Net-Zero America - kansas state report

Larson et al. 2020

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

Notes

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

List of Tables

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

18	E- scenario - PILLAR 1: Efficiency/Electrification - Transportation	10
19	E- scenario - PILLAR 1: Efficiency/Electrification - Overview	11
20	E- scenario - PILLAR 1: Efficiency/Electrification - Commercial	11
21	E- scenario - PILLAR 1: Efficiency/Electrification - Electricity demand	11
22	E- scenario - PILLAR 6: Land sinks - Agriculture	11
23	E- scenario - PILLAR 6: Land sinks - Forests	12
24	E- scenario - IMPACTS - Health	14
25	E+RE+ scenario - PILLAR 1: Efficiency/Electrification - Residential	14
26	E+RE+ scenario - PILLAR 1: Efficiency/Electrification - Transportation	15
27	E+RE+ scenario - PILLAR 1: Efficiency/Electrification - Overview	15
28	E+RE+ scenario - PILLAR 1: Efficiency/Electrification - Commercial	15
29	E+RE+ scenario - PILLAR 1: Efficiency/Electrification - Electricity demand	16
30	E+RE+ scenario - PILLAR 2: Clean Electricity - Generating capacity	16
31	E+RE+ scenario - PILLAR 2: Clean Electricity - Generation	16
32	E+RE+ scenario - PILLAR 6: Land sinks - Agriculture	16
33	E+RE+ scenario - PILLAR 6: Land sinks - Forests	17
34	E+RE+ scenario - IMPACTS - Health	19
35	E+RE- scenario - PILLAR 1: Efficiency/Electrification - Residential	19
36	E+RE- scenario - PILLAR 1: Efficiency/Electrification - Transportation	19
37	E+RE- scenario - PILLAR 1: Efficiency/Electrification - Overview	20
38	E+RE- scenario - PILLAR 1: Efficiency/Electrification - Commercial	20
39	E+RE- scenario - PILLAR 1: Efficiency/Electrification - Electricity demand	20
40	E+RE- scenario - PILLAR 2: Clean Electricity - Generating capacity	20
41	E+RE- scenario - PILLAR 2: Clean Electricity - Generation	20
42	E+RE- scenario - PILLAR 6: Land sinks - Agriculture	20
43	E+RE- scenario - PILLAR 6: Land sinks - Forests	21
44	E+RE- scenario - IMPACTS - Health	23
45	E-B+ scenario - PILLAR 1: Efficiency/Electrification - Residential	23
46	E-B+ scenario - PILLAR 1: Efficiency/Electrification - Transportation	24
47	E-B+ scenario - PILLAR 1: Efficiency/Electrification - Overview	24
48	E-B+ scenario - PILLAR 1: Efficiency/Electrification - Commercial	24
49	E-B+ scenario - PILLAR 1: Efficiency/Electrification - Electricity demand	24
50	E-B+ scenario - PILLAR 2: Clean Electricity - Generating capacity	25
51	E-B+ scenario - PILLAR 2: Clean Electricity - Generation	25
52	E-B+ scenario - PILLAR 3: Clean fuels - Bioenergy	25
53	E-B+ scenario - PILLAR 4: CCUS - CO2 capture	25
54	E-B+ scenario - PILLAR 4: CCUS - CO2 storage	25
55	E-B+ scenario - PILLAR 4: CCUS - CO2 pipelines	25
56	E-B+ scenario - PILLAR 6: Land sinks - Agriculture	26
57	E-B+ scenario - PILLAR 6: Land sinks - Forests	27
58	REF scenario - PILLAR 1: Efficiency/Electrification - Residential	29

59	REF scenario - PILLAR 1: Efficiency/Electrification - Transportation	29
60	REF scenario - PILLAR 1: Efficiency/Electrification - Overview	29
61	REF scenario - PILLAR 1: Efficiency/Electrification - Commercial	29
62	REF scenario - PILLAR 1: Efficiency/Electrification - Electricity demand	30
63	REF scenario - PILLAR 6: Land sinks - Forests	30
64	REF scenario - IMPACTS - Health	32

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

Item	2020	2025	2030	2035	2040	2045	2050
Residential HVAC investment in 2020s vs. REF -	0	3.01	4.04	0	0	0	0
Cumulative 5-yr (billion \$2018)							
Sales of cooking units - Electric Resistance (%)	66.4	73.6	95.5	99.8	100	100	100
Sales of cooking units - Gas (%)	33.6	26.4	4.52	0.228	0	0	0
Sales of space heating units - Electric Heat Pump	4.79	20.7	76.2	90.8	91.9	91.9	91.7
(%)							
Sales of space heating units - Electric Resistance	11.9	15	6.62	4.42	4.27	4.39	4.55
(%)							
Sales of space heating units - Fossil (%)	5.87	9.2	4.05	2.66	2.42	2.31	2.37
Sales of space heating units - Gas (%)	77.4	55.1	13.1	2.17	1.44	1.41	1.38
Sales of water heating units - Electric Heat Pump	0	9.31	49.7	59.7	60.3	60.3	60.3
(%)							
Sales of water heating units - Electric Resistance	27.3	41.9	39.5	39.6	39.7	39.7	39.7
(%)							
Sales of water heating units - Gas Furnace (%)	72.7	48.8	10.7	0.692	0.019	0	0
Sales of water heating units - Other (%)	0.024	0.027	0.027	0.027	0.027	0.027	0.027

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

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Item	2020	2025	2030	2035	2040	2045	2050
Light-duty vehicle capital costs - Cumulative 5-yr	0	515	1,320	2,139	3,240	3,527	3,363
(million \$2018)							
Public EV charging plugs - DC Fast (1000 units)	0.119	0	0.964	0	4.24	0	6.85
Public EV charging plugs - L2 (1000 units)	0.786	0	23.3	0	102	0	165
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 (%)	1.63	1.89	1.29	0.414	0.076	0.013	0
Vehicle sales - Light-duty - EV (%)	3.63	14.3	45.1	81.3	96.3	99.3	100
Vehicle sales - Light-duty - gasoline (%)	90.4	79	50.2	17.1	3.36	0.592	0
Vehicle sales - Light-duty - hybrid (%)	4.15	4.34	3.12	1.17	0.283	0.061	0
Vehicle sales - Light-duty - hydrogen FC (%)	0.111	0.344	0.21	0.065	0.013	0.002	0
Vehicle sales - Light-duty - other (%)	0.105	0.102	0.067	0.024	0.005	0.001	0
Vehicle sales - Medium-duty - diesel (%)	64.7	59.7	42.3	14.4	2.59	0.384	0
Vehicle sales - Medium-duty - EV (%)	0.784	5.07	25.3	60.8	76.5	79.5	80
Vehicle sales - Medium-duty - gasoline (%)	33.7	33.3	25.5	9.32	1.77	0.277	0
Vehicle sales - Medium-duty - hybrid (%)	0.363	0.402	0.341	0.14	0.03	0.005	0
Vehicle sales - Medium-duty - hydrogen FC (%)	0.196	1.27	6.33	15.2	19.1	19.9	20
Vehicle sales - Medium-duty - other (%)	0.253	0.255	0.205	0.083	0.019	0.004	0

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

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Commercial (PJ)	110	107	101	92.6	85.5	81	78.6
Final energy use - Industry (PJ)	174	182	189	190	195	204	206
Final energy use - Residential (PJ)	120	113	102	86.8	74.3	66.4	62.6
Final energy use - Transportation (PJ)	286	268	235	195	160	139	131

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

Item	2020	2025	2030	2035	2040	2045	2050
Commercial HVAC investment in 2020s -	0	8,255	8,955	0	0	0	0
Cumulative 5-yr (million \$2018)							
Sales of cooking units - Electric Resistance (%)	44.8	57.1	84	89.3	89.6	89.6	89.6
Sales of cooking units - Gas (%)	55.2	42.9	16	10.7	10.4	10.4	10.4
Sales of space heating units - Electric Heat Pump (%)	2.13	24.7	71.3	88	89.8	89.9	89.8
Sales of space heating units - Electric Resistance (%)	4.54	5.67	7.02	9.23	9.68	9.7	9.71
Sales of space heating units - Fossil (%)	0	1.73	0.333	0.014	0	0	0

Table 4: E+ scenario -	PTI I AR 1: Efficiency	//Flectrification -	Commercial	(continued)
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Item	2020	2025	2030	2035	2040	2045	2050
Sales of space heating units - Gas Furnace (%)	93.3	67.9	21.4	2.81	0.539	0.45	0.45
Sales of water heating units - Electric Heat Pump (%)	0.677	10.7	53.8	64.7	65.3	65.3	65.3
Sales of water heating units - Electric Resistance (%)	5.85	10.9	28.5	33.6	34	34	34
Sales of water heating units - Gas Furnace (%)	92.9	77.4	17	1.1	0.03	0	0
Sales of water heating units - Other (%)	0.567	0.935	0.728	0.68	0.677	0.679	0.679

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

Item	2020	2025	2030	2035	2040	2045	2050
Electricity distribution capital invested -	0	1.98	2.05	3.35	3.56	3.35	3.52
Cumulative 5-yr (billion \$2018)							

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

Item	2020	2025	2030	2035	2040	2045	2050
Capital invested - Biomass power plant (billion	0	0	0	0	0	0	0
\$2018)							
Capital invested - Biomass w/ccu allam power	0	0	0	0	0	0	0.042
plant (billion \$2018)							
Capital invested - Biomass w/ccu power plant	0	0	0	0	0	0	0.171
(billion \$2018)							
Capital invested - Solar PV - Base (billion \$2018)	0	0	0	0	0	0	0.072
Capital invested - Solar PV - Constrained (billion	0	0.03	0	0.231	0	0	0.072
\$2018)							
Capital invested - Wind - Base (billion \$2018)	0	0	0.43	1.58	2.73	3.71	0.208
Capital invested - Wind - Constrained (billion	0	0.552	0.572	3.14	5.93	6.23	0.442
\$2018)							

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

Item	2020	2025	2030	2035	2040	2045	2050
Biomass power plant (GWh)	0	0	0	0	0	0	0
Biomass w/ccu allam power plant (GWh)	0	0	0	0	0	0	41.8
Biomass w/ccu power plant (GWh)	0	0	0	0	0	0	192
Solar - Base land use assumptions (GWh)	58.5	0	0	0	0	0	151
Solar - Constrained land use assumptions (GWh)	45.5	0	0	404	0	0	0
Wind - Base land use assumptions (GWh)	31,394	0	1,203	4,680	8,362	11,889	693
Wind - Constrained land use assumptions (GWh)	31,394	0	1,808	6,462	15,395	17,716	1,272

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

oction gy						
2020	2025	2030	2035	2040	2045	2050
0	0	0	461	461	853	1,051
0	0	0	6,624	0	5,640	2,843
0	0	0	0	0	0	1
0	0	0	6	6	11	13
0	0	0	0	0	0	0
0	0	0	0	0	0	1
0	0	0	0	0	0	0
0	0	0	0	0	0	1
0	0	0	0	0	0	0
0	0	0	0	0	0	1
0	0	0	0	0	0	0
0	0	0	0	0	0	0
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Table 9: E+ scenario - PILLAR 4: CCUS - CO2 capture

Item	2020	2025	2030	2035	2040	2045	2050
Annual - All (MMT)	0	0	0.01	8.54	11.9	19.2	23
Annual - BECCS (MMT)	0	0	0	8.51	8.51	15.8	19.4
Annual - Cement and lime (MMT)	0	0	0	0	3.32	3.42	3.53
Annual - NGCC (MMT)	0	0	0.01	0.03	0.02	0.02	0.02
Cumulative - All (MMT)	0	0	0.01	8.55	20.4	39.6	62.6
Cumulative - BECCS (MMT)	0	0	0	8.51	17	32.8	52.2
Cumulative - Cement and lime (MMT)	0	0	0	0	3.32	6.74	10.3
Cumulative - NGCC (MMT)	0	0	0.01	0.04	0.06	0.08	0.1

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

Item	2020	2025	2030	2035	2040	2045	2050
CO2 storage (MMT)	0	0	0	1.76	2.71	4.3	5.59
Injection wells (wells)	0	0	1	3	6	10	12
Resource characterization, appraisal, permitting	0	77.2	185	216	216	216	216
costs (million \$2020)							
Wells and facilities construction costs (million	0	0	25.7	100	178	298	371
\$2020)							

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

Item	2020	2025	2030	2035	2040	2045	2050
All (km)	0	0	1,055	2,020	2,287	2,644	3,263
Cumulative investment - All (million \$2018)	0	0	4,984	7,372	7,594	7,850	8,335
Cumulative investment - Spur (million \$2018)	0	0	30.9	494	715	971	1,456
Cumulative investment - Trunk (million \$2018)	0	0	4,953	6,879	6,879	6,879	6,879
Spur (km)	0	0	58.5	659	926	1,283	1,902
Trunk (km)	0	0	997	1,361	1,361	1,361	1,361

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

Carbon sink potential - Aggressive deployment - Corn-ethanol to energy grasses (1000 tC02e/y) Carbon sink potential - Aggressive deployment - Cropland measures (1000 tC02e/y) Carbon sink potential - Aggressive deployment - Permanent conservation cover (1000 tC02e/y) Carbon sink potential - Aggressive deployment - Permanent conservation cover (1000 tC02e/y) Carbon sink potential - Aggressive deployment - Corn-ethanol to energy grasses (1000 tC02e/y) Carbon sink potential - Moderate deployment - Corn-ethanol to energy grasses (1000 tC02e/y) Carbon sink potential - Moderate deployment - Cropland measures (1000 tC02e/y) Carbon sink potential - Moderate deployment - Permanent conservation cover (1000 tC02e/y) Carbon sink potential - Moderate deployment - Potal (1000 tC02e/y) Land impacted for carbon sink - Aggressive deployment - Corn-ethanol to energy grasses (1000 hectares) Land impacted for carbon sink - Aggressive deployment - Cropland measures (1000 hectares)	Item	2020	2025	2050
Carbon sink potential - Aggressive deployment - Cropland measures (1000 tCO2e/y) Carbon sink potential - Aggressive deployment - Permanent conservation cover (1000 tCO2e/y) Carbon sink potential - Aggressive deployment - O O O -624 Carbon sink potential - Aggressive deployment - Total (1000 tCO2e/y) Carbon sink potential - Moderate deployment - Corn-ethanol to energy grasses (1000 tCO2e/y) Carbon sink potential - Moderate deployment - Cropland measures (1000 tCO2e/y) Carbon sink potential - Moderate deployment - Permanent conservation cover (1000 tCO2e/y) Carbon sink potential - Moderate deployment - Permanent conservation cover (1000 tCO2e/y) Carbon sink potential - Moderate deployment - Total (1000 tCO2e/y) Land impacted for carbon sink - Aggressive deployment - Corn-ethanol to energy grasses (1000 hectares) Land impacted for carbon sink - Aggressive deployment - Cropland measures (1000	Carbon sink potential - Aggressive deployment -	0	0	-696
Cropland measures (1000 tCO2e/y) Carbon sink potential - Aggressive deployment - Permanent conservation cover (1000 tCO2e/y) Carbon sink potential - Aggressive deployment - Total (1000 tCO2e/y) Carbon sink potential - Moderate deployment - Corn-ethanol to energy grasses (1000 tCO2e/y) Carbon sink potential - Moderate deployment - Cropland measures (1000 tCO2e/y) Carbon sink potential - Moderate deployment - Permanent conservation cover (1000 tCO2e/y) Carbon sink potential - Moderate deployment - Potal (1000 tCO2e/y) Carbon sink potential - Moderate deployment - Total (1000 tCO2e/y) Land impacted for carbon sink - Aggressive deployment - Corn-ethanol to energy grasses (1000 hectares) Land impacted for carbon sink - Aggressive deployment - Cropland measures (1000	Corn-ethanol to energy grasses (1000 tCO2e/y)			
Carbon sink potential - Aggressive deployment - Permanent conservation cover (1000 tC02e/y) Carbon sink potential - Aggressive deployment - Total (1000 tC02e/y) Carbon sink potential - Moderate deployment - Corn-ethanol to energy grasses (1000 tC02e/y) Carbon sink potential - Moderate deployment - Cropland measures (1000 tC02e/y) Carbon sink potential - Moderate deployment - Cropland measures (1000 tC02e/y) Carbon sink potential - Moderate deployment - Permanent conservation cover (1000 tC02e/y) Carbon sink potential - Moderate deployment - Total (1000 tC02e/y) Land impacted for carbon sink - Aggressive deployment - Corn-ethanol to energy grasses (1000 hectares) Land impacted for carbon sink - Aggressive deployment - Cropland measures (1000	Carbon sink potential - Aggressive deployment -	0	0	-10,263
Permanent conservation cover (1000 tCO2e/y) Carbon sink potential - Aggressive deployment - 0 0 -11,583 Total (1000 tCO2e/y) Carbon sink potential - Moderate deployment - 0 0 -696 Corn-ethanol to energy grasses (1000 tCO2e/y) Carbon sink potential - Moderate deployment - 0 0 -5,387 Cropland measures (1000 tCO2e/y) Carbon sink potential - Moderate deployment - 0 0 -312 Permanent conservation cover (1000 tCO2e/y) Carbon sink potential - Moderate deployment - 0 0 -6,395 Total (1000 tCO2e/y) Land impacted for carbon sink - Aggressive 0 0 413 deployment - Corn-ethanol to energy grasses (1000 hectares) Land impacted for carbon sink - Aggressive 0 0 10,336 deployment - Cropland measures (1000	Cropland measures (1000 tCO2e/y)			
Carbon sink potential - Aggressive deployment - Total (1000 tCO2e/y) Carbon sink potential - Moderate deployment - Corn-ethanol to energy grasses (1000 tCO2e/y) Carbon sink potential - Moderate deployment - Cropland measures (1000 tCO2e/y) Carbon sink potential - Moderate deployment - Cropland measures (1000 tCO2e/y) Carbon sink potential - Moderate deployment - Permanent conservation cover (1000 tCO2e/y) Carbon sink potential - Moderate deployment - Total (1000 tCO2e/y) Land impacted for carbon sink - Aggressive deployment - Corn-ethanol to energy grasses (1000 hectares) Land impacted for carbon sink - Aggressive deployment - Cropland measures (1000	Carbon sink potential - Aggressive deployment -	0	0	-624
Total (1000 tCO2e/y) Carbon sink potential - Moderate deployment - Corn-ethanol to energy grasses (1000 tCO2e/y) Carbon sink potential - Moderate deployment - Cropland measures (1000 tCO2e/y) Carbon sink potential - Moderate deployment - Permanent conservation cover (1000 tCO2e/y) Carbon sink potential - Moderate deployment - Total (1000 tCO2e/y) Land impacted for carbon sink - Aggressive deployment - Corn-ethanol to energy grasses (1000 hectares) Land impacted for carbon sink - Aggressive deployment - Cropland measures (1000	Permanent conservation cover (1000 tCO2e/y)			
Carbon sink potential - Moderate deployment - Corn-ethanol to energy grasses (1000 tC02e/y) Carbon sink potential - Moderate deployment - Cropland measures (1000 tC02e/y) Carbon sink potential - Moderate deployment - Permanent conservation cover (1000 tC02e/y) Carbon sink potential - Moderate deployment - Total (1000 tC02e/y) Land impacted for carbon sink - Aggressive deployment - Corn-ethanol to energy grasses (1000 hectares) Land impacted for carbon sink - Aggressive deployment - Cropland measures (1000	Carbon sink potential - Aggressive deployment -	0	0	-11,583
Corn-ethanol to energy grasses (1000 tCO2e/y) Carbon sink potential - Moderate deployment - Cropland measures (1000 tCO2e/y) Carbon sink potential - Moderate deployment - Permanent conservation cover (1000 tCO2e/y) Carbon sink potential - Moderate deployment - Total (1000 tCO2e/y) Land impacted for carbon sink - Aggressive deployment - Corn-ethanol to energy grasses (1000 hectares) Land impacted for carbon sink - Aggressive deployment - Cropland measures (1000	Total (1000 tCO2e/y)			
Carbon sink potential - Moderate deployment - Cropland measures (1000 tC02e/y) Carbon sink potential - Moderate deployment - Permanent conservation cover (1000 tC02e/y) Carbon sink potential - Moderate deployment - Total (1000 tC02e/y) Land impacted for carbon sink - Aggressive deployment - Corn-ethanol to energy grasses (1000 hectares) Land impacted for carbon sink - Aggressive deployment - Cropland measures (1000	Carbon sink potential - Moderate deployment -	0	0	-696
Cropland measures (1000 tCO2e/y) Carbon sink potential - Moderate deployment - Permanent conservation cover (1000 tCO2e/y) Carbon sink potential - Moderate deployment - Total (1000 tCO2e/y) Land impacted for carbon sink - Aggressive deployment - Corn-ethanol to energy grasses (1000 hectares) Land impacted for carbon sink - Aggressive deployment - Cropland measures (1000	Corn-ethanol to energy grasses (1000 tCO2e/y)			
Carbon sink potential - Moderate deployment - Permanent conservation cover (1000 tC02e/y) Carbon sink potential - Moderate deployment - Total (1000 tC02e/y) Land impacted for carbon sink - Aggressive deployment - Corn-ethanol to energy grasses (1000 hectares) Land impacted for carbon sink - Aggressive deployment - Cropland measures (1000	Carbon sink potential - Moderate deployment -	0	0	-5,387
Permanent conservation cover (1000 tCO2e/y) Carbon sink potential - Moderate deployment - 0	Cropland measures (1000 tCO2e/y)			
Carbon sink potential - Moderate deployment - 0 0 -6,395 Total (1000 tC02e/y) Land impacted for carbon sink - Aggressive 0 0 413 deployment - Corn-ethanol to energy grasses (1000 hectares) Land impacted for carbon sink - Aggressive 0 0 10,336 deployment - Cropland measures (1000	Carbon sink potential - Moderate deployment -	0	0	-312
Total (1000 tC02e/y) Land impacted for carbon sink - Aggressive 0 413 deployment - Corn-ethanol to energy grasses (1000 hectares) Land impacted for carbon sink - Aggressive 0 0 10,336 deployment - Cropland measures (1000	Permanent conservation cover (1000 tCO2e/y)			
Land impacted for carbon sink - Aggressive 0 0 413 deployment - Corn-ethanol to energy grasses (1000 hectares) Land impacted for carbon sink - Aggressive 0 0 10,336 deployment - Cropland measures (1000	Carbon sink potential - Moderate deployment -	0	0	-6,395
deployment - Corn-ethanol to energy grasses [1000 hectares] Land impacted for carbon sink - Aggressive	Total (1000 tC02e/y)			
(1000 hectares) Land impacted for carbon sink - Aggressive 0 0 10,336 deployment - Cropland measures (1000	Land impacted for carbon sink - Aggressive	0	0	413
Land impacted for carbon sink - Aggressive 0 0 10,336 deployment - Cropland measures (1000	deployment - Corn-ethanol to energy grasses			
deployment - Cropland measures (1000	(1000 hectares)			
	Land impacted for carbon sink - Aggressive	0	0	10,336
hectares)	deployment - Cropland measures (1000			
	hectares)			
Land impacted for carbon sink - Aggressive 0 0 1,047	Land impacted for carbon sink - Aggressive	0	0	1,047
deployment - Permanent conservation cover	deployment - Permanent conservation cover			
(1000 hectares)	(1000 hectares)			
Land impacted for carbon sink - Aggressive 0 0 11,796	Land impacted for carbon sink - Aggressive	0	0	11,796
deployment - Total (1000 hectares)	deployment - Total (1000 hectares)			
Land impacted for carbon sink - Moderate 0 0 413	Land impacted for carbon sink - Moderate	0	0	413
deployment - Corn-ethanol to energy grasses	deployment - Corn-ethanol to energy grasses			
(1000 hectares)	(1000 hectares)			

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

Item	2020	2025	2050
Land impacted for carbon sink - Moderate	0	0	5,430
deployment - Cropland measures (1000			
hectares)			
Land impacted for carbon sink - Moderate	0	0	524
deployment - Permanent conservation cover			
(1000 hectares)			
Land impacted for carbon sink - Moderate	0	0	6,366
deployment - Total (1000 hectares)			

Table 13: E+ scenario - PILLAR 6: Land sinks - Fo	rests		
Item	2020	2025	2050
Carbon sink potential - High - Accelerate regeneration (1000 tCO2e/y)	0	0	149
Carbon sink potential - High - All (not counting overlap) (1000 tC02e/y)	0	0	41,112
Carbon sink potential - High - Avoid deforestation (1000 tCO2e/y)	0	0	1,700
Carbon sink potential - High - Extend rotation length (1000 tCO2e/y)	0	0	983
Carbon sink potential - High - Improve plantations (1000 tCO2e/y)	0	0	44.9
Carbon sink potential - High - Increase retention of HWP (1000 tCO2e/y)	0	0	536
Carbon sink potential - High - Increase trees outside forests (1000 tCO2e/y)	0	0	3,607
Carbon sink potential - High - Reforest cropland (1000 tCO2e/y)	0	0	26,772
Carbon sink potential - High - Reforest pasture (1000 tCO2e/y)	0	0	6,646
Carbon sink potential - High - Restore productivity (1000 tCO2e/y)	0	0	674
Carbon sink potential - Low - Accelerate regeneration (1000 tCO2e/y)	0	0	74.7
Carbon sink potential - Low - All (not counting overlap) (1000 tCO2e/y)	0	0	16,316
Carbon sink potential - Low - Avoid deforestation (1000 tCO2e/y)	0	0	283
Carbon sink potential - Low - Extend rotation length (1000 tCO2e/y)	0	0	378
Carbon sink potential - Low - Improve plantations (1000 tCO2e/y)	0	0	22.8
Carbon sink potential - Low - Increase retention of HWP (1000 tCO2e/y)	0	0	179
Carbon sink potential - Low - Increase trees outside forests (1000 tCO2e/y)	0	0	1,263
Carbon sink potential - Low - Reforest cropland (1000 tCO2e/y)	0	0	13,386
Carbon sink potential - Low - Reforest pasture (1000 tCO2e/y)	0	0	503
Carbon sink potential - Low - Restore productivity (1000 tC02e/y)	0	0	227
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO2e/y)	0	0	112
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO2e/y)	0	0	28,714
Carbon sink potential - Mid - Avoid deforestation (1000 tCO2e/y)	0	0	992
Carbon sink potential - Mid - Extend rotation length (1000 tCO2e/y)	0	0	680
Carbon sink potential - Mid - Improve plantations (1000 tCO2e/y)	0	0	33.4
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO2e/y)	0	0	357

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

Item	2020	2025	2050
Carbon sink potential - Mid - Increase trees	0	0	2,435
outside forests (1000 tC02e/y)	0	0	00.070
Carbon sink potential - Mid - Reforest cropland (1000 tCO2e/y)	0	0	20,079
Carbon sink potential - Mid - Reforest pasture	0	0	3,575
(1000 tC02e/y)			0,010
Carbon sink potential - Mid - Restore	0	0	451
productivity (1000 tC02e/y)			
Land impacted for carbon sink potential - High -	0	0	24.4
Accelerate regeneration (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	230
Avoid deforestation (over 30 years) (1000			
hectares)			F.0.4
Land impacted for carbon sink potential - High -	0	0	501
Extend rotation length (1000 hectares)	0	0	1/ 5
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)	0	0	16.5
Land impacted for carbon sink potential - High -	0	0	0
Increase retention of HWP (1000 hectares)		0	U
Land impacted for carbon sink potential - High -	0	0	343
Increase trees outside forests (1000 hectares)			0.10
Land impacted for carbon sink potential - High -	0	0	1,770
Reforest cropland (1000 hectares)			.,
Land impacted for carbon sink potential - High -	0	0	189
Reforest pasture (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	223
Restore productivity (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	3,297
Total impacted (over 30 years) (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	12.2
Accelerate regeneration (1000 hectares)			01/
Land impacted for carbon sink potential - Low -	0	0	216
Avoid deforestation (over 30 years) (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	192
Extend rotation length (1000 hectares)		0	172
Land impacted for carbon sink potential - Low -	0	0	8.26
Improve plantations (1000 hectares)			0.20
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	180
Increase trees outside forests (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	885
Reforest cropland (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	32.7
Reforest pasture (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	135
Restore productivity (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	1,662
Total impacted (over 30 years) (1000 hectares)			40.0
Land impacted for carbon sink potential - Mid -	0	0	18.3
Accelerate regeneration (1000 hectares)	0	0	000
Land impacted for carbon sink potential - Mid -	0	0	223
Avoid deforestation (over 30 years) (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	347
Extend rotation length (1000 hectares)		U	347
Land impacted for carbon sink potential - Mid -	0	0	12.4
Improve plantations (1000 hectares)		0	12.4
Land impacted for carbon sink potential - Mid -	0	0	0
Increase retention of HWP (1000 hectares)		0	U
Jaco i oconcion di rivvi (1000 libutai 60)			0.40
Land impacted for carbon sink potential - Mid -	0	0	262

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

Item	2020	2025	2050
Land impacted for carbon sink potential - Mid -	0	0	1,328
Reforest cropland (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	237
Reforest pasture (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	272
Restore productivity (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	2,699
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	198	0.196	0.189	0.157	0.102	0.002
(million 2019\$)							
Monetary damages from air pollution - Natural	0	124	61.4	29	22	13.5	6.87
Gas (million 2019\$)							
Monetary damages from air pollution -	0	408	381	291	169	78.3	32.6
Transportation (million 2019\$)							
Premature deaths from air pollution - Coal	0	22.2	0.022	0.021	0.018	0.011	0
(deaths)							
Premature deaths from air pollution - Natural	0	14	6.93	3.27	2.48	1.53	0.776
Gas (deaths)							
Premature deaths from air pollution -	0	45.8	42.9	32.7	19	8.81	3.67
Transportation (deaths)							

Table 15: E+ scenario - IMPACTS - Jobs

Item	2020	2025	2030	2035	2040	2045	2050
By economic sector - Agriculture (jobs)	859	859	862	1,542	1,069	1,011	967
By economic sector - Construction (jobs)	7,260	7,087	8,243	8,491	8,274	9,418	9,949
By economic sector - Manufacturing (jobs)	5,718	9,499	10,949	13,842	12,820	10,621	12,644
By economic sector - Mining (jobs)	6,924	5,896	4,715	3,680	2,449	1,671	1,018
By economic sector - Other (jobs)	607	589	604	795	998	1,266	1,675
By economic sector - Pipeline (jobs)	457	462	898	638	333	282	285
By economic sector - Professional (jobs)	4,807	4,808	4,519	5,658	5,807	7,081	7,424
By economic sector - Trade (jobs)	4,275	3,966	3,634	3,760	3,632	4,017	4,200
By economic sector - Utilities (jobs)	5,724	5,314	6,897	6,851	6,241	7,443	7,285
By education level - All sectors - Associates	10,710	11,362	12,518	13,637	12,731	13,228	14,164
degree or some college (jobs)							
By education level - All sectors - Bachelors	8,378	8,681	8,921	9,627	8,800	9,042	9,460
degree (jobs)							
By education level - All sectors - Doctoral degree	300	298	285	318	301	337	348
(jobs)							
By education level - All sectors - High school	15,205	16,075	17,520	19,421	17,711	17,987	19,178
diploma or less (jobs)							
By education level - All sectors - Masters or	2,038	2,063	2,078	2,254	2,080	2,213	2,296
professional degree (jobs)							
By resource sector - Biomass (jobs)	2,076	2,016	1,965	3,877	2,915	3,727	4,270
By resource sector - CO2 (jobs)	0	40.2	4,051	2,478	673	946	1,523
By resource sector - Coal (jobs)	1,461	375	0	0	0	0	0
By resource sector - Grid (jobs)	6,400	6,177	6,527	8,658	9,892	12,196	11,959
By resource sector - Natural Gas (jobs)	4,807	4,634	3,727	3,007	2,479	1,988	1,210
By resource sector - Nuclear (jobs)	650	640	630	365	0.013	0.015	0.026
By resource sector - Oil (jobs)	12,613	11,916	10,519	9,106	6,609	4,912	3,139
By resource sector - Solar (jobs)	3,534	4,543	5,079	7,264	8,239	8,410	12,458
By resource sector - Wind (jobs)	5,089	8,138	8,823	10,502	10,816	10,627	10,886
Median wages - Annual - All (\$2019 per job)	56,238	56,394	56,747	56,900	57,507	58,686	58,809
On-Site or In-Plant Training - Total jobs - 1 to 4	5,712	5,990	6,559	7,079	6,552	6,789	7,192
years (jobs)							
On-Site or In-Plant Training - Total jobs - 4 to 10	2,288	2,286	2,537	2,643	2,457	2,663	2,767
years (jobs)							
On-Site or In-Plant Training - Total jobs - None	5,944	6,281	6,694	7,399	6,834	7,049	7,535
(jobs)							

Table 15:	E+ scenario -	IMPACTS	Johs	(continued)
Table 10.	L' SCCHUITO	11'11 7010		i Continuaca.

Item	2020	2025	2030	2035	2040	2045	2050
On-Site or In-Plant Training - Total jobs - Over 10	280	296	334	362	338	356	378
years (jobs)							
On-Site or In-Plant Training - Total jobs - Up to 1	22,408	23,626	25,197	27,774	25,442	25,951	27,574
year (jobs)							
On-the-Job Training - All sectors - 1 to 4 years	7,279	7,616	8,369	8,993	8,342	8,687	9,197
_(jobs)							
On-the-Job Training - All sectors - 4 to 10 years	2,135	2,124	2,390	2,494	2,341	2,572	2,684
(jobs)							
On-the-Job Training - All sectors - None (jobs)	2,081	2,151	2,243	2,438	2,238	2,308	2,466
On-the-Job Training - All sectors - Over 10 years	354	391	426	464	427	422	459
_(jobs)							
On-the-Job Training - All sectors - Up to 1 year	24,782	26,198	27,894	30,868	28,275	28,818	30,640
(jobs)							
Related work experience - All sectors - 1 to 4	13,331	13,916	14,859	16,205	14,916	15,393	16,241
years (jobs)							
Related work experience - All sectors - 4 to 10	8,469	8,861	9,535	10,294	9,513	9,860	10,418
years (jobs)							
Related work experience - All sectors - None	5,171	5,414	5,885	6,454	5,918	6,112	6,499
(jobs)							
Related work experience - All sectors - Over 10	2,325	2,492	2,665	2,895	2,663	2,691	2,862
years (jobs)							
Related work experience - All sectors - Up to 1	7,335	7,797	8,378	9,408	8,613	8,752	9,427
year (jobs)							
Wage income - All (million \$2019)	2,060	2,170	2,345	2,575	2,394	2,512	2,673

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

Item	2020	2025	2030	2035	2040	2045	2050
Natural gas consumption - Annual (tcf)	236	240	202	162	122	76.7	53.2
Natural gas consumption - Cumulative (tcf)	0	0	0	0	0	0	4,880
Natural gas production - Annual (tcf)	201	223	211	184	155	123	95.6
Oil consumption - Annual (million bbls)	85.4	82.3	73.3	59.2	45.7	35.1	26.3
Oil consumption - Cumulative (million bbls)	0	0	0	0	0	0	1,813
Oil production - Annual (million bbls)	41.6	45	45.1	45.1	35.7	29	19.3

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	2.99	4.02	0	0	0	0
Cumulative 5-yr (billion \$2018)							
Sales of cooking units - Electric Resistance (%)	66.3	67.2	70.2	78.4	89.7	96.7	99.1
Sales of cooking units - Gas (%)	33.7	32.8	29.8	21.6	10.3	3.33	0.895
Sales of space heating units - Electric Heat Pump (%)	4.79	10.1	16.5	34.7	63.2	82.5	89.3
Sales of space heating units - Electric Resistance (%)	11.9	16.6	15.6	12.9	8.54	5.65	4.74
Sales of space heating units - Fossil (%)	5.87	10.2	9.69	7.94	5.1	3.2	2.63
Sales of space heating units - Gas (%)	77.4	63	58.2	44.5	23.1	8.65	3.34
Sales of water heating units - Electric Heat Pump (%)	0	1.62	6.21	19.5	40	53.6	58.5
Sales of water heating units - Electric Resistance (%)	27.3	42.3	42	41.2	40.3	39.8	39.7
Sales of water heating units - Gas Furnace (%)	72.7	56	51.8	39.3	19.8	6.56	1.76
Sales of water heating units - Other (%)	0.024	0.027	0.027	0.027	0.027	0.027	0.027

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	83.3	175	591	1,861	2,710
(million \$2018)							
Public EV charging plugs - DC Fast (1000 units)	0.119	0	0.298	0	1.57	0	4.39
Public EV charging plugs - L2 (1000 units)	0.786	0	7.18	0	37.9	0	106
Vehicle sales - Heavy-duty - diesel (%)	97.4	96	91.3	79.8	58.2	32.1	13.7

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

Item	2020	2025	2030	2035	2040	2045	2050
Vehicle sales - Heavy-duty - EV (%)	0.498	1.45	4.11	10.8	23.6	39.5	51
Vehicle sales - Heavy-duty - gasoline (%)	0.228	0.236	0.239	0.225	0.179	0.109	0.051
Vehicle sales - Heavy-duty - hybrid (%)	0.083	0.094	0.104	0.107	0.092	0.06	0.03
Vehicle sales - Heavy-duty - hydrogen FC (%)	0.332	0.969	2.74	7.17	15.7	26.3	34
Vehicle sales - Heavy-duty - other (%)	1.5	1.28	1.46	1.95	2.25	1.96	1.14
Vehicle sales - Light-duty - diesel (%)	1.65	2.04	2.07	1.65	1.06	0.548	0.234
Vehicle sales - Light-duty - EV (%)	1.79	4.46	11.4	25.1	47.6	71.5	87.4
Vehicle sales - Light-duty - gasoline (%)	92.1	87.9	80.3	67.6	47.1	25.4	11.2
Vehicle sales - Light-duty - hybrid (%)	4.29	5.12	5.77	5.3	4.01	2.39	1.17
Vehicle sales - Light-duty - hydrogen FC (%)	0.113	0.383	0.331	0.254	0.182	0.101	0.047
Vehicle sales - Light-duty - other (%)	0.107	0.11	0.101	0.088	0.064	0.035	0.016
Vehicle sales - Medium-duty - diesel (%)	64.8	62.2	57.7	49.4	35.6	19.6	8.37
Vehicle sales - Medium-duty - EV (%)	0.664	1.94	5.49	14.3	31.4	52.6	68
Vehicle sales - Medium-duty - gasoline (%)	33.8	34.7	34.7	31.9	24.4	14.2	6.33
Vehicle sales - Medium-duty - hybrid (%)	0.363	0.418	0.464	0.478	0.414	0.275	0.141
Vehicle sales - Medium-duty - hydrogen FC (%)	0.166	0.485	1.37	3.58	7.86	13.2	17
Vehicle sales - Medium-duty - other (%)	0.253	0.266	0.279	0.286	0.258	0.184	0.102

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

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Commercial (PJ)	110	107	104	99.9	95.2	90.4	86.3
Final energy use - Industry (PJ)	174	182	190	193	200	209	211
Final energy use - Residential (PJ)	120	114	109	103	93.6	83.1	73.8
Final energy use - Transportation (PJ)	287	270	245	226	212	195	175

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

Item	2020	2025	2030	2035	2040	2045	2050
Commercial HVAC investment in 2020s -	0	8,253	8,961	0	0	0	0
Cumulative 5-yr (million \$2018)							
Sales of cooking units - Electric Resistance (%)	44.8	49.3	53.1	63	76.9	85.5	88.5
Sales of cooking units - Gas (%)	55.2	50.7	46.9	37	23.1	14.5	11.5
Sales of space heating units - Electric Heat Pump	2.13	16	21.4	36.9	61.7	79.8	87
(%)							
Sales of space heating units - Electric Resistance	4.54	5.5	5.66	6.18	7.29	8.59	9.36
(%)							
Sales of space heating units - Fossil (%)	0	2	1.88	1.4	0.684	0.222	0.059
Sales of space heating units - Gas Furnace (%)	93.3	76.5	71.1	55.5	30.3	11.4	3.55
Sales of water heating units - Electric Heat Pump	0.677	2.54	7.44	21.6	43.5	58.2	63.4
(%)							
Sales of water heating units - Electric Resistance	5.85	7.67	9.68	15.4	24.5	30.8	33.1
(%)							
Sales of water heating units - Gas Furnace (%)	92.9	88.8	81.9	62.1	31.2	10.4	2.79
Sales of water heating units - Other (%)	0.567	0.974	0.953	0.882	0.777	0.711	0.687

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

Item	2020	2025	2030	2035	2040	2045	2050
Electricity distribution capital invested -	0	1.64	1.66	2.05	2.12	3.02	3.19
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	-696
Corn-ethanol to energy grasses (1000 tCO2e/y)			
Carbon sink potential - Aggressive deployment -	0	0	-10,263
Cropland measures (1000 tCO2e/y)			
Carbon sink potential - Aggressive deployment -	0	0	-624
Permanent conservation cover (1000 tCO2e/y)			
Carbon sink potential - Aggressive deployment -	0	0	-11,583
Total (1000 tC02e/y)			

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

Table 22. E Scenario I IEEAN S. Earla Siliks 7	igi icaitai c (c	ontinacaj	
Item	2020	2025	2050
Carbon sink potential - Moderate deployment -	0	0	-696
Corn-ethanol to energy grasses (1000 tCO2e/y)			
Carbon sink potential - Moderate deployment -	0	0	-5,387
Cropland measures (1000 tCO2e/y)			
Carbon sink potential - Moderate deployment -	0	0	-312
Permanent conservation cover (1000 tC02e/y)			
Carbon sink potential - Moderate deployment -	0	0	-6,395
Total (1000 tC02e/y)			
Land impacted for carbon sink - Aggressive	0	0	413
deployment - Corn-ethanol to energy grasses			
(1000 hectares)			
Land impacted for carbon sink - Aggressive	0	0	10,336
deployment - Cropland measures (1000			
hectares)			
Land impacted for carbon sink - Aggressive	0	0	1,047
deployment - Permanent conservation cover			
(1000 hectares)			
Land impacted for carbon sink - Aggressive	0	0	11,796
deployment - Total (1000 hectares)			
Land impacted for carbon sink - Moderate	0	0	413
deployment - Corn-ethanol to energy grasses			
(1000 hectares)			
Land impacted for carbon sink - Moderate	0	0	5,430
deployment - Cropland measures (1000			
hectares)			
Land impacted for carbon sink - Moderate	0	0	524
deployment - Permanent conservation cover			
(1000 hectares)			
Land impacted for carbon sink - Moderate	0	0	6,366
deployment - Total (1000 hectares)			•

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

0	0	149
		/
0	0	41,112
0	0	1,700
0	0	983
0	0	44.9
0	0	536
0	0	3,607
0	0	26,772
0	0	6,646
0	0	674
0	0	74.7
0	0	16,316
0	0	283
0	0	378
0	0	22.8

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

Table 23: E- scenario - PILLAR 6: Land sinks - Fo	rests (contin	ued)	
Item	2020	2025	2050
Carbon sink potential - Low - Increase retention	0	0	179
of HWP (1000 tCO2e/y)			
Carbon sink potential - Low - Increase trees	0	0	1,263
outside forests (1000 tCO2e/y)			
Carbon sink potential - Low - Reforest cropland	0	0	13,386
(1000 tC02e/y)			
Carbon sink potential - Low - Reforest pasture	0	0	503
(1000 tCO2e/y)			
Carbon sink potential - Low - Restore	0	0	227
productivity (1000 tCO2e/y)			
Carbon sink potential - Mid - Accelerate	0	0	112
regeneration (1000 tCO2e/y)			
Carbon sink potential - Mid - All (not counting	0	0	28,714
overlap) (1000 tCO2e/y)			
Carbon sink potential - Mid - Avoid deforestation	0	0	992
(1000 tC02e/y)			
Carbon sink potential - Mid - Extend rotation	0	0	680
length (1000 tCO2e/y)			
Carbon sink potential - Mid - Improve plantations	0	0	33.4
(1000 tCO2e/y)			
Carbon sink potential - Mid - Increase retention	0	0	357
of HWP (1000 tCO2e/y)			
Carbon sink potential - Mid - Increase trees	0	0	2,435
outside forests (1000 tCO2e/y)			
Carbon sink potential - Mid - Reforest cropland	0	0	20,079
(1000 tC02e/y)			
Carbon sink potential - Mid - Reforest pasture	0	0	3,575
(1000 tC02e/y)			
Carbon sink potential - Mid - Restore	0	0	451
productivity (1000 tCO2e/y)			
Land impacted for carbon sink potential - High -	0	0	24.4
Accelerate regeneration (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	230
Avoid deforestation (over 30 years) (1000			
hectares)			
Land impacted for carbon sink potential - High -	0	0	501
Extend rotation length (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	16.5
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	343
Increase trees outside forests (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	1,770
Reforest cropland (1000 hectares)			•
Land impacted for carbon sink potential - High -	0	0	189
Reforest pasture (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	223
Restore productivity (1000 hectares)		_	
Land impacted for carbon sink potential - High -	0	0	3,297
Total impacted (over 30 years) (1000 hectares)			0,271
Land impacted for carbon sink potential - Low -	0	0	12.2
Accelerate regeneration (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	216
Avoid deforestation (over 30 years) (1000			210
hectares)			
Land impacted for carbon sink potential - Low -	0	0	192
Extend rotation length (1000 hectares)		١	1/2
Land impacted for carbon sink potential - Low -	0	0	8.26
Improve plantations (1000 hectares)		0	0.20
ing. ore plantations (1000 hootal to)	 	0	0
Land impacted for carbon sink notantial - Low	11		
Land impacted for carbon sink potential - Low - Increase retention of HWP (1000 hectares)	0	0	U

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

Item	2020	2025	2050
Land impacted for carbon sink potential - Low -	0	0	180
Increase trees outside forests (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	885
Reforest cropland (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	32.7
Reforest pasture (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	135
Restore productivity (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	1,662
Total impacted (over 30 years) (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	18.3
Accelerate regeneration (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	223
Avoid deforestation (over 30 years) (1000			
hectares)			
Land impacted for carbon sink potential - Mid -	0	0	347
Extend rotation length (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	12.4
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	262
Increase trees outside forests (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	1,328
Reforest cropland (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	237
Reforest pasture (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	272
Restore productivity (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	2,699
Total impacted (over 30 years) (1000 hectares)			

Table 24: E- scenario - IMPACTS - Health

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal	0	198	0.196	0.189	0.157	0.102	0.002
(million 2019\$)							
Monetary damages from air pollution - Natural	0	122	51.1	25.4	13.5	5.34	4.06
Gas (million 2019\$)							
Monetary damages from air pollution -	0	414	419	410	371	297	205
Transportation (million 2019\$)							
Premature deaths from air pollution - Coal	0	22.2	0.022	0.021	0.018	0.011	0
(deaths)							
Premature deaths from air pollution - Natural	0	13.8	5.77	2.87	1.52	0.604	0.459
Gas (deaths)							
Premature deaths from air pollution -	0	46.6	47.1	46.1	41.7	33.4	23
Transportation (deaths)							

 ${\it Table~25: E+RE+scenario-PILLAR~1: Efficiency/Electrification-Residential}$

Item	2020	2025	2030	2035	2040	2045	2050
Residential HVAC investment in 2020s vs. REF -	0	3.01	4.04	0	0	0	0
Cumulative 5-yr (billion \$2018)							
Sales of cooking units - Electric Resistance (%)	66.4	73.6	95.5	99.8	100	100	100
Sales of cooking units - Gas (%)	33.6	26.4	4.52	0.228	0	0	0
Sales of space heating units - Electric Heat Pump	4.79	20.7	76.2	90.8	91.9	91.9	91.7
(%)							
Sales of space heating units - Electric Resistance	11.9	15	6.62	4.42	4.27	4.39	4.55
(%)							
Sales of space heating units - Fossil (%)	5.87	9.2	4.05	2.66	2.42	2.31	2.37
Sales of space heating units - Gas (%)	77.4	55.1	13.1	2.17	1.44	1.41	1.38
Sales of water heating units - Electric Heat Pump	0	9.31	49.7	59.7	60.3	60.3	60.3
(%)							

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

Item	2020	2025	2030	2035	2040	2045	2050
Sales of water heating units - Electric Resistance	27.3	41.9	39.5	39.6	39.7	39.7	39.7
(%)							
Sales of water heating units - Gas Furnace (%)	72.7	48.8	10.7	0.692	0.019	0	0
Sales of water heating units - Other (%)	0.024	0.027	0.027	0.027	0.027	0.027	0.027

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	515	1,320	2,139	3,240	3,527	3,363
Public EV charging plugs - DC Fast (1000 units)	0.119	0	0.964	0	4.24	0	6.85
Public EV charging plugs - L2 (1000 units)	0.786	0	23.3	0	102	0	165
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 (%)	1.63	1.89	1.29	0.414	0.076	0.013	0
Vehicle sales - Light-duty - EV (%)	3.63	14.3	45.1	81.3	96.3	99.3	100
Vehicle sales - Light-duty - gasoline (%)	90.4	79	50.2	17.1	3.36	0.592	0
Vehicle sales - Light-duty - hybrid (%)	4.15	4.34	3.12	1.17	0.283	0.061	0
Vehicle sales - Light-duty - hydrogen FC (%)	0.111	0.344	0.21	0.065	0.013	0.002	0
Vehicle sales - Light-duty - other (%)	0.105	0.102	0.067	0.024	0.005	0.001	0
Vehicle sales - Medium-duty - diesel (%)	64.7	59.7	42.3	14.4	2.59	0.384	0
Vehicle sales - Medium-duty - EV (%)	0.784	5.07	25.3	60.8	76.5	79.5	80
Vehicle sales - Medium-duty - gasoline (%)	33.7	33.3	25.5	9.32	1.77	0.277	0
Vehicle sales - Medium-duty - hybrid (%)	0.363	0.402	0.341	0.14	0.03	0.005	0
Vehicle sales - Medium-duty - hydrogen FC (%)	0.196	1.27	6.33	15.2	19.1	19.9	20
Vehicle sales - Medium-duty - other (%)	0.253	0.255	0.205	0.083	0.019	0.004	0

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

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Commercial (PJ)	110	107	101	92.6	85.5	81	78.6
Final energy use - Industry (PJ)	174	182	189	190	195	204	206
Final energy use - Residential (PJ)	120	113	102	86.8	74.3	66.4	62.6
Final energy use - Transportation (PJ)	286	268	235	195	160	139	131

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

Item	2020	2025	2030	2035	2040	2045	2050
Commercial HVAC investment in 2020s -	0	8,255	8,955	0	0	0	0
Cumulative 5-yr (million \$2018)							
Sales of cooking units - Electric Resistance (%)	44.8	57.1	84	89.3	89.6	89.6	89.6
Sales of cooking units - Gas (%)	55.2	42.9	16	10.7	10.4	10.4	10.4
Sales of space heating units - Electric Heat Pump	2.13	24.7	71.3	88	89.8	89.9	89.8
(%)							
Sales of space heating units - Electric Resistance	4.54	5.67	7.02	9.23	9.68	9.7	9.71
(%)							
Sales of space heating units - Fossil (%)	0	1.73	0.333	0.014	0	0	0
Sales of space heating units - Gas Furnace (%)	93.3	67.9	21.4	2.81	0.539	0.45	0.45
Sales of water heating units - Electric Heat Pump	0.677	10.7	53.8	64.7	65.3	65.3	65.3
(%)							
Sales of water heating units - Electric Resistance	5.85	10.9	28.5	33.6	34	34	34
(%)							
Sales of water heating units - Gas Furnace (%)	92.9	77.4	17	1.1	0.03	0	0
Sales of water heating units - Other (%)	0.567	0.935	0.728	0.68	0.677	0.679	0.679

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

Item	2020	2025	2030	2035	2040	2045	2050
Electricity distribution capital invested -	0	1.98	2.05	3.35	3.56	3.35	3.52
Cumulative 5-yr (billion \$2018)							

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

Item	2020	2025	2030	2035	2040	2045	2050
Capital invested - Solar PV - Base (billion \$2018)	0	0	0	0	0	0	0.093
Capital invested - Wind - Base (billion \$2018)	0	0.117	0.849	4.31	12.7	27.9	36.6

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

Item	2020	2025	2030	2035	2040	2045	2050
Solar - Base land use assumptions (GWh)	58.5	0	0	0	0	0	215
Solar - Constrained land use assumptions (GWh)	58.5	0	0	0	0	1,038	1,379
Wind - Base land use assumptions (GWh)	31,394	298	2,369	12,623	38,092	86,979	119,344
Wind - Constrained land use assumptions (GWh)	31,394	826	1,988	22,890	47,949	92,177	83,533

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

Table 62: 2 The Coonaire Tree in or Land 611116	, igi iodicai	Ü	
Item	2020	2025	2050
Carbon sink potential - Aggressive deployment -	0	0	-696
Corn-ethanol to energy grasses (1000 tCO2e/y)			
Carbon sink potential - Aggressive deployment -	0	0	-10,263
Cropland measures (1000 tCO2e/y)			
Carbon sink potential - Aggressive deployment -	0	0	-624
Permanent conservation cover (1000 tCO2e/y)			
Carbon sink potential - Aggressive deployment -	0	0	-11,583
Total (1000 tC02e/y)			
Carbon sink potential - Moderate deployment -	0	0	-696
Corn-ethanol to energy grasses (1000 tCO2e/y)			
Carbon sink potential - Moderate deployment -	0	0	-5,387
Cropland measures (1000 tC02e/y)			
Carbon sink potential - Moderate deployment -	0	0	-312
Permanent conservation cover (1000 tC02e/y)			
Carbon sink potential - Moderate deployment -	0	0	-6,395
Total (1000 tC02e/y)			
Land impacted for carbon sink - Aggressive	0	0	413
deployment - Corn-ethanol to energy grasses			
(1000 hectares)			
Land impacted for carbon sink - Aggressive	0	0	10,336
deployment - Cropland measures (1000			
hectares)			
Land impacted for carbon sink - Aggressive	0	0	1,047
deployment - Permanent conservation cover			
(1000 hectares)			
Land impacted for carbon sink - Aggressive	0	0	11,796
deployment - Total (1000 hectares)			
Land impacted for carbon sink - Moderate	0	0	413
deployment - Corn-ethanol to energy grasses			
(1000 hectares)			
Land impacted for carbon sink - Moderate	0	0	5,430
deployment - Cropland measures (1000			
hectares)			
Land impacted for carbon sink - Moderate	0	0	524
deployment - Permanent conservation cover			
(1000 hectares)			
Land impacted for carbon sink - Moderate	0	0	6,366
deployment - Total (1000 hectares)			

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

Table 33: E+RE+ scenario - PILLAR 6: Land sinks	- Forests		
Item	2020	2025	2050
Carbon sink potential - High - Accelerate	0	0	149
regeneration (1000 tCO2e/y)			
Carbon sink potential - High - All (not counting	0	0	41,112
overlap) (1000 tCO2e/y)			
Carbon sink potential - High - Avoid deforestation	0	0	1,700
(1000 tCO2e/y)			
Carbon sink potential - High - Extend rotation	0	0	983
length (1000 tC02e/y)			
Carbon sink potential - High - Improve	0	0	44.9
plantations (1000 tCO2e/y)			
Carbon sink potential - High - Increase retention	0	0	536
of HWP (1000 tC02e/y)			
Carbon sink potential - High - Increase trees	0	0	3,607
outside forests (1000 tCO2e/y)			-,
Carbon sink potential - High - Reforest cropland	0	0	26,772
(1000 tC02e/y)	Ŭ	9	20,112
Carbon sink potential - High - Reforest pasture	0	0	6,646
(1000 tCO2e/y)	o	0	0,040
Carbon sink potential - High - Restore	0	0	674
productivity (1000 tCO2e/y)	U	0	014
Carbon sink potential - Low - Accelerate	0	0	74.7
	U	U	(4.(
regeneration (1000 tC02e/y)	0	0	1/ 01/
Carbon sink potential - Low - All (not counting	0	0	16,316
overlap) (1000 tC02e/y)			000
Carbon sink potential - Low - Avoid deforestation	0	0	283
(1000 tC02e/y)		_	
Carbon sink potential - Low - Extend rotation	0	0	378
length (1000 tCO2e/y)			
Carbon sink potential - Low - Improve	0	0	22.8
plantations (1000 tCO2e/y)			
Carbon sink potential - Low - Increase retention	0	0	179
of HWP (1000 tCO2e/y)			
Carbon sink potential - Low - Increase trees	0	0	1,263
outside forests (1000 tCO2e/y)			
Carbon sink potential - Low - Reforest cropland	0	0	13,386
(1000 tC02e/y)			
Carbon sink potential - Low - Reforest pasture	0	0	503
(1000 tC02e/y)			
Carbon sink potential - Low - Restore	0	0	227
productivity (1000 tCO2e/y)			
Carbon sink potential - Mid - Accelerate	0	0	112
regeneration (1000 tCO2e/y)			
Carbon sink potential - Mid - All (not counting	0	0	28,714
overlap) (1000 tC02e/y)			
Carbon sink potential - Mid - Avoid deforestation	0	0	992
(1000 tC02e/y)			
Carbon sink potential - Mid - Extend rotation	0	0	680
length (1000 tCO2e/y)			
Carbon sink potential - Mid - Improve plantations	0	0	33.4
(1000 tCO2e/y)	Ŭ	9	00.4
Carbon sink potential - Mid - Increase retention	0	0	357
of HWP (1000 tC02e/y)	Ŭ	9	001
Carbon sink potential - Mid - Increase trees	0	0	2,435
outside forests (1000 tCO2e/y)	0	U	۷,400
Carbon sink potential - Mid - Reforest cropland	0	0	20,079
	U	U	20,017
(1000 tC02e/y)	0	0	0 575
Carbon sink potential - Mid - Reforest pasture	0	0	3,575
(1000 tC02e/y)			,
Carbon sink potential - Mid - Restore	0	0	451
productivity (1000 tC02e/y)			<u> </u>
Land impacted for carbon sink potential - High -	0	0	24.4
Accelerate regeneration (1000 hectares)	l l		

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

Table 33: E+RE+ scenario - PILLAR 6: Land sinks	•		
Item	2020	2025	2050
Land impacted for carbon sink potential - High -	0	0	230
Avoid deforestation (over 30 years) (1000			
hectares)			
Land impacted for carbon sink potential - High -	0	0	501
Extend rotation length (1000 hectares)	0	9	501
	0	0	1/ 5
Land impacted for carbon sink potential - High -	0	0	16.5
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	343
Increase trees outside forests (1000 hectares)			0.0
Land impacted for carbon sink potential - High -	0	0	1,770
	o	0	1,110
Reforest cropland (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	189
Reforest pasture (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	223
Restore productivity (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	3,297
Total impacted (over 30 years) (1000 hectares)	0	<u> </u>	0,271
	0	0	10.0
Land impacted for carbon sink potential - Low -	0	0	12.2
Accelerate regeneration (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	216
Avoid deforestation (over 30 years) (1000			
hectares)			
Land impacted for carbon sink potential - Low -	0	0	192
Extend rotation length (1000 hectares)	0	<u> </u>	172
	0	0	0.07
Land impacted for carbon sink potential - Low -	0	0	8.26
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	180
Increase trees outside forests (1000 hectares)		_	
Land impacted for carbon sink potential - Low -	0	0	885
	o	0	000
Reforest cropland (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	32.7
Reforest pasture (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	135
Restore productivity (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	1,662
Total impacted (over 30 years) (1000 hectares)			.,002
	0	0	10.0
Land impacted for carbon sink potential - Mid -	0	0	18.3
Accelerate regeneration (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	223
Avoid deforestation (over 30 years) (1000			
hectares)			
Land impacted for carbon sink potential - Mid -	0	0	347
Extend rotation length (1000 hectares)	0	<u> </u>	0-11
	0	0	10 /
Land impacted for carbon sink potential - Mid -	0	0	12.4
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	262
Increase trees outside forests (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	1,328
	U	0	1,320
Reforest cropland (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	237
Reforest pasture (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	272
Restore productivity (1000 hectares)	-	-	
Land impacted for carbon sink potential - Mid -	0	0	2,699
Total impacted (over 30 years) (1000 hectares)	U	U	2,077
	1	1	

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

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal	0	198	0.196	0.189	0.157	0.102	0.002
(million 2019\$)							
Monetary damages from air pollution - Natural	0	116	56.3	17.7	12.2	5.66	3.59
Gas (million 2019\$)							
Monetary damages from air pollution -	0	408	381	291	169	78.3	32.6
Transportation (million 2019\$)							
Premature deaths from air pollution - Coal	0	22.2	0.022	0.021	0.018	0.011	0
(deaths)							
Premature deaths from air pollution - Natural	0	13.1	6.36	2	1.38	0.639	0.405
Gas (deaths)							
Premature deaths from air pollution -	0	45.8	42.9	32.7	19	8.81	3.67
Transportation (deaths)							

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

Item	2020	2025	2030	2035	2040	2045	2050
Residential HVAC investment in 2020s vs. REF -	0	3.01	4.04	0	0	0	0
Cumulative 5-yr (billion \$2018)							
Sales of cooking units - Electric Resistance (%)	66.4	73.6	95.5	99.8	100	100	100
Sales of cooking units - Gas (%)	33.6	26.4	4.52	0.228	0	0	0
Sales of space heating units - Electric Heat Pump	4.79	20.7	76.2	90.8	91.9	91.9	91.7
(%)							
Sales of space heating units - Electric Resistance	11.9	15	6.62	4.42	4.27	4.39	4.55
(%)							
Sales of space heating units - Fossil (%)	5.87	9.2	4.05	2.66	2.42	2.31	2.37
Sales of space heating units - Gas (%)	77.4	55.1	13.1	2.17	1.44	1.41	1.38
Sales of water heating units - Electric Heat Pump	0	9.31	49.7	59.7	60.3	60.3	60.3
(%)							
Sales of water heating units - Electric Resistance	27.3	41.9	39.5	39.6	39.7	39.7	39.7
(%)							
Sales of water heating units - Gas Furnace (%)	72.7	48.8	10.7	0.692	0.019	0	0
Sales of water heating units - Other (%)	0.024	0.027	0.027	0.027	0.027	0.027	0.027

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	515	1,320	2,139	3,240	3,527	3,363
(million \$2018)							
Public EV charging plugs - DC Fast (1000 units)	0.119	0	0.964	0	4.24	0	6.85
Public EV charging plugs - L2 (1000 units)	0.786	0	23.3	0	102	0	165
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 (%)	1.63	1.89	1.29	0.414	0.076	0.013	0
Vehicle sales - Light-duty - EV (%)	3.63	14.3	45.1	81.3	96.3	99.3	100
Vehicle sales - Light-duty - gasoline (%)	90.4	79	50.2	17.1	3.36	0.592	0
Vehicle sales - Light-duty - hybrid (%)	4.15	4.34	3.12	1.17	0.283	0.061	0
Vehicle sales - Light-duty - hydrogen FC (%)	0.111	0.344	0.21	0.065	0.013	0.002	0
Vehicle sales - Light-duty - other (%)	0.105	0.102	0.067	0.024	0.005	0.001	0
Vehicle sales - Medium-duty - diesel (%)	64.7	59.7	42.3	14.4	2.59	0.384	0
Vehicle sales - Medium-duty - EV (%)	0.784	5.07	25.3	60.8	76.5	79.5	80
Vehicle sales - Medium-duty - gasoline (%)	33.7	33.3	25.5	9.32	1.77	0.277	0
Vehicle sales - Medium-duty - hybrid (%)	0.363	0.402	0.341	0.14	0.03	0.005	0
Vehicle sales - Medium-duty - hydrogen FC (%)	0.196	1.27	6.33	15.2	19.1	19.9	20
Vehicle sales - Medium-duty - other (%)	0.253	0.255	0.205	0.083	0.019	0.004	0

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

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Commercial (PJ)	110	107	101	92.6	85.5	81	78.6
Final energy use - Industry (PJ)	174	182	189	190	195	204	206
Final energy use - Residential (PJ)	120	113	102	86.8	74.3	66.4	62.6
Final energy use - Transportation (PJ)	286	268	235	195	160	139	131

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

Item	2020	2025	2030	2035	2040	2045	2050
Commercial HVAC investment in 2020s -	0	8,255	8,955	0	0	0	0
Cumulative 5-yr (million \$2018)							
Sales of cooking units - Electric Resistance (%)	44.8	57.1	84	89.3	89.6	89.6	89.6
Sales of cooking units - Gas (%)	55.2	42.9	16	10.7	10.4	10.4	10.4
Sales of space heating units - Electric Heat Pump (%)	2.13	24.7	71.3	88	89.8	89.9	89.8
Sales of space heating units - Electric Resistance	4.54	5.67	7.02	9.23	9.68	9.7	9.71
(%)	7.57	3.01	1.02	7.23	7.00	7.1	7.11
Sales of space heating units - Fossil (%)	0	1.73	0.333	0.014	0	0	0
Sales of space heating units - Gas Furnace (%)	93.3	67.9	21.4	2.81	0.539	0.45	0.45
Sales of water heating units - Electric Heat Pump (%)	0.677	10.7	53.8	64.7	65.3	65.3	65.3
Sales of water heating units - Electric Resistance (%)	5.85	10.9	28.5	33.6	34	34	34
Sales of water heating units - Gas Furnace (%)	92.9	77.4	17	1.1	0.03	0	0
Sales of water heating units - Other (%)	0.567	0.935	0.728	0.68	0.677	0.679	0.679

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

Item	2020	2025	2030	2035	2040	2045	2050
Electricity distribution capital invested -	0	1.98	2.05	3.35	3.56	3.35	3.52
Cumulative 5-yr (billion \$2018)							

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

Item	2020	2025	2030	2035	2040	2045	2050
Capital invested - Solar PV - Base (billion \$2018)	0	0	0	0	0	0	0
Capital invested - Solar PV - Constrained (billion \$2018)	0	0	0	0	0	0	0
Capital invested - Wind - Base (billion \$2018)	0	0	0	0.447	0.999	0.435	0
Capital invested - Wind - Constrained (billion \$2018)	0	0	0	0.7	1.06	0.879	0

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

Item	2020	2025	2035	2040	2045
Solar - Base land use assumptions (GWh)	58.5	0	0	0	0
Solar - Constrained land use assumptions (GWh)	58.5	0	0	0	0
Wind - Base land use assumptions (GWh)	31,394	0	1,343	3,117	1,423
Wind - Constrained land use assumptions (GWh)	31,394	0	2,076	3,243	2,823

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

Item	2020	2025	2050
Carbon sink potential - Aggressive deployment -	0	0	-696
Corn-ethanol to energy grasses (1000 tCO2e/y)			
Carbon sink potential - Aggressive deployment -	0	0	-10,263
Cropland measures (1000 tCO2e/y)			
Carbon sink potential - Aggressive deployment -	0	0	-624
Permanent conservation cover (1000 tCO2e/y)			
Carbon sink potential - Aggressive deployment -	0	0	-11,583
Total (1000 tC02e/y)			
Carbon sink potential - Moderate deployment -	0	0	-696
Corn-ethanol to energy grasses (1000 tCO2e/y)			

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

Item	2020	2025	2050
Carbon sink potential - Moderate deployment -	0	0	-5,387
Cropland measures (1000 tCO2e/y)			
Carbon sink potential - Moderate deployment -	0	0	-312
Permanent conservation cover (1000 tC02e/y)			
Carbon sink potential - Moderate deployment -	0	0	-6,395
Total (1000 tC02e/y)			
Land impacted for carbon sink - Aggressive	0	0	413
deployment - Corn-ethanol to energy grasses			
(1000 hectares)			
Land impacted for carbon sink - Aggressive	0	0	10,336
deployment - Cropland measures (1000			
hectares)			
Land impacted for carbon sink - Aggressive	0	0	1,047
deployment - Permanent conservation cover			
(1000 hectares)			
Land impacted for carbon sink - Aggressive	0	0	11,796
deployment - Total (1000 hectares)			
Land impacted for carbon sink - Moderate	0	0	413
deployment - Corn-ethanol to energy grasses			
(1000 hectares)			
Land impacted for carbon sink - Moderate	0	0	5,430
deployment - Cropland measures (1000			
hectares)			
Land impacted for carbon sink - Moderate	0	0	524
deployment - Permanent conservation cover			
(1000 hectares)			
Land impacted for carbon sink - Moderate	0	0	6,366
deployment - Total (1000 hectares)			

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

Item	2020	2025	2050
Carbon sink potential - High - Accelerate regeneration (1000 tCO2e/y)	0	0	149
Carbon sink potential - High - All (not counting overlap) (1000 tC02e/y)	0	0	41,112
Carbon sink potential - High - Avoid deforestation (1000 tCO2e/y)	0	0	1,700
Carbon sink potential - High - Extend rotation length (1000 tCO2e/y)	0	0	983
Carbon sink potential - High - Improve plantations (1000 tCO2e/y)	0	0	44.9
Carbon sink potential - High - Increase retention of HWP (1000 tCO2e/y)	0	0	536
Carbon sink potential - High - Increase trees outside forests (1000 tCO2e/y)	0	0	3,607
Carbon sink potential - High - Reforest cropland (1000 tCO2e/y)	0	0	26,772
Carbon sink potential - High - Reforest pasture (1000 tCO2e/y)	0	0	6,646
Carbon sink potential - High - Restore productivity (1000 tC02e/y)	0	0	674
Carbon sink potential - Low - Accelerate regeneration (1000 tCO2e/y)	0	0	74.7
Carbon sink potential - Low - All (not counting overlap) (1000 tCO2e/y)	0	0	16,316
Carbon sink potential - Low - Avoid deforestation (1000 tCO2e/y)	0	0	283
Carbon sink potential - Low - Extend rotation length (1000 tCO2e/y)	0	0	378
Carbon sink potential - Low - Improve plantations (1000 tCO2e/y)	0	0	22.8
Carbon sink potential - Low - Increase retention of HWP (1000 tCO2e/y)	0	0	179

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

Table 43: E+RE- scenario - PILLAR 6: Land sinks	- Forests (co	ontinued)	
Item	2020	2025	2050
Carbon sink potential - Low - Increase trees	0	0	1,263
outside forests (1000 tCO2e/y)			
Carbon sink potential - Low - Reforest cropland	0	0	13,386
(1000 tC02e/y)			,
Carbon sink potential - Low - Reforest pasture	0	0	503
(1000 tC02e/y)			
Carbon sink potential - Low - Restore	0	0	227
productivity (1000 tCO2e/y)	0	0	221
Carbon sink potential - Mid - Accelerate	0	0	112
regeneration (1000 tC02e/y)	0	0	112
Carbon sink potential - Mid - All (not counting	0	0	00.71/
	U	U	28,714
overlap) (1000 tC02e/y)	0	0	000
Carbon sink potential - Mid - Avoid deforestation	0	0	992
(1000 tC02e/y)			
Carbon sink potential - Mid - Extend rotation	0	0	680
length (1000 tC02e/y)			
Carbon sink potential - Mid - Improve plantations	0	0	33.4
(1000 tC02e/y)			
Carbon sink potential - Mid - Increase retention	0	0	357
of HWP (1000 tCO2e/y)			
Carbon sink potential - Mid - Increase trees	0	0	2,435
outside forests (1000 tCO2e/y)			
Carbon sink potential - Mid - Reforest cropland	0	0	20,079
(1000 tC02e/y)			-,-
Carbon sink potential - Mid - Reforest pasture	0	0	3,575
(1000 tCO2e/y)	ŭ	<u> </u>	0,010
Carbon sink potential - Mid - Restore	0	0	451
productivity (1000 tCO2e/y)	0	0	431
Land impacted for carbon sink potential - High -	0	0	24.4
Accelerate regeneration (1000 hectares)	U	U	24.4
Land impacted for carbon sink potential - High -	0	0	230
	0	0	230
Avoid deforestation (over 30 years) (1000			
hectares)			- F01
Land impacted for carbon sink potential - High -	0	0	501
Extend rotation length (1000 hectares)	_	_	
Land impacted for carbon sink potential - High -	0	0	16.5
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	343
Increase trees outside forests (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	1,770
Reforest cropland (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	189
Reforest pasture (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	223
Restore productivity (1000 hectares)	9	ŭ	220
Land impacted for carbon sink potential - High -	0	0	3,297
Total impacted (over 30 years) (1000 hectares)	0	0	5,271
	0	0	12.2
Land impacted for carbon sink potential - Low -	U	U	12.2
Accelerate regeneration (1000 hectares)			01/
Land impacted for carbon sink potential - Low -	0	0	216
Avoid deforestation (over 30 years) (1000			
hectares)			
Land impacted for carbon sink potential - Low -	0	0	192
Extend rotation length (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	8.26
Land impacted for carbon sink potential - Low -			
Improve plantations (1000 hectares)		_	
Improve plantations (1000 hectares)	0	0	0
Improve plantations (1000 hectares) Land impacted for carbon sink potential - Low -	0	0	U
Improve plantations (1000 hectares)	0	0	180

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

Table for Ethe deciration of Teen of Earla of the	1010000		
Item	2020	2025	2050
Land impacted for carbon sink potential - Low -	0	0	885
Reforest cropland (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	32.7
Reforest pasture (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	135
Restore productivity (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	1,662
Total impacted (over 30 years) (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	18.3
Accelerate regeneration (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	223
Avoid deforestation (over 30 years) (1000			
hectares)			
Land impacted for carbon sink potential - Mid -	0	0	347
Extend rotation length (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	12.4
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	262
Increase trees outside forests (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	1,328
Reforest cropland (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	237
Reforest pasture (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	272
Restore productivity (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	2,699
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	198	0.196	0.189	0.157	0.102	0.002
(million 2019\$)							
Monetary damages from air pollution - Natural	0	129	56.7	58.2	44.1	18.6	7.41
Gas (million 2019\$)							
Monetary damages from air pollution -	0	408	381	291	169	78.3	32.6
Transportation (million 2019\$)							
Premature deaths from air pollution - Coal	0	22.2	0.022	0.021	0.018	0.011	0
(deaths)							
Premature deaths from air pollution - Natural	0	14.6	6.4	6.57	4.98	2.1	0.837
Gas (deaths)							
Premature deaths from air pollution -	0	45.8	42.9	32.7	19	8.81	3.67
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	2.99	4.02	0	0	0	0
Cumulative 5-yr (billion \$2018)							
Sales of cooking units - Electric Resistance (%)	66.3	67.2	70.2	78.4	89.7	96.7	99.1
Sales of cooking units - Gas (%)	33.7	32.8	29.8	21.6	10.3	3.33	0.895
Sales of space heating units - Electric Heat Pump	4.79	10.1	16.5	34.7	63.2	82.5	89.3
(%)							
Sales of space heating units - Electric Resistance	11.9	16.6	15.6	12.9	8.54	5.65	4.74
(%)							
Sales of space heating units - Fossil (%)	5.87	10.2	9.69	7.94	5.1	3.2	2.63
Sales of space heating units - Gas (%)	77.4	63	58.2	44.5	23.1	8.65	3.34
Sales of water heating units - Electric Heat Pump	0	1.62	6.21	19.5	40	53.6	58.5
(%)							
Sales of water heating units - Electric Resistance	27.3	42.3	42	41.2	40.3	39.8	39.7
(%)							

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

Item	2020	2025	2030	2035	2040	2045	2050
Sales of water heating units - Gas Furnace (%)	72.7	56	51.8	39.3	19.8	6.56	1.76
Sales of water heating units - Other (%)	0.024	0.027	0.027	0.027	0.027	0.027	0.027

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	83.3	175	591	1,861	2,710
(million \$2018)							
Public EV charging plugs - DC Fast (1000 units)	0.119	0	0.298	0	1.57	0	4.39
Public EV charging plugs - L2 (1000 units)	0.786	0	7.18	0	37.9	0	106
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 (%)	1.65	2.04	2.07	1.65	1.06	0.548	0.234
Vehicle sales - Light-duty - EV (%)	1.79	4.46	11.4	25.1	47.6	71.5	87.4
Vehicle sales - Light-duty - gasoline (%)	92.1	87.9	80.3	67.6	47.1	25.4	11.2
Vehicle sales - Light-duty - hybrid (%)	4.29	5.12	5.77	5.3	4.01	2.39	1.17
Vehicle sales - Light-duty - hydrogen FC (%)	0.113	0.383	0.331	0.254	0.182	0.101	0.047
Vehicle sales - Light-duty - other (%)	0.107	0.11	0.101	0.088	0.064	0.035	0.016
Vehicle sales - Medium-duty - diesel (%)	64.8	62.2	57.7	49.4	35.6	19.6	8.37
Vehicle sales - Medium-duty - EV (%)	0.664	1.94	5.49	14.3	31.4	52.6	68
Vehicle sales - Medium-duty - gasoline (%)	33.8	34.7	34.7	31.9	24.4	14.2	6.33
Vehicle sales - Medium-duty - hybrid (%)	0.363	0.418	0.464	0.478	0.414	0.275	0.141
Vehicle sales - Medium-duty - hydrogen FC (%)	0.166	0.485	1.37	3.58	7.86	13.2	17
Vehicle sales - Medium-duty - other (%)	0.253	0.266	0.279	0.286	0.258	0.184	0.102

Table 47: E-B+ scenario - PILLAR 1: Efficiency/Electrification - Overview

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Commercial (PJ)	110	107	104	99.9	95.2	90.4	86.3
Final energy use - Industry (PJ)	174	182	190	193	200	209	211
Final energy use - Residential (PJ)	120	114	109	103	93.6	83.1	73.8
Final energy use - Transportation (PJ)	287	270	245	226	212	195	175

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

Item	2020	2025	2030	2035	2040	2045	2050
Commercial HVAC investment in 2020s -	0	8,253	8,961	0	0	0	0
Cumulative 5-yr (million \$2018)							
Sales of cooking units - Electric Resistance (%)	44.8	49.3	53.1	63	76.9	85.5	88.5
Sales of cooking units - Gas (%)	55.2	50.7	46.9	37	23.1	14.5	11.5
Sales of space heating units - Electric Heat Pump	2.13	16	21.4	36.9	61.7	79.8	87
(%)							
Sales of space heating units - Electric Resistance	4.54	5.5	5.66	6.18	7.29	8.59	9.36
(%)							
Sales of space heating units - Fossil (%)	0	2	1.88	1.4	0.684	0.222	0.059
Sales of space heating units - Gas Furnace (%)	93.3	76.5	71.1	55.5	30.3	11.4	3.55
Sales of water heating units - Electric Heat Pump	0.677	2.54	7.44	21.6	43.5	58.2	63.4
(%)							
Sales of water heating units - Electric Resistance	5.85	7.67	9.68	15.4	24.5	30.8	33.1
(%)							
Sales of water heating units - Gas Furnace (%)	92.9	88.8	81.9	62.1	31.2	10.4	2.79
Sales of water heating units - Other (%)	0.567	0.974	0.953	0.882	0.777	0.711	0.687

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

Item	2020	2025	2030	2035	2040	2045	2050
Electricity distribution capital invested -	0	1.64	1.66	2.05	2.12	3.02	3.19
Cumulative 5-yr (billion \$2018)							

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Item	2020	2025	2030	2035	2040	2045	2050
Capital invested - Biomass power plant (billion \$2018)	0	0.004	0.02	0	0	0	0
Capital invested - Biomass w/ccu allam power plant (billion \$2018)	0	0	0	0	0	0.009	0
Capital invested - Biomass w/ccu power plant (billion \$2018)	0	0	0	0	13.7	21.5	9.82

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

Item	2020	2025	2030	2035	2040	2045	2050
Biomass power plant (GWh)	0	7.3	46.3	46.3	46.3	46.3	46.3
Biomass w/ccu allam power plant (GWh)	0	0	0	0	0	8.96	8.96
Biomass w/ccu power plant (GWh)	0	0	0	0	15,353	39,484	50,500

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

•	Ο,						
Item	2020	2025	2030	2035	2040	2045	2050
Biomass purchases (million \$2018/year)	0	60	154	156	1,144	3,772	4,531
Conversion capital investment - Cumulative 5-yr	0	4.25	22.2	27.7	12,551	31,594	9,940
(million \$2018)							
Number of facilities - Allam power w ccu	0	0	0	0	0	1	1
(quantity)							
Number of facilities - Beccs hydrogen (quantity)	0	0	0	0	0	14	14
Number of facilities - Diesel (quantity)	0	0	0	1	1	1	1
Number of facilities - Diesel ccu (quantity)	0	0	0	0	0	1	1
Number of facilities - Power (quantity)	0	1	1	1	1	1	1
Number of facilities - Power ccu (quantity)	0	0	0	0	12	32	40
Number of facilities - Pyrolysis (quantity)	0	0	0	1	1	1	1
Number of facilities - Pyrolysis ccu (quantity)	0	0	0	0	0	1	2
Number of facilities - Sng (quantity)	0	1	1	1	1	1	1
Number of facilities - Sng ccu (quantity)	0	0	0	0	0	0	0

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

Item	2020	2025	2030	2035	2040	2045	2050
Annual - All (MMT)	0	0	0	0.03	18.5	57.7	69
Annual - BECCS (MMT)	0	0	0	0	15.2	54.3	65.5
Annual - Cement and lime (MMT)	0	0	0	0	3.32	3.42	3.53
Annual - NGCC (MMT)	0	0	0	0.03	0.03	0.02	0.02
Cumulative - All (MMT)	0	0	0	0.03	18.6	76.3	145
Cumulative - BECCS (MMT)	0	0	0	0	15.2	69.5	135
Cumulative - Cement and lime (MMT)	0	0	0	0	3.32	6.74	10.3
Cumulative - NGCC (MMT)	0	0	0	0.03	0.06	0.08	0.1

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

Item	2020	2025	2030	2035	2040	2045	2050
CO2 storage (MMT)	0	0	0.92	3.21	7.13	9.85	10
Injection wells (wells)	0	0	2	7	12	20	25
Resource characterization, appraisal, permitting costs (million \$2020)	0	77.2	216	278	278	278	278
Wells and facilities construction costs (million \$2020)	0	0	51.4	200	357	597	741

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

Item	2020	2025	2030	2035	2040	2045	2050
All (km)	0	0	1,055	1,478	2,751	4,720	5,048
Cumulative investment - All (million \$2018)	0	0	5,205	7,550	10,712	12,651	13,109
Cumulative investment - Spur (million \$2018)	0	0	30.8	61.8	951	2,889	3,347
Cumulative investment - Trunk (million \$2018)	0	0	5,174	7,488	9,761	9,761	9,761
Spur (km)	0	0	58.5	117	1,026	2,994	3,323
Trunk (km)	0	0	997	1,361	1,725	1,725	1,725

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

Table 56: E-B+ scenario - PILLAR 6: Land sinks			
Item	2020	2025	2050
Carbon sink potential - Aggressive deployment -	0	0	-2,596
Corn-ethanol to energy grasses (1000 tCO2e/y)			
Carbon sink potential - Aggressive deployment -	0	0	-9,241
Cropland measures (1000 tCO2e/y)			
Carbon sink potential - Aggressive deployment -	0	0	0
Cropland to woody energy crops (1000 tCO2e/y)			
Carbon sink potential - Aggressive deployment -	0	0	0
Pasture to energy crops (1000 tC02e/y)			
Carbon sink potential - Aggressive deployment -	0	0	-556
Permanent conservation cover (1000 tCO2e/y)			
Carbon sink potential - Aggressive deployment -	0	0	-12,393
Total (1000 tC02e/y)			,
Carbon sink potential - Moderate deployment -	0	0	-2,596
Corn-ethanol to energy grasses (1000 tCO2e/y)			_,070
Carbon sink potential - Moderate deployment -	0	0	-4,848
Cropland measures (1000 tC02e/y)		0	4,040
Carbon sink potential - Moderate deployment -	0	0	0
Cropland to woody energy crops (1000 tC02e/y)		0	O
Carbon sink potential - Moderate deployment -	0	0	0
Pasture to energy crops (1000 tCO2e/y)		0	U
Carbon sink potential - Moderate deployment -	0	0	-278
Permanent conservation cover (1000 tCO2e/y)	0	0	-210
	0	0	7701
Carbon sink potential - Moderate deployment -	0	U	-7,721
Total (1000 tC02e/y)	0	0	1 500
Land impacted for carbon sink - Aggressive	0	0	1,528
deployment - Corn-ethanol to energy grasses			
(1000 hectares)			00.007
Land impacted for carbon sink - Aggressive	0	0	22,937
deployment - Cropland measures (1000			
hectares)			
Land impacted for carbon sink - Aggressive	0	0	496
deployment - Cropland to woody energy crops			
(1000 hectares)		_	
Land impacted for carbon sink - Aggressive	0	0	1,272
deployment - Pasture to energy crops (1000			
hectares)			
Land impacted for carbon sink - Aggressive	0	0	931
deployment - Permanent conservation cover			
(1000 hectares)			
Land impacted for carbon sink - Aggressive	0	0	27,165
deployment - Total (1000 hectares)			
Land impacted for carbon sink - Moderate	0	0	1,528
deployment - Corn-ethanol to energy grasses			
(1000 hectares)			
Land impacted for carbon sink - Moderate	0	0	4,878
deployment - Cropland measures (1000			
hectares)			
Land impacted for carbon sink - Moderate	0	0	496
deployment - Cropland to woody energy crops			
(1000 hectares)			
Land impacted for carbon sink - Moderate	0	0	1,272
deployment - Pasture to energy crops (1000		-	,
hectares)			
Land impacted for carbon sink - Moderate	0	0	466
deployment - Permanent conservation cover		0	.00
(1000 hectares)			
Land impacted for carbon sink - Moderate	0	0	8,639
deployment - Total (1000 hectares)		0	0,007
aopio, monte Total (1000 Hootal 60)			

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

Table 57: E-B+ scenario - PILLAR 6: Land sinks -	Forests		
Item	2020	2025	2050
Carbon sink potential - High - Accelerate	0	0	149
regeneration (1000 tCO2e/y)			
Carbon sink potential - High - All (not counting	0	0	41,112
overlap) (1000 tCO2e/y)			
Carbon sink potential - High - Avoid deforestation	0	0	1,700
(1000 tCO2e/y)			
Carbon sink potential - High - Extend rotation	0	0	983
length (1000 tCO2e/y)			
Carbon sink potential - High - Improve	0	0	44.9
plantations (1000 tCO2e/y)			
Carbon sink potential - High - Increase retention	0	0	536
of HWP (1000 tCO2e/y)			
Carbon sink potential - High - Increase trees	0	0	3,607
outside forests (1000 tCO2e/y)			
Carbon sink potential - High - Reforest cropland	0	0	26,772
(1000 tCO2e/y)			
Carbon sink potential - High - Reforest pasture	0	0	6,646
(1000 tCO2e/y)			
Carbon sink potential - High - Restore	0	0	674
productivity (1000 tCO2e/y)			
Carbon sink potential - Low - Accelerate	0	0	74.7
regeneration (1000 tC02e/y)			
Carbon sink potential - Low - All (not counting	0	0	16,316
overlap) (1000 tCO2e/y)			-,
Carbon sink potential - Low - Avoid deforestation	0	0	283
(1000 tC02e/y)			
Carbon sink potential - Low - Extend rotation	0	0	378
length (1000 tC02e/y)			0.0
Carbon sink potential - Low - Improve	0	0	22.8
plantations (1000 tCO2e/y)			22.0
Carbon sink potential - Low - Increase retention	0	0	179
of HWP (1000 tCO2e/y)			
Carbon sink potential - Low - Increase trees	0	0	1,263
outside forests (1000 tCO2e/y)		•	.,200
Carbon sink potential - Low - Reforest cropland	0	0	13,386
(1000 tC02e/y)		Ŭ	10,000
Carbon sink potential - Low - Reforest pasture	0	0	503
(1000 tCO2e/y)		0	505
Carbon sink potential - Low - Restore	0	0	227
productivity (1000 tC02e/y)		0	221
Carbon sink potential - Mid - Accelerate	0	0	112
regeneration (1000 tCO2e/y)		0	112
Carbon sink potential - Mid - All (not counting	0	0	28,714
overlap) (1000 tCO2e/y)		0	20,114
Carbon sink potential - Mid - Avoid deforestation	0	0	992
(1000 tC02e/y)		0	772
Carbon sink potential - Mid - Extend rotation	0	0	680
length (1000 tC02e/y)	"	0	000
Carbon sink potential - Mid - Improve plantations	0	0	33.4
(1000 tC02e/y)	"	0	33.4
Carbon sink potential - Mid - Increase retention	0	0	357
of HWP (1000 tC02e/y)	"	0	331
	0	0	0 / 05
Carbon sink potential - Mid - Increase trees	0	0	2,435
outside forests (1000 tC02e/y)			00.070
Carbon sink potential - Mid - Reforest cropland	0	0	20,079
(1000 tC02e/y)			0 575
Carbon sink potential - Mid - Reforest pasture	0	0	3,575
(1000 tC02e/y)			,
Carbon sink potential - Mid - Restore	0	0	451
productivity (1000 tC02e/y)			
Land impacted for carbon sink potential - High -	0	0	24.4
Accelerate regeneration (1000 hectares)			

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

Table 57: E-B+ scenario - PILLAR 6: Land sinks	- Forests (coi	ntinued)	
Item	2020	2025	2050
Land impacted for carbon sink potential - High -	0	0	230
Avoid deforestation (over 30 years) (1000			
hectares)			
Land impacted for carbon sink potential - High -	0	0	501
Extend rotation length (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	16.5
Improve plantations (1000 hectares)			.5.5
Land impacted for carbon sink potential - High -	0	0	0
Increase retention of HWP (1000 hectares)		0	U
Land impacted for carbon sink potential - High -	0	0	343
Increase trees outside forests (1000 hectares)	0	0	343
	0	0	1770
Land impacted for carbon sink potential - High -	U	U	1,770
Reforest cropland (1000 hectares)			100
Land impacted for carbon sink potential - High -	0	0	189
Reforest pasture (1000 hectares)	_	_	
Land impacted for carbon sink potential - High -	0	0	223
Restore productivity (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	3,297
Total impacted (over 30 years) (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	12.2
Accelerate regeneration (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	216
Avoid deforestation (over 30 years) (1000			
hectares)			
Land impacted for carbon sink potential - Low -	0	0	192
Extend rotation length (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	8.26
Improve plantations (1000 hectares)		0	0.20
Land impacted for carbon sink potential - Low -	0	0	0
Increase retention of HWP (1000 hectares)		0	U
		0	100
Land impacted for carbon sink potential - Low -	0	0	180
Increase trees outside forests (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	885
Reforest cropland (1000 hectares)		_	
Land impacted for carbon sink potential - Low -	0	0	32.7
Reforest pasture (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	135
Restore productivity (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	1,662
Total impacted (over 30 years) (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	18.3
Accelerate regeneration (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	223
Avoid deforestation (over 30 years) (1000			
hectares)			
Land impacted for carbon sink potential - Mid -	0	0	347
Extend rotation length (1000 hectares)		0	341
Land impacted for carbon sink potential - Mid -	0	0	12.4
	U	U	12.4
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	262
Increase trees outside forests (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	1,328
Reforest cropland (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	237
Reforest pasture (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	272
Restore productivity (1000 hectares)		-	-
Land impacted for carbon sink potential - Mid -	0	0	2,699
Total impacted (over 30 years) (1000 hectares)		0	2,077
rotar impactou (over 50 years) (1000 lieutal es)			

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

Item	2020	2025	2030	2035	2040	2045	2050
Residential HVAC investment in 2020s vs. REF -	0	2.83	3.07	0	0	0	0
Cumulative 5-yr (billion \$2018)							
Sales of cooking units - Electric Resistance (%)	66	66	66	66	66	66	66
Sales of cooking units - Gas (%)	34	34	34	34	34	34	34
Sales of space heating units - Electric Heat Pump	2.8	27.6	29.1	31.3	32.6	33.7	35
(%)							
Sales of space heating units - Electric Resistance	12.4	13.9	13.6	13.3	13.1	12.1	10.6
(%)							
Sales of space heating units - Fossil (%)	6.08	6.99	7.07	7.06	6.83	6.72	6.86
Sales of space heating units - Gas (%)	78.7	51.5	50.2	48.4	47.5	47.5	47.5
Sales of water heating units - Electric Heat Pump	0	0	0	0	0	0	0
(%)							
Sales of water heating units - Electric Resistance	27.3	42.4	42.3	42.2	42.2	42.2	42.1
(%)							
Sales of water heating units - Gas Furnace (%)	72.7	57.5	57.6	57.7	57.7	57.8	57.8
Sales of water heating units - Other (%)	0.024	0.027	0.027	0.027	0.027	0.027	0.027

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 (%)	1.64	2.04	2.2	2.05	1.85	1.72	1.64
Vehicle sales - Light-duty - EV (%)	3.28	5.24	5.99	7.34	8.97	10.4	11.6
Vehicle sales - Light-duty - gasoline (%)	90.7	87.2	85.2	83.5	81.4	79.5	77.9
Vehicle sales - Light-duty - hybrid (%)	4.16	5.02	6.16	6.74	7.32	7.94	8.45
Vehicle sales - Light-duty - hydrogen FC (%)	0.111	0.38	0.351	0.313	0.311	0.312	0.323
Vehicle sales - Light-duty - other (%)	0.106	0.11	0.106	0.107	0.107	0.105	0.108
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)	110	110	109	108	107	108	111
Final energy use - Industry (PJ)	174	186	192	198	205	212	220
Final energy use - Residential (PJ)	120	113	109	106	105	106	106
Final energy use - Transportation (PJ)	286	270	247	233	233	241	250

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

Item	2020	2025	2030	2035	2040	2045	2050
Commercial HVAC investment in 2020s -	0	8,160	8,377	0	0	0	0
Cumulative 5-yr (million \$2018)							
Sales of cooking units - Electric Resistance (%)	44.8	47.8	47.9	47.8	47.9	47.9	48
Sales of cooking units - Gas (%)	55.2	52.2	52.1	52.2	52.1	52.1	52
Sales of space heating units - Electric Heat Pump	2.13	20.6	48.3	71.1	74.8	75.3	75.3
(%)							
Sales of space heating units - Electric Resistance	4.54	6.37	10.8	18.4	23.4	24.2	24.3
(%)							
Sales of space heating units - Fossil (%)	0	1.96	1.54	0.687	0.101	0.009	0
Sales of space heating units - Gas Furnace (%)	93.3	71.1	39.4	9.85	1.63	0.515	0.452
Sales of water heating units - Electric Heat Pump	0.677	0.816	0.812	0.813	0.809	0.806	0.805
(%)							

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

Item	2020	2025	2030	2035	2040	2045	2050
Sales of water heating units - Electric Resistance	5.85	6.96	6.99	6.96	6.96	6.97	6.97
(%)							
Sales of water heating units - Gas Furnace (%)	92.9	91.2	91.2	91.2	91.2	91.2	91.2
Sales of water heating units - Other (%)	0.567	0.983	0.985	0.982	0.982	0.985	0.986

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

Item	2020	2025	2030	2035	2040	2045	2050
Electricity distribution capital invested -	0	1.74	1.77	1.9	1.95	2.5	2.61
Cumulative 5-yr (billion \$2018)							

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

Table 63: REF scenario - PILLAR 6: Land sinks - F				
Item	2020	2025	2030	2050
Business-as-usual carbon sink - Natural uptake (Mt CO2e/y)	-6.75	0	0.507	0.145
Business-as-usual carbon sink - Retained in Hardwood Products (Mt CO2e/y)	-0.146	0	-0.303	-0.319
Business-as-usual carbon sink - Total (Mt CO2e/y)	-6.9	0	0.204	-0.174
Carbon sink potential - High - Accelerate regeneration (1000 tCO2e/y)	0	0	0	149
Carbon sink potential - High - All (not counting overlap) (1000 tC02e/y)	0	0	0	41,112
Carbon sink potential - High - Avoid deforestation (1000 tCO2e/y)	0	0	0	1,700
Carbon sink potential - High - Extend rotation length (1000 tC02e/y)	0	0	0	983
Carbon sink potential - High - Improve plantations (1000 tCO2e/y)	0	0	0	44.9
Carbon sink potential - High - Increase retention of HWP (1000 tC02e/y)	0	0	0	536
Carbon sink potential - High - Increase trees outside forests (1000 tCO2e/y)	0	0	0	3,607
Carbon sink potential - High - Reforest cropland (1000 tCO2e/y)	0	0	0	26,772
Carbon sink potential - High - Reforest pasture (1000 tCO2e/y)	0	0	0	6,646
Carbon sink potential - High - Restore productivity (1000 tCO2e/y)	0	0	0	674
Carbon sink potential - Low - Accelerate regeneration (1000 tCO2e/y)	0	0	0	74.7
Carbon sink potential - Low - All (not counting overlap) (1000 tCO2e/y)	0	0	0	16,316
Carbon sink potential - Low - Avoid deforestation (1000 tCO2e/y)	0	0	0	283
Carbon sink potential - Low - Extend rotation length (1000 tCO2e/y)	0	0	0	378
Carbon sink potential - Low - Improve plantations (1000 tCO2e/y)	0	0	0	22.8
Carbon sink potential - Low - Increase retention of HWP (1000 tCO2e/y)	0	0	0	179
Carbon sink potential - Low - Increase trees outside forests (1000 tCO2e/y)	0	0	0	1,263
Carbon sink potential - Low - Reforest cropland (1000 tCO2e/y)	0	0	0	13,386
Carbon sink potential - Low - Reforest pasture (1000 tCO2e/y)	0	0	0	503
Carbon sink potential - Low - Restore productivity (1000 tCO2e/y)	0	0	0	227
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO2e/y)	0	0	0	112
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO2e/y)	0	0	0	28,714

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

Table 63: REF scenario - PILLAR 6: Land sinks - I				
Item	2020	2025	2030	2050
Carbon sink potential - Mid - Avoid deforestation	0	0	0	992
(1000 tC02e/y)	0	0	0	/00
Carbon sink potential - Mid - Extend rotation	0	0	0	680
length (1000 tCO2e/y) Carbon sink potential - Mid - Improve plantations	0	0	0	33.4
	U	U	U	33.4
(1000 tC02e/y)	0	0	0	357
Carbon sink potential - Mid - Increase retention	U	U	U	357
of HWP (1000 tCO2e/y)	0	0	0	0 / 05
Carbon sink potential - Mid - Increase trees	0	0	0	2,435
outside forests (1000 tCO2e/y) Carbon sink potential - Mid - Reforest cropland	0	0	0	20,079
(1000 tCO2e/y)	U	U	U	20,079
Carbon sink potential - Mid - Reforest pasture	0	0	0	3,575
(1000 tCO2e/y)	U	U	U	3,515
Carbon sink potential - Mid - Restore	0	0	0	451
productivity (1000 tC02e/y)	U	U	U	431
Land impacted for carbon sink potential - High -	0	0	0	24.4
Accelerate regeneration (1000 hectares)	U	U	U	24.4
Land impacted for carbon sink potential - High -	0	0	0	230
Avoid deforestation (over 30 years) (1000	U	U	U	230
hectares)				
Land impacted for carbon sink potential - High -	0	0	0	501
Extend rotation length (1000 hectares)	U	U	U	301
Land impacted for carbon sink potential - High -	0	0	0	16.5
Improve plantations (1000 hectares)	U	U	U	10.5
Land impacted for carbon sink potential - High -	0	0	0	0
Increase retention of HWP (1000 hectares)	U	U	U	U
Land impacted for carbon sink potential - High -	0	0	0	343
Increase trees outside forests (1000 hectares)	U	U	U	343
Land impacted for carbon sink potential - High -	0	0	0	1,770
	U	0	U	1,770
Reforest cropland (1000 hectares) Land impacted for carbon sink potential - High -	0	0	0	189
	U	U	U	109
Reforest pasture (1000 hectares) Land impacted for carbon sink potential - High -	0	0	0	223
	U	U	U	223
Restore productivity (1000 hectares) Land impacted for carbon sink potential - High -	0	0	0	3,297
Total impacted (over 30 years) (1000 hectares)	U	U	U	3,291
Land impacted for carbon sink potential - Low -	0	0	0	12.2
Accelerate regeneration (1000 hectares)	0	U	0	12.2
Land impacted for carbon sink potential - Low -	0	0	0	216
Avoid deforestation (over 30 years) (1000	U	U	U	210
hectares)				
Land impacted for carbon sink potential - Low -	0	0	0	192
	U	U	U	192
Extend rotation length (1000 hectares)	0	0	0	0.07
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)	0	0	0	8.26
	0	0	0	0
Land impacted for carbon sink potential - Low -	0	0	0	0
Increase retention of HWP (1000 hectares)	0		0	100
Land impacted for carbon sink potential - Low -	0	0	0	180
Increase trees outside forests (1000 hectares)	0		0	005
Land impacted for carbon sink potential - Low -	0	0	0	885
Reforest cropland (1000 hectares)				
Land impacted for carbon sink potential - Low -	0	0	0	32.7
Reforest pasture (1000 hectares)				10-
Land impacted for carbon sink potential - Low -	0	0	0	135
Restore productivity (1000 hectares)	_			
Land impacted for carbon sink potential - Low -	0	0	0	1,662
Total impacted (over 30 years) (1000 hectares)				
Land impacted for carbon sink potential - Mid -	0	0	0	18.3
Accelerate regeneration (1000 hectares)				
Land impacted for carbon sink potential - Mid -	0	0	0	223
Avoid deforestation (over 30 years) (1000				
hectares)				

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

Item	2020	2025	2030	2050
Land impacted for carbon sink potential - Mid -	0	0	0	347
Extend rotation length (1000 hectares)				
Land impacted for carbon sink potential - Mid -	0	0	0	12.4
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	262
Increase trees outside forests (1000 hectares)				
Land impacted for carbon sink potential - Mid -	0	0	0	1,328
Reforest cropland (1000 hectares)				
Land impacted for carbon sink potential - Mid -	0	0	0	237
Reforest pasture (1000 hectares)				
Land impacted for carbon sink potential - Mid -	0	0	0	272
Restore productivity (1000 hectares)				
Land impacted for carbon sink potential - Mid -	0	0	0	2,699
Total impacted (over 30 years) (1000 hectares)				

Table 64: REF scenario - IMPACTS - Health

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal (million 2019\$)	0	691	347	219	173	152	148
Monetary damages from air pollution - Natural Gas (million 2019\$)	0	127	113	117	81.3	73.6	62.2
Monetary damages from air pollution - Transportation (million 2019\$)	0	414	425	437	452	465	479
Premature deaths from air pollution - Coal (deaths)	0	77.6	39	24.5	19.5	17	16.6
Premature deaths from air pollution - Natural Gas (deaths)	0	14.4	12.7	13.2	9.19	8.31	7.03
Premature deaths from air pollution - Transportation (deaths)	0	46.6	47.8	49.2	50.8	52.3	53.9