Net-Zero America - new york state report

Larson et al. 2020

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

Notes

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

List of Tables

1	E+ scenario - PILLAR 1: Efficiency/Electrification - Residential	4
2	E+ scenario - PILLAR 1: Efficiency/Electrification - Transportation	4
3	E+ scenario - PILLAR 1: Efficiency/Electrification - Overview	4
4	E+ scenario - PILLAR 1: Efficiency/Electrification - Commercial	4
5	E+ scenario - PILLAR 1: Efficiency/Electrification - Electricity demand	5
6	E+ scenario - PILLAR 2: Clean Electricity - Generating capacity	5
7	E+ scenario - PILLAR 2: Clean Electricity - Generation	5
8	E+ scenario - PILLAR 3: Clean fuels - Bioenergy	5
9	E+ scenario - PILLAR 4: CCUS - CO2 capture	6
10	E+ scenario - PILLAR 4: CCUS - CO2 storage	6
11	E+ scenario - PILLAR 4: CCUS - CO2 pipelines	6
12	E+ scenario - PILLAR 6: Land sinks - Agriculture	6
13	E+ scenario - PILLAR 6: Land sinks - Forests	7
14	E+ scenario - IMPACTS - Health	9
15	E+ scenario - IMPACTS - Jobs	9
16	E+ scenario - IMPACTS - Fossil fuel industries	0
17	E- scenario - PILLAR 1: Efficiency/Electrification - Residential	O

18	E- scenario - PILLAR 1: Efficiency/Electrification - Transportation	11
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	21
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	24
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	25
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	26
55	E-B+ scenario - PILLAR 4: CCUS - CO2 pipelines	26
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	30
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	14.3	15.2	0	0	0	0
Cumulative 5-yr (billion \$2018)							
Sales of cooking units - Electric Resistance (%)	34.6	48.6	91.2	99.6	100	100	100
Sales of cooking units - Gas (%)	65.4	51.4	8.8	0.443	0	0	0
Sales of space heating units - Electric Heat Pump	3.63	16.2	66.1	89	91.7	91.9	92
(%)							
Sales of space heating units - Electric Resistance	8.47	10.5	6.04	3.28	2.89	2.96	3.08
(%)							
Sales of space heating units - Fossil (%)	24.2	32.1	10.3	4.74	4.39	4.24	4.06
Sales of space heating units - Gas (%)	63.7	41.2	17.6	3.03	0.991	0.876	0.88
Sales of water heating units - Electric Heat Pump	0	6.54	37.2	51.7	53.5	53.6	53.6
(%)							
Sales of water heating units - Electric Resistance	18.7	35.7	39.8	45.4	46.3	46.4	46.3
(%)							
Sales of water heating units - Gas Furnace (%)	71.1	52	21.9	2.85	0.155	0	0
Sales of water heating units - Other (%)	10.3	5.8	1.12	0.083	0.037	0.038	0.038

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	2,187	5,658	9,084	13,794	14,977	14,299
(million \$2018)							
Public EV charging plugs - DC Fast (1000 units)	0.56	0	3.54	0	15	0	24.1
Public EV charging plugs - L2 (1000 units)	4.23	0	85.1	0	360	0	579
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 (%)	1.44	1.72	1.21	0.387	0.073	0.013	0
Vehicle sales - Light-duty - EV (%)	4.28	16.3	48.1	82.5	96.4	99.3	100
Vehicle sales - Light-duty - gasoline (%)	89.3	76.7	47.1	15.8	3.2	0.587	0
Vehicle sales - Light-duty - hybrid (%)	4.78	4.8	3.33	1.23	0.301	0.066	0
Vehicle sales - Light-duty - hydrogen FC (%)	0.11	0.333	0.194	0.06	0.012	0.002	0
Vehicle sales - Light-duty - other (%)	0.097	0.093	0.059	0.021	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)	690	677	650	604	560	538	533
Final energy use - Industry (PJ)	488	505	512	521	523	530	532
Final energy use - Residential (PJ)	880	819	735	612	496	413	364
Final energy use - Transportation (PJ)	1,161	1,104	995	858	731	647	604

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

Item	2020	2025	2030	2035	2040	2045	2050
Commercial HVAC investment in 2020s -	0	89,684	98,037	0	0	0	0
Cumulative 5-yr (million \$2018)							
Sales of cooking units - Electric Resistance (%)	18.5	33.7	75.3	83.5	83.9	84	84
Sales of cooking units - Gas (%)	81.5	66.3	24.7	16.5	16.1	16	16
Sales of space heating units - Electric Heat Pump (%)	0.625	15.6	51.1	76.3	79.8	80.3	80.2
Sales of space heating units - Electric Resistance (%)	2.13	4.73	12.8	18	19.1	18.8	18.9
Sales of space heating units - Fossil (%)	19.1	14.5	2.85	0.124	0	0	0

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Item	2020	2025	2030	2035	2040	2045	2050
Sales of space heating units - Gas Furnace (%)	78.2	65.2	33.3	5.6	1.11	0.87	0.863
Sales of water heating units - Electric Heat Pump (%)	0.224	7.35	41	58.7	61	61.2	61.2
Sales of water heating units - Electric Resistance (%)	1.34	5.14	22.3	36.4	38.5	38.7	38.7
Sales of water heating units - Gas Furnace (%)	97	86.3	36.3	4.73	0.256	0	0
Sales of water heating units - Other (%)	1.45	1.19	0.377	0.184	0.175	0.176	0.176

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

Item	2020	2025	2030	2035	2040	2045	2050
Electricity distribution capital invested -	0	7.59	7.79	18.2	19.6	18.4	19.5
Cumulative 5-yr (billion \$2018)							

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

Item	2020	2025	2030	2035	2040	2045	2050
Capital invested - Biomass power plant (billion	0	0	0	0	0	0	0
\$2018)							
Capital invested - Biomass w/ccu allam power	0	0	0	0.005	0.001	0	0.013
plant (billion \$2018)							
Capital invested - Biomass w/ccu power plant	0	0	0.008	0	0.001	0	0
(billion \$2018)							
Capital invested - Offshore Wind - Base (billion	0	0.393	0.409	15.9	10.9	11	11.3
\$2018)							
Capital invested - Offshore Wind - Constrained	0	0.782	0.412	15.4	10.8	9.53	12.4
(billion \$2018)							
Capital invested - Solar PV - Base (billion \$2018)	0	6.82	6.34	2.75	6.46	14.1	7.55
Capital invested - Solar PV - Constrained (billion	0	11.5	11.2	5.23	7.17	8.6	3.67
\$2018)							
Capital invested - Wind - Base (billion \$2018)	0	0	5.05	7.37	1.23	3.44	1.04
Capital invested - Wind - Constrained (billion	0	0	8.47	7.67	1.8	3.59	1.05
\$2018)							

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

Item	2020	2025	2030	2035	2040	2045	2050
Biomass power plant (GWh)	0	0	0	0	0	0	0
Biomass w/ccu allam power plant (GWh)	0	0	0	4.5	5.42	5.42	18.8
Biomass w/ccu power plant (GWh)	0	0	8.55	8.55	9.28	9.28	9.28
OffshoreWind - Base land use assumptions (GWh)	0	562	687	31,510	22,203	28,224	36,190
OffshoreWind - Constrained land use	0	562	687	31,510	22,203	28,224	36,190
assumptions (GWh)							
Solar - Base land use assumptions (GWh)	2,912	8,743	9,008	4,160	10,465	24,337	13,832
Solar - Constrained land use assumptions (GWh)	935	9,932	16,979	7,578	11,882	15,990	9,640
Wind - Base land use assumptions (GWh)	14,244	0	7,891	11,920	2,068	6,000	1,894
Wind - Constrained land use assumptions (GWh)	14,244	0	7,812	12,176	2,987	6,102	1,899

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

•	Ο,						
Item	2020	2025	2030	2035	2040	2045	2050
Biomass purchases (million \$2018/year)	0	0	0.322	0.902	1.04	1.04	235
Conversion capital investment - Cumulative 5-yr	0	0	7.03	19.2	4.22	0	4,926
(million \$2018)							
Number of facilities - Allam power w ccu	0	0	0	1	1	1	2
(quantity)							
Number of facilities - Beccs hydrogen (quantity)	0	0	0	1	1	1	3
Number of facilities - Diesel (quantity)	0	0	0	0	0	0	0
Number of facilities - Diesel ccu (quantity)	0	0	0	1	1	1	2
Number of facilities - Power (quantity)	0	0	0	0	0	0	0
Number of facilities - Power ccu (quantity)	0	0	1	1	1	1	1
Number of facilities - Pyrolysis (quantity)	0	0	0	0	0	0	2
Number of facilities - Pyrolysis ccu (quantity)	0	0	0	1	1	1	1

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

Item	2020	2025	2030	2035	2040	2045	2050
Number of facilities - Sng (quantity)	0	0	0	0	0	0	0
Number of facilities - Sng ccu (quantity)	0	0	1	1	1	1	2

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

Item	2020	2025	2030	2035	2040	2045	2050
Annual - All (MMT)	0	0	0.01	3.38	3.35	3.45	7.35
Annual - BECCS (MMT)	0	0	0.01	0.02	0.02	0.02	3.8
Annual - Cement and lime (MMT)	0	0	0	3.35	3.32	3.42	3.53
Annual - NGCC (MMT)	0	0	0	0.01	0.01	0.01	0.01
Cumulative - All (MMT)	0	0	0.01	3.39	6.74	10.2	17.5
Cumulative - BECCS (MMT)	0	0	0.01	0.03	0.05	0.07	3.87
Cumulative - Cement and lime (MMT)	0	0	0	3.35	6.67	10.1	13.6
Cumulative - NGCC (MMT)	0	0	0	0.01	0.02	0.03	0.04

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

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

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

Item	2020	2025	2030	2035	2040	2045	2050
All (km)	0	0	279	437	612	612	1,309
Cumulative investment - All (million \$2018)	0	0	225	402	493	496	905
Cumulative investment - Spur (million \$2018)	0	0	111	288	379	382	791
Cumulative investment - Trunk (million \$2018)	0	0	114	114	114	114	114
Spur (km)	0	0	216	374	549	549	1,246
Trunk (km)	0	0	63	63	63	63	63

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

Item	2020	2025	2050
Carbon sink potential - Aggressive deployment -	0	0	-264
Corn-ethanol to energy grasses (1000 tC02e/y)			
Carbon sink potential - Aggressive deployment -	0	0	-2,322
Cropland measures (1000 tCO2e/y)			
Carbon sink potential - Aggressive deployment -	0	0	-89.7
Permanent conservation cover (1000 tC02e/y)			
Carbon sink potential - Aggressive deployment -	0	0	-2,675
Total (1000 tC02e/y)			
Carbon sink potential - Moderate deployment -	0	0	-264
Corn-ethanol to energy grasses (1000 tCO2e/y)			
Carbon sink potential - Moderate deployment -	0	0	-1,224
Cropland measures (1000 tCO2e/y)			
Carbon sink potential - Moderate deployment -	0	0	-44.8
Permanent conservation cover (1000 tC02e/y)			
Carbon sink potential - Moderate deployment -	0	0	-1,532
Total (1000 tC02e/y)			
Land impacted for carbon sink - Aggressive	0	0	85.7
deployment - Corn-ethanol to energy grasses			
(1000 hectares)			
Land impacted for carbon sink - Aggressive	0	0	1,489
deployment - Cropland measures (1000			
hectares)			
Land impacted for carbon sink - Aggressive	0	0	163
deployment - Permanent conservation cover			
(1000 hectares)			

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

Item	2020	2025	2050
Land impacted for carbon sink - Aggressive	0	0	1,738
deployment - Total (1000 hectares)			
Land impacted for carbon sink - Moderate	0	0	85.7
deployment - Corn-ethanol to energy grasses			
(1000 hectares)			
Land impacted for carbon sink - Moderate	0	0	785
deployment - Cropland measures (1000			
hectares)			
Land impacted for carbon sink - Moderate	0	0	81.5
deployment - Permanent conservation cover			
(1000 hectares)			
Land impacted for carbon sink - Moderate	0	0	953
deployment - Total (1000 hectares)			

Table 13: E+ scenario - PILLAR 6: Land sinks - Fo		2005	2050
Item	2020	2025	2050
Carbon sink potential - High - Accelerate	0	0	383
regeneration (1000 tCO2e/y)		_	
Carbon sink potential - High - All (not counting	0	0	31,435
overlap) (1000 tCO2e/y)			
Carbon sink potential - High - Avoid deforestation	0	0	2,752
(1000 tC02e/y)			
Carbon sink potential - High - Extend rotation	0	0	11,858
length (1000 tCO2e/y)			
Carbon sink potential - High - Improve	0	0	604
plantations (1000 tCO2e/y)			
Carbon sink potential - High - Increase retention	0	0	5,464
of HWP (1000 tCO2e/y)			,
Carbon sink potential - High - Increase trees	0	0	1,072
outside forests (1000 tCO2e/y)	· ·		.,
Carbon sink potential - High - Reforest cropland	0	0	273
(1000 tC02e/y)	Ü		2.0
Carbon sink potential - High - Reforest pasture	0	0	5,516
(1000 tC02e/y)	U		3,310
Carbon sink potential - High - Restore	0	0	3,513
productivity (1000 tCO2e/y)	U		3,515
Carbon sink potential - Low - Accelerate	0	0	192
	U	U	192
regeneration (1000 tC02e/y)		0	0,7,0
Carbon sink potential - Low - All (not counting	0	0	9,448
overlap) (1000 tC02e/y)			/ 50
Carbon sink potential - Low - Avoid deforestation	0	0	459
(1000 tC02e/y)			,
Carbon sink potential - Low - Extend rotation	0	0	4,555
length (1000 tC02e/y)		_	
Carbon sink potential - Low - Improve	0	0	307
plantations (1000 tCO2e/y)			
Carbon sink potential - Low - Increase retention	0	0	1,821
of HWP (1000 tCO2e/y)			
Carbon sink potential - Low - Increase trees	0	0	375
outside forests (1000 tCO2e/y)			
Carbon sink potential - Low - Reforest cropland	0	0	136
(1000 tCO2e/y)			
Carbon sink potential - Low - Reforest pasture	0	0	418
(1000 tC02e/y)			
Carbon sink potential - Low - Restore	0	0	1,184
productivity (1000 tCO2e/y)			,
Carbon sink potential - Mid - Accelerate	0	0	287
regeneration (1000 tCO2e/y)			
Carbon sink potential - Mid - All (not counting	0	0	20,436
overlap) (1000 tC02e/y)			25,400
Carbon sink potential - Mid - Avoid deforestation	0	0	1,605
(1000 tCO2e/y)	J		1,003
(1000 to025/ y J			

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

Table 13: E+ scenario - PILLAR 6: Land sinks - Fo Item	2020	2025	2050
Carbon sink potential - Mid - Extend rotation	0	0	8,206
length (1000 tC02e/y)		0	0,200
Carbon sink potential - Mid - Improve plantations	0	0	450
(1000 tC02e/y)			100
Carbon sink potential - Mid - Increase retention	0	0	3,642
of HWP (1000 tCO2e/y)			-,
Carbon sink potential - Mid - Increase trees	0	0	724
outside forests (1000 tCO2e/y)			
Carbon sink potential - Mid - Reforest cropland	0	0	205
(1000 tC02e/y)			
Carbon sink potential - Mid - Reforest pasture	0	0	2,967
(1000 tC02e/y)			_,, 0.
Carbon sink potential - Mid - Restore	0	0	2,349
productivity (1000 tC02e/y)			_,
Land impacted for carbon sink potential - High -	0	0	62.6
Accelerate regeneration (1000 hectares)			02.0
Land impacted for carbon sink potential - High -	0	0	373
Avoid deforestation (over 30 years) (1000		9	0.0
hectares)			
Land impacted for carbon sink potential - High -	0	0	6,047
Extend rotation length (1000 hectares)	o	0	0,041
Land impacted for carbon sink potential - High -	0	0	223
	U	0	223
Improve plantations (1000 hectares)	0	0	0
Land impacted for carbon sink potential - High -	0	0	0
Increase retention of HWP (1000 hectares)			100
Land impacted for carbon sink potential - High -	0	0	102
Increase trees outside forests (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	18
Reforest cropland (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	157
Reforest pasture (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	1,164
Restore productivity (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	8,146
Total impacted (over 30 years) (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	31.3
Accelerate regeneration (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	350
Avoid deforestation (over 30 years) (1000			
hectares)			
Land impacted for carbon sink potential - Low -	0	0	2,317
Extend rotation length (1000 hectares)			_,
Land impacted for carbon sink potential - Low -	0	0	111
Improve plantations (1000 hectares)			• • • • • • • • • • • • • • • • • • • •
Land impacted for carbon sink potential - Low -	0	0	0
Increase retention of HWP (1000 hectares)		0	U
Land impacted for carbon sink potential - Low -	0	0	53.6
Increase trees outside forests (1000 hectares)	0	0	55.0
Land impacted for carbon sink potential - Low -	0	0	9.02
	U	0	9.02
Reforest cropland (1000 hectares)	0	0	07.0
Land impacted for carbon sink potential - Low -	0	0	27.2
Reforest pasture (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	705
Restore productivity (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	3,603
Total impacted (over 30 years) (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	47
Accelerate regeneration (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	361
Avoid deforestation (over 30 years) (1000			
hectares)			
Land impacted for carbon sink potential - Mid -	0	0	4,182
Extend rotation length (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	167
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	77.7
Increase trees outside forests (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	13.5
Reforest cropland (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	196
Reforest pasture (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	1,419
Restore productivity (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	6,464
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	1,892	2.03	2.02	1.91	1.19	0.064
(million 2019\$)							
Monetary damages from air pollution - Natural	0	2,230	1,631	1,158	1,101	849	318
Gas (million 2019\$)							
Monetary damages from air pollution -	0	7,317	7,231	5,804	3,530	1,675	662
Transportation (million 2019\$)							
Premature deaths from air pollution - Coal	0	212	0.228	0.227	0.215	0.134	0.007
(deaths)							
Premature deaths from air pollution - Natural	0	252	184	131	124	95.9	35.9
Gas (deaths)							
Premature deaths from air pollution -	0	823	813	653	397	188	74.4
Transportation (deaths)							

Table 15: E+ scenario - IMPACTS - Jobs

Item	2020	2025	2030	2035	2040	2045	2050
By economic sector - Agriculture (jobs)	456	481	669	431	268	106	368
By economic sector - Construction (jobs)	20,988	20,387	20,455	27,156	32,689	39,643	48,993
By economic sector - Manufacturing (jobs)	8,058	11,546	19,113	19,203	21,505	29,080	42,590
By economic sector - Mining (jobs)	5,963	4,807	3,439	2,289	1,447	864	516
By economic sector - Other (jobs)	2,510	2,536	2,751	3,294	4,521	6,473	8,647
By economic sector - Pipeline (jobs)	1,247	1,235	1,063	877	669	460	416
By economic sector - Professional (jobs)	8,564	8,724	8,961	12,804	16,053	20,586	29,307
By economic sector - Trade (jobs)	6,914	6,685	6,452	8,127	9,941	12,838	17,587
By economic sector - Utilities (jobs)	15,248	16,105	15,702	26,570	32,114	37,844	61,268
By education level - All sectors - Associates	21,816	22,844	24,849	32,391	38,634	47,903	66,739
degree or some college (jobs)							
By education level - All sectors - Bachelors	14,387	14,775	15,756	19,991	23,552	29,435	43,855
_degree (jobs)							
By education level - All sectors - Doctoral degree	505	500	504	655	789	1,005	1,549
(jobs)							
By education level - All sectors - High school	29,771	30,861	33,823	42,897	50,492	62,360	86,719
diploma or less (jobs)							
By education level - All sectors - Masters or	3,469	3,525	3,673	4,817	5,738	7,188	10,829
professional degree (jobs)							
By resource sector - Biomass (jobs)	1,375	1,481	1,700	1,049	700	400	1,622
By resource sector - CO2 (jobs)	0	0	120	359	357	356	1,028
By resource sector - Coal (jobs)	706	481	139	10.1	9.64	9.2	3.53
By resource sector - Grid (jobs)	15,495	16,815	20,756	44,821	54,716	64,769	79,742
By resource sector - Natural Gas (jobs)	13,329	14,747	10,460	8,380	9,432	7,326	5,429
By resource sector - Nuclear (jobs)	2,655	1,883	1,369	1,224	1,031	3,074	24,820
By resource sector - Oil (jobs)	11,856	10,343	8,327	6,120	4,320	3,031	2,063
By resource sector - Solar (jobs)	21,874	23,548	26,599	20,144	27,960	44,430	54,376
By resource sector - Wind (jobs)	2,657	3,206	9,135	18,645	20,680	24,498	40,607
Median wages - Annual - All (\$2019 per job)	68,927	69,341	68,899	71,169	72,306	73,075	75,182

Table 15: E+ scenario - IMPACTS - Jobs (continued)

Table 13. E+ Scellul 10 - IMPAG 13 - Jubs (collillius	Juj						
Item	2020	2025	2030	2035	2040	2045	2050
On-Site or In-Plant Training - Total jobs - 1 to 4 years (jobs)	11,457	11,888	12,800	16,684	19,821	24,460	34,114
On-Site or In-Plant Training - Total jobs - 4 to 10 years (jobs)	4,904	4,987	5,092	6,883	8,241	10,009	13,555
On-Site or In-Plant Training - Total jobs - None (jobs)	11,379	11,786	12,831	16,219	19,218	24,032	34,555
On-Site or In-Plant Training - Total jobs - Over 10 years (jobs)	590	621	667	897	1,074	1,313	1,762
On-Site or In-Plant Training - Total jobs - Up to 1 year (jobs)	41,618	43,223	47,216	60,069	70,852	88,078	125,705
On-the-Job Training - All sectors - 1 to 4 years (jobs)	14,768	15,319	16,425	21,524	25,613	31,579	44,038
On-the-Job Training - All sectors - 4 to 10 years (jobs)	4,800	4,883	4,978	6,806	8,188	9,944	13,312
On-the-Job Training - All sectors - None (jobs)	3,903	3,976	4,253	5,329	6,299	7,901	11,520
On-the-Job Training - All sectors - Over 10 years (jobs)	705	734	820	988	1,159	1,458	2,096
On-the-Job Training - All sectors - Up to 1 year (jobs)	45,771	47,593	52,129	66,105	77,945	97,011	138,725
Related work experience - All sectors - 1 to 4 years (jobs)	25,144	26,014	28,034	36,052	42,667	52,900	75,236
Related work experience - All sectors - 4 to 10 years (jobs)	16,311	16,897	18,134	23,486	27,855	34,480	48,899
Related work experience - All sectors - None (jobs)	10,104	10,497	11,336	14,604	17,304	21,370	29,856
Related work experience - All sectors - Over 10 years (jobs)	4,295	4,490	4,944	6,293	7,417	9,249	13,425
Related work experience - All sectors - Up to 1 year (jobs)	14,092	14,607	16,155	20,317	23,963	29,894	42,274
Wage income - All (million \$2019)	4,822	5,028	5,416	7,171	8,620	10,809	15,767

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

Item	2020	2025	2030	2035	2040	2045	2050
Natural gas consumption - Annual (tcf)	1,030	1,045	881	707	532	335	232
Natural gas consumption - Cumulative (tcf)	0	0	0	0	0	0	21,286
Natural gas production - Annual (tcf)	13	14.4	13.6	11.9	10	7.95	6.18
Oil consumption - Annual (million bbls)	241	230	202	160	122	91.3	66.3
Oil consumption - Cumulative (million bbls)	0	0	0	0	0	0	4,947
Oil production - Annual (million bbls)	0.265	0.286	0.287	0.287	0.227	0.185	0.123

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	14.3	16.3	0	0	0	0
Cumulative 5-yr (billion \$2018)							
Sales of cooking units - Electric Resistance (%)	34.4	36.1	42.1	57.9	80	93.5	98.3
Sales of cooking units - Gas (%)	65.6	63.9	57.9	42.1	20	6.47	1.74
Sales of space heating units - Electric Heat Pump	3.63	7.47	12.9	28.9	55.2	75.3	83.7
(%)							
Sales of space heating units - Electric Resistance	8.47	11.2	10.6	9.22	6.74	4.65	3.8
(%)							
Sales of space heating units - Fossil (%)	24.2	36.3	34	27.2	16.6	9.64	6.99
Sales of space heating units - Gas (%)	63.7	45.1	42.4	34.7	21.5	10.4	5.47
Sales of water heating units - Electric Heat Pump	0	1.21	4.63	14.7	31.2	43.9	49.3
(%)							
Sales of water heating units - Electric Resistance	18.7	35.3	35.6	36.9	39.6	42.6	44.2
(%)							
Sales of water heating units - Gas Furnace (%)	71.1	56.8	53.6	43.7	26.7	12.4	5.95
Sales of water heating units - Other (%)	10.3	6.7	6.2	4.75	2.54	1.09	0.587

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	363	742	2,526	7,889	11,514
(million \$2018)							
Public EV charging plugs - DC Fast (1000 units)	0.56	0	1.17	0	5.61	0	15.4
Public EV charging plugs - L2 (1000 units)	4.23	0	28.1	0	135	0	371
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 (%)	1.45	1.88	2.04	1.61	1.02	0.524	0.225
Vehicle sales - Light-duty - EV (%)	2.02	4.97	12.4	26.8	49.4	72.7	87.8
Vehicle sales - Light-duty - gasoline (%)	91.4	86.9	78.7	65.5	45.1	24.2	10.7
Vehicle sales - Light-duty - hybrid (%)	4.96	5.75	6.41	5.79	4.28	2.5	1.2
Vehicle sales - Light-duty - hydrogen FC (%)	0.112	0.377	0.32	0.242	0.17	0.094	0.044
Vehicle sales - Light-duty - other (%)	0.098	0.102	0.092	0.08	0.057	0.031	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)	690	679	673	667	654	636	618
Final energy use - Industry (PJ)	488	505	514	526	531	538	538
Final energy use - Residential (PJ)	880	823	783	735	664	579	494
Final energy use - Transportation (PJ)	1,163	1,112	1,033	964	905	837	757

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

2020	2025	2030	2035	2040	2045	2050
0	89,637	97,820	0	0	0	0
18.5	21.6	27.5	43	64.5	77.7	82.3
81.5	78.4	72.5	57	35.5	22.3	17.7
0.625	10	13.9	25.5	45.9	63.9	72.2
2.13	3.41	4.29	6.96	11.7	15.4	17.3
19.1	16.8	16.2	12.8	7.04	2.9	1.58
78.2	69.8	65.6	54.7	35.3	17.8	8.88
0.224	1.65	5.4	16.4	34.9	49.5	55.9
1.34	2.6	4.47	10.1	20.3	29.6	34
97	94.4	88.8	72.4	44.1	20.6	9.85
1.45	1.35	1.33	1.05	0.642	0.377	0.282
	18.5 81.5 0.625 2.13 19.1 78.2 0.224 1.34	0 89,637 18.5 21.6 81.5 78.4 0.625 10 2.13 3.41 19.1 16.8 78.2 69.8 0.224 1.65 1.34 2.6 97 94.4	0 89,637 97,820 18.5 21.6 27.5 81.5 78.4 72.5 0.625 10 13.9 2.13 3.41 4.29 19.1 16.8 16.2 78.2 69.8 65.6 0.224 1.65 5.4 1.34 2.6 4.47 97 94.4 88.8	0 89,637 97,820 0 18.5 21.6 27.5 43 81.5 78.4 72.5 57 0.625 10 13.9 25.5 2.13 3.41 4.29 6.96 19.1 16.8 16.2 12.8 78.2 69.8 65.6 54.7 0.224 1.65 5.4 16.4 1.34 2.6 4.47 10.1 97 94.4 88.8 72.4	0 89,637 97,820 0 0 18.5 21.6 27.5 43 64.5 81.5 78.4 72.5 57 35.5 0.625 10 13.9 25.5 45.9 2.13 3.41 4.29 6.96 11.7 19.1 16.8 16.2 12.8 7.04 78.2 69.8 65.6 54.7 35.3 0.224 1.65 5.4 16.4 34.9 1.34 2.6 4.47 10.1 20.3 97 94.4 88.8 72.4 44.1	0 89,637 97,820 0 0 0 18.5 21.6 27.5 43 64.5 77.7 81.5 78.4 72.5 57 35.5 22.3 0.625 10 13.9 25.5 45.9 63.9 2.13 3.41 4.29 6.96 11.7 15.4 19.1 16.8 16.2 12.8 7.04 2.9 78.2 69.8 65.6 54.7 35.3 17.8 0.224 1.65 5.4 16.4 34.9 49.5 1.34 2.6 4.47 10.1 20.3 29.6 97 94.4 88.8 72.4 44.1 20.6

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

Item	2020	2025	2030	2035	2040	2045	2050
Electricity distribution capital invested -	0	6.03	6.04	8.86	9.2	14.7	15.6
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	-264
Corn-ethanol to energy grasses (1000 tCO2e/y)			

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

Item	2020	2025	2050
Carbon sink potential - Aggressive deployment -	0	0	-2,322
Cropland measures (1000 tCO2e/y)		U	-2,322
Carbon sink potential - Aggressive deployment -	0	0	-89.7
Permanent conservation cover (1000 tC02e/y)		0	07.1
Carbon sink potential - Aggressive deployment -	0	0	-2,675
Total (1000 tC02e/y)		o	2,010
Carbon sink potential - Moderate deployment -	0	0	-264
Corn-ethanol to energy grasses (1000 tC02e/y)			20.
Carbon sink potential - Moderate deployment -	0	0	-1,224
Cropland measures (1000 tCO2e/y)			.,
Carbon sink potential - Moderate deployment -	0	0	-44.8
Permanent conservation cover (1000 tCO2e/y)			
Carbon sink potential - Moderate deployment -	0	0	-1,532
Total (1000 tC02e/y)			,
Land impacted for carbon sink - Aggressive	0	0	85.7
deployment - Corn-ethanol to energy grasses			
(1000 hectares)			
Land impacted for carbon sink - Aggressive	0	0	1,489
deployment - Cropland measures (1000			
hectares)			
Land impacted for carbon sink - Aggressive	0	0	163
deployment - Permanent conservation cover			
(1000 hectares)			
Land impacted for carbon sink - Aggressive	0	0	1,738
deployment - Total (1000 hectares)			
Land impacted for carbon sink - Moderate	0	0	85.7
deployment - Corn-ethanol to energy grasses			
(1000 hectares)			
Land impacted for carbon sink - Moderate	0	0	785
deployment - Cropland measures (1000			
hectares)			
Land impacted for carbon sink - Moderate	0	0	81.5
deployment - Permanent conservation cover			
(1000 hectares)			
Land impacted for carbon sink - Moderate	0	0	953
deployment - Total (1000 hectares)			

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

Table 20: E decitatio Tillinik di Lana diliko To	, 0010		
Item	2020	2025	2050
Carbon sink potential - High - Accelerate	0	0	383
regeneration (1000 tCO2e/y)			
Carbon sink potential - High - All (not counting	0	0	31,435
overlap) (1000 tCO2e/y)			
Carbon sink potential - High - Avoid deforestation	0	0	2,752
(1000 tCO2e/y)			
Carbon sink potential - High - Extend rotation	0	0	11,858
length (1000 tCO2e/y)			
Carbon sink potential - High - Improve	0	0	604
plantations (1000 tCO2e/y)			
Carbon sink potential - High - Increase retention	0	0	5,464
of HWP (1000 tCO2e/y)			
Carbon sink potential - High - Increase trees	0	0	1,072
outside forests (1000 tCO2e/y)			
Carbon sink potential - High - Reforest cropland	0	0	273
(1000 tCO2e/y)			
Carbon sink potential - High - Reforest pasture	0	0	5,516
(1000 tCO2e/y)			
Carbon sink potential - High - Restore	0	0	3,513
productivity (1000 tCO2e/y)			
Carbon sink potential - Low - Accelerate	0	0	192
regeneration (1000 tCO2e/y)			
Carbon sink potential - Low - All (not counting	0	0	9,448
overlap) (1000 tCO2e/y)			

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

Item	2020	2025	2050
Carbon sink potential - Low - Avoid deforestation	0	0	459
(1000 tCO2e/y) Carbon sink potential - Low - Extend rotation	0	0	4,555
length (1000 tCO2e/y)			4,000
Carbon sink potential - Low - Improve plantations (1000 tCO2e/y)	0	0	307
Carbon sink potential - Low - Increase retention of HWP (1000 tCO2e/y)	0	0	1,821
Carbon sink potential - Low - Increase trees outside forests (1000 tCO2e/y)	0	0	375
Carbon sink potential - Low - Reforest cropland (1000 tCO2e/y)	0	0	136
Carbon sink potential - Low - Reforest pasture (1000 tCO2e/y)	0	0	418
Carbon sink potential - Low - Restore productivity (1000 tCO2e/y)	0	0	1,184
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO2e/y)	0	0	287
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO2e/y)	0	0	20,436
Carbon sink potential - Mid - Avoid deforestation (1000 tCO2e/y)	0	0	1,605
Carbon sink potential - Mid - Extend rotation length (1000 tCO2e/y)	0	0	8,206
Carbon sink potential - Mid - Improve plantations (1000 tCO2e/y)	0	0	450
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO2e/y)	0	0	3,642
Carbon sink potential - Mid - Increase trees outside forests (1000 tCO2e/y)	0	0	724
Carbon sink potential - Mid - Reforest cropland (1000 tCO2e/y)	0	0	205
Carbon sink potential - Mid - Reforest pasture (1000 tCO2e/y)	0	0	2,967
Carbon sink potential - Mid - Restore productivity (1000 tCO2e/y)	0	0	2,349
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)	0	0	62.6
Land impacted for carbon sink potential - High - Avoid deforestation (over 30 years) (1000 hectares)	0	0	373
Land impacted for carbon sink potential - High - Extend rotation length (1000 hectares)	0	0	6,047
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)	0	0	223
Land impacted for carbon sink potential - High - Increase retention of HWP (1000 hectares)	0	0	0
Land impacted for carbon sink potential - High - Increase trees outside forests (1000 hectares)	0	0	102
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)	0	0	18
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)	0	0	157
Land impacted for carbon sink potential - High - Restore productivity (1000 hectares)	0	0	1,164
Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)	0	0	8,146
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)	0	0	31.3
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000	0	0	350

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

Item	2020	2025	2050
Land impacted for carbon sink potential - Low -	0	0	2,317
Extend rotation length (1000 hectares)			,
Land impacted for carbon sink potential - Low -	0	0	111
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	53.6
Increase trees outside forests (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	9.02
Reforest cropland (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	27.2
Reforest pasture (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	705
Restore productivity (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	3,603
Total impacted (over 30 years) (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	47
Accelerate regeneration (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	361
Avoid deforestation (over 30 years) (1000			
hectares)			
Land impacted for carbon sink potential - Mid -	0	0	4,182
Extend rotation length (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	167
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	77.7
Increase trees outside forests (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	13.5
Reforest cropland (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	196
Reforest pasture (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	1,419
Restore productivity (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	6,464
Total impacted (over 30 years) (1000 hectares)			

Table 24: E- scenario - IMPACTS - Health

Table 24. L Scenario Init Aoro Ticalen							
Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal	0	1,892	2.03	2.02	1.91	1.19	0.064
(million 2019\$)							
Monetary damages from air pollution - Natural	0	2,198	1,242	561	221	56.9	78
Gas (million 2019\$)							
Monetary damages from air pollution -	0	7,451	7,988	8,203	7,769	6,492	4,675
Transportation (million 2019\$)							
Premature deaths from air pollution - Coal	0	212	0.228	0.227	0.215	0.134	0.007
(deaths)							
Premature deaths from air pollution - Natural	0	248	140	63.4	25	6.42	8.81
Gas (deaths)							
Premature deaths from air pollution -	0	838	898	923	874	730	526
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	14.3	15.2	0	0	0	0
Cumulative 5-yr (billion \$2018)							
Sales of cooking units - Electric Resistance (%)	34.6	48.6	91.2	99.6	100	100	100
Sales of cooking units - Gas (%)	65.4	51.4	8.8	0.443	0	0	0
Sales of space heating units - Electric Heat Pump	3.63	16.2	66.1	89	91.7	91.9	92
(%)							

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

Item	2020	2025	2030	2035	2040	2045	2050
Sales of space heating units - Electric Resistance	8.47	10.5	6.04	3.28	2.89	2.96	3.08
(%)							
Sales of space heating units - Fossil (%)	24.2	32.1	10.3	4.74	4.39	4.24	4.06
Sales of space heating units - Gas (%)	63.7	41.2	17.6	3.03	0.991	0.876	0.88
Sales of water heating units - Electric Heat Pump	0	6.54	37.2	51.7	53.5	53.6	53.6
(%)							
Sales of water heating units - Electric Resistance	18.7	35.7	39.8	45.4	46.3	46.4	46.3
(%)							
Sales of water heating units - Gas Furnace (%)	71.1	52	21.9	2.85	0.155	0	0
Sales of water heating units - Other (%)	10.3	5.8	1.12	0.083	0.037	0.038	0.038

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	2,187	5,658	9,084	13,794	14,977	14,299
Public EV charging plugs - DC Fast (1000 units)	0.56	0	3.54	0	15	0	24.1
Public EV charging plugs - L2 (1000 units)	4.23	0	85.1	0	360	0	579
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 (%)	1.44	1.72	1.21	0.387	0.073	0.013	0
Vehicle sales - Light-duty - EV (%)	4.28	16.3	48.1	82.5	96.4	99.3	100
Vehicle sales - Light-duty - gasoline (%)	89.3	76.7	47.1	15.8	3.2	0.587	0
Vehicle sales - Light-duty - hybrid (%)	4.78	4.8	3.33	1.23	0.301	0.066	0
Vehicle sales - Light-duty - hydrogen FC (%)	0.11	0.333	0.194	0.06	0.012	0.002	0
Vehicle sales - Light-duty - other (%)	0.097	0.093	0.059	0.021	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)	690	677	650	604	560	538	533
Final energy use - Industry (PJ)	488	505	512	521	523	530	532
Final energy use - Residential (PJ)	880	819	735	612	496	413	364
Final energy use - Transportation (PJ)	1,161	1,104	995	858	731	647	604

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

Item	2020	2025	2030	2035	2040	2045	2050
Commercial HVAC investment in 2020s -	0	89,684	98,037	0	0	0	0
Cumulative 5-yr (million \$2018)							
Sales of cooking units - Electric Resistance (%)	18.5	33.7	75.3	83.5	83.9	84	84
Sales of cooking units - Gas (%)	81.5	66.3	24.7	16.5	16.1	16	16
Sales of space heating units - Electric Heat Pump	0.625	15.6	51.1	76.3	79.8	80.3	80.2
(%)							
Sales of space heating units - Electric Resistance	2.13	4.73	12.8	18	19.1	18.8	18.9
(%)							
Sales of space heating units - Fossil (%)	19.1	14.5	2.85	0.124	0	0	0
Sales of space heating units - Gas Furnace (%)	78.2	65.2	33.3	5.6	1.11	0.87	0.863
Sales of water heating units - Electric Heat Pump	0.224	7.35	41	58.7	61	61.2	61.2
(%)							
Sales of water heating units - Electric Resistance	1.34	5.14	22.3	36.4	38.5	38.7	38.7
(%)							
Sales of water heating units - Gas Furnace (%)	97	86.3	36.3	4.73	0.256	0	0

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

Item	2020	2025	2030	2035	2040	2045	2050
Sales of water heating units - Other (%)	1.45	1.19	0.377	0.184	0.175	0.176	0.176

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

Item	2020	2025	2030	2035	2040	2045	2050
Electricity distribution capital invested -	0	7.59	7.79	18.2	19.6	18.4	19.5
Cumulative 5-yr (billion \$2018)							

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

Item	2020	2025	2030	2035	2040	2045	2050
Capital invested - Offshore Wind - Base (billion \$2018)	0	0.393	0.409	25.7	17.3	18.6	28.4
Capital invested - Solar PV - Base (billion \$2018)	0	8.73	8.17	9.85	8.95	12.1	4.29
Capital invested - Wind - Base (billion \$2018)	0	0	5.05	8.67	2.98	8.08	5.03

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

Item	2020	2025	2030	2035	2040	2045	2050
OffshoreWind - Base land use assumptions (GWh)	0	562	687	51,201	35,945	47,900	94,412
OffshoreWind - Constrained land use assumptions (GWh)	0	1,121	694	50,066	27,607	0	127,156
Solar - Base land use assumptions (GWh)	4,001	11,206	11,525	15,022	14,631	20,848	7,859
Solar - Constrained land use assumptions (GWh)	3,079	15,489	12,427	12,765	14,133	16,711	7,456
Wind - Base land use assumptions (GWh)	14,244	0	7,891	13,988	4,937	13,792	8,839
Wind - Constrained land use assumptions (GWh)	14,244	0	7,812	15,056	5,132	13,095	7,925

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

Item	2020	2025	2050
Carbon sink potential - Aggressive deployment -	0	0	-264
Corn-ethanol to energy grasses (1000 tC02e/y)	U	0	-204
Carbon sink potential - Aggressive deployment -	0	0	-2,322
Cropland measures (1000 tC02e/y)	U	0	-2,322
· · · · · · · · · · · · · · · · · · ·	0	0	-89.7
Carbon sink potential - Aggressive deployment -	0	0	-89.7
Permanent conservation cover (1000 tC02e/y)	0	0	0.775
Carbon sink potential - Aggressive deployment -	U	0	-2,675
Total (1000 tC02e/y)	0		0//
Carbon sink potential - Moderate deployment -	0	0	-264
Corn-ethanol to energy grasses (1000 tC02e/y)			1.00/
Carbon sink potential - Moderate deployment -	0	0	-1,224
Cropland measures (1000 tC02e/y)	_	_	
Carbon sink potential - Moderate deployment -	0	0	-44.8
Permanent conservation cover (1000 tCO2e/y)			
Carbon sink potential - Moderate deployment -	0	0	-1,532
Total (1000 tC02e/y)			
Land impacted for carbon sink - Aggressive	0	0	85.7
deployment - Corn-ethanol to energy grasses			
(1000 hectares)			
Land impacted for carbon sink - Aggressive	0	0	1,489
deployment - Cropland measures (1000			
hectares)			
Land impacted for carbon sink - Aggressive	0	0	163
deployment - Permanent conservation cover			
(1000 hectares)			
Land impacted for carbon sink - Aggressive	0	0	1,738
deployment - Total (1000 hectares)			
Land impacted for carbon sink - Moderate	0	0	85.7
deployment - Corn-ethanol to energy grasses			
(1000 hectares)			
Land impacted for carbon sink - Moderate	0	0	785
deployment - Cropland measures (1000			
hectares)			
,			

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

Item	2020	2025	2050
Land impacted for carbon sink - Moderate	0	0	81.5
deployment - Permanent conservation cover (1000 hectares)			
Land impacted for carbon sink - Moderate	0	0	953
deployment - Total (1000 hectares)			

Table 33: F+RF+ scenario - PILLAR 6: Land sinks - Forests

Table 33: E+RE+ scenario - PILLAR 6: Land sinks			
Item	2020	2025	2050
Carbon sink potential - High - Accelerate regeneration (1000 tCO2e/y)	0	0	383
Carbon sink potential - High - All (not counting overlap) (1000 tCO2e/y)	0	0	31,435
Carbon sink potential - High - Avoid deforestation (1000 tCO2e/y)	0	0	2,752
Carbon sink potential - High - Extend rotation length (1000 tC02e/y)	0	0	11,858
Carbon sink potential - High - Improve	0	0	604
plantations (1000 tC02e/y) Carbon sink potential - High - Increase retention	0	0	5,464
of HWP (1000 tCO2e/y) Carbon sink potential - High - Increase trees	0	0	1,072
outside forests (1000 tCO2e/y) Carbon sink potential - High - Reforest cropland	0	0	273
(1000 tCO2e/y) Carbon sink potential - High - Reforest pasture	0	0	5,516
(1000 tCO2e/y) Carbon sink potential - High - Restore	0	0	3,513
productivity (1000 tCO2e/y) Carbon sink potential - Low - Accelerate	0	0	192
regeneration (1000 tCO2e/y) Carbon sink potential - Low - All (not counting	0	0	9,448
overlap) (1000 tCO2e/y) Carbon sink potential - Low - Avoid deforestation	0	0	459
(1000 tCO2e/γ) Carbon sink potential - Low - Extend rotation	0	0	4,555
length (1000 tCO2e/y) Carbon sink potential - Low - Improve	0	0	307
plantations (1000 tCO2e/y) Carbon sink potential - Low - Increase retention	0	0	1,821
of HWP (1000 tCO2e/y) Carbon sink potential - Low - Increase trees	0	0	375
outside forests (1000 tCO2e/y) Carbon sink potential - Low - Reforest cropland	0	0	136
(1000 tCO2e/y) Carbon sink potential - Low - Reforest pasture	0	0	418
(1000 tCO2e/γ) Carbon sink potential - Low - Restore	0	0	1,184
productivity (1000 tCO2e/y) Carbon sink potential - Mid - Accelerate	0	0	287
regeneration (1000 tCO2e/y) Carbon sink potential - Mid - All (not counting	0	0	20,436
overlap) (1000 tCO2e/y) Carbon sink potential - Mid - Avoid deforestation	0	0	1,605
(1000 tCO2e/y) Carbon sink potential - Mid - Extend rotation	0	0	8,206
length (1000 tC02e/y) Carbon sink potential - Mid - Improve plantations	0	0	450
(1000 tCO2e/y) Carbon sink potential - Mid - Increase retention	0	0	3,642
of HWP (1000 tCO2e/y) Carbon sink potential - Mid - Increase trees	0	0	724
outside forests (1000 tCO2e/y)	J	J.	

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

- Forests (co	ntinued)	
2020	2025	2050
0		205
<u> </u>	n	2,967
0	0	2,701
0	0	2,349
U	U	2,349
0	0	62.6
0	0	373
n	n	6,047
	0	0,041
		223
U	U	223
0	0	0
0	0	102
0	0	18
0	0	157
o	0	101
0	0	1,164
0	0	8,146
0	0	31.3
n	n	350
0	0	550
0	0	2,317
0	0	111
0	0	0
		_
0	0	53.6
0	0	33.0
0	0	0.00
U	U	9.02
0	0	27.2
0	0	705
Ω	n	3,603
0	0	0,000
U	U	47
0	0	361
0	0	4,182
		·
0	0	167
U	١	101
l		
		^
0	0	0
0	0	77.7
	2020 0 0 0 0 0 0 0 0 0 0 0 0 0	

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

Item	2020	2025	2050
Land impacted for carbon sink potential - Mid -	0	0	196
Reforest pasture (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	1,419
Restore productivity (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	6,464
Total impacted (over 30 years) (1000 hectares)			

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

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal (million 2019\$)	0	1,892	2.03	2.02	1.91	1.19	0.064
Monetary damages from air pollution - Natural Gas (million 2019\$)	0	2,114	1,540	874	719	302	70.4
Monetary damages from air pollution - Transportation (million 2019\$)	0	7,317	7,231	5,804	3,530	1,675	662
Premature deaths from air pollution - Coal (deaths)	0	212	0.228	0.227	0.215	0.134	0.007
Premature deaths from air pollution - Natural Gas (deaths)	0	239	174	98.7	81.2	34.1	7.95
Premature deaths from air pollution - Transportation (deaths)	0	823	813	653	397	188	74.4

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	14.3	15.2	0	0	0	0
Cumulative 5-yr (billion \$2018)							
Sales of cooking units - Electric Resistance (%)	34.6	48.6	91.2	99.6	100	100	100
Sales of cooking units - Gas (%)	65.4	51.4	8.8	0.443	0	0	0
Sales of space heating units - Electric Heat Pump	3.63	16.2	66.1	89	91.7	91.9	92
(%)							
Sales of space heating units - Electric Resistance	8.47	10.5	6.04	3.28	2.89	2.96	3.08
(%)							
Sales of space heating units - Fossil (%)	24.2	32.1	10.3	4.74	4.39	4.24	4.06
Sales of space heating units - Gas (%)	63.7	41.2	17.6	3.03	0.991	0.876	0.88
Sales of water heating units - Electric Heat Pump	0	6.54	37.2	51.7	53.5	53.6	53.6
(%)							
Sales of water heating units - Electric Resistance	18.7	35.7	39.8	45.4	46.3	46.4	46.3
(%)							
Sales of water heating units - Gas Furnace (%)	71.1	52	21.9	2.85	0.155	0	0
Sales of water heating units - Other (%)	10.3	5.8	1.12	0.083	0.037	0.038	0.038

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

Item	2020	2025	2030	2035	2040	2045	2050
Light-duty vehicle capital costs - Cumulative 5-yr	0	2,187	5,658	9,084	13,794	14,977	14,299
(million \$2018)							
Public EV charging plugs - DC Fast (1000 units)	0.56	0	3.54	0	15	0	24.1
Public EV charging plugs - L2 (1000 units)	4.23	0	85.1	0	360	0	579
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 (%)	1.44	1.72	1.21	0.387	0.073	0.013	0
Vehicle sales - Light-duty - EV (%)	4.28	16.3	48.1	82.5	96.4	99.3	100
Vehicle sales - Light-duty - gasoline (%)	89.3	76.7	47.1	15.8	3.2	0.587	0
Vehicle sales - Light-duty - hybrid (%)	4.78	4.8	3.33	1.23	0.301	0.066	0
Vehicle sales - Light-duty - hydrogen FC (%)	0.11	0.333	0.194	0.06	0.012	0.002	0
Vehicle sales - Light-duty - other (%)	0.097	0.093	0.059	0.021	0.004	0.001	0
Vehicle sales - Medium-duty - diesel (%)	64.7	59.7	42.3	14.4	2.59	0.384	0

Table 36: E+RE- scenario - PILLAR 1: Efficiency/E Item	2020	2025	2030	2035	2040	2045	2050
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	
Vehicle sales - Medium-duty - hybrid (%)	0.363	0.402	0.341	0.14	0.03	0.005	
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	
able 37: E+RE- scenario - PILLAR 1: Efficiency/E				0005	2010	00/5	005
Item	2020	2025	2030	2035	2040	2045	205
Final energy use - Commercial (PJ) Final energy use - Industry (PJ)	690 488	677 505	650 512	604 521	560 523	538 530	53 53
Final energy use - Residential (PJ) Final energy use - Transportation (PJ)	880 1,161	819 1,104	735 995	612 858	496 731	413 647	36 60
	<u>'</u>	1		030	131	041	- 00
able 38: E+RE- scenario - PILLAR 1: Efficiency/E	-			2005	2010	00/5	
Item	2020	2025	2030	2035	2040	2045	205
Commercial HVAC investment in 2020s -	0	89,684	98,037	0	0	0	
Cumulative 5-yr (million \$2018)	10.5	00.7	75.0	00.5	00.0	0/	
Sales of cooking units - Electric Resistance (%)	18.5	33.7	75.3	83.5	83.9	84	8
Sales of cooking units - Gas (%)	81.5	66.3	24.7	16.5	16.1	16	
Sales of space heating units - Electric Heat Pump (%)	0.625	15.6	51.1	76.3	79.8	80.3	80
Sales of space heating units - Electric Resistance (%)	2.13	4.73	12.8	18	19.1	18.8	18
Sales of space heating units - Fossil (%)	19.1	14.5	2.85	0.124	0	0	
Sales of space heating units - Gas Furnace (%)	78.2	65.2	33.3	5.6	1.11	0.87	0.86
Sales of water heating units - Electric Heat Pump (%)	0.224	7.35 5.14	22.3	58.7 36.4	38.5	61.2 38.7	38
Sales of water heating units - Electric Resistance (%)							30
Sales of water heating units - Gas Furnace (%) Sales of water heating units - Other (%)	97 1.45	86.3 1.19	36.3 0.377	4.73 0.184	0.256 0.175	0.176	0.17
able 39: <i>E+RE- scenario - PILLAR 1: Efficiency/E</i> Item Electricity distribution capital invested - Cumulative 5-yr (billion \$2018)	lectrificatio 2020 0	on - Electric 2025 7.59	2030 27.79	2035 18.2	2040	2045	205 19
	·						
	ricity - Gen	erating cap 2025	acity 2030	2035	2040	2045	205
Item Capital invested - Offshore Wind - Base (billion \$2018)	2020	2025 7.13	2030 6.26	9.69	2.94	0.085	2.8
Item Capital invested - Offshore Wind - Base (billion \$2018) Capital invested - Offshore Wind - Constrained (billion \$2018)	2020	2025 7.13 7.43	2030 6.26 6.23	9.69 9.75	2.94	0.085	2.8
Item Capital invested - Offshore Wind - Base (billion \$2018) Capital invested - Offshore Wind - Constrained (billion \$2018) Capital invested - Solar PV - Base (billion \$2018)	2020 0 0	2025 7.13 7.43	2030 6.26 6.23	9.69 9.75 0.837	2.94 2.95 0.659	0.085	2.8 2. 14
Item Capital invested - Offshore Wind - Base (billion \$2018) Capital invested - Offshore Wind - Constrained (billion \$2018) Capital invested - Solar PV - Base (billion \$2018) Capital invested - Solar PV - Constrained (billion \$2018)	2020 0 0 0	2025 7.13 7.43 1.75 0.54	2030 6.26 6.23	9.69 9.75 0.837 0.646	2.94 2.95 0.659 1.19	0.085 0 1.62 1.28	2.8
Item Capital invested - Offshore Wind - Base (billion \$2018) Capital invested - Offshore Wind - Constrained (billion \$2018) Capital invested - Solar PV - Base (billion \$2018) Capital invested - Solar PV - Constrained (billion \$2018) Capital invested - Wind - Base (billion \$2018)	2020 0 0 0 0	2025 7.13 7.43 1.75 0.54	2030 6.26 6.23 0.092 0	9.69 9.75 0.837 0.646	2.94 2.95 0.659 1.19	0.085 0 1.62 1.28 5.29	2.8
Item Capital invested - Offshore Wind - Base (billion \$2018) Capital invested - Offshore Wind - Constrained (billion \$2018) Capital invested - Solar PV - Base (billion \$2018) Capital invested - Solar PV - Constrained (billion \$2018) Capital invested - Wind - Base (billion \$2018) Capital invested - Wind - Constrained (billion \$2018)	2020 0 0 0	2025 7.13 7.43 1.75 0.54	2030 6.26 6.23 0.092	9.69 9.75 0.837 0.646	2.94 2.95 0.659 1.19	0.085 0 1.62 1.28	2.8
Item Capital invested - Offshore Wind - Base (billion \$2018) Capital invested - Offshore Wind - Constrained (billion \$2018) Capital invested - Solar PV - Base (billion \$2018) Capital invested - Solar PV - Constrained (billion \$2018) Capital invested - Wind - Base (billion \$2018) Capital invested - Wind - Constrained (billion \$2018) Capital invested - Wind - Constrained (billion \$2018)	2020 0 0 0 0 0 0	2025 7.13 7.43 1.75 0.54	2030 6.26 6.23 0.092 0	9.69 9.75 0.837 0.646	2.94 2.95 0.659 1.19	0.085 0 1.62 1.28 5.29	2.8 2.4 14 3.5
Item Capital invested - Offshore Wind - Base (billion \$2018) Capital invested - Offshore Wind - Constrained (billion \$2018) Capital invested - Solar PV - Base (billion \$2018) Capital invested - Solar PV - Constrained (billion \$2018) Capital invested - Wind - Base (billion \$2018) Capital invested - Wind - Constrained (billion \$2018) Capital invested - Wind - Constrained (billion \$2018) Capital invested - Wind - Constrained (billion \$2018)	2020 0 0 0 0 0 0	2025 7.13 7.43 1.75 0.54 0 0	2030 6.26 6.23 0.092 0 0 0.072	9.69 9.75 0.837 0.646 1.36 1.29	2.94 2.95 0.659 1.19 4.2 4.31	0.085 0 1.62 1.28 5.29 5.29	2.8 2.4 14 1 3.5 3.5
Item Capital invested - Offshore Wind - Base (billion \$2018) Capital invested - Offshore Wind - Constrained (billion \$2018) Capital invested - Solar PV - Base (billion \$2018) Capital invested - Solar PV - Constrained (billion \$2018) Capital invested - Wind - Base (billion \$2018) Capital invested - Wind - Constrained (billion \$2018) Table 41: E+RE- scenario - PILLAR 2: Clean Electron Item OffshoreWind - Base land use assumptions (GWh)	2020 0 0 0 0 0 0 0 0 0	2025 7.13 7.43 1.75 0.54 0 0 0	2030 6.26 6.23 0.092 0 0 0.072	9.69 9.75 0.837 0.646 1.36 1.29 2035 19,501	2.94 2.95 0.659 1.19 4.2 4.31	0.085 0 1.62 1.28 5.29 5.29 5.29	2.8 2. 14 3.5 3.5 205 8,94
\$2018) Capital invested - Offshore Wind - Constrained (billion \$2018) Capital invested - Solar PV - Base (billion \$2018) Capital invested - Solar PV - Constrained (billion \$2018) Capital invested - Wind - Base (billion \$2018) Capital invested - Wind - Constrained (billion \$2018) Capital invested - Wind - Constrained (billion \$2018) Capital invested - Wind - Constrained (billion \$2018)	2020 0 0 0 0 0 0 0 0	2025 7.13 7.43 1.75 0.54 0 0	2030 6.26 6.23 0.092 0 0 0.072	9.69 9.75 0.837 0.646 1.36 1.29	2.94 2.95 0.659 1.19 4.2 4.31	0.085 0 1.62 1.28 5.29 5.29	2. 2 14 3. 3.

2,259

711

1,285 998

128

0

1,084 1,997 2,807 2,210

26,467

32,774

3,185 1,883

assumptions (GWh)

Solar - Base land use assumptions (GWh)

Solar - Constrained land use assumptions (GWh)

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

Item	2020	2025	2030	2035	2040	2045	2050
Wind - Base land use assumptions (GWh)	14,244	0	0	2,321	7,327	9,437	6,665
Wind - Constrained land use assumptions (GWh)	14,244	0	111	2,221	7,449	9,330	6,526

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

- Agricuiture		
2020	2025	2050
0	0	-264
0	0	-2,322
0	0	-89.7
0	0	-2,675
0	0	-264
0	0	-1,224
0	0	-44.8
0	0	-1,532
0	0	85.7
0	0	1,489
0	0	163
0	0	1,738
0	0	85.7
0	0	785
0	0	81.5
0	0	953
U	U	/55

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

Item	2020	2025	2050
Carbon sink potential - High - Accelerate	0	0	383
regeneration (1000 tCO2e/y)			
Carbon sink potential - High - All (not counting	0	0	31,435
overlap) (1000 tCO2e/y)			
Carbon sink potential - High - Avoid deforestation	0	0	2,752
(1000 tC02e/y)			
Carbon sink potential - High - Extend rotation	0	0	11,858
length (1000 tCO2e/y)			
Carbon sink potential - High - Improve	0	0	604
plantations (1000 tCO2e/y)			
Carbon sink potential - High - Increase retention	0	0	5,464
of HWP (1000 tCO2e/y)			
Carbon sink potential - High - Increase trees	0	0	1,072
outside forests (1000 tCO2e/y)			
Carbon sink potential - High - Reforest cropland	0	0	273
(1000 tC02e/y)			

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

Table 43: E+RE- scenario - PILLAR 6: Land sinks	- Forests (co	ntinued)	
Item	2020	2025	2050
Carbon sink potential - High - Reforest pasture	0	0	5,516
(1000 tCO2e/y)		-	
Carbon sink potential - High - Restore	0	0	3,513
productivity (1000 tCO2e/y)			0,010
Carbon sink potential - Low - Accelerate	0	0	192
regeneration (1000 tCO2e/y)		•	172
Carbon sink potential - Low - All (not counting	0	0	9,448
overlap) (1000 tC02e/y)	0	0	7,440
Carbon sink potential - Low - Avoid deforestation	0	0	459
	0	0	439
(1000 tC02e/y)	0	0	, , , , ,
Carbon sink potential - Low - Extend rotation	0	0	4,555
length (1000 tC02e/y)			007
Carbon sink potential - Low - Improve	0	0	307
plantations (1000 tC02e/y)			
Carbon sink potential - Low - Increase retention	0	0	1,821
of HWP (1000 tC02e/y)			
Carbon sink potential - Low - Increase trees	0	0	375
outside forests (1000 tCO2e/y)			
Carbon sink potential - Low - Reforest cropland	0	0	136
(1000 tCO2e/y)			
Carbon sink potential - Low - Reforest pasture	0	0	418
(1000 tCO2e/y)			
Carbon sink potential - Low - Restore	0	0	1,184
productivity (1000 tCO2e/y)			
Carbon sink potential - Mid - Accelerate	0	0	287
regeneration (1000 tCO2e/y)			
Carbon sink potential - Mid - All (not counting	0	0	20,436
overlap) (1000 tC02e/y)			•
Carbon sink potential - Mid - Avoid deforestation	0	0	1,605
(1000 tC02e/y)			.,000
Carbon sink potential - Mid - Extend rotation	0	0	8,206
length (1000 tCO2e/y)			0,200
Carbon sink potential - Mid - Improve plantations	0	0	450
(1000 tC02e/y)	0	0	430
Carbon sink potential - Mid - Increase retention	0	0	3,642
of HWP (1000 tCO2e/y)	0	0	3,042
	0	0	707
Carbon sink potential - Mid - Increase trees	0	0	724
outside forests (1000 tC02e/y)			005
Carbon sink potential - Mid - Reforest cropland	0	0	205
(1000 tC02e/y)			
Carbon sink potential - Mid - Reforest pasture	0	0	2,967
(1000 tCO2e/y)			
Carbon sink potential - Mid - Restore	0	0	2,349
productivity (1000 tCO2e/y)			
Land impacted for carbon sink potential - High -	0	0	62.6
Accelerate regeneration (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	373
Avoid deforestation (over 30 years) (1000			
hectares)			
Land impacted for carbon sink potential - High -	0	0	6,047
Extend rotation length (1000 hectares)			3,5
Land impacted for carbon sink potential - High -	0	0	223
Improve plantations (1000 hectares)		0	225
Land impacted for carbon sink potential - High -	0	0	0
Increase retention of HWP (1000 hectares)		U	U
			100
Land impacted for carbon sink potential - High -	0	0	102
Increase trees outside forests (1000 hectares)	_	_	
	0	0	18
Land impacted for carbon sink potential - High -			
Reforest cropland (1000 hectares)			
Reforest cropland (1000 hectares) Land impacted for carbon sink potential - High -	0	0	157
Reforest cropland (1000 hectares) Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)	0	0	157
Reforest cropland (1000 hectares) Land impacted for carbon sink potential - High -	0	0	157 1,164

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

Table 43: E+RE- scenario - PILLAR 6: Land sinks		ntinuedJ	
Item	2020	2025	2050
Land impacted for carbon sink potential - High -	0	0	8,146
Total impacted (over 30 years) (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	31.3
Accelerate regeneration (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	350
Avoid deforestation (over 30 years) (1000			
hectares)			
Land impacted for carbon sink potential - Low -	0	0	2,317
Extend rotation length (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	111
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	53.6
Increase trees outside forests (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	9.02
Reforest cropland (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	27.2
Reforest pasture (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	705
Restore productivity (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	3,603
Total impacted (over 30 years) (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	47
Accelerate regeneration (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	361
Avoid deforestation (over 30 years) (1000			
hectares)			
Land impacted for carbon sink potential - Mid -	0	0	4,182
Extend rotation length (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	167
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	77.7
Increase trees outside forests (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	13.5
Reforest cropland (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	196
Reforest pasture (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	1,419
Restore productivity (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	6,464
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	1,892	2.03	2.02	1.91	1.19	0.064
(million 2019\$)							
Monetary damages from air pollution - Natural	0	2,123	1,300	1,572	1,387	961	156
Gas (million 2019\$)							
Monetary damages from air pollution -	0	7,317	7,231	5,804	3,530	1,675	662
Transportation (million 2019\$)							
Premature deaths from air pollution - Coal	0	212	0.228	0.227	0.215	0.134	0.007
(deaths)							
Premature deaths from air pollution - Natural	0	240	147	178	157	109	17.6
Gas (deaths)							
Premature deaths from air pollution -	0	823	813	653	397	188	74.4
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	14.3	16.3	0	0	0	0
Cumulative 5-yr (billion \$2018)							
Sales of cooking units - Electric Resistance (%)	34.4	36.1	42.1	57.9	80	93.5	98.3
Sales of cooking units - Gas (%)	65.6	63.9	57.9	42.1	20	6.47	1.74
Sales of space heating units - Electric Heat Pump	3.63	7.47	12.9	28.9	55.2	75.3	83.7
(%)							
Sales of space heating units - Electric Resistance	8.47	11.2	10.6	9.22	6.74	4.65	3.8
(%)							
Sales of space heating units - Fossil (%)	24.2	36.3	34	27.2	16.6	9.64	6.99
Sales of space heating units - Gas (%)	63.7	45.1	42.4	34.7	21.5	10.4	5.47
Sales of water heating units - Electric Heat Pump	0	1.21	4.63	14.7	31.2	43.9	49.3
(%)							
Sales of water heating units - Electric Resistance	18.7	35.3	35.6	36.9	39.6	42.6	44.2
(%)							
Sales of water heating units - Gas Furnace (%)	71.1	56.8	53.6	43.7	26.7	12.4	5.95
Sales of water heating units - Other (%)	10.3	6.7	6.2	4.75	2.54	1.09	0.587

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	363	742	2,526	7,889	11,514
(million \$2018)							
Public EV charging plugs - DC Fast (1000 units)	0.56	0	1.17	0	5.61	0	15.4
Public EV charging plugs - L2 (1000 units)	4.23	0	28.1	0	135	0	371
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 (%)	1.45	1.88	2.04	1.61	1.02	0.524	0.225
Vehicle sales - Light-duty - EV (%)	2.02	4.97	12.4	26.8	49.4	72.7	87.8
Vehicle sales - Light-duty - gasoline (%)	91.4	86.9	78.7	65.5	45.1	24.2	10.7
Vehicle sales - Light-duty - hybrid (%)	4.96	5.75	6.41	5.79	4.28	2.5	1.2
Vehicle sales - Light-duty - hydrogen FC (%)	0.112	0.377	0.32	0.242	0.17	0.094	0.044
Vehicle sales - Light-duty - other (%)	0.098	0.102	0.092	0.08	0.057	0.031	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)	690	679	673	667	654	636	618
Final energy use - Industry (PJ)	488	505	514	526	531	538	538
Final energy use - Residential (PJ)	880	823	783	735	664	579	494
Final energy use - Transportation (PJ)	1,163	1,112	1,033	964	905	837	757

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

Item	2020	2025	2030	2035	2040	2045	2050
Commercial HVAC investment in 2020s -	0	89,637	97,820	0	0	0	0
Cumulative 5-yr (million \$2018)							
Sales of cooking units - Electric Resistance (%)	18.5	21.6	27.5	43	64.5	77.7	82.3
Sales of cooking units - Gas (%)	81.5	78.4	72.5	57	35.5	22.3	17.7
Sales of space heating units - Electric Heat Pump (%)	0.625	10	13.9	25.5	45.9	63.9	72.2
Sales of space heating units - Electric Resistance (%)	2.13	3.41	4.29	6.96	11.7	15.4	17.3
Sales of space heating units - Fossil (%)	19.1	16.8	16.2	12.8	7.04	2.9	1.58

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

Item	2020	2025	2030	2035	2040	2045	2050
Sales of space heating units - Gas Furnace (%)	78.2	69.8	65.6	54.7	35.3	17.8	8.88
Sales of water heating units - Electric Heat Pump (%)	0.224	1.65	5.4	16.4	34.9	49.5	55.9
Sales of water heating units - Electric Resistance (%)	1.34	2.6	4.47	10.1	20.3	29.6	34
Sales of water heating units - Gas Furnace (%)	97	94.4	88.8	72.4	44.1	20.6	9.85
Sales of water heating units - Other (%)	1.45	1.35	1.33	1.05	0.642	0.377	0.282

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

Item	2020	2025	2030	2035	2040	2045	2050
Electricity distribution capital invested -	0	6.03	6.04	8.86	9.2	14.7	15.6
Cumulative 5-yr (billion \$2018)							

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

2020	2025	2030	2035	2040	2045	2050
0	0	0	0	0	0	0
0	0	0	0.005	0.001	0	0.011
0	0	0.007	0	0.001	0	0.011
	0	0 0	0 0 0	0 0 0 0 0 0 0 0.005	0 0 0 0 0 0 0 0 0 0.005	0 0 0 0 0 0 0 0 0 0 0.005 0.001 0

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

Item	2020	2025	2030	2035	2040	2045	2050
Biomass power plant (GWh)	0	0	0	0	0	0	0
Biomass w/ccu allam power plant (GWh)	0	0	0	4.49	5.23	5.45	16.9
Biomass w/ccu power plant (GWh)	0	0	8.38	8.38	9.01	9.12	21.7

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	0.652	1.94	2.2	6.27	1,070
Conversion capital investment - Cumulative 5-yr (million \$2018)	0	0	6.95	22.2	4.22	47.7	12,245
Number of facilities - Allam power w ccu (quantity)	0	0	0	1	1	1	1
Number of facilities - Beccs hydrogen (quantity)	0	0	0	1	1	1	1
Number of facilities - Diesel (quantity)	0	0	0	0	0	1	1
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	1	1	1	1	1
Number of facilities - Pyrolysis (quantity)	0	0	0	0	0	1	13
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	1	1	1	1	1

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

Item	2020	2025	2030	2035	2040	2045	2050
Annual - All (MMT)	0	0	0.01	3.38	3.35	3.45	3.67
Annual - BECCS (MMT)	0	0	0.01	0.02	0.02	0.03	0.12
Annual - Cement and lime (MMT)	0	0	0	3.35	3.32	3.42	3.53
Annual - NGCC (MMT)	0	0	0	0.01	0.01	0.01	0.01
Cumulative - All (MMT)	0	0	0.01	3.39	6.74	10.2	13.9
Cumulative - BECCS (MMT)	0	0	0.01	0.03	0.05	0.08	0.2
Cumulative - Cement and lime (MMT)	0	0	0	3.35	6.67	10.1	13.6
Cumulative - NGCC (MMT)	0	0	0	0.01	0.02	0.03	0.04

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

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

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

Item	2020	2025	2030	2035	2040	2045	2050
All (km)	0	0	279	612	612	437	612
Cumulative investment - All (million \$2018)	0	0	223	490	489	400	499
Cumulative investment - Spur (million \$2018)	0	0	109	376	375	286	385
Cumulative investment - Trunk (million \$2018)	0	0	114	114	114	114	114
Spur (km)	0	0	216	549	549	374	549
Trunk (km)	0	0	63	63	63	63	63

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

0 0	2025 0	2050 -414
		-414
0	0	
0		-2,200
	9	-2,200
0	0	0
0	0	U
0	0	0
0	0	· ·
Ω	0	-84.9
		0 1,
0	0	-2,698
		_,0,0
0	0	-414
0	0	-1,160
		,
0	0	0
0	0	0
0	0	-42.4
0	0	-1,616
0	0	172
_		
0	0	3,483
		4.04
U	0	1.31
0	0	78.3
U	U	10.3
0	0	154
0	0	154
n	n	3,889
0	١ '	0,009
n	n	172
	ŭ	112
	0 0 0	

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

Item	2020	2025	2050
Land impacted for carbon sink - Moderate	0	0	744
deployment - Cropland measures (1000			
hectares)			
Land impacted for carbon sink - Moderate	0	0	1.31
deployment - Cropland to woody energy crops			
(1000 hectares)			
Land impacted for carbon sink - Moderate	0	0	78.3
deployment - Pasture to energy crops (1000			
hectares)			
Land impacted for carbon sink - Moderate	0	0	77.2
deployment - Permanent conservation cover			
(1000 hectares)			
Land impacted for carbon sink - Moderate	0	0	1,072
deployment - Total (1000 hectares)			

Table 57: E-B+ scenario - PILLAR 6: Land sinks -	Forests		
Item	2020	2025	2050
Carbon sink potential - High - Accelerate regeneration (1000 tCO2e/y)	0	0	383
Carbon sink potential - High - All (not counting overlap) (1000 tCO2e/y)	0	0	31,435
Carbon sink potential - High - Avoid deforestation (1000 tC02e/y)	0	0	2,752
Carbon sink potential - High - Extend rotation length (1000 tCO2e/y)	0	0	11,858
Carbon sink potential - High - Improve plantations (1000 tCO2e/y)	0	0	604
Carbon sink potential - High - Increase retention of HWP (1000 tC02e/y)	0	0	5,464
Carbon sink potential - High - Increase trees outside forests (1000 tC02e/y)	0	0	1,072
Carbon sink potential - High - Reforest cropland (1000 tC02e/y)	0	0	273
Carbon sink potential - High - Reforest pasture (1000 tC02e/y)	0	0	5,516
Carbon sink potential - High - Restore productivity (1000 tC02e/y)	0	0	3,513
Carbon sink potential - Low - Accelerate regeneration (1000 tCO2e/y)	0	0	192
Carbon sink potential - Low - All (not counting overlap) (1000 tCO2e/y)	0	0	9,448
Carbon sink potential - Low - Avoid deforestation (1000 tCO2e/y)	0	0	459
Carbon sink potential - Low - Extend rotation length (1000 tCO2e/y)	0	0	4,555
Carbon sink potential - Low - Improve plantations (1000 tC02e/y)	0	0	307
Carbon sink potential - Low - Increase retention of HWP (1000 tCO2e/y)	0	0	1,821
Carbon sink potential - Low - Increase trees outside forests (1000 tC02e/y)	0	0	375
Carbon sink potential - Low - Reforest cropland (1000 tCO2e/y)	0	0	136
Carbon sink potential - Low - Reforest pasture (1000 tC02e/y)	0	0	418
Carbon sink potential - Low - Restore productivity (1000 tC02e/y)	0	0	1,184
Carbon sink potential - Mid - Accelerate regeneration (1000 tC02e/y)	0	0	287
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO2e/y)	0	0	20,436
Carbon sink potential - Mid - Avoid deforestation (1000 tC02e/y)	0	0	1,605

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

Table 57: E-B+ scenario - PILLAR 6: Land sinks -	Forests (con	tinued)	
Item	2020	2025	2050
Carbon sink potential - Mid - Extend rotation	0	0	8,206
length (1000 tCO2e/y)			
Carbon sink potential - Mid - Improve plantations	0	0	450
(1000 tC02e/y)			
Carbon sink potential - Mid - Increase retention	0	0	3,642
of HWP (1000 tCO2e/y)			
Carbon sink potential - Mid - Increase trees	0	0	724
outside forests (1000 tCO2e/y)			
Carbon sink potential - Mid - Reforest cropland	0	0	205
(1000 tC02e/y)			
Carbon sink potential - Mid - Reforest pasture	0	0	2,967
(1000 tC02e/y)			
Carbon sink potential - Mid - Restore	0	0	2,349
productivity (1000 tCO2e/y)			
Land impacted for carbon sink potential - High -	0	0	62.6
Accelerate regeneration (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	373
Avoid deforestation (over 30 years) (1000			
hectares)			
Land impacted for carbon sink potential - High -	0	0	6,047
Extend rotation length (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	223
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	102
Increase trees outside forests (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	18
Reforest cropland (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	157
Reforest pasture (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	1,164
Restore productivity (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	8,146
Total impacted (over 30 years) (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	31.3
Accelerate regeneration (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	350
Avoid deforestation (over 30 years) (1000			
hectares)			
Land impacted for carbon sink potential - Low -	0	0	2,317
Extend rotation length (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	111
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	53.6
Increase trees outside forests (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	9.02
Reforest cropland (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	27.2
Reforest pasture (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	705
Restore productivity (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	3,603
Total impacted (over 30 years) (1000 hectares)		-	2,300
Land impacted for carbon sink potential - Mid -	0	0	47
Accelerate regeneration (1000 hectares)		ŭ	71
Land impacted for carbon sink potential - Mid -	0	0	361
Avoid deforestation (over 30 years) (1000		·	301
hectares)			
hectares) Land impacted for carbon sink potential - Mid -	0	0	4,182

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

Item	2020	2025	2050
Land impacted for carbon sink potential - Mid -	0	0	167
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	77.7
Increase trees outside forests (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	13.5
Reforest cropland (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	196
Reforest pasture (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	1,419
Restore productivity (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	6,464
Total impacted (over 30 years) (1000 hectares)			

Table 58: REF scenario - PILLAR 1: Efficiency/Electrification - Residential

	·						
Item	2020	2025	2030	2035	2040	2045	2050
Residential HVAC investment in 2020s vs. REF -	0	13.5	14.1	0	0	0	0
Cumulative 5-yr (billion \$2018)							
Sales of cooking units - Electric Resistance (%)	33.8	33.8	33.8	33.8	33.8	33.8	33.8
Sales of cooking units - Gas (%)	66.2	66.2	66.2	66.2	66.2	66.2	66.2
Sales of space heating units - Electric Heat Pump	1.94	19.2	20	21	21.5	22.1	22.9
(%)							
Sales of space heating units - Electric Resistance	8.69	9.88	9.71	9.54	9.43	8.85	8.05
(%)							
Sales of space heating units - Fossil (%)	24.6	30	16	7.63	6.8	6.76	6.79
Sales of space heating units - Gas (%)	64.8	40.9	54.3	61.9	62.2	62.3	62.3
Sales of water heating units - Electric Heat Pump	0	0	0	0	0	0	0
(%)							
Sales of water heating units - Electric Resistance	18.7	35.1	35	35	35	34.9	34.9
(%)							
Sales of water heating units - Gas Furnace (%)	71.1	58	58.1	58.1	58.1	58.2	58.2
Sales of water heating units - Other (%)	10.3	6.88	6.87	6.87	6.88	6.87	6.87

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 (%)	1.44	1.87	2.17	2.02	1.81	1.69	1.6
Vehicle sales - Light-duty - EV (%)	3.92	6.07	6.88	8.48	10.3	11.8	13
Vehicle sales - Light-duty - gasoline (%)	89.6	86	83.7	81.7	79.5	77.6	76.1
Vehicle sales - Light-duty - hybrid (%)	4.8	5.63	6.86	7.42	7.96	8.48	8.86
Vehicle sales - Light-duty - hydrogen FC (%)	0.11	0.373	0.339	0.3	0.296	0.296	0.306
Vehicle sales - Light-duty - other (%)	0.097	0.101	0.097	0.098	0.097	0.096	0.098
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)	690	686	690	689	696	725	772
Final energy use - Industry (PJ)	488	516	537	550	569	586	604
Final energy use - Residential (PJ)	880	816	779	749	730	718	709

Table 60: REF scenario - PILLAR 1: Efficiency/Electrification - Overview (continued)

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Transportation (PJ)	1,162	1,127	1,072	1,042	1,053	1,087	1,129

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

Item	2020	2025	2030	2035	2040	2045	2050
Commercial HVAC investment in 2020s -	0	88,595	91,263	0	0	0	0
Cumulative 5-yr (million \$2018)							
Sales of cooking units - Electric Resistance (%)	18.5	19.4	19.4	19.6	19.7	19.8	19.9
Sales of cooking units - Gas (%)	81.5	80.6	80.6	80.4	80.3	80.2	80.1
Sales of space heating units - Electric Heat Pump	0.625	14.7	40.7	61.9	65.1	65.7	65.5
(%)							
Sales of space heating units - Electric Resistance	2.13	4.03	8.89	21.3	31.8	33.3	33.6
(%)							
Sales of space heating units - Fossil (%)	19.1	16.3	12.8	5.74	0.874	0.07	0
Sales of space heating units - Gas Furnace (%)	78.2	65	37.7	11	2.19	0.952	0.86
Sales of water heating units - Electric Heat Pump	0.224	0.326	0.327	0.328	0.329	0.331	0.331
(%)							
Sales of water heating units - Electric Resistance	1.34	1.93	1.92	1.93	1.93	1.92	1.93
(%)							
Sales of water heating units - Gas Furnace (%)	97	96.4	96.3	96.3	96.3	96.3	96.3
Sales of water heating units - Other (%)	1.45	1.38	1.45	1.44	1.45	1.49	1.49

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

Item	2020	2025	2030	2035	2040	2045	2050
Electricity distribution capital invested -	0	6.35	6.41	12.1	12.8	14.6	15.5
Cumulative 5-yr (billion \$2018)							

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

Item	2020	2025	2030	2050
Business-as-usual carbon sink - Natural uptake (Mt CO2e/y)	-10.2	0	-16.4	-14.7
Business-as-usual carbon sink - Retained in Hardwood Products (Mt CO2e/y)	-1.49	0	-2.67	-2.78
Business-as-usual carbon sink - Total (Mt CO2e/y)	-11.7	0	-19.1	-17.5
Carbon sink potential - High - Accelerate regeneration (1000 tCO2e/y)	0	0	0	383
Carbon sink potential - High - All (not counting overlap) (1000 tCO2e/y)	0	0	0	31,435
Carbon sink potential - High - Avoid deforestation (1000 tCO2e/y)	0	0	0	2,752
Carbon sink potential - High - Extend rotation length (1000 tCO2e/y)	0	0	0	11,858
Carbon sink potential - High - Improve plantations (1000 tCO2e/y)	0	0	0	604
Carbon sink potential - High - Increase retention of HWP (1000 tCO2e/y)	0	0	0	5,464
Carbon sink potential - High - Increase trees outside forests (1000 tCO2e/y)	0	0	0	1,072
Carbon sink potential - High - Reforest cropland (1000 tCO2e/y)	0	0	0	273
Carbon sink potential - High - Reforest pasture (1000 tCO2e/y)	0	0	0	5,516
Carbon sink potential - High - Restore productivity (1000 tC02e/y)	0	0	0	3,513
Carbon sink potential - Low - Accelerate regeneration (1000 tCO2e/y)	0	0	0	192
Carbon sink potential - Low - All (not counting overlap) (1000 tCO2e/y)	0	0	0	9,448
Carbon sink potential - Low - Avoid deforestation (1000 tCO2e/y)	0	0	0	459

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

Table 63: REF scenario - PILLAR 6: Land sinks - I	Forests (con	tinued)		
Item	2020	2025	2030	2050
Carbon sink potential - Low - Extend rotation	0	0	0	4,555
length (1000 tCO2e/y)				
Carbon sink potential - Low - Improve	0	0	0	307
plantations (1000 tCO2e/y)				
Carbon sink potential - Low - Increase retention	0	0	0	1,821
of HWP (1000 tCO2e/y)				
Carbon sink potential - Low - Increase trees	0	0	0	375
outside forests (1000 tCO2e/y)				
Carbon sink potential - Low - Reforest cropland	0	0	0	136
(1000 tCO2e/y)				
Carbon sink potential - Low - Reforest pasture	0	0	0	418
(1000 tCO2e/y)				
Carbon sink potential - Low - Restore	0	0	0	1,184
productivity (1000 tCO2e/y)				
Carbon sink potential - Mid - Accelerate	0	0	0	287
regeneration (1000 tCO2e/y)				
Carbon sink potential - Mid - All (not counting	0	0	0	20,436
overlap) (1000 tCO2e/y)				
Carbon sink potential - Mid - Avoid deforestation	0	0	0	1,605
(1000 tCO2e/y)				
Carbon sink potential - Mid - Extend rotation	0	0	0	8,206
length (1000 tCO2e/y)				
Carbon sink potential - Mid - Improve plantations	0	0	0	450
(1000 tC02e/y)				
Carbon sink potential - Mid - Increase retention	0	0	0	3,642
of HWP (1000 tCO2e/y)				•
Carbon sink potential - Mid - Increase trees	0	0	0	724
outside forests (1000 tCO2e/y)				
Carbon sink potential - Mid - Reforest cropland	0	0	0	205
(1000 tC02e/y)		-		
Carbon sink potential - Mid - Reforest pasture	0	0	0	2,967
(1000 tC02e/y)		-		_,
Carbon sink potential - Mid - Restore	0	0	0	2,349
productivity (1000 tCO2e/y)				_,0 .,
Land impacted for carbon sink potential - High -	0	0	0	62.6
Accelerate regeneration (1000 hectares)		-		
Land impacted for carbon sink potential - High -	0	0	0	373
Avoid deforestation (over 30 years) (1000				0.0
hectares)				
Land impacted for carbon sink potential - High -	0	0	0	6,047
Extend rotation length (1000 hectares)				5,5
Land impacted for carbon sink potential - High -	0	0	0	223
Improve plantations (1000 hectares)		0	·	220
Land impacted for carbon sink potential - High -	0	0	0	0
Increase retention of HWP (1000 hectares)	0	0	0	Ü
Land impacted for carbon sink potential - High -	0	0	0	102
Increase trees outside forests (1000 hectares)	0	0	0	102
Land impacted for carbon sink potential - High -	0	0	0	18
Reforest cropland (1000 hectares)	0	0	0	10
Land impacted for carbon sink potential - High -	0	0	0	157
Reforest pasture (1000 hectares)	0	0	0	131
Land impacted for carbon sink potential - High -	0	0	0	1,164
	U	0	0	1,104
Restore productivity (1000 hectares)		0		01//
Land impacted for carbon sink potential - High -	0	0	0	8,146
Total impacted (over 30 years) (1000 hectares)				01.0
Land impacted for carbon sink potential - Low -	0	0	0	31.3
Accelerate regeneration (1000 hectares)				050
Land impacted for carbon sink potential - Low -	0	0	0	350
Avoid deforestation (over 30 years) (1000				
hectares)				0.047
Land impacted for carbon sink potential - Low -	0	0	0	2,317
Extend rotation length (1000 hectares)				

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

Table 63: REF SCENDITO - PILLAR 6: LUNU SINKS - I	•	•		
Item	2020	2025	2030	2050
Land impacted for carbon sink potential - Low -	0	0	0	111
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	53.6
Increase trees outside forests (1000 hectares)				
Land impacted for carbon sink potential - Low -	0	0	0	9.02
Reforest cropland (1000 hectares)				
Land impacted for carbon sink potential - Low -	0	0	0	27.2
Reforest pasture (1000 hectares)				
Land impacted for carbon sink potential - Low -	0	0	0	705
Restore productivity (1000 hectares)				
Land impacted for carbon sink potential - Low -	0	0	0	3,603
Total impacted (over 30 years) (1000 hectares)				
Land impacted for carbon sink potential - Mid -	0	0	0	47
Accelerate regeneration (1000 hectares)				
Land impacted for carbon sink potential - Mid -	0	0	0	361
Avoid deforestation (over 30 years) (1000				
hectares)				
Land impacted for carbon sink potential - Mid -	0	0	0	4,182
Extend rotation length (1000 hectares)				
Land impacted for carbon sink potential - Mid -	0	0	0	167
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	77.7
Increase trees outside forests (1000 hectares)				
Land impacted for carbon sink potential - Mid -	0	0	0	13.5
Reforest cropland (1000 hectares)				
Land impacted for carbon sink potential - Mid -	0	0	0	196
Reforest pasture (1000 hectares)				
Land impacted for carbon sink potential - Mid -	0	0	0	1,419
Restore productivity (1000 hectares)				
Land impacted for carbon sink potential - Mid -	0	0	0	6,464
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	0	5,195	3,239	2,997	2,900	2,839	2,551
(million 2019\$)							
Monetary damages from air pollution - Natural	0	1,652	1,595	2,179	2,161	2,470	2,731
Gas (million 2019\$)							
Monetary damages from air pollution -	0	7,434	8,078	8,725	9,431	10,167	10,949
Transportation (million 2019\$)							
Premature deaths from air pollution - Coal	0	583	364	336	325	319	286
(deaths)							
Premature deaths from air pollution - Natural	0	187	180	246	244	279	309
Gas (deaths)							
Premature deaths from air pollution -	0	836	909	981	1,061	1,143	1,231
Transportation (deaths)							