0	0	0
Number of facilities - Pyrolysis ccu (quantity)	0	0	0	2	2	2	2
Number of facilities - Sng (quantity)	0	0	0	0	0	0	0
Number of facilities - Sng ccu (quantity)	0	0	2	2	2	2	2

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

Item	2020	2025	2030	2035	2040	2045	2050
Annual - All (MMT)	0	0	2.13	83.5	142	142	143
Annual - BECCS (MMT)	0	0	2.12	80	139	139	139
Annual - Cement and lime (MMT)	0	0	0	3.35	3.32	3.42	3.53
Annual - NGCC (MMT)	0	0	0.01	0.09	0.11	0.08	0.03
Cumulative - All (MMT)	0	0	2.13	85.6	228	371	513
Cumulative - BECCS (MMT)	0	0	2.12	82.2	221	360	499
Cumulative - Cement and lime (MMT)	0	0	0	3.35	6.67	10.1	13.6
Cumulative - NGCC (MMT)	0	0	0.01	0.1	0.21	0.29	0.32

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

Item	2020	2025	2030	2035	2040	2045	2050
CO2 storage (MMT)	0	0	2.77	13.9	27.3	38.4	40.1
Injection wells (wells)	0	0	7	26	46	78	96
Resource characterization, appraisal, permitting costs (million \$2020)	0	100	441	682	682	682	682
Wells and facilities construction costs (million \$2020)	0	0	200	781	1,392	2,327	2,890

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

Item	2020	2025	2030	2035	2040	2045	2050
All (km)	0	0	1,311	5,604	8,760	8,881	8,894
Cumulative investment - All (million \$2018)	0	0	6,509	13,041	20,368	21,553	21,678
Cumulative investment - Spur (million \$2018)	0	0	240	4,152	6,968	8,152	8,277
Cumulative investment - Trunk (million \$2018)	0	0	6,269	8,888	13,401	13,401	13,401
Spur (km)	0	0	354	4,280	6,716	6,837	6,849
Trunk (km)	0	0	958	1,324	2,045	2,045	2,045

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

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

Table 57: E-B+ scenario - PILLAR 6: Land sinks -	- Forests		
Item	2020	2025	2050
Carbon sink potential - High - Accelerate	0	0	95.6
regeneration (1000 tCO2e/y)			
Carbon sink potential - High - All (not counting	0	0	21,662
overlap) (1000 tCO2e/y)			
Carbon sink potential - High - Avoid deforestation	0	0	2,692
(1000 tCO2e/y)			
Carbon sink potential - High - Extend rotation	0	0	2,426
length (1000 tCO2e/y)			
Carbon sink potential - High - Improve	0	0	108
plantations (1000 tCO2e/y)			
Carbon sink potential - High - Increase retention	0	0	1,364
of HWP (1000 tCO2e/y)			
Carbon sink potential - High - Increase trees	0	0	3,477
outside forests (1000 tCO2e/y)			
Carbon sink potential - High - Reforest cropland	0	0	5,430
(1000 tC02e/y)			
Carbon sink potential - High - Reforest pasture	0	0	4,831
(1000 tCO2e/y)			
Carbon sink potential - High - Restore	0	0	1,239
productivity (1000 tC02e/y)			
Carbon sink potential - Low - Accelerate	0	0	47.9
regeneration (1000 tCO2e/y)			
Carbon sink potential - Low - All (not counting	0	0	6,654
overlap) (1000 tCO2e/y)			-,
Carbon sink potential - Low - Avoid deforestation	0	0	449
(1000 tCO2e/y)			
Carbon sink potential - Low - Extend rotation	0	0	932
length (1000 tC02e/y)			
Carbon sink potential - Low - Improve	0	0	55.1
plantations (1000 tCO2e/y)			00.1
Carbon sink potential - Low - Increase retention	0	0	455
of HWP (1000 tCO2e/y)			.00
Carbon sink potential - Low - Increase trees	0	0	1,217
outside forests (1000 tCO2e/y)			1,211
Carbon sink potential - Low - Reforest cropland	0	0	2,715
(1000 tC02e/y)		0	2,110
Carbon sink potential - Low - Reforest pasture	0	0	366
(1000 tC02e/y)		0	300
Carbon sink potential - Low - Restore	0	0	418
productivity (1000 tCO2e/y)		9	410
Carbon sink potential - Mid - Accelerate	0	0	71.7
regeneration (1000 tCO2e/y)		0	1 1.1
Carbon sink potential - Mid - All (not counting	0	0	14,157
overlap) (1000 tC02e/y)		0	14,131
Carbon sink potential - Mid - Avoid deforestation	0	0	1,570
(1000 tC02e/y)		0	1,510
Carbon sink potential - Mid - Extend rotation	0	0	1,679
length (1000 tC02e/y)	0	U	1,019
	0	0	00.0
Carbon sink potential - Mid - Improve plantations	0	0	80.8
(1000 tC02e/y)	0	0	000
Carbon sink potential - Mid - Increase retention	0	0	909
of HWP (1000 tCO2e/y)			0017
Carbon sink potential - Mid - Increase trees	0	0	2,347
outside forests (1000 tC02e/y)			, .=-
Carbon sink potential - Mid - Reforest cropland	0	0	4,073
(1000 tC02e/y)			
Carbon sink potential - Mid - Reforest pasture	0	0	2,599
(1000 tC02e/y)			
Carbon sink potential - Mid - Restore	0	0	828
nnad ( ) at in the (1000 t000 a /e)			
productivity (1000 tCO2e/y)			
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)	0	0	15.6

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

Table 57: E-B+ scenario - PILLAR 6: Land sinks	- Forests (co		
Item	2020	2025	2050
Land impacted for carbon sink potential - High -	0	0	364
Avoid deforestation (over 30 years) (1000			
hectares)			
Land impacted for carbon sink potential - High -	0	0	1,237
Extend rotation length (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	39.9
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	330
Increase trees outside forests (1000 hectares)			333
Land impacted for carbon sink potential - High -	0	0	359
Reforest cropland (1000 hectares)		<u> </u>	007
Land impacted for carbon sink potential - High -	0	0	137
Reforest pasture (1000 hectares)		0	101
Land impacted for carbon sink potential - High -	0	0	411
	0	0	411
Restore productivity (1000 hectares)	0	0	0.007
Land impacted for carbon sink potential - High -	0	0	2,894
Total impacted (over 30 years) (1000 hectares)			7.00
Land impacted for carbon sink potential - Low -	0	0	7.82
Accelerate regeneration (1000 hectares)	_	_	
Land impacted for carbon sink potential - Low -	0	0	342
Avoid deforestation (over 30 years) (1000			
hectares)			
Land impacted for carbon sink potential - Low -	0	0	474
Extend rotation length (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	20
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	174
Increase trees outside forests (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	180
Reforest cropland (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	23.8
Reforest pasture (1000 hectares)		ı ı	20.0
Land impacted for carbon sink potential - Low -	0	0	248
Restore productivity (1000 hectares)		0	240
	0	0	1 /.40
Land impacted for carbon sink potential - Low -	0	0	1,469
Total impacted (over 30 years) (1000 hectares)	0	0	11 7
Land impacted for carbon sink potential - Mid -	0	0	11.7
Accelerate regeneration (1000 hectares)			0.50
Land impacted for carbon sink potential - Mid -	0	0	353
Avoid deforestation (over 30 years) (1000			
hectares)	_	_	
Land impacted for carbon sink potential - Mid -	0	0	855
Extend rotation length (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	30
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	252
Increase trees outside forests (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	269
Reforest cropland (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	172
Reforest pasture (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	500
Restore productivity (1000 hectares)		~	300
Land impacted for carbon sink potential - Mid -	0	0	2,444
Total impacted (over 30 years) (1000 hectares)	"	0	۷,744
rotal illipactou (ovel ou year of (1000 lieutal 68)			

Table CO DCC assessia	DILLADA EEC-!	/F1 4 - 161 41	Desidential
Table 58: REF scenario -	PILLAR I: Efficiency	/Electrification -	Kesiaentiai

Item	2020	2025	2030	2035	2040	2045	2050
Residential HVAC investment in 2020s vs. REF -	0	10.3	11.1	0	0	0	0
Cumulative 5-yr (billion \$2018)							
Sales of cooking units - Electric Resistance (%)	50.2	50.2	50.2	50.2	50.2	50.2	50.2
Sales of cooking units - Gas (%)	49.8	49.8	49.8	49.8	49.8	49.8	49.8
Sales of space heating units - Electric Heat Pump	2.39	12.9	13.5	14.3	15	15.6	16.5
(%)							
Sales of space heating units - Electric Resistance	12.9	17.8	17.6	17.4	16.8	16	15.2
(%)							
Sales of space heating units - Fossil (%)	2.6	4.13	4.15	4.15	4.16	4.19	4.17
Sales of space heating units - Gas (%)	82.1	65.2	64.8	64.2	64.1	64.2	64
Sales of water heating units - Electric Heat Pump	0	0	0	0	0	0	0
(%)							
Sales of water heating units - Electric Resistance	22.7	38.1	37.9	37.8	37.8	37.7	37.7
(%)							
Sales of water heating units - Gas Furnace (%)	77.3	61.8	62	62.1	62.1	62.2	62.2
Sales of water heating units - Other (%)	0.046	0.112	0.113	0.113	0.113	0.114	0.114

# 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 (%)	1.4	1.84	2.16	2.01	1.81	1.68	1.6
Vehicle sales - Light-duty - EV (%)	4.06	6.24	7.06	8.71	10.6	12.1	13.3
Vehicle sales - Light-duty - gasoline (%)	89.4	85.7	83.3	81.3	79.2	77.2	75.7
Vehicle sales - Light-duty - hybrid (%)	4.93	5.75	7	7.56	8.09	8.59	8.95
Vehicle sales - Light-duty - hydrogen FC (%)	0.11	0.371	0.337	0.297	0.293	0.293	0.303
Vehicle sales - Light-duty - other (%)	0.095	0.099	0.095	0.096	0.095	0.094	0.096
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)	441	441	437	426	415	414	426
Final energy use - Industry (PJ)	634	673	695	715	742	766	795
Final energy use - Residential (PJ)	591	553	532	516	507	501	496
Final energy use - Transportation (PJ)	1,044	993	935	904	914	947	988

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

Item	2020	2025	2030	2035	2040	2045	2050
Commercial HVAC investment in 2020s -	0	40,483	41,990	0	0	0	0
Cumulative 5-yr (million \$2018)							
Sales of cooking units - Electric Resistance (%)	41	44.2	44.3	44.3	44.3	44.4	44.5
Sales of cooking units - Gas (%)	59	55.8	55.7	55.7	55.7	55.6	55.5
Sales of space heating units - Electric Heat Pump	0.751	12.5	44.7	71.1	75.5	75.9	75.9
(%)							
Sales of space heating units - Electric Resistance	2.86	4.31	8.93	17.1	22.7	23.6	23.7
(%)							
Sales of space heating units - Fossil (%)	0	2.21	1.15	0.205	0.023	0	0
Sales of space heating units - Gas Furnace (%)	96.4	81	45.2	11.6	1.78	0.443	0.362
Sales of water heating units - Electric Heat Pump	0.271	0.342	0.346	0.345	0.34	0.342	0.342
(%)							

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	2.65	3.2	3.17	3.18	3.17	3.15	3.16
(%)							
Sales of water heating units - Gas Furnace (%)	96.9	96.3	96.3	96.3	96.3	96.3	96.3
Sales of water heating units - Other (%)	0.154	0.185	0.186	0.187	0.186	0.187	0.187

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

Item	2020	2025	2030	2035	2040	2045	2050
Electricity distribution capital invested -	0	5.74	5.83	7.97	8.31	10.3	10.9
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)	-11.1	0	-4.33	-3.87
Business-as-usual carbon sink - Retained in Hardwood Products (Mt CO2e/y)	-0.371	0	-0.667	-0.694
Business-as-usual carbon sink - Total (Mt CO2e/y)	-11.5	0	-5	-4.57
Carbon sink potential - High - Accelerate	0	0	0	95.6
regeneration (1000 tCO2e/y)				
Carbon sink potential - High - All (not counting overlap) (1000 tCO2e/y)	0	0	0	21,662
Carbon sink potential - High - Avoid deforestation (1000 tCO2e/y)	0	0	0	2,692
Carbon sink potential - High - Extend rotation length (1000 tCO2e/y)	0	0	0	2,426
Carbon sink potential - High - Improve plantations (1000 tCO2e/y)	0	0	0	108
Carbon sink potential - High - Increase retention of HWP (1000 tCO2e/y)	0	0	0	1,364
Carbon sink potential - High - Increase trees outside forests (1000 tCO2e/y)	0	0	0	3,477
Carbon sink potential - High - Reforest cropland (1000 tCO2e/y)	0	0	0	5,430
Carbon sink potential - High - Reforest pasture (1000 tCO2e/y)	0	0	0	4,831
Carbon sink potential - High - Restore productivity (1000 tCO2e/y)	0	0	0	1,239
Carbon sink potential - Low - Accelerate regeneration (1000 tCO2e/y)	0	0	0	47.9
Carbon sink potential - Low - All (not counting overlap) (1000 tCO2e/y)	0	0	0	6,654
Carbon sink potential - Low - Avoid deforestation (1000 tCO2e/y)	0	0	0	449
Carbon sink potential - Low - Extend rotation length (1000 tCO2e/y)	0	0	0	932
Carbon sink potential - Low - Improve plantations (1000 tCO2e/y)	0	0	0	55.1
Carbon sink potential - Low - Increase retention of HWP (1000 tCO2e/y)	0	0	0	455
Carbon sink potential - Low - Increase trees outside forests (1000 tCO2e/y)	0	0	0	1,217
Carbon sink potential - Low - Reforest cropland (1000 tCO2e/y)	0	0	0	2,715
Carbon sink potential - Low - Reforest pasture (1000 tCO2e/y)	0	0	0	366
Carbon sink potential - Low - Restore productivity (1000 tCO2e/y)	0	0	0	418
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO2e/y)	0	0	0	71.7
Carbon sink potential - Mid - All (not counting overlap) (1000 tC02e/y)	0	0	0	14,157

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	1,570
Carbon sink potential - Mid - Extend rotation	0	0	0	1,679
length (1000 tCO2e/y)  Carbon sink potential - Mid - Improve plantations	0	0	0	80.8
(1000 tC02e/y)  Carbon sink potential - Mid - Increase retention	0	0	0	909
of HWP (1000 tCO2e/y)  Carbon sink potential - Mid - Increase trees	0	0	0	2,347
outside forests (1000 tCO2e/y)  Carbon sink potential - Mid - Reforest cropland	0	0	0	4,073
(1000 tC02e/y)			_	
Carbon sink potential - Mid - Reforest pasture (1000 tCO2e/y)	0	0	0	2,599
Carbon sink potential - Mid - Restore productivity (1000 tCO2e/y)	0	0	0	828
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)	0	0	0	15.6
Land impacted for carbon sink potential - High -	0	0	0	364
Avoid deforestation (over 30 years) (1000 hectares)				
Land impacted for carbon sink potential - High - Extend rotation length (1000 hectares)	0	0	0	1,237
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)	0	0	0	39.9
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	330
Increase trees outside forests (1000 hectares)  Land impacted for carbon sink potential - High -	0	0	0	359
Reforest cropland (1000 hectares)  Land impacted for carbon sink potential - High -	0	0	0	137
Reforest pasture (1000 hectares)  Land impacted for carbon sink potential - High -	0	0	0	411
Restore productivity (1000 hectares)				
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)	0	0	0	2,894
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)	0	0	0	7.82
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000	0	0	0	342
hectares)  Land impacted for carbon sink potential - Low -	0	0	0	474
Extend rotation length (1000 hectares)  Land impacted for carbon sink potential - Low -	0	0	0	20
Improve plantations (1000 hectares)  Land impacted for carbon sink potential - Low -	0	0	0	0
Increase retention of HWP (1000 hectares)  Land impacted for carbon sink potential - Low -	0	0	0	174
Increase trees outside forests (1000 hectares)				
Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares)	0	0	0	180
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)	0	0	0	23.8
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)	0	0	0	248
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)	0	0	0	1,469
Land impacted for carbon sink potential - Mid -	0	0	0	11.7
Accelerate regeneration (1000 hectares)  Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000	0	0	0	353
hectares)				

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

Item	2020	2025	2030	2050
Land impacted for carbon sink potential - Mid -	0	0	0	855
Extend rotation length (1000 hectares)				
Land impacted for carbon sink potential - Mid -	0	0	0	30
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	252
Increase trees outside forests (1000 hectares)				
Land impacted for carbon sink potential - Mid -	0	0	0	269
Reforest cropland (1000 hectares)				
Land impacted for carbon sink potential - Mid -	0	0	0	172
Reforest pasture (1000 hectares)				
Land impacted for carbon sink potential - Mid -	0	0	0	500
Restore productivity (1000 hectares)				
Land impacted for carbon sink potential - Mid -	0	0	0	2,444
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	3,848	2,388	1,664	1,343	1,220	1,201
Monetary damages from air pollution - Natural Gas (million 2019\$)	0	410	476	592	593	630	563
Monetary damages from air pollution - Transportation (million 2019\$)	0	4,980	5,129	5,287	5,472	5,655	5,836
Premature deaths from air pollution - Coal (deaths)	0	432	268	187	151	137	135
Premature deaths from air pollution - Natural Gas (deaths)	0	46.3	53.8	66.9	67	71.1	63.5
Premature deaths from air pollution - Transportation (deaths)	0	560	577	595	615	636	656