Net-Zero America - indiana 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	5.74	7.82	0	0	0	0
Cumulative 5-yr (billion \$2018)							
Sales of cooking units - Electric Resistance (%)	67.6	74.5	95.6	99.8	100	100	100
Sales of cooking units - Gas (%)	32.4	25.5	4.36	0.22	0	0	0
Sales of space heating units - Electric Heat Pump	7.14	16.5	45.4	84.9	91.7	92.1	91.9
(%)							
Sales of space heating units - Electric Resistance	18.1	24.2	17.6	8.04	6.29	6.24	6.46
(%)							
Sales of space heating units - Fossil (%)	6.08	9.3	6.1	2.21	1.58	1.53	1.49
Sales of space heating units - Gas (%)	68.7	49.9	30.9	4.83	0.406	0.132	0.133
Sales of water heating units - Electric Heat Pump	0	2.32	17.1	34.9	37.8	38	38.1
(%)							
Sales of water heating units - Electric Resistance	39.3	55.4	55.8	60.8	61.7	61.8	61.7
(%)							
Sales of water heating units - Gas Furnace (%)	60.6	42.1	26.8	4.14	0.241	0	0
Sales of water heating units - Other (%)	0.101	0.202	0.203	0.203	0.201	0.202	0.203

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

Item	2020	2025	2030	2035	2040	2045	2050
Light-duty vehicle capital costs - Cumulative 5-yr	0	1,189	3,044	4,939	7,479	8,143	7,762
(million \$2018)							
Public EV charging plugs - DC Fast (1000 units)	0.168	0	2.17	0	9.57	0	15.5
Public EV charging plugs - L2 (1000 units)	0.43	0	52.1	0	230	0	372
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 (%)	1.59	1.85	1.27	0.407	0.075	0.013	0
Vehicle sales - Light-duty - EV (%)	3.79	14.8	45.9	81.6	96.3	99.3	100
Vehicle sales - Light-duty - gasoline (%)	90.1	78.4	49.4	16.8	3.32	0.591	0
Vehicle sales - Light-duty - hybrid (%)	4.3	4.45	3.17	1.18	0.287	0.063	0
Vehicle sales - Light-duty - hydrogen FC (%)	0.111	0.342	0.206	0.064	0.013	0.002	0
Vehicle sales - Light-duty - other (%)	0.103	0.099	0.065	0.023	0.004	0.001	0
Vehicle sales - Medium-duty - diesel (%)	64.7	59.7	42.3	14.4	2.59	0.384	0
Vehicle sales - Medium-duty - EV (%)	0.784	5.07	25.3	60.8	76.5	79.5	80
Vehicle sales - Medium-duty - gasoline (%)	33.7	33.3	25.5	9.32	1.77	0.277	0
Vehicle sales - Medium-duty - hybrid (%)	0.363	0.402	0.341	0.14	0.03	0.005	0
Vehicle sales - Medium-duty - hydrogen FC (%)	0.196	1.27	6.33	15.2	19.1	19.9	20
Vehicle sales - Medium-duty - other (%)	0.253	0.255	0.205	0.083	0.019	0.004	0

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

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Commercial (PJ)	190	187	179	166	151	140	135
Final energy use - Industry (PJ)	680	692	706	721	751	767	776
Final energy use - Residential (PJ)	311	288	267	232	196	169	152
Final energy use - Transportation (PJ)	652	610	534	441	358	306	285

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

Item	2020	2025	2030	2035	2040	2045	2050
Commercial HVAC investment in 2020s -	0	19,994	21,829	0	0	0	0
Cumulative 5-yr (million \$2018)							
Sales of cooking units - Electric Resistance (%)	41	54.2	82.9	88.6	88.9	88.9	88.9
Sales of cooking units - Gas (%)	59	45.8	17.1	11.4	11.1	11.1	11.1
Sales of space heating units - Electric Heat Pump	2.05	9.66	38.6	81.8	89.2	89.7	89.7
(%)							
Sales of space heating units - Electric Resistance	6.04	3.52	5.22	9.16	9.92	9.96	9.94
(%)							
Sales of space heating units - Fossil (%)	3.02	2.32	0.438	0.019	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 (%)	88.9	84.5	55.7	9.03	0.86	0.359	0.36
Sales of water heating units - Electric Heat Pump (%)	0.622	3.21	22.6	47.9	52.2	52.5	52.5
Sales of water heating units - Electric Resistance (%)	5.71	4.94	19	42.9	47.1	47.4	47.4
Sales of water heating units - Gas Furnace (%)	93.3	91.7	58.2	8.97	0.524	0	0
Sales of water heating units - Other (%)	0.34	0.189	0.189	0.191	0.19	0.19	0.19

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

Item	2020	2025	2030	2035	2040	2045	2050
Electricity distribution capital invested -	0	4.81	4.97	8.01	8.51	7.33	7.63
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	0.006	0.021	0
plant (billion \$2018)							
Capital invested - Biomass w/ccu power plant	0	0	0	0	0	0.909	0
(billion \$2018)							
Capital invested - Solar PV - Base (billion \$2018)	0	0.952	13.2	19.6	8.1	2.03	2.42
Capital invested - Solar PV - Constrained (billion	0	1.79	15.2	20	8.27	4.43	1.1
\$2018)							
Capital invested - Wind - Base (billion \$2018)	0	0	28.7	19.6	12.6	0.095	0
Capital invested - Wind - Constrained (billion	0	0	9.95	0	0	0	7.78
\$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	6.38	27.4	27.4
Biomass w/ccu power plant (GWh)	0	0	0	0	0	1,020	1,020
Solar - Base land use assumptions (GWh)	245	1,279	19,828	31,904	13,870	3,677	4,552
Solar - Constrained land use assumptions (GWh)	36.1	3,257	31,198	30,308	12,835	3,367	1,578
Wind - Base land use assumptions (GWh)	12,511	0	69,770	47,656	30,422	219	0
Wind - Constrained land use assumptions (GWh)	12,511	0	21,947	0	0	0	9,557

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

Item	2020	2025	2030	2035	2040	2045	2050
Biomass purchases (million \$2018/year)	0	0	0	0	531	2,880	2,928
Conversion capital investment - Cumulative 5-yr (million \$2018)	0	0	0	0	7,842	34,786	704
Number of facilities - Allam power w ccu (quantity)	0	0	0	0	1	2	2
Number of facilities - Beccs hydrogen (quantity)	0	0	0	0	9	46	47
Number of facilities - Diesel (quantity)	0	0	0	0	0	0	0
Number of facilities - Diesel ccu (quantity)	0	0	0	0	1	2	2
Number of facilities - Power (quantity)	0	0	0	0	0	0	0
Number of facilities - Power ccu (quantity)	0	0	0	0	0	1	1
Number of facilities - Pyrolysis (quantity)	0	0	0	0	0	0	0
Number of facilities - Pyrolysis ccu (quantity)	0	0	0	0	1	2	2
Number of facilities - Sng (quantity)	0	0	0	0	0	0	0
Number of facilities - Sng ccu (quantity)	0	0	0	0	0	0	0

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

Item	2020	2025	2030	2035	2040	2045	2050
Annual - All (MMT)	0	0	0	1.08	11.5	59.5	60.5
Annual - BECCS (MMT)	0	0	0	0	10.1	54.7	55.6
Annual - Cement and lime (MMT)	0	0	0	0	0	3.42	3.53
Annual - NGCC (MMT)	0	0	0	1.08	1.43	1.45	1.36
Cumulative - All (MMT)	0	0	0	1.08	12.6	72.1	133
Cumulative - BECCS (MMT)	0	0	0	0	10.1	64.7	120
Cumulative - Cement and lime (MMT)	0	0	0	0	0	3.42	6.95
Cumulative - NGCC (MMT)	0	0	0	1.08	2.51	3.96	5.32

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

Item	2020	2025	2030	2035	2040	2045	2050
CO2 storage (MMT)	0	0	1.1	1.76	3.61	6.02	7.46
Injection wells (wells)	0	0	1	4	8	13	16
Resource characterization, appraisal, permitting	0	50.6	142	182	182	182	182
costs (million \$2020)							
Wells and facilities construction costs (million	0	0	33.7	131	234	391	485
\$2020)							

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

Item	2020	2025	2030	2035	2040	2045	2050
All (km)	0	0	499	758	788	2,397	2,712
Cumulative investment - All (million \$2018)	0	0	2,413	2,617	2,670	4,365	4,596
Cumulative investment - Spur (million \$2018)	0	0	57.6	249	302	1,997	2,228
Cumulative investment - Trunk (million \$2018)	0	0	2,355	2,368	2,368	2,368	2,368
Spur (km)	0	0	34.3	292	321	1,930	2,245
Trunk (km)	0	0	465	467	467	467	467

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

Table 12. L. Scenario Tillan O. Lana Sinks A	igr roureur c		
Item	2020	2025	2050
Carbon sink potential - Aggressive deployment -	0	0	-1,845
Corn-ethanol to energy grasses (1000 tCO2e/y)			
Carbon sink potential - Aggressive deployment -	0	0	-7,474
Cropland measures (1000 tCO2e/y)			
Carbon sink potential - Aggressive deployment -	0	0	-234
Permanent conservation cover (1000 tCO2e/y)			
Carbon sink potential - Aggressive deployment -	0	0	-9,552
Total (1000 tCO2e/y)			
Carbon sink potential - Moderate deployment -	0	0	-1,845
Corn-ethanol to energy grasses (1000 tCO2e/y)			
Carbon sink potential - Moderate deployment -	0	0	-3,936
Cropland measures (1000 tCO2e/y)			
Carbon sink potential - Moderate deployment -	0	0	-117
Permanent conservation cover (1000 tCO2e/y)			
Carbon sink potential - Moderate deployment -	0	0	-5,898
Total (1000 tCO2e/y)			
Land impacted for carbon sink - Aggressive	0	0	808
deployment - Corn-ethanol to energy grasses			
(1000 hectares)			
Land impacted for carbon sink - Aggressive	0	0	3,995
deployment - Cropland measures (1000			
hectares)			
Land impacted for carbon sink - Aggressive	0	0	425
deployment - Permanent conservation cover			
(1000 hectares)			
Land impacted for carbon sink - Aggressive	0	0	5,228
deployment - Total (1000 hectares)			
Land impacted for carbon sink - Moderate	0	0	808
deployment - Corn-ethanol to energy grasses			
(1000 hectares)			

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

Item	2020	2025	2050
Land impacted for carbon sink - Moderate	0	0	2,104
deployment - Cropland measures (1000			
hectares)			
Land impacted for carbon sink - Moderate	0	0	213
deployment - Permanent conservation cover			
(1000 hectares)			
Land impacted for carbon sink - Moderate	0	0	3,124
deployment - Total (1000 hectares)			

Table 13: E+ scenario - PILLAR 6: Land sinks - Foi			
Item	2020	2025	2050
Carbon sink potential - High - Accelerate regeneration (1000 tCO2e/y)	0	0	77.5
Carbon sink potential - High - All (not counting overlap) (1000 tCO2e/y)	0	0	14,566
Carbon sink potential - High - Avoid deforestation (1000 tCO2e/y)	0	0	1,952
Carbon sink potential - High - Extend rotation length (1000 tC02e/y)	0	0	2,158
Carbon sink potential - High - Improve plantations (1000 tCO2e/y)	0	0	168
Carbon sink potential - High - Increase retention of HWP (1000 tCO2e/y)	0	0	1,834
Carbon sink potential - High - Increase trees outside forests (1000 tCO2e/y)	0	0	2,006
Carbon sink potential - High - Reforest cropland (1000 tCO2e/y)	0	0	1,264
Carbon sink potential - High - Reforest pasture (1000 tCO2e/y)	0	0	3,822
Carbon sink potential - High - Restore productivity (1000 tC02e/y)	0	0	1,284
Carbon sink potential - Low - Accelerate regeneration (1000 tCO2e/y)	0	0	38.8
Carbon sink potential - Low - All (not counting overlap) (1000 tCO2e/y)	0	0	3,947
Carbon sink potential - Low - Avoid deforestation (1000 tCO2e/y)	0	0	325
Carbon sink potential - Low - Extend rotation length (1000 tC02e/y)	0	0	829
Carbon sink potential - Low - Improve plantations (1000 tCO2e/y)	0	0	85.6
Carbon sink potential - Low - Increase retention of HWP (1000 tCO2e/y)	0	0	611
Carbon sink potential - Low - Increase trees outside forests (1000 tC02e/y)	0	0	702
Carbon sink potential - Low - Reforest cropland (1000 tC02e/y)	0	0	632
Carbon sink potential - Low - Reforest pasture (1000 tCO2e/y)	0	0	290
Carbon sink potential - Low - Restore productivity (1000 tC02e/y)	0	0	433
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO2e/y)	0	0	58.2
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO2e/y)	0	0	9,255
Carbon sink potential - Mid - Avoid deforestation (1000 tCO2e/y)	0	0	1,138
Carbon sink potential - Mid - Extend rotation length (1000 tC02e/y)	0	0	1,493
Carbon sink potential - Mid - Improve plantations (1000 tC02e/y)	0	0	125
Carbon sink potential - Mid - Increase retention of HWP (1000 tC02e/y)	0	0	1,223

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

Carbon sink potential - Mid - Increase trees outside forests (1000 tCO2e/y) Carbon sink potential - Mid - Reforest cropland (1000 tCO2e/y) Carbon sink potential - Mid - Reforest cropland (1000 tCO2e/y) Carbon sink potential - Mid - Reforest pasture (1000 tCO2e/y) Carbon sink potential - Mid - Restore productivity (1000 tCO2e/y) Land impacted for carbon sink potential - High - 0 0 12.7 Accelerate regeneration (1000 hectares) Land impacted for carbon sink potential - High - 0 0 264 Avoid deforestation (over 30 years) (1000 hectares) Land impacted for carbon sink potential - High - 0 0 264 Avoid deforestation (over 30 years) (1000 hectares) Land impacted for carbon sink potential - High - 0 0 62 Improve plantations (1000 hectares) Land impacted for carbon sink potential - High - 0 0 62 Improve plantations (1000 hectares) Land impacted for carbon sink potential - High - 0 0 62 Improve plantations (1000 hectares) Land impacted for carbon sink potential - High - 1 0 0 0 191 Increase retention of HWP (1000 hectares) Land impacted for carbon sink potential - High - 1 0 0 191 Increase rese outside forests (1000 hectares) Land impacted for carbon sink potential - High - 0 0 199 Reforest cropland (1000 hectares) Land impacted for carbon sink potential - High - 0 0 83.6 Reforest cropland (1000 hectares) Land impacted for carbon sink potential - High - 0 0 20 Reforest pasture (1000 hectares) Land impacted for carbon sink potential - High - 0 0 2,2248 Total impacted for carbon sink potential - High - 0 0 426 Restore productivity (1000 hectares) Land impacted for carbon sink potential - Low - 0 0 426 Restore productivity (1000 hectares) Land impacted for carbon sink potential - Low - 0 0 0 422 Extend rotation length (1000 hectares) Land impacted for carbon sink potential - Low - 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Table 13: E+ scenario - PILLAR 6: Land sinks - F	or coto (contin	ucuj	
Dutside forests (1000 toOze/y) Carbon sink potential - Mid - Reforest cropland (1000 toOze/y) Carbon sink potential - Mid - Reforest pasture (1000 toOze/y) Carbon sink potential - Mid - Restore productivity (1000 toOze/y) Carbon sink potential - Mid - Restore productivity (1000 toOze/y) Carbon sink potential - Mid - Restore productivity (1000 toOze/y) Carbon sink potential - Mig - Restore productivity (1000 toOze/y) Carbon sink potential - Migh - Restore productivity (1000 toOze/y) Carbon sink potential - Migh - Restore productivity (1000 toOze/y) Carbon sink potential - Migh - Restore productivity (1000 tectares) Carbon sink potential - Migh - Restore prove plantations (1000 hectares) Carbon sink potential - Migh - Restore prove plantations (1000 hectares) Carbon sink potential - Migh - Carbon sink potential - Low - Carbon sink potential - Lo		2020	2025	2050
Carbon sink potential - Mid - Reforest cropland 0		0	0	1,354
(1000 tC02e/y) Carbon sink potential - Mid - Reforest pasture (1000 tC02e/y) Carbon sink potential - Mid - Restore productivity (1000 tC02e/y) Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares) Land impacted for carbon sink potential - High - Avoid deforestation (over 30 years) (1000 hectares) Land impacted for carbon sink potential - High - Restore prove plantations (1000 hectares) Land impacted for carbon sink potential - High - Restored for carbon sink potential - High - Reforest cropland (1000 hectares) Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares) Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares) Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares) Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares) Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares) Land impacted for carbon sink potential - High - Restore productivity (1000 hectares) Land impacted for carbon sink potential - Low - Restored for carbon sink potential - Low - Restore				
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Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares) Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares) Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares) Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares) Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares) Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares) Land impacted for carbon sink potential - Mid - Increase retention of HWP (1000 hectares)	·			
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Land impacted for carbon sink potential - Mid - OOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOO				7.01
Avoid deforestation (over 30 years) (1000 hectares) Land impacted for carbon sink potential - Mid - 0 761 Extend rotation length (1000 hectares) Land impacted for carbon sink potential - Mid - 0 0 46.6 Improve plantations (1000 hectares) Land impacted for carbon sink potential - Mid - 0 0 0 Increase retention of HWP (1000 hectares)		0	0	256
hectares) Land impacted for carbon sink potential - Mid - 0 0 761 Extend rotation length (1000 hectares) Land impacted for carbon sink potential - Mid - 0 0 46.6 Improve plantations (1000 hectares) Land impacted for carbon sink potential - Mid - 0 0 0 Increase retention of HWP (1000 hectares)			0	230
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Extend rotation length (1000 hectares) Land impacted for carbon sink potential - Mid - 0 46.6 Improve plantations (1000 hectares) Land impacted for carbon sink potential - Mid - 0 0 0 Increase retention of HWP (1000 hectares)		n	n	741
Land impacted for carbon sink potential - Mid - 0 46.6 Improve plantations (1000 hectares) Land impacted for carbon sink potential - Mid - 0 0 0 Increase retention of HWP (1000 hectares)		"	١ ٠	101
Improve plantations (1000 hectares) Land impacted for carbon sink potential - Mid - 0 0 0 Increase retention of HWP (1000 hectares)			0	1.7.7
Land impacted for carbon sink potential - Mid - 0 0 0 Increase retention of HWP (1000 hectares)		U	U	46.6
Increase retention of HWP (1000 hectares)		_		
		0	U	U
the and communicate of the communication of the control of the con				4/-
Land impacted for carbon sink potential - Mid - 0 0 145		U	U	145
Increase trees outside forests (1000 hectares)			1	I

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

Item	2020	2025	2050
Land impacted for carbon sink potential - Mid -	0	0	62.7
Reforest cropland (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	136
Reforest pasture (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	519
Restore productivity (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	1,936
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	828	1.01	0.998	0.872	0.634	0.056
(million 2019\$)							
Monetary damages from air pollution - Natural	0	203	153	103	88.6	48	19.9
Gas (million 2019\$)							
Monetary damages from air pollution -	0	1,813	1,690	1,283	740	339	136
Transportation (million 2019\$)							
Premature deaths from air pollution - Coal	0	92.9	0.113	0.112	0.098	0.071	0.006
(deaths)							
Premature deaths from air pollution - Natural	0	22.9	17.2	11.6	10	5.42	2.25
Gas (deaths)							
Premature deaths from air pollution -	0	204	190	144	83.2	38.1	15.3
Transportation (deaths)							

Table 15: E+ scenario - IMPACTS - Jobs

Item	2020	2025	2030	2035	2040	2045	2050
By economic sector - Agriculture (jobs)	2,021	2,024	2,048	1,949	1,792	3,432	2,767
By economic sector - Construction (jobs)	8,214	8,136	25,157	36,051	33,704	29,553	28,716
By economic sector - Manufacturing (jobs)	6,388	10,527	13,063	17,489	16,961	14,999	17,931
By economic sector - Mining (jobs)	6,383	3,873	2,301	1,595	1,045	704	486
By economic sector - Other (jobs)	515	572	3,173	5,274	4,739	4,029	4,326
By economic sector - Pipeline (jobs)	760	751	905	535	409	381	291
By economic sector - Professional (jobs)	5,374	4,717	13,008	19,560	20,564	21,999	21,593
By economic sector - Trade (jobs)	5,810	4,346	8,197	11,831	11,692	11,188	11,331
By economic sector - Utilities (jobs)	11,392	9,913	17,094	25,225	27,186	25,731	25,200
By education level - All sectors - Associates	13,989	13,562	26,706	38,008	37,704	35,117	35,463
degree or some college (jobs)							
By education level - All sectors - Bachelors	9,427	9,014	16,787	23,650	23,751	22,963	23,140
degree (jobs)							
By education level - All sectors - Doctoral degree	299	273	629	907	924	948	935
(jobs)							
By education level - All sectors - High school	20,902	19,913	36,668	51,006	49,683	47,037	47,162
diploma or less (jobs)							
By education level - All sectors - Masters or	2,242	2,096	4,156	5,938	6,031	5,950	5,942
professional degree (jobs)							
By resource sector - Biomass (jobs)	4,911	4,782	4,683	4,346	4,688	12,609	12,142
By resource sector - CO2 (jobs)	0	26.8	2,275	376	439	1,369	1,311
By resource sector - Coal (jobs)	9,662	4,776	1,153	227	191	168	148
By resource sector - Grid (jobs)	12,826	10,883	24,844	43,681	48,041	46,064	46,682
By resource sector - Natural Gas (jobs)	7,578	7,694	6,136	5,869	5,252	3,344	2,042
By resource sector - Nuclear (jobs)	0	0	0	0	0	0	0
By resource sector - Oil (jobs)	7,005	6,069	4,885	3,582	2,434	1,622	998
By resource sector - Solar (jobs)	2,177	4,858	19,592	30,562	23,628	17,533	20,963
By resource sector - Wind (jobs)	2,700	5,769	21,376	30,866	33,420	29,305	28,356
Median wages - Annual - All (\$2019 per job)	56,418	56,477	57,177	58,000	59,270	60,370	61,031
On-Site or In-Plant Training - Total jobs - 1 to 4	7,299	7,007	13,782	19,527	19,321	17,988	18,078
years (jobs)							
On-Site or In-Plant Training - Total jobs - 4 to 10	2,937	2,728	5,859	8,316	8,215	7,608	7,519
years (jobs)							
On-Site or In-Plant Training - Total jobs - None	7,273	7,125	13,838	19,505	19,290	18,426	18,533
(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	382	375	752	1,067	1,057	981	984
years (jobs)							
On-Site or In-Plant Training - Total jobs - Up to 1	28,968	27,623	50,713	71,093	70,209	67,012	67,527
year (jobs)							
On-the-Job Training - All sectors - 1 to 4 years	9,252	8,896	17,748	25,196	24,979	23,201	23,295
(jobs)							
On-the-Job Training - All sectors - 4 to 10 years	2,821	2,609	5,792	8,270	8,169	7,537	7,438
(jobs)							
On-the-Job Training - All sectors - None (jobs)	2,511	2,402	4,634	6,510	6,363	6,047	6,097
On-the-Job Training - All sectors - Over 10 years	401	426	845	1,175	1,130	1,024	1,044
(jobs)							
On-the-Job Training - All sectors - Up to 1 year	31,873	30,525	55,925	78,358	77,451	74,205	74,768
(jobs)							
Related work experience - All sectors - 1 to 4	16,798	15,860	30,032	42,402	42,159	40,127	40,307
years (jobs)							
Related work experience - All sectors - 4 to 10	10,441	10,041	19,539	27,638	27,490	25,888	26,035
years (jobs)							
Related work experience - All sectors - None	6,854	6,587	12,383	17,356	17,095	16,244	16,290
(jobs)							
Related work experience - All sectors - Over 10	2,764	2,744	5,136	7,247	7,202	6,749	6,859
years (jobs)							
Related work experience - All sectors - Up to 1	10,000	9,626	17,855	24,867	24,146	23,007	23,152
year (jobs)							
Wage income - All (million \$2019)	2,644	2,534	4,857	6,932	7,000	6,763	6,875

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

Item	2020	2025	2030	2035	2040	2045	2050
Natural gas consumption - Annual (tcf)	651	661	557	447	336	212	147
Natural gas consumption - Cumulative (tcf)	0	0	0	0	0	0	13,461
Natural gas production - Annual (tcf)	5.57	6.17	5.83	5.08	4.3	3.41	2.65
Oil consumption - Annual (million bbls)	133	125	109	84.3	61.1	42.8	28
Oil consumption - Cumulative (million bbls)	0	0	0	0	0	0	2,596
Oil production - Annual (million bbls)	2.02	2.18	2.19	2.19	1.73	1.41	0.937

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	5.71	7.71	0	0	0	0
Cumulative 5-yr (billion \$2018)							
Sales of cooking units - Electric Resistance (%)	67.5	68.3	71.3	79.1	90.1	96.8	99.1
Sales of cooking units - Gas (%)	32.5	31.7	28.7	20.9	9.94	3.21	0.863
Sales of space heating units - Electric Heat Pump (%)	7.14	13.6	16.9	27.4	49.2	73	86
Sales of space heating units - Electric Resistance (%)	18.1	24.8	24	21.6	16.2	10.6	7.72
Sales of space heating units - Fossil (%)	6.08	9.67	9.33	8.18	5.9	3.46	2.13
Sales of space heating units - Gas (%)	68.7	51.9	49.7	42.9	28.7	12.9	4.2
Sales of water heating units - Electric Heat Pump (%)	0	0.608	2.31	7.59	18.2	29.3	35.3
Sales of water heating units - Electric Resistance (%)	39.3	55.7	55.6	55.8	57.2	59.4	61
Sales of water heating units - Gas Furnace (%)	60.6	43.5	41.9	36.4	24.4	11	3.54
Sales of water heating units - Other (%)	0.101	0.202	0.203	0.204	0.204	0.204	0.204

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 (million \$2018)	0	0	192	404	1,364	4,297	6,258
Public EV charging plugs - DC Fast (1000 units)	0.168	0	0.662	0	3.54	0	9.92
Public EV charging plugs - L2 (1000 units)	0.43	0	15.9	0	85.2	0	238
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 (%)	1.6	2	2.06	1.64	1.05	0.542	0.232
Vehicle sales - Light-duty - EV (%)	1.85	4.59	11.7	25.5	48	71.8	87.5
Vehicle sales - Light-duty - gasoline (%)	91.9	87.6	79.9	67.1	46.6	25.1	11.1
Vehicle sales - Light-duty - hybrid (%)	4.46	5.27	5.93	5.42	4.08	2.42	1.18
Vehicle sales - Light-duty - hydrogen FC (%)	0.113	0.381	0.328	0.251	0.179	0.099	0.046
Vehicle sales - Light-duty - other (%)	0.105	0.108	0.098	0.086	0.062	0.034	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)	190	187	183	179	172	164	155
Final energy use - Industry (PJ)	680	693	708	728	762	777	784
Final energy use - Residential (PJ)	311	289	273	257	238	214	188
Final energy use - Transportation (PJ)	653	615	559	514	480	439	392

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

Item	2020	2025	2030	2035	2040	2045	2050
Commercial HVAC investment in 2020s -	0	19,992	21,841	0	0	0	0
Cumulative 5-yr (million \$2018)							
Sales of cooking units - Electric Resistance (%)	41	45.8	49.8	60.5	75.4	84.5	87.7
Sales of cooking units - Gas (%)	59	54.2	50.2	39.5	24.6	15.5	12.3
Sales of space heating units - Electric Heat Pump	2.05	6.96	10.3	20.9	43.5	68.9	83
(%)							
Sales of space heating units - Electric Resistance	6.04	3.45	3.62	4.3	5.98	8.09	9.31
(%)							
Sales of space heating units - Fossil (%)	3.02	2.68	2.47	1.87	0.951	0.308	0.081
Sales of space heating units - Gas Furnace (%)	88.9	86.9	83.6	72.9	49.6	22.7	7.57
Sales of water heating units - Electric Heat Pump	0.622	1.14	3.37	10.3	24.6	40.1	48.5
(%)							
Sales of water heating units - Electric Resistance	5.71	3.86	5.44	10.7	22.3	35.9	43.7
(%)							
Sales of water heating units - Gas Furnace (%)	93.3	94.8	91	78.8	52.9	23.8	7.64
Sales of water heating units - Other (%)	0.34	0.189	0.189	0.191	0.19	0.19	0.19
-							

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

Item	2020	2025	2030	2035	2040	2045	2050
Electricity distribution capital invested -	0	4.04	4.11	5.15	5.33	7.04	7.41
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	-1,845
Corn-ethanol to energy grasses (1000 tCO2e/y)			
Carbon sink potential - Aggressive deployment -	0	0	-7,474
Cropland measures (1000 tCO2e/y)			
Carbon sink potential - Aggressive deployment -	0	0	-234
Permanent conservation cover (1000 tCO2e/y)			
Carbon sink potential - Aggressive deployment -	0	0	-9,552
Total (1000 tC02e/y)			

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

Table 22. L Scenario I ILLAN S. Lana Sinks 7	iks Agriculture (continued)				
Item	2020	2025	2050		
Carbon sink potential - Moderate deployment -	0	0	-1,845		
Corn-ethanol to energy grasses (1000 tCO2e/y)					
Carbon sink potential - Moderate deployment -	0	0	-3,936		
Cropland measures (1000 tCO2e/y)					
Carbon sink potential - Moderate deployment -	0	0	-117		
Permanent conservation cover (1000 tC02e/y)					
Carbon sink potential - Moderate deployment -	0	0	-5,898		
Total (1000 tC02e/y)					
Land impacted for carbon sink - Aggressive	0	0	808		
deployment - Corn-ethanol to energy grasses					
(1000 hectares)					
Land impacted for carbon sink - Aggressive	0	0	3,995		
deployment - Cropland measures (1000					
hectares)					
Land impacted for carbon sink - Aggressive	0	0	425		
deployment - Permanent conservation cover					
(1000 hectares)					
Land impacted for carbon sink - Aggressive	0	0	5,228		
deployment - Total (1000 hectares)					
Land impacted for carbon sink - Moderate	0	0	808		
deployment - Corn-ethanol to energy grasses					
(1000 hectares)					
Land impacted for carbon sink - Moderate	0	0	2,104		
deployment - Cropland measures (1000					
hectares)					
Land impacted for carbon sink - Moderate	0	0	213		
deployment - Permanent conservation cover					
(1000 hectares)					
Land impacted for carbon sink - Moderate	0	0	3,124		
deployment - Total (1000 hectares)			•		

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

Item	2020	2025	2050
Carbon sink potential - High - Accelerate	0	0	77.5
regeneration (1000 tCO2e/y)			
Carbon sink potential - High - All (not counting	0	0	14,566
overlap) (1000 tCO2e/y)			
Carbon sink potential - High - Avoid deforestation	0	0	1,952
(1000 tCO2e/y)			
Carbon sink potential - High - Extend rotation	0	0	2,158
length (1000 tCO2e/y)			
Carbon sink potential - High - Improve	0	0	168
plantations (1000 tCO2e/y)			
Carbon sink potential - High - Increase retention	0	0	1,834
of HWP (1000 tCO2e/y)			
Carbon sink potential - High - Increase trees	0	0	2,006
outside forests (1000 tCO2e/y)			
Carbon sink potential - High - Reforest cropland	0	0	1,264
(1000 tC02e/y)			
Carbon sink potential - High - Reforest pasture	0	0	3,822
(1000 tCO2e/y)			
Carbon sink potential - High - Restore	0	0	1,284
productivity (1000 tCO2e/y)			
Carbon sink potential - Low - Accelerate	0	0	38.8
regeneration (1000 tCO2e/y)			
Carbon sink potential - Low - All (not counting	0	0	3,947
overlap) (1000 tCO2e/y)			
Carbon sink potential - Low - Avoid deforestation	0	0	325
(1000 tC02e/y)			
Carbon sink potential - Low - Extend rotation	0	0	829
length (1000 tCO2e/y)			
Carbon sink potential - Low - Improve	0	0	85.6
plantations (1000 tCO2e/y)			

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

Table 23: E- scenario - PILLAR 6: Land sinks - Fo	rests (contin	иеај	
Item	2020	2025	2050
Carbon sink potential - Low - Increase retention	0	0	611
of HWP (1000 tCO2e/y)			
Carbon sink potential - Low - Increase trees	0	0	702
outside forests (1000 tCO2e/y)			
Carbon sink potential - Low - Reforest cropland	0	0	632
(1000 tC02e/y)			
Carbon sink potential - Low - Reforest pasture	0	0	290
(1000 tCO2e/y)			
Carbon sink potential - Low - Restore	0	0	433
productivity (1000 tCO2e/y)			
Carbon sink potential - Mid - Accelerate	0	0	58.2
regeneration (1000 tCO2e/y)			
Carbon sink potential - Mid - All (not counting	0	0	9,255
overlap) (1000 tCO2e/y)			
Carbon sink potential - Mid - Avoid deforestation	0	0	1,138
(1000 tC02e/y)			
Carbon sink potential - Mid - Extend rotation	0	0	1,493
length (1000 tC02e/y)			•
Carbon sink potential - Mid - Improve plantations	0	0	125
(1000 tCO2e/y)			
Carbon sink potential - Mid - Increase retention	0	0	1,223
of HWP (1000 tCO2e/y)		9	1,220
Carbon sink potential - Mid - Increase trees	0	0	1,354
outside forests (1000 tCO2e/y)		0	1,004
Carbon sink potential - Mid - Reforest cropland	0	0	948
(1000 tC02e/y)		0	740
Carbon sink potential - Mid - Reforest pasture	0	0	2,056
(1000 tCO2e/y)		0	2,000
Carbon sink potential - Mid - Restore	0	0	858
productivity (1000 tC02e/y)	"	0	000
Land impacted for carbon sink potential - High -	0	0	12.7
	"	U	12.7
Accelerate regeneration (1000 hectares)	0	0	0//
Land impacted for carbon sink potential - High -	0	0	264
Avoid deforestation (over 30 years) (1000			
hectares)			1100
Land impacted for carbon sink potential - High -	0	0	1,100
Extend rotation length (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	62
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	191
Increase trees outside forests (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	83.6
Reforest cropland (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	109
Reforest pasture (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	426
Restore productivity (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	2,248
Total impacted (over 30 years) (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	6.34
Accelerate regeneration (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	248
Avoid deforestation (over 30 years) (1000			
hectares)			
Land impacted for carbon sink potential - Low -	0	0	422
Extend rotation length (1000 hectares)			122
Land impacted for carbon sink potential - Low -	0	0	31
Improve plantations (1000 hectares)	"	0	JI
Land impacted for carbon sink potential - Low -	0	0	0
Increase retention of HWP (1000 hectares)	"	0	J
	1	1	

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

Land impacted for carbon sink potential - Low - 100	Item	2020	2025	2050
Increase trees outside forests (1000 hectares) Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares) Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares) Land impacted for carbon sink potential - Low - O O O O O O O O O O O O O O O O O O	Land impacted for carbon sink potential - Low -	0	0	100
Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares) Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares) Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares) Land impacted for carbon sink potential - Low - OOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOO				
Reforest cropland (1000 hectares) Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares) Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares) Land impacted for carbon sink potential - Low - Total impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares) Land impacted for carbon sink potential - Mid - Total impacted for carbon sink po		0	0	41.8
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares) Land impacted for carbon sink potential - Low - OOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOO				
Reforest pasture (1000 hectares) Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares) Land impacted for carbon sink potential - Low - O O O O O O O O O O O O O O O O O O	Land impacted for carbon sink potential - Low -	0	0	18.8
Restore productivity (1000 hectares) Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares) Land impacted for carbon sink potential - Mid - OOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOO	Reforest pasture (1000 hectares)			
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares) Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares) Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares) Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares) Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares) Land impacted for carbon sink potential - Mid - Increase retention of HWP (1000 hectares) Land impacted for carbon sink potential - Mid - Increase trees outside forests (1000 hectares) Land impacted for carbon sink potential - Mid - Increase trees outside forests (1000 hectares) Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares) Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares) Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares) Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares) Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares) Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares) Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)		0	0	258
Total impacted (over 30 years) (1000 hectares) Land impacted for carbon sink potential - Mid -	Restore productivity (1000 hectares)			
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares) Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares) Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares) Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares) Land impacted for carbon sink potential - Mid - Increase retention of HWP (1000 hectares) Land impacted for carbon sink potential - Mid - Increase trees outside forests (1000 hectares) Land impacted for carbon sink potential - Mid - Increase trees outside forests (1000 hectares) Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares) Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares) Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares) Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares) Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares) Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares) Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares) Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)	Land impacted for carbon sink potential - Low -	0	0	1,125
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares) Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares) Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares) Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares) Land impacted for carbon sink potential - Mid - Increase retention of HWP (1000 hectares) Land impacted for carbon sink potential - Mid - Increase trees outside forests (1000 hectares) Land impacted for carbon sink potential - Mid - Increase trees outside forests (1000 hectares) Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares) Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares) Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares) Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares) Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares) Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares) Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares) Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)	Total impacted (over 30 years) (1000 hectares)			
Land impacted for carbon sink potential - Mid -		0	0	9.51
Avoid deforestation (over 30 years) (1000 hectares) Land impacted for carbon sink potential - Mid -	Accelerate regeneration (1000 hectares)			
hectares) Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares) Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares) Land impacted for carbon sink potential - Mid - Increase retention of HWP (1000 hectares) Land impacted for carbon sink potential - Mid - Increase trees outside forests (1000 hectares) Land impacted for carbon sink potential - Mid - Increase trees outside forests (1000 hectares) Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares) Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares) Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares) Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares) Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares) Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)	Land impacted for carbon sink potential - Mid -	0	0	256
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares) Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares) Land impacted for carbon sink potential - Mid - Increase retention of HWP (1000 hectares) Land impacted for carbon sink potential - Mid - Increase trees outside forests (1000 hectares) Land impacted for carbon sink potential - Mid - Increase trees outside forests (1000 hectares) Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares) Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares) Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares) Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares) Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares) Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)	Avoid deforestation (over 30 years) (1000			
Extend rotation length (1000 hectares) Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares) Land impacted for carbon sink potential - Mid - Increase retention of HWP (1000 hectares) Land impacted for carbon sink potential - Mid - Increase trees outside forests (1000 hectares) Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares) Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares) Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares) Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares) Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares) Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)	hectares)			
Land impacted for carbon sink potential - Mid -	Land impacted for carbon sink potential - Mid -	0	0	761
Improve plantations (1000 hectares) Land impacted for carbon sink potential - Mid -	Extend rotation length (1000 hectares)			
Land impacted for carbon sink potential - Mid -	Land impacted for carbon sink potential - Mid -	0	0	46.6
Increase retention of HWP (1000 hectares) Land impacted for carbon sink potential - Mid -	Improve plantations (1000 hectares)			
Land impacted for carbon sink potential - Mid -	Land impacted for carbon sink potential - Mid -	0	0	0
Increase trees outside forests (1000 hectares) Land impacted for carbon sink potential - Mid -	Increase retention of HWP (1000 hectares)			
Land impacted for carbon sink potential - Mid -	Land impacted for carbon sink potential - Mid -	0	0	145
Reforest cropland (1000 hectares) Land impacted for carbon sink potential - Mid - 0 0 136 Reforest pasture (1000 hectares) Land impacted for carbon sink potential - Mid - 0 0 519 Restore productivity (1000 hectares) Land impacted for carbon sink potential - Mid - 0 0 1,936	Increase trees outside forests (1000 hectares)			
Land impacted for carbon sink potential - Mid - 0 0 136 Reforest pasture (1000 hectares) Land impacted for carbon sink potential - Mid - 0 0 519 Restore productivity (1000 hectares) Land impacted for carbon sink potential - Mid - 0 0 1,936	Land impacted for carbon sink potential - Mid -	0	0	62.7
Reforest pasture (1000 hectares) Land impacted for carbon sink potential - Mid - 0 0 519 Restore productivity (1000 hectares) Land impacted for carbon sink potential - Mid - 0 0 1,936	Reforest cropland (1000 hectares)			
Land impacted for carbon sink potential - Mid - 0 0 519 Restore productivity (1000 hectares) Land impacted for carbon sink potential - Mid - 0 0 1,936	Land impacted for carbon sink potential - Mid -	0	0	136
Restore productivity (1000 hectares) Land impacted for carbon sink potential - Mid - 0 0 1,936	Reforest pasture (1000 hectares)			
Land impacted for carbon sink potential - Mid - 0 0 1,936	Land impacted for carbon sink potential - Mid -	0	0	519
	Restore productivity (1000 hectares)			
Total impacted (over 30 years) (1000 hectares)	Land impacted for carbon sink potential - Mid -	0	0	1,936
	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	828	1.01	0.998	0.872	0.634	0.056
(million 2019\$)							
Monetary damages from air pollution - Natural	0	213	138	58.5	27	9.16	6.15
Gas (million 2019\$)							
Monetary damages from air pollution -	0	1,843	1,859	1,807	1,625	1,292	887
Transportation (million 2019\$)							
Premature deaths from air pollution - Coal	0	92.9	0.113	0.112	0.098	0.071	0.006
(deaths)							
Premature deaths from air pollution - Natural	0	24.1	15.6	6.61	3.05	1.03	0.695
Gas (deaths)							
Premature deaths from air pollution -	0	207	209	203	183	145	99.7
Transportation (deaths)							

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

Item	2020	2025	2030	2035	2040	2045	2050
Residential HVAC investment in 2020s vs. REF -	0	5.74	7.82	0	0	0	0
Cumulative 5-yr (billion \$2018)							
Sales of cooking units - Electric Resistance (%)	67.6	74.5	95.6	99.8	100	100	100
Sales of cooking units - Gas (%)	32.4	25.5	4.36	0.22	0	0	0
Sales of space heating units - Electric Heat Pump	7.14	16.5	45.4	84.9	91.7	92.1	91.9
(%)							
Sales of space heating units - Electric Resistance	18.1	24.2	17.6	8.04	6.29	6.24	6.46
(%)							
Sales of space heating units - Fossil (%)	6.08	9.3	6.1	2.21	1.58	1.53	1.49
Sales of space heating units - Gas (%)	68.7	49.9	30.9	4.83	0.406	0.132	0.133
Sales of water heating units - Electric Heat Pump	0	2.32	17.1	34.9	37.8	38	38.1
(%)							

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	39.3	55.4	55.8	60.8	61.7	61.8	61.7
(%)							
Sales of water heating units - Gas Furnace (%)	60.6	42.1	26.8	4.14	0.241	0	0
Sales of water heating units - Other (%)	0.101	0.202	0.203	0.203	0.201	0.202	0.203

Table 26: E+RE+ scenario - PILLAR 1: Efficiency/Electrification - Transportation

Item	2020	2025	2030	2035	2040	2045	2050
Light-duty vehicle capital costs - Cumulative 5-yr	0	1,189	3,044	4,939	7,479	8,143	7,762
(million \$2018)							
Public EV charging plugs - DC Fast (1000 units)	0.168	0	2.17	0	9.57	0	15.5
Public EV charging plugs - L2 (1000 units)	0.43	0	52.1	0	230	0	372
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 (%)	1.59	1.85	1.27	0.407	0.075	0.013	0
Vehicle sales - Light-duty - EV (%)	3.79	14.8	45.9	81.6	96.3	99.3	100
Vehicle sales - Light-duty - gasoline (%)	90.1	78.4	49.4	16.8	3.32	0.591	0
Vehicle sales - Light-duty - hybrid (%)	4.3	4.45	3.17	1.18	0.287	0.063	0
Vehicle sales - Light-duty - hydrogen FC (%)	0.111	0.342	0.206	0.064	0.013	0.002	0
Vehicle sales - Light-duty - other (%)	0.103	0.099	0.065	0.023	0.004	0.001	0
Vehicle sales - Medium-duty - diesel (%)	64.7	59.7	42.3	14.4	2.59	0.384	0
Vehicle sales - Medium-duty - EV (%)	0.784	5.07	25.3	60.8	76.5	79.5	80
Vehicle sales - Medium-duty - gasoline (%)	33.7	33.3	25.5	9.32	1.77	0.277	0
Vehicle sales - Medium-duty - hybrid (%)	0.363	0.402	0.341	0.14	0.03	0.005	0
Vehicle sales - Medium-duty - hydrogen FC (%)	0.196	1.27	6.33	15.2	19.1	19.9	20
Vehicle sales - Medium-duty - other (%)	0.253	0.255	0.205	0.083	0.019	0.004	0

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

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Commercial (PJ)	190	187	179	166	151	140	135
Final energy use - Industry (PJ)	680	692	706	721	751	767	776
Final energy use - Residential (PJ)	311	288	267	232	196	169	152
Final energy use - Transportation (PJ)	652	610	534	441	358	306	285

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

Item	2020	2025	2030	2035	2040	2045	2050
Commercial HVAC investment in 2020s -	0	19,994	21,829	0	0	0	0
Cumulative 5-yr (million \$2018)							
Sales of cooking units - Electric Resistance (%)	41	54.2	82.9	88.6	88.9	88.9	88.9
Sales of cooking units - Gas (%)	59	45.8	17.1	11.4	11.1	11.1	11.1
Sales of space heating units - Electric Heat Pump	2.05	9.66	38.6	81.8	89.2	89.7	89.7
(%)							
Sales of space heating units - Electric Resistance	6.04	3.52	5.22	9.16	9.92	9.96	9.94
(%)							
Sales of space heating units - Fossil (%)	3.02	2.32	0.438	0.019	0	0	0
Sales of space heating units - Gas Furnace (%)	88.9	84.5	55.7	9.03	0.86	0.359	0.36
Sales of water heating units - Electric Heat Pump	0.622	3.21	22.6	47.9	52.2	52.5	52.5
(%)							
Sales of water heating units - Electric Resistance	5.71	4.94	19	42.9	47.1	47.4	47.4
(%)							
Sales of water heating units - Gas Furnace (%)	93.3	91.7	58.2	8.97	0.524	0	0
Sales of water heating units - Other (%)	0.34	0.189	0.189	0.191	0.19	0.19	0.19

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

Item	2020	2025	2030	2035	2040	2045	2050
Electricity distribution capital invested -	0	4.81	4.97	8.01	8.51	7.33	7.63
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	6.9	19.5	15.4	2.85	5.57	54.9
Capital invested - Wind - Base (billion \$2018)	0	0	36.8	24.1	1.13	0	0

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

Item	2020	2025	2030	2035	2040	2045	2050
Solar - Base land use assumptions (GWh)	245	9,278	29,360	25,060	4,791	9,692	106,429
Solar - Constrained land use assumptions (GWh)	245	11,719	16,065	11,874	4,989	3,681	140,455
Wind - Base land use assumptions (GWh)	12,511	0	88,473	57,025	2,570	0	0
Wind - Constrained land use assumptions (GWh)	12,511	0	21,947	0	0	0	143,283

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

Table 32. LTRLT Scenario - FILLAN O. Lana Sinks	•		
Item	2020	2025	2050
Carbon sink potential - Aggressive deployment -	0	0	-1,845
Corn-ethanol to energy grasses (1000 tCO2e/y)			
Carbon sink potential - Aggressive deployment -	0	0	-7,474
Cropland measures (1000 tCO2e/y)			
Carbon sink potential - Aggressive deployment -	0	0	-234
Permanent conservation cover (1000 tC02e/y)			
Carbon sink potential - Aggressive deployment -	0	0	-9,552
Total (1000 tC02e/y)			
Carbon sink potential - Moderate deployment -	0	0	-1,845
Corn-ethanol to energy grasses (1000 tCO2e/y)			
Carbon sink potential - Moderate deployment -	0	0	-3,936
Cropland measures (1000 tCO2e/y)			
Carbon sink potential - Moderate deployment -	0	0	-117
Permanent conservation cover (1000 tCO2e/y)			
Carbon sink potential - Moderate deployment -	0	0	-5,898
Total (1000 tCO2e/y)			
Land impacted for carbon sink - Aggressive	0	0	808
deployment - Corn-ethanol to energy grasses			
(1000 hectares)			
Land impacted for carbon sink - Aggressive	0	0	3,995
deployment - Cropland measures (1000			
hectares)			
Land impacted for carbon sink - Aggressive	0	0	425
deployment - Permanent conservation cover			
(1000 hectares)			
Land impacted for carbon sink - Aggressive	0	0	5,228
deployment - Total (1000 hectares)			
Land impacted for carbon sink - Moderate	0	0	808
deployment - Corn-ethanol to energy grasses			
(1000 hectares)			
Land impacted for carbon sink - Moderate	0	0	2,104
deployment - Cropland measures (1000			
hectares)			
Land impacted for carbon sink - Moderate	0	0	213
deployment - Permanent conservation cover			
(1000 hectares)			
Land impacted for carbon sink - Moderate	0	0	3,124
deployment - Total (1000 hectares)			

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

2020	2025	2050
0		
	0	77.5
0	0	14,566
		,
0	0	1,952
	-	.,
0	0	2,158
	•	2,100
0	n	168
0	0	100
0	0	1,834
0	١	1,034
0	0	2,006
U	0	2,006
	0	10//
U	U	1,264
		0.000
U	0	3,822
_		
0	0	1,284
0	0	38.8
0	0	3,947
0	0	325
0	0	829
	-	
n	n	85.6
0	0	00.0
0	0	611
0	0	011
0	0	702
U	0	102
0	0	/00
U	U	632
0	0	290
0	0	433
0	0	58.2
0	0	9,255
0	0	1,138
		,
0	0	1,493
		1, 170
0	n	125
0	0	120
0	0	1,223
0	١	1,223
	0	105/
U	U	1,354
0	0	948
0	0	2,056
	0	858
0	0	
0	0	
0	0	12.7

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

Table 33: E+RE+ scenario - PILLAR 6: Land sinks	•	ontinueuj	
Item	2020	2025	2050
Land impacted for carbon sink potential - High -	0	0	264
Avoid deforestation (over 30 years) (1000			
hectares)			
Land impacted for carbon sink potential - High -	0	0	1,100
Extend rotation length (1000 hectares)	0	0	1,100
= ,	0		
Land impacted for carbon sink potential - High -	0	0	62
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	191
Increase trees outside forests (1000 hectares)			.,.
Land impacted for carbon sink potential - High -	0	0	83.6
	0	0	03.0
Reforest cropland (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	109
Reforest pasture (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	426
Restore productivity (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	2,248
Total impacted (over 30 years) (1000 hectares)	0	·	2,240
	0	0	/ 0/
Land impacted for carbon sink potential - Low -	0	0	6.34
Accelerate regeneration (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	248
Avoid deforestation (over 30 years) (1000			
hectares)			
Land impacted for carbon sink potential - Low -	0	0	422
Extend rotation length (1000 hectares)	0	<u> </u>	722
	0	0	01
Land impacted for carbon sink potential - Low -	0	0	31
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	100
Increase trees outside forests (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	41.8
·	0	0	41.0
Reforest cropland (1000 hectares)			10.0
Land impacted for carbon sink potential - Low -	0	0	18.8
Reforest pasture (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	258
Restore productivity (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	1,125
Total impacted (over 30 years) (1000 hectares)			.,0
Land impacted for carbon sink potential - Mid -	0	0	9.51
	U	U	9.51
Accelerate regeneration (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	256
Avoid deforestation (over 30 years) (1000			
hectares)			
Land impacted for carbon sink potential - Mid -	0	0	761
Extend rotation length (1000 hectares)			
	0	0	46.6
Land impacted for carbon sink potential - Mid -	U	U	46.6
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	145
Increase trees outside forests (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	62.7
	0	0	02.1
Reforest cropland (1000 hectares)		_	
Land impacted for carbon sink potential - Mid -	0	0	136
Reforest pasture (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	519
Restore productivity (1000 hectares)		-	-
Land impacted for carbon sink potential - Mid -	0	0	1,936
Total impacted (over 30 years) (1000 hectares)	o	١ ٠	1,700
rotai impacted tover 30 years) (1000 nectares)			

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

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal	0	828	1.01	0.998	0.872	0.634	0.056
(million 2019\$)							
Monetary damages from air pollution - Natural	0	209	143	83.1	57.1	19.7	5.12
Gas (million 2019\$)							
Monetary damages from air pollution -	0	1,813	1,690	1,283	740	339	136
Transportation (million 2019\$)							
Premature deaths from air pollution - Coal	0	92.9	0.113	0.112	0.098	0.071	0.006
(deaths)							
Premature deaths from air pollution - Natural	0	23.7	16.1	9.39	6.45	2.23	0.578
Gas (deaths)							
Premature deaths from air pollution -	0	204	190	144	83.2	38.1	15.3
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	5.74	7.82	0	0	0	0
Cumulative 5-yr (billion \$2018)							
Sales of cooking units - Electric Resistance (%)	67.6	74.5	95.6	99.8	100	100	100
Sales of cooking units - Gas (%)	32.4	25.5	4.36	0.22	0	0	0
Sales of space heating units - Electric Heat Pump	7.14	16.5	45.4	84.9	91.7	92.1	91.9
(%)							
Sales of space heating units - Electric Resistance	18.1	24.2	17.6	8.04	6.29	6.24	6.46
(%)							
Sales of space heating units - Fossil (%)	6.08	9.3	6.1	2.21	1.58	1.53	1.49
Sales of space heating units - Gas (%)	68.7	49.9	30.9	4.83	0.406	0.132	0.133
Sales of water heating units - Electric Heat Pump	0	2.32	17.1	34.9	37.8	38	38.1
(%)							
Sales of water heating units - Electric Resistance	39.3	55.4	55.8	60.8	61.7	61.8	61.7
(%)							
Sales of water heating units - Gas Furnace (%)	60.6	42.1	26.8	4.14	0.241	0	0
Sales of water heating units - Other (%)	0.101	0.202	0.203	0.203	0.201	0.202	0.203

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

Item	2020	2025	2030	2035	2040	2045	2050
Light-duty vehicle capital costs - Cumulative 5-yr	0	1,189	3,044	4,939	7,479	8,143	7,762
(million \$2018)							
Public EV charging plugs - DC Fast (1000 units)	0.168	0	2.17	0	9.57	0	15.5
Public EV charging plugs - L2 (1000 units)	0.43	0	52.1	0	230	0	372
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 (%)	1.59	1.85	1.27	0.407	0.075	0.013	0
Vehicle sales - Light-duty - EV (%)	3.79	14.8	45.9	81.6	96.3	99.3	100
Vehicle sales - Light-duty - gasoline (%)	90.1	78.4	49.4	16.8	3.32	0.591	0
Vehicle sales - Light-duty - hybrid (%)	4.3	4.45	3.17	1.18	0.287	0.063	0
Vehicle sales - Light-duty - hydrogen FC (%)	0.111	0.342	0.206	0.064	0.013	0.002	0
Vehicle sales - Light-duty - other (%)	0.103	0.099	0.065	0.023	0.004	0.001	0
Vehicle sales - Medium-duty - diesel (%)	64.7	59.7	42.3	14.4	2.59	0.384	0
Vehicle sales - Medium-duty - EV (%)	0.784	5.07	25.3	60.8	76.5	79.5	80
Vehicle sales - Medium-duty - gasoline (%)	33.7	33.3	25.5	9.32	1.77	0.277	0
Vehicle sales - Medium-duty - hybrid (%)	0.363	0.402	0.341	0.14	0.03	0.005	0
Vehicle sales - Medium-duty - hydrogen FC (%)	0.196	1.27	6.33	15.2	19.1	19.9	20
Vehicle sales - Medium-duty - other (%)	0.253	0.255	0.205	0.083	0.019	0.004	0

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

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Commercial (PJ)	190	187	179	166	151	140	135
Final energy use - Industry (PJ)	680	692	706	721	751	767	776
Final energy use - Residential (PJ)	311	288	267	232	196	169	152
Final energy use - Transportation (PJ)	652	610	534	441	358	306	285

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

Item	2020	2025	2030	2035	2040	2045	2050
Commercial HVAC investment in 2020s -	0	19,994	21,829	0	0	0	0
Cumulative 5-yr (million \$2018)							
Sales of cooking units - Electric Resistance (%)	41	54.2	82.9	88.6	88.9	88.9	88.9
Sales of cooking units - Gas (%)	59	45.8	17.1	11.4	11.1	11.1	11.1
Sales of space heating units - Electric Heat Pump	2.05	9.66	38.6	81.8	89.2	89.7	89.7
(%)							
Sales of space heating units - Electric Resistance	6.04	3.52	5.22	9.16	9.92	9.96	9.94
(%)							
Sales of space heating units - Fossil (%)	3.02	2.32	0.438	0.019	0	0	0
Sales of space heating units - Gas Furnace (%)	88.9	84.5	55.7	9.03	0.86	0.359	0.36
Sales of water heating units - Electric Heat Pump	0.622	3.21	22.6	47.9	52.2	52.5	52.5
(%)							
Sales of water heating units - Electric Resistance	5.71	4.94	19	42.9	47.1	47.4	47.4
(%)							
Sales of water heating units - Gas Furnace (%)	93.3	91.7	58.2	8.97	0.524	0	0
Sales of water heating units - Other (%)	0.34	0.189	0.189	0.191	0.19	0.19	0.19

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

Item	2020	2025	2030	2035	2040	2045	2050
Electricity distribution capital invested -	0	4.81	4.97	8.01	8.51	7.33	7.63
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	2.53	5.35	4.05	2.84	0.454
Capital invested - Solar PV - Constrained (billion \$2018)	0	0	3.23	5.34	3.48	4.56	0.08
Capital invested - Wind - Base (billion \$2018)	0	0.955	10.4	0	2.02	0.645	0.849
Capital invested - Wind - Constrained (billion \$2018)	0	0	2.48	0	1.74	0.35	0.394

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

Item	2020	2025	2030	2035	2040	2045	2050
Solar - Base land use assumptions (GWh)	245	0	3,769	8,731	7,022	5,183	870
Solar - Constrained land use assumptions (GWh)	245	0	4,836	8,692	6,008	8,353	155
Wind - Base land use assumptions (GWh)	12,511	2,180	25,818	0	5,506	1,848	2,559
Wind - Constrained land use assumptions (GWh)	12,511	0	5,689	0	4,401	937	1,089

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

Item	2020	2025	2050
Carbon sink potential - Aggressive deployment -	0	0	-1,845
Corn-ethanol to energy grasses (1000 tCO2e/y)			
Carbon sink potential - Aggressive deployment -	0	0	-7,474
Cropland measures (1000 tCO2e/y)			
Carbon sink potential - Aggressive deployment -	0	0	-234
Permanent conservation cover (1000 tCO2e/y)			
Carbon sink potential - Aggressive deployment -	0	0	-9,552
Total (1000 tC02e/y)			
Carbon sink potential - Moderate deployment -	0	0	-1,845
Corn-ethanol to energy grasses (1000 tCO2e/y)			

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

Table 42. LTNE Scenario Tillar O. Lana Sinks	rigilicalta	i e (continu	Juj
Item	2020	2025	2050
Carbon sink potential - Moderate deployment -	0	0	-3,936
Cropland measures (1000 tCO2e/y)			
Carbon sink potential - Moderate deployment -	0	0	-117
Permanent conservation cover (1000 tCO2e/y)			
Carbon sink potential - Moderate deployment -	0	0	-5,898
Total (1000 tC02e/y)			
Land impacted for carbon sink - Aggressive	0	0	808
deployment - Corn-ethanol to energy grasses			
(1000 hectares)			
Land impacted for carbon sink - Aggressive	0	0	3,995
deployment - Cropland measures (1000			
hectares)			
Land impacted for carbon sink - Aggressive	0	0	425
deployment - Permanent conservation cover			
(1000 hectares)			
Land impacted for carbon sink - Aggressive	0	0	5,228
deployment - Total (1000 hectares)			
Land impacted for carbon sink - Moderate	0	0	808
deployment - Corn-ethanol to energy grasses			
(1000 hectares)			
Land impacted for carbon sink - Moderate	0	0	2,104
deployment - Cropland measures (1000			
hectares)			
Land impacted for carbon sink - Moderate	0	0	213
deployment - Permanent conservation cover			
(1000 hectares)			
Land impacted for carbon sink - Moderate	0	0	3,124
deployment - Total (1000 hectares)			

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

Table 45. LTRE-Scenario - FILLAN O. Lana Sinks			
Item	2020	2025	2050
Carbon sink potential - High - Accelerate	0	0	77.5
regeneration (1000 tCO2e/y)			
Carbon sink potential - High - All (not counting	0	0	14,566
overlap) (1000 tCO2e/y)			
Carbon sink potential - High - Avoid deforestation	0	0	1,952
(1000 tCO2e/y)			
Carbon sink potential - High - Extend rotation	0	0	2,158
length (1000 tCO2e/y)			
Carbon sink potential - High - Improve	0	0	168
plantations (1000 tCO2e/y)			
Carbon sink potential - High - Increase retention	0	0	1,834
of HWP (1000 tCO2e/y)			
Carbon sink potential - High - Increase trees	0	0	2,006
outside forests (1000 tCO2e/y)			
Carbon sink potential - High - Reforest cropland	0	0	1,264
(1000 tCO2e/y)			
Carbon sink potential - High - Reforest pasture	0	0	3,822
(1000 tCO2e/y)			
Carbon sink potential - High - Restore	0	0	1,284
productivity (1000 tCO2e/y)			
Carbon sink potential - Low - Accelerate	0	0	38.8
regeneration (1000 tCO2e/y)			
Carbon sink potential - Low - All (not counting	0	0	3,947
overlap) (1000 tCO2e/y)			
Carbon sink potential - Low - Avoid deforestation	0	0	325
(1000 tC02e/y)			
Carbon sink potential - Low - Extend rotation	0	0	829
length (1000 tCO2e/y)			
Carbon sink potential - Low - Improve	0	0	85.6
plantations (1000 tCO2e/y)			
Carbon sink potential - Low - Increase retention	0	0	611
of HWP (1000 tCO2e/y)			
·			

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

Table 43: E+RE- scenario - PILLAR 6: Land sinks	- Forests (co	intinued)	
Item	2020	2025	2050
Carbon sink potential - Low - Increase trees	0	0	702
outside forests (1000 tCO2e/y)			
Carbon sink potential - Low - Reforest cropland	0	0	632
(1000 tC02e/y)			
Carbon sink potential - Low - Reforest pasture	0	0	290
(1000 tC02e/y)			_, _
Carbon sink potential - Low - Restore	0	0	433
productivity (1000 tCO2e/y)	0	0	400
Carbon sink potential - Mid - Accelerate	0	0	58.2
regeneration (1000 tC02e/y)	0	0	30.2
Carbon sink potential - Mid - All (not counting	0	0	0.055
	U	U	9,255
overlap) (1000 tC02e/y)	0		1 100
Carbon sink potential - Mid - Avoid deforestation	0	0	1,138
(1000 tC02e/y)			
Carbon sink potential - Mid - Extend rotation	0	0	1,493
length (1000 tCO2e/y)			
Carbon sink potential - Mid - Improve plantations	0	0	125
(1000 tC02e/y)			
Carbon sink potential - Mid - Increase retention	0	0	1,223
of HWP (1000 tCO2e/y)			
Carbon sink potential - Mid - Increase trees	0	0	1,354
outside forests (1000 tCO2e/y)			·
Carbon sink potential - Mid - Reforest cropland	0	0	948
(1000 tCO2e/y)			
Carbon sink potential - Mid - Reforest pasture	0	0	2,056
(1000 tC02e/y)	9	•	2,000
Carbon sink potential - Mid - Restore	0	0	858
productivity (1000 tCO2e/y)	0	0	000
	0	0	12.7
Land impacted for carbon sink potential - High -	U	U	12.7
Accelerate regeneration (1000 hectares)	0	-	0//
Land impacted for carbon sink potential - High -	0	0	264
Avoid deforestation (over 30 years) (1000			
hectares)			1100
Land impacted for carbon sink potential - High -	0	0	1,100
Extend rotation length (1000 hectares)	_		
Land impacted for carbon sink potential - High -	0	0	62
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	191
Increase trees outside forests (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	83.6
Reforest cropland (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	109
Reforest pasture (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	426
Restore productivity (1000 hectares)	9	•	720
Land impacted for carbon sink potential - High -	0	0	2,248
Total impacted (over 30 years) (1000 hectares)	0	0	2,240
	0	0	/ 0/
Land impacted for carbon sink potential - Low -	0	0	6.34
Accelerate regeneration (1000 hectares)			0/0
Land impacted for carbon sink potential - Low -	0	0	248
Avoid deforestation (over 30 years) (1000			
hectares)			
Land impacted for carbon sink potential - Low -	0	0	422
Extend rotation length (1000 hectares)			
	0	0	31
Land impacted for carbon sink potential - Low -			
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)	0	0	0
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares) Land impacted for carbon sink potential - Low -	0	0	0
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)	0	0	100

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

Item	2020	2025	2050
Land impacted for carbon sink potential - Low -	0	0	41.8
Reforest cropland (1000 hectares)		0	41.0
Land impacted for carbon sink potential - Low -	0	0	18.8
Reforest pasture (1000 hectares)		0	10.0
Land impacted for carbon sink potential - Low -	0	0	258
	"	U	256
Restore productivity (1000 hectares)		0	1 105
Land impacted for carbon sink potential - Low -	0	0	1,125
Total impacted (over 30 years) (1000 hectares)			0.51
Land impacted for carbon sink potential - Mid -	0	0	9.51
Accelerate regeneration (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	256
Avoid deforestation (over 30 years) (1000			
hectares)			
Land impacted for carbon sink potential - Mid -	0	0	761
Extend rotation length (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	46.6
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	145
Increase trees outside forests (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	62.7
Reforest cropland (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	136
Reforest pasture (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	519
Restore productivity (1000 hectares)			0.7
Land impacted for carbon sink potential - Mid -	0	0	1,936
Total impacted (over 30 years) (1000 hectares)		-	.,, 50

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

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal	0	828	1.01	0.998	0.872	0.634	0.056
(million 2019\$)							
Monetary damages from air pollution - Natural	0	188	118	140	102	35.3	11.2
Gas (million 2019\$)							
Monetary damages from air pollution -	0	1,813	1,690	1,283	740	339	136
Transportation (million 2019\$)							
Premature deaths from air pollution - Coal	0	92.9	0.113	0.112	0.098	0.071	0.006
(deaths)							
Premature deaths from air pollution - Natural	0	21.2	13.3	15.8	11.6	3.99	1.26
Gas (deaths)							
Premature deaths from air pollution -	0	204	190	144	83.2	38.1	15.3
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	5.71	7.71	0	0	0	0
Cumulative 5-yr (billion \$2018)							
Sales of cooking units - Electric Resistance (%)	67.5	68.3	71.3	79.1	90.1	96.8	99.1
Sales of cooking units - Gas (%)	32.5	31.7	28.7	20.9	9.94	3.21	0.863
Sales of space heating units - Electric Heat Pump	7.14	13.6	16.9	27.4	49.2	73	86
(%)							
Sales of space heating units - Electric Resistance	18.1	24.8	24	21.6	16.2	10.6	7.72
(%)							
Sales of space heating units - Fossil (%)	6.08	9.67	9.33	8.18	5.9	3.46	2.13
Sales of space heating units - Gas (%)	68.7	51.9	49.7	42.9	28.7	12.9	4.2
Sales of water heating units - Electric Heat Pump	0	0.608	2.31	7.59	18.2	29.3	35.3
(%)							
Sales of water heating units - Electric Resistance	39.3	55.7	55.6	55.8	57.2	59.4	61
(%)							

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 (%)	60.6	43.5	41.9	36.4	24.4	11	3.54
Sales of water heating units - Other (%)	0.101	0.202	0.203	0.204	0.204	0.204	0.204

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	192	404	1,364	4,297	6,258
(million \$2018)							
Public EV charging plugs - DC Fast (1000 units)	0.168	0	0.662	0	3.54	0	9.92
Public EV charging plugs - L2 (1000 units)	0.43	0	15.9	0	85.2	0	238
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 (%)	1.6	2	2.06	1.64	1.05	0.542	0.232
Vehicle sales - Light-duty - EV (%)	1.85	4.59	11.7	25.5	48	71.8	87.5
Vehicle sales - Light-duty - gasoline (%)	91.9	87.6	79.9	67.1	46.6	25.1	11.1
Vehicle sales - Light-duty - hybrid (%)	4.46	5.27	5.93	5.42	4.08	2.42	1.18
Vehicle sales - Light-duty - hydrogen FC (%)	0.113	0.381	0.328	0.251	0.179	0.099	0.046
Vehicle sales - Light-duty - other (%)	0.105	0.108	0.098	0.086	0.062	0.034	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)	190	187	183	179	172	164	155
Final energy use - Industry (PJ)	680	693	708	728	762	777	784
Final energy use - Residential (PJ)	311	289	273	257	238	214	188
Final energy use - Transportation (PJ)	653	615	559	514	480	439	392

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

2020	2025	2030	2035	2040	2045	2050
0	19,992	21,841	0	0	0	0
41	45.8	49.8	60.5	75.4	84.5	87.7
59	54.2	50.2	39.5	24.6	15.5	12.3
2.05	6.96	10.3	20.9	43.5	68.9	83
6.04	3.45	3.62	4.3	5.98	8.09	9.31
3.02	2.68	2.47	1.87	0.951	0.308	0.081
88.9	86.9	83.6	72.9	49.6	22.7	7.57
0.622	1.14	3.37	10.3	24.6	40.1	48.5
5.71	3.86	5.44	10.7	22.3	35.9	43.7
93.3	94.8	91	78.8	52.9	23.8	7.64
0.34	0.189	0.189	0.191	0.19	0.19	0.19
	0 41 59 2.05 6.04 3.02 88.9 0.622 5.71	0 19,992 41 45.8 59 54.2 2.05 6.96 6.04 3.45 3.02 2.68 88.9 86.9 0.622 1.14 5.71 3.86 93.3 94.8	0 19,992 21,841 41 45.8 49.8 59 54.2 50.2 2.05 6.96 10.3 6.04 3.45 3.62 3.02 2.68 2.47 88.9 86.9 83.6 0.622 1.14 3.37 5.71 3.86 5.44 93.3 94.8 91	0 19,992 21,841 0 41 45.8 49.8 60.5 59 54.2 50.2 39.5 2.05 6.96 10.3 20.9 6.04 3.45 3.62 4.3 3.02 2.68 2.47 1.87 88.9 86.9 83.6 72.9 0.622 1.14 3.37 10.3 5.71 3.86 5.44 10.7 93.3 94.8 91 78.8	0 19,992 21,841 0 0 41 45.8 49.8 60.5 75.4 59 54.2 50.2 39.5 24.6 2.05 6.96 10.3 20.9 43.5 6.04 3.45 3.62 4.3 5.98 3.02 2.68 2.47 1.87 0.951 88.9 86.9 83.6 72.9 49.6 0.622 1.14 3.37 10.3 24.6 5.71 3.86 5.44 10.7 22.3 93.3 94.8 91 78.8 52.9	0 19,992 21,841 0 0 0 41 45.8 49.8 60.5 75.4 84.5 59 54.2 50.2 39.5 24.6 15.5 2.05 6.96 10.3 20.9 43.5 68.9 6.04 3.45 3.62 4.3 5.98 8.09 3.02 2.68 2.47 1.87 0.951 0.308 88.9 86.9 83.6 72.9 49.6 22.7 0.622 1.14 3.37 10.3 24.6 40.1 5.71 3.86 5.44 10.7 22.3 35.9 93.3 94.8 91 78.8 52.9 23.8

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

•••	•		•				
Item	2020	2025	2030	2035	2040	2045	2050
Electricity distribution capital invested -	0	4.04	4.11	5.15	5.33	7.04	7.41
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	0	0	0	0	0
Capital invested - Biomass w/ccu allam power plant (billion \$2018)	0	0	0	0	0.009	0	0
Capital invested - Biomass w/ccu power plant (billion \$2018)	0	0	0	0	0.001	0	0

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

Item	2020	2025	2030	2035	2040	2045	2050
Biomass power plant (GWh)	0	0	0	0	0	0	0
Biomass w/ccu allam power plant (GWh)	0	0	0	0	9.16	9.16	9.16
Biomass w/ccu power plant (GWh)	0	0	0	0	0.958	0.958	0.958

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

•	0,						
Item	2020	2025	2030	2035	2040	2045	2050
Biomass purchases (million \$2018/year)	0	0	0	1,634	4,541	9,183	9,183
Conversion capital investment - Cumulative 5-yr	0	0	0	16,160	28,771	45,905	0
(million \$2018)							
Number of facilities - Allam power w ccu	0	0	0	0	1	1	1
(quantity)							
Number of facilities - Beccs hydrogen (quantity)	0	0	0	19	52	105	105
Number of facilities - Diesel (quantity)	0	0	0	0	0	0	0
Number of facilities - Diesel ccu (quantity)	0	0	0	0	1	1	1
Number of facilities - Power (quantity)	0	0	0	0	0	0	0
Number of facilities - Power ccu (quantity)	0	0	0	0	1	1	1
Number of facilities - Pyrolysis (quantity)	0	0	0	0	0	0	0
Number of facilities - Pyrolysis ccu (quantity)	0	0	0	0	1	1	1
Number of facilities - Sng (quantity)	0	0	0	0	0	0	0
Number of facilities - Sng ccu (quantity)	0	0	0	0	0	0	0

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

Item	2020	2025	2030	2035	2040	2045	2050
Annual - All (MMT)	0	0	0	20.8	57.7	120	120
Annual - BECCS (MMT)	0	0	0	20.8	57.7	117	117
Annual - Cement and lime (MMT)	0	0	0	0	0	3.42	3.53
Annual - NGCC (MMT)	0	0	0	0	0	0	0
Cumulative - All (MMT)	0	0	0	20.8	78.5	199	319
Cumulative - BECCS (MMT)	0	0	0	20.8	78.5	195	312
Cumulative - Cement and lime (MMT)	0	0	0	0	0	3.42	6.95
Cumulative - NGCC (MMT)	0	0	0	0	0	0	0

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

Item	2020	2025	2030	2035	2040	2045	2050
CO2 storage (MMT)	0	0	1.85	7.49	14.3	19.7	20.1
Injection wells (wells)	0	0	3	13	23	39	49
Resource characterization, appraisal, permitting costs (million \$2020)	0	50.6	222	344	344	344	344
Wells and facilities construction costs (million \$2020)	0	0	101	394	701	1,173	1,456

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

Item	2020	2025	2030	2035	2040	2045	2050
All (km)	0	0	499	518	1,642	3,995	4,659
Cumulative investment - All (million \$2018)	0	0	2,487	2,637	3,825	7,043	7,503
Cumulative investment - Spur (million \$2018)	0	0	130	265	1,323	4,317	4,777
Cumulative investment - Trunk (million \$2018)	0	0	2,358	2,372	2,502	2,726	2,726
Spur (km)	0	0	34.3	51.8	1,171	3,524	4,188
Trunk (km)	0	0	465	467	471	471	471

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	-2,302
Corn-ethanol to energy grasses (1000 tCO2e/y)			
Carbon sink potential - Aggressive deployment -	0	0	-6,796
Cropland measures (1000 tCO2e/y)			
Carbon sink potential - Aggressive deployment -	0	0	0
Cropland to woody energy crops (1000 tCO2e/y)			
Carbon sink potential - Aggressive deployment -	0	0	0
Pasture to energy crops (1000 tCO2e/y)			
Carbon sink potential - Aggressive deployment -	0	0	-211
Permanent conservation cover (1000 tC02e/y)			
Carbon sink potential - Aggressive deployment -	0	0	-9,309
Total (1000 tC02e/y)			•
Carbon sink potential - Moderate deployment -	0	0	-2,302
Corn-ethanol to energy grasses (1000 tCO2e/y)			,
Carbon sink potential - Moderate deployment -	0	0	-3,578
Cropland measures (1000 tCO2e/y)			0,0.0
Carbon sink potential - Moderate deployment -	0	0	0
Cropland to woody energy crops (1000 tCO2e/y)			Ü
Carbon sink potential - Moderate deployment -	0	0	0
Pasture to energy crops (1000 tC02e/y)		0	J
Carbon sink potential - Moderate deployment -	0	0	-105
Permanent conservation cover (1000 tC02e/y)		0	-103
Carbon sink potential - Moderate deployment -	0	0	-5,986
Total (1000 tCO2e/y)		0	-5,760
Land impacted for carbon sink - Aggressive	0	0	1.007
	0	0	1,204
deployment - Corn-ethanol to energy grasses			
(1000 hectares)	0	0	0.000
Land impacted for carbon sink - Aggressive	0	0	8,939
deployment - Cropland measures (1000			
hectares)	0	0	/ 00
Land impacted for carbon sink - Aggressive	0	0	400
deployment - Cropland to woody energy crops			
(1000 hectares)			(7.0
Land impacted for carbon sink - Aggressive	0	0	67.8
deployment - Pasture to energy crops (1000			
hectares)			
Land impacted for carbon sink - Aggressive	0	0	383
deployment - Permanent conservation cover			
(1000 hectares)			
Land impacted for carbon sink - Aggressive	0	0	10,994
deployment - Total (1000 hectares)			
Land impacted for carbon sink - Moderate	0	0	1,204
deployment - Corn-ethanol to energy grasses			
(1000 hectares)			
Land impacted for carbon sink - Moderate	0	0	1,906
deployment - Cropland measures (1000			
hectares)			
Land impacted for carbon sink - Moderate	0	0	400
deployment - Cropland to woody energy crops			
(1000 hectares)			
Land impacted for carbon sink - Moderate	0	0	67.8
deployment - Pasture to energy crops (1000			
hectares)			
Land impacted for carbon sink - Moderate	0	0	192
deployment - Permanent conservation cover			
(1000 hectares)			
Land impacted for carbon sink - Moderate	0	0	3,769
deployment - Total (1000 hectares)			-

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	77.5
regeneration (1000 tCO2e/y)			
Carbon sink potential - High - All (not counting	0	0	14,566
overlap) (1000 tC02e/y)			
Carbon sink potential - High - Avoid deforestation	0	0	1,952
(1000 tC02e/y)			
Carbon sink potential - High - Extend rotation	0	0	2,158
length (1000 tCO2e/y)			
Carbon sink potential - High - Improve	0	0	168
plantations (1000 tCO2e/y)			
Carbon sink potential - High - Increase retention	0	0	1,834
of HWP (1000 tCO2e/y)		_	
Carbon sink potential - High - Increase trees	0	0	2,006
outside forests (1000 tC02e/y)			
Carbon sink potential - High - Reforest cropland	0	0	1,264
(1000 tC02e/y)			
Carbon sink potential - High - Reforest pasture	0	0	3,822
(1000 tC02e/y)			1.00/
Carbon sink potential - High - Restore	0	0	1,284
productivity (1000 tC02e/y)			00.0
Carbon sink potential - Low - Accelerate	0	0	38.8
regeneration (1000 tCO2e/y)			0.07
Carbon sink potential - Low - All (not counting	0	0	3,947
overlap) (1000 tC02e/y)		0	005
Carbon sink potential - Low - Avoid deforestation	0	0	325
(1000 tC02e/y)		0	000
Carbon sink potential - Low - Extend rotation	0	0	829
length (1000 tC02e/y)	0	0	05 /
Carbon sink potential - Low - Improve plantations (1000 tCO2e/y)	0	0	85.6
Carbon sink potential - Low - Increase retention		0	/11
of HWP (1000 tCO2e/y)	0	0	611
Carbon sink potential - Low - Increase trees	0	0	702
outside forests (1000 tC02e/y)		0	102
Carbon sink potential - Low - Reforest cropland	0	0	632
(1000 tC02e/y)		0	032
Carbon sink potential - Low - Reforest pasture	0	0	290
(1000 tC02e/y)		0	270
Carbon sink potential - Low - Restore	0	0	433
productivity (1000 tCO2e/y)		0	400
Carbon sink potential - Mid - Accelerate	0	0	58.2
regeneration (1000 tCO2e/y)		0	30.2
Carbon sink potential - Mid - All (not counting	0	0	9,255
overlap) (1000 tC02e/y)		<u> </u>	7,200
Carbon sink potential - Mid - Avoid deforestation	0	0	1,138
(1000 tCO2e/y)		0	1,100
Carbon sink potential - Mid - Extend rotation	0	0	1,493
length (1000 tCO2e/y)			1, 170
Carbon sink potential - Mid - Improve plantations	0	0	125
(1000 tCO2e/y)		<u> </u>	120
Carbon sink potential - Mid - Increase retention	0	0	1,223
of HWP (1000 tC02e/y)		<u> </u>	1,220
Carbon sink potential - Mid - Increase trees	0	0	1,354
outside forests (1000 tCO2e/y)		0	1,004
Carbon sink potential - Mid - Reforest cropland	0	0	948
(1000 tC02e/y)		١ .	/40
Carbon sink potential - Mid - Reforest pasture	0	0	2,056
(1000 tC02e/y)		0	2,000
Carbon sink potential - Mid - Restore	0	0	858
productivity (1000 tC02e/y)		0	000
Land impacted for carbon sink potential - High -	0	0	12.7
Accelerate regeneration (1000 hectares)		0	14.1
Account ato regeneration (1000 lieutal es)			

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

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Table 58: RFF scenario -	DTLLAD 1. Efficiency	//Electrification	Pacidontial
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Item	2020	2025	2030	2035	2040	2045	2050
Residential HVAC investment in 2020s vs. REF -	0	5.46	5.93	0	0	0	0
Cumulative 5-yr (billion \$2018)							
Sales of cooking units - Electric Resistance (%)	67.2	67.2	67.2	67.2	67.2	67.2	67.2
Sales of cooking units - Gas (%)	32.8	32.8	32.8	32.8	32.8	32.8	32.8
Sales of space heating units - Electric Heat Pump	5.73	19.2	19.7	20.7	21.5	22.5	23.7
(%)							
Sales of space heating units - Electric Resistance	18.5	23.4	23.1	22.7	21.9	20.9	19.8
(%)							
Sales of space heating units - Fossil (%)	6.24	8.46	8.19	7.99	8.01	8.01	8.02
Sales of space heating units - Gas (%)	69.5	49	48.9	48.6	48.6	48.6	48.5
Sales of water heating units - Electric Heat Pump	0	0	0	0	0	0	0
(%)							
Sales of water heating units - Electric Resistance	39.3	55.6	55.5	55.3	55.3	55.2	55.1
(%)							
Sales of water heating units - Gas Furnace (%)	60.6	44.2	44.3	44.5	44.5	44.6	44.7
Sales of water heating units - Other (%)	0.101	0.202	0.203	0.204	0.204	0.205	0.206

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 (%)	1.59	2	2.19	2.04	1.84	1.71	1.63
Vehicle sales - Light-duty - EV (%)	3.44	5.44	6.21	7.63	9.3	10.8	12
Vehicle sales - Light-duty - gasoline (%)	90.4	86.9	84.8	83	81	79	77.4
Vehicle sales - Light-duty - hybrid (%)	4.32	5.17	6.34	6.91	7.48	8.08	8.56
Vehicle sales - Light-duty - hydrogen FC (%)	0.111	0.378	0.348	0.31	0.307	0.308	0.319
Vehicle sales - Light-duty - other (%)	0.104	0.108	0.104	0.105	0.104	0.103	0.106
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)	190	190	188	184	179	179	183
Final energy use - Industry (PJ)	681	703	718	717	727	733	738
Final energy use - Residential (PJ)	311	289	277	269	264	262	259
Final energy use - Transportation (PJ)	653	615	563	533	532	548	569

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

Item	2020	2025	2030	2035	2040	2045	2050
Commercial HVAC investment in 2020s -	0	19,774	20,475	0	0	0	0
Cumulative 5-yr (million \$2018)							
Sales of cooking units - Electric Resistance (%)	41	44.2	44.3	44.3	44.3	44.4	44.5
Sales of cooking units - Gas (%)	59	55.8	55.7	55.7	55.7	55.6	55.5
Sales of space heating units - Electric Heat Pump	2.05	13.1	45	71.1	75.4	75.9	75.9
(%)							
Sales of space heating units - Electric Resistance	6.04	4.34	8.93	17.2	22.8	23.7	23.7
(%)							
Sales of space heating units - Fossil (%)	3.02	2.48	1.25	0.221	0.025	0.001	0
Sales of space heating units - Gas Furnace (%)	88.9	80.1	44.8	11.5	1.77	0.439	0.36
Sales of water heating units - Electric Heat Pump	0.622	0.346	0.35	0.35	0.344	0.346	0.347
(%)							

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	5.71	3.27	3.23	3.24	3.22	3.2	3.2
(%)							
Sales of water heating units - Gas Furnace (%)	93.3	96.2	96.2	96.2	96.3	96.3	96.3
Sales of water heating units - Other (%)	0.34	0.189	0.189	0.191	0.19	0.19	0.19

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

Item	2020	2025	2030	2035	2040	2045	2050
Electricity distribution capital invested -	0	4.26	4.35	4.69	4.81	5.72	5.94
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)	-6.5	0	-4.24	-3.79
Business-as-usual carbon sink - Retained in Hardwood Products (Mt CO2e/y)	-0.499	0	-0.898	-0.933
Business-as-usual carbon sink - Total (Mt CO2e/y)	-7	0	-5.14	-4.73
Carbon sink potential - High - Accelerate	0	0	0	77.5
regeneration (1000 tCO2e/y)				
Carbon sink potential - High - All (not counting overlap) (1000 tCO2e/y)	0	0	0	14,566
Carbon sink potential - High - Avoid deforestation (1000 tCO2e/y)	0	0	0	1,952
Carbon sink potential - High - Extend rotation length (1000 tCO2e/y)	0	0	0	2,158
Carbon sink potential - High - Improve plantations (1000 tCO2e/y)	0	0	0	168
Carbon sink potential - High - Increase retention of HWP (1000 tCO2e/y)	0	0	0	1,834
Carbon sink potential - High - Increase trees outside forests (1000 tCO2e/y)	0	0	0	2,006
Carbon sink potential - High - Reforest cropland (1000 tCO2e/y)	0	0	0	1,264
Carbon sink potential - High - Reforest pasture (1000 tCO2e/y)	0	0	0	3,822
Carbon sink potential - High - Restore productivity (1000 tCO2e/y)	0	0	0	1,284
Carbon sink potential - Low - Accelerate regeneration (1000 tCO2e/y)	0	0	0	38.8
Carbon sink potential - Low - All (not counting overlap) (1000 tCO2e/y)	0	0	0	3,947
Carbon sink potential - Low - Avoid deforestation (1000 tCO2e/y)	0	0	0	325
Carbon sink potential - Low - Extend rotation length (1000 tCO2e/y)	0	0	0	829
Carbon sink potential - Low - Improve plantations (1000 tCO2e/y)	0	0	0	85.6
Carbon sink potential - Low - Increase retention of HWP (1000 tCO2e/y)	0	0	0	611
Carbon sink potential - Low - Increase trees outside forests (1000 tCO2e/y)	0	0	0	702
Carbon sink potential - Low - Reforest cropland (1000 tCO2e/y)	0	0	0	632
Carbon sink potential - Low - Reforest pasture (1000 tCO2e/y)	0	0	0	290
Carbon sink potential - Low - Restore productivity (1000 tC02e/y)	0	0	0	433
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO2e/y)	0	0	0	58.2
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO2e/y)	0	0	0	9,255

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

Team	Table 63: REF scenario - PILLAR 6: Land sinks - I	Forests (coi	ntinued)		
Grabon sink potential - Mid - Extend rotation		2020	2025	2030	2050
Carbon sink potential - Mid - Extend rotation O	Carbon sink potential - Mid - Avoid deforestation	0	0	0	1,138
Indigit 1000 tC02e/y	(1000 tCO2e/y)				
Carbon sink potential - Mid - Improve plantations 0	Carbon sink potential - Mid - Extend rotation	0	0	0	1,493
1000 tC02e/y Carbon sink potential - Mid - Increase retention Carbon sink potential - Mid - Increase trees O O O 1,354	length (1000 tCO2e/y)				
1000 tC02e/y Carbon sink potential - Mid - Increase retention Carbon sink potential - Mid - Increase trees O O O 1,354	Carbon sink potential - Mid - Improve plantations	0	0	0	125
Carbon sink potential - Mid - Increase retention					
GFHWP (1000 CC22e/v)		0	0	0	1,223
Carbon sink potential - Mid - Increase trees			J		.,
Outside forests (1000 tC02e/y) Carbon sink potential - Mid - Reforest pasture O		n	Λ	n	1354
Carbon sink potential - Mid - Reforest cropland 0			J		1,004
(1000 tCO2e/y) Carbon sink potential - Mid - Reforest pasture 0		0	0	0	0/.0
Carbon sink potential - Mid - Reforest pasture		0	U	"	940
Carbon sink potential - Mid - Restore 0		0	0		0.057
Carbon sink potential - Mid - Restore productivity (1000 tCO2e/v) Land impacted for carbon sink potential - High -		0	U	"	2,056
Department Company C					050
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares) Carbon sink potential - High - Avoid deforestation (over 30 years) (1000 hectares) Carbon sink potential - High - Avoid deforestation (over 30 years) (1000 hectares) Carbon sink potential - High - Carbon sink potential - Low - Carbon sink		U	U	U	858
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Table 63: REF scenario - PILLAR 6: Land sinks - Forests (continued)

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Item	2020	2025	2030	2050
Land impacted for carbon sink potential - Mid -	0	0	0	761
Extend rotation length (1000 hectares)				
Land impacted for carbon sink potential - Mid -	0	0	0	46.6
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	145
Increase trees outside forests (1000 hectares)				
Land impacted for carbon sink potential - Mid -	0	0	0	62.7
Reforest cropland (1000 hectares)				
Land impacted for carbon sink potential - Mid -	0	0	0	136
Reforest pasture (1000 hectares)				
Land impacted for carbon sink potential - Mid -	0	0	0	519
Restore productivity (1000 hectares)				
Land impacted for carbon sink potential - Mid -	0	0	0	1,936
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	2,684	1,775	1,369	1,167	1,097	1,071
Monetary damages from air pollution - Natural Gas (million 2019\$)	0	201	233	286	306	265	234
Monetary damages from air pollution - Transportation (million 2019\$)	0	1,842	1,885	1,926	1,975	2,025	2,076
Premature deaths from air pollution - Coal (deaths)	0	301	199	154	131	123	120
Premature deaths from air pollution - Natural Gas (deaths)	0	22.8	26.3	32.3	34.5	29.9	26.5
Premature deaths from air pollution - Transportation (deaths)	0	207	212	217	222	228	234