# Net-Zero America - north dakota state report

Larson et al. 2020

#### February 2021

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

#### **Notes**

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

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

Item	2020	2025	2030	2035	2040	2045	2050
Residential HVAC investment in 2020s vs. REF -	0	0.514	0.598	0	0	0	0
Cumulative 5-yr (billion \$2018)							
Sales of cooking units - Electric Resistance (%)	80.2	84.4	97.3	99.9	100	100	100
Sales of cooking units - Gas (%)	19.8	15.6	2.66	0.134	0	0	0
Sales of space heating units - Electric Heat Pump	8.4	12.9	25.9	58.5	84	88	87.9
(%)							
Sales of space heating units - Electric Resistance	28.4	34.1	30.9	19.4	10.1	8.76	8.9
(%)							
Sales of space heating units - Fossil (%)	13.7	18.3	14.3	8.01	3.29	2.43	2.5
Sales of space heating units - Gas (%)	49.5	34.6	28.9	14.1	2.65	0.854	0.684
Sales of water heating units - Electric Heat Pump	0	0.203	3.49	14.3	21.9	23	23.1
(%)							
Sales of water heating units - Electric Resistance	52.4	66.9	67.7	71.6	76.1	76.8	76.8
(%)							
Sales of water heating units - Gas Furnace (%)	47.6	32.8	28.8	14	2.01	0.152	0
Sales of water heating units - Other (%)	0.036	0.035	0.035	0.035	0.035	0.035	0.035

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	173	442	719	1,088	1,186	1,130
(million \$2018)							
Public EV charging plugs - DC Fast (1000 units)	0.024	0	0.353	0	1.57	0	2.54
Public EV charging plugs - L2 (1000 units)	0.043	0	8.49	0	37.8	0	61.2
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 (%)	1.96	2.17	1.42	0.461	0.082	0.013	0
Vehicle sales - Light-duty - EV (%)	2.56	11.1	39.9	79.2	96	99.3	100
Vehicle sales - Light-duty - gasoline (%)	92.2	82.7	55.6	19.2	3.64	0.601	0
Vehicle sales - Light-duty - hybrid (%)	3.1	3.59	2.75	1.07	0.251	0.052	0
Vehicle sales - Light-duty - hydrogen FC (%)	0.113	0.363	0.237	0.075	0.015	0.002	0
Vehicle sales - Light-duty - other (%)	0.12	0.116	0.081	0.029	0.005	0.001	0
Vehicle sales - Medium-duty - diesel (%)	64.7	59.7	42.3	14.4	2.59	0.384	0
Vehicle sales - Medium-duty - EV (%)	0.784	5.07	25.3	60.8	76.5	79.5	80
Vehicle sales - Medium-duty - gasoline (%)	33.7	33.3	25.5	9.32	1.77	0.277	0
Vehicle sales - Medium-duty - hybrid (%)	0.363	0.402	0.341	0.14	0.03	0.005	0
Vehicle sales - Medium-duty - hydrogen FC (%)	0.196	1.27	6.33	15.2	19.1	19.9	20
Vehicle sales - Medium-duty - other (%)	0.253	0.255	0.205	0.083	0.019	0.004	0

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

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Commercial (PJ)	25.2	24.8	24	22.9	21.6	20.3	19.5
Final energy use - Industry (PJ)	124	130	131	130	129	129	130
Final energy use - Residential (PJ)	38.3	36.3	34.5	31.9	28.4	25	22.3
Final energy use - Transportation (PJ)	104	97.6	88.2	76.6	66	59.6	57.2

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

Item	2020	2025	2030	2035	2040	2045	2050
Commercial HVAC investment in 2020s -	0	2,165	2,361	0	0	0	0
Cumulative 5-yr (million \$2018)							
Sales of cooking units - Electric Resistance (%)	44.8	57.1	84	89.3	89.6	89.6	89.6
Sales of cooking units - Gas (%)	55.2	42.9	16	10.7	10.4	10.4	10.4
Sales of space heating units - Electric Heat Pump (%)	6.09	4.46	15.5	53	81.8	86.3	86.7
Sales of space heating units - Electric Resistance (%)	9.99	5.81	8.04	12	12.9	12.9	12.9
Sales of space heating units - Fossil (%)	9.8	2.42	0.475	0.02	0	0	0

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

Item	2020	2025	2030	2035	2040	2045	2050
Sales of space heating units - Gas Furnace (%)	74.1	87.3	76	35	5.3	0.843	0.483
Sales of water heating units - Electric Heat Pump (%)	1.62	1.17	6.88	27.5	44	46.5	46.7
Sales of water heating units - Electric Resistance (%)	13.6	7.49	13.1	33.4	49.8	52.4	52.6
Sales of water heating units - Gas Furnace (%)	82.1	90.4	79.3	38.4	5.51	0.416	0
Sales of water heating units - Other (%)	2.67	0.964	0.742	0.696	0.692	0.695	0.695

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

Item	2020	2025	2030	2035	2040	2045	2050
Electricity distribution capital invested -	0	0.777	0.801	1.5	1.61	1.57	1.66
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	0.024	0	0.007	0
plant (billion \$2018)							
Capital invested - Biomass w/ccu power plant	0	0	0.081	0	0	0.013	0
(billion \$2018)							
Capital invested - Wind - Base (billion \$2018)	0	0	0	0.287	0.603	3.22	9.02
Capital invested - Wind - Constrained (billion	0	0.092	1.88	4.94	9.39	26.8	72.8
\$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	23.9	23.9	30.8	30.8
Biomass w/ccu power plant (GWh)	0	0	90.7	90.7	90.7	105	105
Wind - Base land use assumptions (GWh)	19,216	0	0	808	1,778	10,268	30,035
Wind - Constrained land use assumptions (GWh)	19,216	0	2,953	13,544	23,229	78,296	215,679

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

Item	2020	2025	2030	2035	2040	2045	2050
Biomass purchases (million \$2018/year)	0	0	4.97	410	529	609	1,023
Conversion capital investment - Cumulative 5-yr	0	0	74.4	5,477	1,614	1,086	5,582
(million \$2018)							
Number of facilities - Allam power w ccu	0	0	0	1	1	2	2
(quantity)							
Number of facilities - Beccs hydrogen (quantity)	0	0	0	7	10	13	17
Number of facilities - Diesel (quantity)	0	0	0	0	0	0	0
Number of facilities - Diesel ccu (quantity)	0	0	0	1	2	3	3
Number of facilities - Power (quantity)	0	0	0	0	0	0	0
Number of facilities - Power ccu (quantity)	0	0	1	1	1	2	2
Number of facilities - Pyrolysis (quantity)	0	0	0	0	0	0	0
Number of facilities - Pyrolysis ccu (quantity)	0	0	0	1	2	3	3
Number of facilities - Sng (quantity)	0	0	0	0	0	0	0
Number of facilities - Sng ccu (quantity)	0	0	1	1	1	2	2

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

Item	2020	2025	2030	2035	2040	2045	2050
Annual - All (MMT)	0	0	0.09	7.12	9.17	10.5	17.7
Annual - BECCS (MMT)	0	0	0.09	7.08	9.15	10.5	17.7
Annual - Cement and lime (MMT)	0	0	0	0	0	0	0
Annual - NGCC (MMT)	0	0	0	0.03	0.03	0.02	0.01
Cumulative - All (MMT)	0	0	0.09	7.21	16.4	26.9	44.6

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

Item	2020	2025	2030	2035	2040	2045	2050
Cumulative - BECCS (MMT)	0	0	0.09	7.17	16.3	26.8	44.5
Cumulative - Cement and lime (MMT)	0	0	0	0	0	0	0
Cumulative - NGCC (MMT)	0	0	0	0.03	0.06	0.08	0.09

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

Item	2020	2025	2030	2035	2040	2045	2050
CO2 storage (MMT)	0	0	2.19	6.17	11.7	18.9	25.2
Injection wells (wells)	0	0	4	15	26	44	54
Resource characterization, appraisal, permitting	0	135	406	542	542	542	542
costs (million \$2020)							
Wells and facilities construction costs (million	0	0	113	439	783	1,309	1,625
\$2020)							

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

Item	2020	2025	2030	2035	2040	2045	2050
All (km)	0	0	554	2,251	2,490	3,079	4,487
Cumulative investment - All (million \$2018)	0	0	416	2,905	3,053	3,385	4,468
Cumulative investment - Spur (million \$2018)	0	0	217	1,178	1,327	1,659	2,742
Cumulative investment - Trunk (million \$2018)	0	0	199	1,726	1,726	1,726	1,726
Spur (km)	0	0	416	1,805	2,044	2,633	4,042
Trunk (km)	0	0	138	446	446	446	446

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

Item	2020	2025	2050
Carbon sink potential - Aggressive deployment - Corn-ethanol to energy grasses (1000 tC02e/y)	0	0	-551
Carbon sink potential - Aggressive deployment - Cropland measures (1000 tC02e/y)	0	0	-10,108
Carbon sink potential - Aggressive deployment - Permanent conservation cover (1000 tCO2e/y)	0	0	-660
Carbon sink potential - Aggressive deployment - Total (1000 tCO2e/y)	0	0	-11,319
Carbon sink potential - Moderate deployment - Corn-ethanol to energy grasses (1000 tCO2e/y)	0	0	-551
Carbon sink potential - Moderate deployment - Cropland measures (1000 tC02e/y)	0	0	-5,330
Carbon sink potential - Moderate deployment - Permanent conservation cover (1000 tC02e/y)	0	0	-330
Carbon sink potential - Moderate deployment - Total (1000 tCO2e/y)	0	0	-6,211
Land impacted for carbon sink - Aggressive deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	300
Land impacted for carbon sink - Aggressive deployment - Cropland measures (1000 hectares)	0	0	9,928
Land impacted for carbon sink - Aggressive deployment - Permanent conservation cover (1000 hectares)	0	0	1,092
Land impacted for carbon sink - Aggressive deployment - Total (1000 hectares)	0	0	11,320
Land impacted for carbon sink - Moderate deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	300
Land impacted for carbon sink - Moderate deployment - Cropland measures (1000 hectares)	0	0	5,237
Land impacted for carbon sink - Moderate deployment - Permanent conservation cover (1000 hectares)	0	0	546

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

Item	2020	2025	2050
Land impacted for carbon sink - Moderate	0	0	6,083
deployment - Total (1000 hectares)			

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

Table 13: E+ scenario - PILLAR 6: Land sinks - Fo		0005	0050
Item	2020	2025	2050
Carbon sink potential - High - Accelerate	0	0	38.5
regeneration (1000 tC02e/y)			
Carbon sink potential - High - All (not counting	0	0	23,528
overlap) (1000 tCO2e/y)			
Carbon sink potential - High - Avoid deforestation	0	0	821
(1000 tC02e/y)			
Carbon sink potential - High - Extend rotation	0	0	414
length (1000 tCO2e/y)			
Carbon sink potential - High - Improve	0	0	20.6
plantations (1000 tCO2e/y)			
Carbon sink potential - High - Increase retention	0	0	41.5
of HWP (1000 tCO2e/y)			
Carbon sink potential - High - Increase trees	0	0	3,342
outside forests (1000 tCO2e/y)			
Carbon sink potential - High - Reforest cropland	0	0	13,386
(1000 tC02e/y)			.0,000
Carbon sink potential - High - Reforest pasture	0	0	5,274
(1000 tCO2e/y)		0	0,214
Carbon sink potential - High - Restore	0	0	191
productivity (1000 tCO2e/y)	0	0	171
Carbon sink potential - Low - Accelerate	0	0	19.3
	0	U	19.3
regeneration (1000 tCO2e/y)			0.///
Carbon sink potential - Low - All (not counting	0	0	8,666
overlap) (1000 tC02e/y)	_	_	
Carbon sink potential - Low - Avoid deforestation	0	0	137
(1000 tC02e/y)			
Carbon sink potential - Low - Extend rotation	0	0	159
length (1000 tCO2e/y)			
Carbon sink potential - Low - Improve	0	0	10.5
plantations (1000 tCO2e/y)			
Carbon sink potential - Low - Increase retention	0	0	13.8
of HWP (1000 tCO2e/y)			
Carbon sink potential - Low - Increase trees	0	0	1,170
outside forests (1000 tCO2e/y)			
Carbon sink potential - Low - Reforest cropland	0	0	6,693
(1000 tC02e/y)		-	-,
Carbon sink potential - Low - Reforest pasture	0	0	400
(1000 tC02e/y)		0	400
Carbon sink potential - Low - Restore	0	0	64.3
productivity (1000 tCO2e/y)		0	04.5
Carbon sink potential - Mid - Accelerate	0	0	28.9
	0	0	26.9
regeneration (1000 tCO2e/y)			14.007
Carbon sink potential - Mid - All (not counting	0	0	16,097
overlap) (1000 tC02e/y)			
Carbon sink potential - Mid - Avoid deforestation	0	0	479
(1000 tC02e/y)			
Carbon sink potential - Mid - Extend rotation	0	0	286
length (1000 tCO2e/y)			
Carbon sink potential - Mid - Improve plantations	0	0	15.4
(1000 tCO2e/y)			
Carbon sink potential - Mid - Increase retention	0	0	27.6
of HWP (1000 tC02e/y)			
Carbon sink potential - Mid - Increase trees	0	0	2,256
outside forests (1000 tCO2e/y)		ı	2,200
Carbon sink potential - Mid - Reforest cropland	0	0	10,039
(1000 tC02e/y)		0	10,037
Carbon sink potential - Mid - Reforest pasture	0	0	2,837
		U	2,001
(1000 tCO2e/y)			

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

Table 13: E+ scenario - PILLAR 6: Land sinks - Fo	orests (contir	nued)	
Item	2020	2025	2050
Carbon sink potential - Mid - Restore	0	0	127
productivity (1000 tCO2e/y)			
Land impacted for carbon sink potential - High -	0	0	6.3
Accelerate regeneration (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	111
Avoid deforestation (over 30 years) (1000			
hectares)			
Land impacted for carbon sink potential - High -	0	0	211
Extend rotation length (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	7.59
Improve plantations (1000 hectares)		0	1.07
Land impacted for carbon sink potential - High -	0	0	0
		0	١
Increase retention of HWP (1000 hectares)		0	017
Land impacted for carbon sink potential - High -	0	0	317
Increase trees outside forests (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	885
Reforest cropland (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	150
Reforest pasture (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	63.2
Restore productivity (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	1,752
Total impacted (over 30 years) (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	3.15
Accelerate regeneration (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	104
Avoid deforestation (over 30 years) (1000			
hectares)			
Land impacted for carbon sink potential - Low -	0	0	80.8
Extend rotation length (1000 hectares)		· · ·	00.0
Land impacted for carbon sink potential - Low -	0	0	3.79
Improve plantations (1000 hectares)		0	5.19
		0	
Land impacted for carbon sink potential - Low -	0	0	0
Increase retention of HWP (1000 hectares)			4.7
Land impacted for carbon sink potential - Low -	0	0	167
Increase trees outside forests (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	443
Reforest cropland (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	26
Reforest pasture (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	38.2
Restore productivity (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	866
Total impacted (over 30 years) (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	4.72
Accelerate regeneration (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	108
Avoid deforestation (over 30 years) (1000			.00
hectares)			
Land impacted for carbon sink potential - Mid -	0	0	146
Extend rotation length (1000 hectares)		0	140
	0	0	5.71
Land impacted for carbon sink potential - Mid -	"	0	5.71
Improve plantations (1000 hectares)		-	
Land impacted for carbon sink potential - Mid -	0	0	0
Increase retention of HWP (1000 hectares)			2/2
Land impacted for carbon sink potential - Mid -	0	0	242
Increase trees outside forests (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	664
Reforest cropland (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	188
Reforest pasture (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	77
Restore productivity (1000 hectares)			
-, (,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	1		

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

Item	2020	2025	2050
Land impacted for carbon sink potential - Mid -	0	0	1,435
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	25.1	0.018	0.018	0.013	0.008	0
(million 2019\$)							
Monetary damages from air pollution - Natural	0	6.03	3.33	1.99	1.7	1.07	0.466
Gas (million 2019\$)							
Monetary damages from air pollution -	0	24.3	22.3	16.7	9.47	4.22	1.6
Transportation (million 2019\$)							
Premature deaths from air pollution - Coal	0	2.82	0.002	0.002	0.001	0.001	0
(deaths)							
Premature deaths from air pollution - Natural	0	0.681	0.376	0.225	0.192	0.121	0.053
Gas (deaths)							
Premature deaths from air pollution -	0	2.73	2.51	1.88	1.06	0.474	0.179
Transportation (deaths)							

## Table 15: E+ scenario - IMPACTS - Jobs

Table 15: E+ Scenario - IMPACTS - Jobs							
Item	2020	2025	2030	2035	2040	2045	2050
By economic sector - Agriculture (jobs)	819	819	825	1,384	1,095	696	883
By economic sector - Construction (jobs)	8,009	8,513	7,968	9,267	7,706	8,666	11,179
By economic sector - Manufacturing (jobs)	7,533	10,549	11,439	13,536	12,081	9,891	11,265
By economic sector - Mining (jobs)	13,001	11,230	8,984	7,222	4,831	3,348	2,008
By economic sector - Other (jobs)	246	267	230	262	270	396	686
By economic sector - Pipeline (jobs)	1,375	1,477	1,486	1,775	1,313	1,210	1,181
By economic sector - Professional (jobs)	4,674	4,758	4,147	4,634	4,202	4,756	6,844
By economic sector - Trade (jobs)	9,668	8,804	7,514	6,824	5,155	4,501	4,598
By economic sector - Utilities (jobs)	3,658	3,426	2,545	4,160	3,639	5,794	9,514
By education level - All sectors - Associates	13,419	13,835	12,551	13,935	11,576	11,698	14,875
degree or some college (jobs)							
By education level - All sectors - Bachelors degree (jobs)	11,629	11,621	10,352	10,762	8,735	8,341	9,983
By education level - All sectors - Doctoral degree (jobs)	370	366	320	328	272	273	344
By education level - All sectors - High school diploma or less (jobs)	20,951	21,431	19,639	21,671	17,778	17,039	20,585
By education level - All sectors - Masters or professional degree (jobs)	2,614	2,590	2,276	2,366	1,932	1,907	2,371
By resource sector - Biomass (jobs)	1,980	1,923	1,882	3,450	3,008	2,575	3,902
By resource sector - CO2 (jobs)	. 0	72	432	3,217	1,824	3,002	5,307
By resource sector - Coal (jobs)	2,774	1,398	306	18.4	13.6	10.5	8.79
By resource sector - Grid (jobs)	4,197	3,938	2,787	4,099	4,717	8,046	13,277
By resource sector - Natural Gas (jobs)	6,791	6,390	5,139	3,906	2,818	2,150	1,561
By resource sector - Nuclear (jobs)	0	0	0	0	0	0	0
By resource sector - Oil (jobs)	29,165	28,669	26,333	24,126	17,859	13,626	8,672
By resource sector - Solar (jobs)	829	2,034	2,406	3,519	3,643	3,208	4,484
By resource sector - Wind (jobs)	3,249	5,420	5,854	6,728	6,411	6,640	10,946
Median wages - Annual - All (\$2019 per job)	60,187	60,555	60,862	61,280	61,936	63,658	64,907
On-Site or In-Plant Training - Total jobs - 1 to 4 years (jobs)	7,239	7,418	6,719	7,403	6,108	6,136	7,689
On-Site or In-Plant Training - Total jobs - 4 to 10 years (jobs)	2,739	2,761	2,462	2,735	2,239	2,387	3,082
On-Site or In-Plant Training - Total jobs - None (jobs)	7,873	8,039	7,274	7,902	6,507	6,318	7,801
On-Site or In-Plant Training - Total jobs - Over 10 years (jobs)	323	339	311	356	297	311	408
On-Site or In-Plant Training - Total jobs - Up to 1 year (jobs)	30,810	31,286	28,372	30,667	25,141	24,105	29,178
On-the-Job Training - All sectors - 1 to 4 years (jobs)	9,014	9,249	8,361	9,249	7,644	7,771	9,842

Table 15.	E+ scenario	IMDMCTQ	lohe loor	tinundl
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Item	2020	2025	2030	2035	2040	2045	2050
On-the-Job Training - All sectors - 4 to 10 years	2,446	2,470	2,197	2,489	2,051	2,247	2,972
(jobs)							
On-the-Job Training - All sectors - None (jobs)	2,963	2,964	2,658	2,793	2,262	2,152	2,575
On-the-Job Training - All sectors - Over 10 years (jobs)	454	483	451	494	408	389	472
On-the-Job Training - All sectors - Up to 1 year (jobs)	34,107	34,677	31,471	34,038	27,928	26,698	32,297
Related work experience - All sectors - 1 to 4 years (jobs)	18,027	18,227	16,425	17,727	14,543	14,190	17,296
Related work experience - All sectors - 4 to 10 years (jobs)	11,048	11,239	10,123	10,964	9,012	8,946	11,109
Related work experience - All sectors - None (jobs)	6,949	7,088	6,441	7,073	5,797	5,666	6,961
Related work experience - All sectors - Over 10 years (jobs)	3,028	3,122	2,839	3,060	2,525	2,451	3,007
Related work experience - All sectors - Up to 1 year (jobs)	9,932	10,168	9,310	10,238	8,416	8,004	9,785
Wage income - All (million \$2019)	2,948	3,018	2,747	3,007	2,496	2,499	3,126

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

Item	2020	2025	2030	2035	2040	2045	2050
Natural gas consumption - Annual (tcf)	96.6	98.1	82.7	66.3	49.9	31.4	21.8
Natural gas consumption - Cumulative (tcf)	0	0	0	0	0	0	1,997
Natural gas production - Annual (tcf)	623	690	653	568	481	381	296
Oil consumption - Annual (million bbls)	45.9	46	42.8	37.1	31.1	26.4	21.8
Oil consumption - Cumulative (million bbls)	0	0	0	0	0	0	1,120
Oil production - Annual (million bbls)	553	598	600	599	475	386	257

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

Residential HVAC investment in 2020s vs. REF - Cumulative 5-yr (billion \$2018)   Sales of cooking units - Electric Resistance (%)   80.2   80.7   82.5   87.3   93.9   98   99.5	Item	2020	2025	2030	2035	2040	2045	2050
Sales of cooking units - Electric Resistance (%)         80.2         80.7         82.5         87.3         93.9         98         99.5           Sales of cooking units - Gas (%)         19.8         19.3         17.5         12.7         6.06         1.96         0.527           Sales of space heating units - Electric Heat Pump (%)         8.4         11.6         12.7         15.6         22.9         33.8         43           Sales of space heating units - Electric Resistance (%)         28.4         34.3         33.8         33         30.5         26.9         23.9           Sales of space heating units - Fossil (%)         13.7         19         18.9         18         16.1         13.6         12           Sales of space heating units - Gas (%)         49.5         35.1         34.6         33.4         30.5         25.7         21.2           Sales of water heating units - Electric Heat Pump (%)         0.054         0.328         1.13         3.24         6.62         9.51           Sales of water heating units - Electric Resistance (%)         52.4         66.9         67         67.1         67.8         69.2         70.5           Sales of water heating units - Gas Furnace (%)         47.6         33         32.6         31.8         29 <td>Residential HVAC investment in 2020s vs. REF -</td> <td>0</td> <td>0.511</td> <td>0.578</td> <td>0</td> <td>0</td> <td>0</td> <td>0</td>	Residential HVAC investment in 2020s vs. REF -	0	0.511	0.578	0	0	0	0
Sales of cooking units - Gas (%)       19.8       19.3       17.5       12.7       6.06       1.96       0.527         Sales of space heating units - Electric Heat Pump (%)       8.4       11.6       12.7       15.6       22.9       33.8       43         Sales of space heating units - Electric Resistance (%)       28.4       34.3       33.8       33       30.5       26.9       23.9         Sales of space heating units - Fossil (%)       13.7       19       18.9       18       16.1       13.6       12         Sales of space heating units - Gas (%)       49.5       35.1       34.6       33.4       30.5       25.7       21.2         Sales of water heating units - Electric Heat Pump (%)       0       0.054       0.328       1.13       3.24       6.62       9.51         Sales of water heating units - Electric Resistance (%)       52.4       66.9       67       67.1       67.8       69.2       70.5         Sales of water heating units - Gas Furnace (%)       47.6       33       32.6       31.8       29       24.2       19.9	Cumulative 5-yr (billion \$2018)							
Sales of space heating units - Electric Heat Pump (%)       8.4       11.6       12.7       15.6       22.9       33.8       43         Sales of space heating units - Electric Resistance (%)       28.4       34.3       33.8       33       30.5       26.9       23.9         Sales of space heating units - Fossil (%)       13.7       19       18.9       18       16.1       13.6       12         Sales of space heating units - Gas (%)       49.5       35.1       34.6       33.4       30.5       25.7       21.2         Sales of water heating units - Electric Heat Pump (%)       0       0.054       0.328       1.13       3.24       6.62       9.51         Sales of water heating units - Electric Resistance (%)       52.4       66.9       67       67.1       67.8       69.2       70.5         Sales of water heating units - Gas Furnace (%)       47.6       33       32.6       31.8       29       24.2       19.9	Sales of cooking units - Electric Resistance (%)	80.2	80.7	82.5	87.3	93.9	98	99.5
(%)       Sales of space heating units - Electric Resistance (%)       28.4       34.3       33.8       33       30.5       26.9       23.9         Sales of space heating units - Fossil (%)       13.7       19       18.9       18       16.1       13.6       12         Sales of space heating units - Gas (%)       49.5       35.1       34.6       33.4       30.5       25.7       21.2         Sales of water heating units - Electric Heat Pump (%)       0       0.054       0.328       1.13       3.24       6.62       9.51         Sales of water heating units - Electric Resistance (%)       52.4       66.9       67       67.1       67.8       69.2       70.5         Sales of water heating units - Gas Furnace (%)       47.6       33       32.6       31.8       29       24.2       19.9	Sales of cooking units - Gas (%)	19.8	19.3	17.5	12.7	6.06	1.96	0.527
Sales of space heating units - Electric Resistance (%)       28.4       34.3       33.8       33       30.5       26.9       23.9         Sales of space heating units - Fossil (%)       13.7       19       18.9       18       16.1       13.6       12         Sales of space heating units - Gas (%)       49.5       35.1       34.6       33.4       30.5       25.7       21.2         Sales of water heating units - Electric Heat Pump (%)       0       0.054       0.328       1.13       3.24       6.62       9.51         Sales of water heating units - Electric Resistance (%)       52.4       66.9       67       67.1       67.8       69.2       70.5         Sales of water heating units - Gas Furnace (%)       47.6       33       32.6       31.8       29       24.2       19.9	Sales of space heating units - Electric Heat Pump	8.4	11.6	12.7	15.6	22.9	33.8	43
(%)       Sales of space heating units - Fossil (%)       13.7       19       18.9       18       16.1       13.6       12         Sales of space heating units - Gas (%)       49.5       35.1       34.6       33.4       30.5       25.7       21.2         Sales of water heating units - Electric Heat Pump (%)       0       0.054       0.328       1.13       3.24       6.62       9.51         Sales of water heating units - Electric Resistance (%)       52.4       66.9       67       67.1       67.8       69.2       70.5         Sales of water heating units - Gas Furnace (%)       47.6       33       32.6       31.8       29       24.2       19.9	(%)							
Sales of space heating units - Fossil (%)       13.7       19       18.9       18       16.1       13.6       12         Sales of space heating units - Gas (%)       49.5       35.1       34.6       33.4       30.5       25.7       21.2         Sales of water heating units - Electric Heat Pump (%)       0.054       0.328       1.13       3.24       6.62       9.51         Sales of water heating units - Electric Resistance (%)       52.4       66.9       67       67.1       67.8       69.2       70.5         Sales of water heating units - Gas Furnace (%)       47.6       33       32.6       31.8       29       24.2       19.9	Sales of space heating units - Electric Resistance	28.4	34.3	33.8	33	30.5	26.9	23.9
Sales of space heating units - Gas (%)       49.5       35.1       34.6       33.4       30.5       25.7       21.2         Sales of water heating units - Electric Heat Pump (%)       0       0.054       0.328       1.13       3.24       6.62       9.51         Sales of water heating units - Electric Resistance (%)       52.4       66.9       67       67.1       67.8       69.2       70.5         Sales of water heating units - Gas Furnace (%)       47.6       33       32.6       31.8       29       24.2       19.9								
Sales of water heating units - Electric Heat Pump (%)       0       0.054       0.328       1.13       3.24       6.62       9.51         Sales of water heating units - Electric Resistance (%)       52.4       66.9       67       67.1       67.8       69.2       70.5         Sales of water heating units - Gas Furnace (%)       47.6       33       32.6       31.8       29       24.2       19.9	Sales of space heating units - Fossil (%)	13.7	19	18.9	18	16.1	13.6	12
(%)       Sales of water heating units - Electric Resistance       52.4       66.9       67       67.1       67.8       69.2       70.5         (%)       Sales of water heating units - Gas Furnace (%)       47.6       33       32.6       31.8       29       24.2       19.9	Sales of space heating units - Gas (%)	49.5	35.1	34.6	33.4	30.5	25.7	21.2
Sales of water heating units - Electric Resistance (%)       52.4       66.9       67       67.1       67.8       69.2       70.5         Sales of water heating units - Gas Furnace (%)       47.6       33       32.6       31.8       29       24.2       19.9	Sales of water heating units - Electric Heat Pump	0	0.054	0.328	1.13	3.24	6.62	9.51
(%)       Sales of water heating units - Gas Furnace (%)       47.6       33       32.6       31.8       29       24.2       19.9	(%)							
Sales of water heating units - Gas Furnace (%)         47.6         33         32.6         31.8         29         24.2         19.9	Sales of water heating units - Electric Resistance	52.4	66.9	67	67.1	67.8	69.2	70.5
	(%)							
Sales of water heating units - Other (%) 0.036 0.035 0.035 0.035 0.035 0.035	Sales of water heating units - Gas Furnace (%)	47.6	33	32.6	31.8	29	24.2	19.9
	Sales of water heating units - Other (%)	0.036	0.035	0.035	0.035	0.035	0.035	0.035

# Table 18: E- scenario - PILLAR 1: Efficiency/Electrification - Transportation

	•						
Item	2020	2025	2030	2035	2040	2045	2050
Light-duty vehicle capital costs - Cumulative 5-yr	0	0	27.7	58.9	198	626	911
(million \$2018)							
Public EV charging plugs - DC Fast (1000 units)	0.024	0	0.106	0	0.58	0	1.63
Public EV charging plugs - L2 (1000 units)	0.043	0	2.55	0	14	0	39.2
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 (%)	1.96	2.3	2.13	1.72	1.14	0.593	0.252

Table 18: E- scenario - PILLAR 1: Efficiency/Electrification - Transportation (continued)

Item	2020	2025	2030	2035	2040	2045	2050
Vehicle sales - Light-duty - EV (%)	1.41	3.65	9.65	22.3	44.4	69.4	86.5
Vehicle sales - Light-duty - gasoline (%)	93.2	89.4	83.1	71.2	50.7	27.7	12.1
Vehicle sales - Light-duty - hybrid (%)	3.19	4.09	4.66	4.44	3.53	2.2	1.11
Vehicle sales - Light-duty - hydrogen FC (%)	0.114	0.392	0.35	0.276	0.203	0.115	0.053
Vehicle sales - Light-duty - other (%)	0.121	0.124	0.116	0.102	0.075	0.042	0.019
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)	25.2	24.8	24.2	23.7	23.1	22.6	22.2
Final energy use - Industry (PJ)	124	130	132	133	133	134	134
Final energy use - Residential (PJ)	38.3	36.3	34.8	33.5	32.4	31.2	29.7
Final energy use - Transportation (PJ)	104	98.2	91.1	85.7	81.6	76.8	71

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

2020	2025	2030	2035	2040	2045	2050
0	2,165	2,363	0	0	0	0
44.8	49.3	53.1	63	76.9	85.5	88.5
55.2	50.7	46.9	37	23.1	14.5	11.5
6.09	3.87	4.9	7.61	14.7	26.5	37
9.99	5.53	5.63	6.05	7.05	8.18	8.82
9.8	2.84	2.83	2.55	2.12	1.71	1.57
74.1	87.8	86.6	83.8	76.1	63.6	52.6
1.62	0.913	1.44	2.92	6.86	13.4	19.4
13.6	7.24	7.77	9.19	13.1	19.6	25.5
82.1	90.8	89.8	86.9	79.2	66.1	54.3
2.67	1.01	0.99	0.955	0.899	0.868	0.856
	9.99 9.8 74.1 1.62 13.6	0 2,165  44.8 49.3  55.2 50.7  6.09 3.87  9.99 5.53  9.8 2.84  74.1 87.8  1.62 0.913  13.6 7.24  82.1 90.8	0     2,165     2,363       44.8     49.3     53.1       55.2     50.7     46.9       6.09     3.87     4.9       9.99     5.53     5.63       9.8     2.84     2.83       74.1     87.8     86.6       1.62     0.913     1.44       13.6     7.24     7.77       82.1     90.8     89.8	0     2,165     2,363     0       44.8     49.3     53.1     63       55.2     50.7     46.9     37       6.09     3.87     4.9     7.61       9.99     5.53     5.63     6.05       9.8     2.84     2.83     2.55       74.1     87.8     86.6     83.8       1.62     0.913     1.44     2.92       13.6     7.24     7.77     9.19       82.1     90.8     89.8     86.9	0       2,165       2,363       0       0         44.8       49.3       53.1       63       76.9         55.2       50.7       46.9       37       23.1         6.09       3.87       4.9       7.61       14.7         9.99       5.53       5.63       6.05       7.05         9.8       2.84       2.83       2.55       2.12         74.1       87.8       86.6       83.8       76.1         1.62       0.913       1.44       2.92       6.86         13.6       7.24       7.77       9.19       13.1         82.1       90.8       89.8       86.9       79.2	0       2,165       2,363       0       0       0         44.8       49.3       53.1       63       76.9       85.5         55.2       50.7       46.9       37       23.1       14.5         6.09       3.87       4.9       7.61       14.7       26.5         9.99       5.53       5.63       6.05       7.05       8.18         9.8       2.84       2.83       2.55       2.12       1.71         74.1       87.8       86.6       83.8       76.1       63.6         1.62       0.913       1.44       2.92       6.86       13.4         13.6       7.24       7.77       9.19       13.1       19.6         82.1       90.8       89.8       86.9       79.2       66.1

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

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Item	2020	2025	2030	2035	2040	2045	2050
Electricity distribution capital invested -	0	0.635	0.643	0.813	0.84	1.28	1.36
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	-551
Corn-ethanol to energy grasses (1000 tC02e/y)			
Carbon sink potential - Aggressive deployment -	0	0	-10,108
Cropland measures (1000 tCO2e/y)			
Carbon sink potential - Aggressive deployment -	0	0	-660
Permanent conservation cover (1000 tCO2e/y)			
Carbon sink potential - Aggressive deployment -	0	0	-11,319
Total (1000 tC02e/y)			
Carbon sink potential - Moderate deployment -	0	0	-551
Corn-ethanol to energy grasses (1000 tC02e/y)			
Carbon sink potential - Moderate deployment -	0	0	-5,330
Cropland measures (1000 tCO2e/y)			
Carbon sink potential - Moderate deployment -	0	0	-330
Permanent conservation cover (1000 tCO2e/y)			

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

Item	2020	2025	2050
Carbon sink potential - Moderate deployment -	0	0	-6,211
Total (1000 tCO2e/y)			
Land impacted for carbon sink - Aggressive	0	0	300
deployment - Corn-ethanol to energy grasses			
(1000 hectares)			
Land impacted for carbon sink - Aggressive	0	0	9,928
deployment - Cropland measures (1000			
hectares)			
Land impacted for carbon sink - Aggressive	0	0	1,092
deployment - Permanent conservation cover			
(1000 hectares)			
Land impacted for carbon sink - Aggressive	0	0	11,320
deployment - Total (1000 hectares)			
Land impacted for carbon sink - Moderate	0	0	300
deployment - Corn-ethanol to energy grasses			
(1000 hectares)			
Land impacted for carbon sink - Moderate	0	0	5,237
deployment - Cropland measures (1000			
hectares)			
Land impacted for carbon sink - Moderate	0	0	546
deployment - Permanent conservation cover			
(1000 hectares)			
Land impacted for carbon sink - Moderate	0	0	6,083
deployment - Total (1000 hectares)			

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

Table 23: E- scenario - PILLAR 6: Land sinks - Foi			
Item	2020	2025	2050
Carbon sink potential - High - Accelerate	0	0	38.5
regeneration (1000 tCO2e/y)			00.500
Carbon sink potential - High - All (not counting	0	0	23,528
overlap) (1000 tCO2e/y)			
Carbon sink potential - High - Avoid deforestation	0	0	821
(1000 tCO2e/y)			
Carbon sink potential - High - Extend rotation	0	0	414
length (1000 tCO2e/y)			
Carbon sink potential - High - Improve	0	0	20.6
plantations (1000 tCO2e/y)			
Carbon sink potential - High - Increase retention	0	0	41.5
of HWP (1000 tC02e/y)			
Carbon sink potential - High - Increase trees	0	0	3,342
outside forests (1000 tCO2e/y)			
Carbon sink potential - High - Reforest cropland	0	0	13,386
(1000 tC02e/y)			
Carbon sink potential - High - Reforest pasture	0	0	5,274
(1000 tC02e/y)			
Carbon sink potential - High - Restore	0	0	191
productivity (1000 tCO2e/y)			
Carbon sink potential - Low - Accelerate	0	0	19.3
regeneration (1000 tC02e/y)			
Carbon sink potential - Low - All (not counting	0	0	8,666
overlap) (1000 tCO2e/y)			
Carbon sink potential - Low - Avoid deforestation	0	0	137
(1000 tCO2e/y)			
Carbon sink potential - Low - Extend rotation	0	0	159
length (1000 tCO2e/y)			
Carbon sink potential - Low - Improve	0	0	10.5
plantations (1000 tC02e/y)			
Carbon sink potential - Low - Increase retention	0	0	13.8
of HWP (1000 tCO2e/y)		-	
Carbon sink potential - Low - Increase trees	0	0	1,170
outside forests (1000 tCO2e/y)	9	<b>5</b>	., 0
Carbon sink potential - Low - Reforest cropland	0	0	6,693
(1000 tC02e/y)	9	<b>5</b>	0,070
(1000 (0020/ ))			

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

Table 23: <i>E- scenario - PILLAR 6: Land sinks - Fo</i> Item	2020	2025	2050
Carbon sink potential - Low - Reforest pasture	0	0	400
(1000 tC02e/y)			
Carbon sink potential - Low - Restore	0	0	64.3
productivity (1000 tCO2e/y)	_		
Carbon sink potential - Mid - Accelerate	0	0	28.9
regeneration (1000 tC02e/y)	0	0	1/ 007
Carbon sink potential - Mid - All (not counting	0	0	16,097
overlap) (1000 tC02e/y)	0	0	/70
Carbon sink potential - Mid - Avoid deforestation	0	0	479
(1000 tC02e/y)  Carbon sink potential - Mid - Extend rotation	0	0	20/
length (1000 tCO2e/y)	0	U	286
Carbon sink potential - Mid - Improve plantations	0	0	15.4
(1000 tCO2e/y)		0	10.4
Carbon sink potential - Mid - Increase retention	0	0	27.6
of HWP (1000 tCO2e/y)		Ŭ	21.0
Carbon sink potential - Mid - Increase trees	0	0	2,256
outside forests (1000 tC02e/y)			_,
Carbon sink potential - Mid - Reforest cropland	0	0	10,039
(1000 tC02e/y)			,
Carbon sink potential - Mid - Reforest pasture	0	0	2,837
(1000 tC02e/y)			,
Carbon sink potential - Mid - Restore	0	0	127
productivity (1000 tCO2e/y)			
Land impacted for carbon sink potential - High -	0	0	6.3
Accelerate regeneration (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	111
Avoid deforestation (over 30 years) (1000			
hectares)			
Land impacted for carbon sink potential - High -	0	0	211
Extend rotation length (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	7.59
Improve plantations (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	0
Increase retention of HWP (1000 hectares)			017
Land impacted for carbon sink potential - High -	0	0	317
Increase trees outside forests (1000 hectares)	0	0	005
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)	0	0	885
Land impacted for carbon sink potential - High -	0	0	150
Reforest pasture (1000 hectares)	0	0	130
Land impacted for carbon sink potential - High -	0	0	63.2
Restore productivity (1000 hectares)		0	03.2
Land impacted for carbon sink potential - High -	0	0	1,752
Total impacted (over 30 years) (1000 hectares)		0	1,1 02
Land impacted for carbon sink potential - Low -	0	0	3.15
Accelerate regeneration (1000 hectares)		0	0.10
Land impacted for carbon sink potential - Low -	0	0	104
Avoid deforestation (over 30 years) (1000			
hectares)			
Land impacted for carbon sink potential - Low -	0	0	80.8
Extend rotation length (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	3.79
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	167
Increase trees outside forests (1000 hectares)		-	
Land impacted for carbon sink potential - Low -	0	0	443
Reforest cropland (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	26
Reforest pasture (1000 hectares)	1		

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

Item	2020	2025	2050
Land impacted for carbon sink potential - Low -	0	0	38.2
Restore productivity (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	866
Total impacted (over 30 years) (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	4.72
Accelerate regeneration (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	108
Avoid deforestation (over 30 years) (1000			
hectares)			
Land impacted for carbon sink potential - Mid -	0	0	146
Extend rotation length (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	5.71
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	242
Increase trees outside forests (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	664
Reforest cropland (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	188
Reforest pasture (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	77
Restore productivity (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	1,435
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 (million 2019\$)	0	25.1	0.018	0.018	0.013	0.008	0
Monetary damages from air pollution - Natural Gas (million 2019\$)	0	6.06	2.98	1.58	0.901	0.439	0.301
Monetary damages from air pollution - Transportation (million 2019\$)	0	24.6	24.4	23.4	20.8	16.4	11.1
Premature deaths from air pollution - Coal (deaths)	0	2.82	0.002	0.002	0.001	0.001	0
Premature deaths from air pollution - Natural Gas (deaths)	0	0.684	0.337	0.178	0.102	0.05	0.034
Premature deaths from air pollution - Transportation (deaths)	0	2.77	2.75	2.63	2.34	1.84	1.25

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

•						
2020	2025	2030	2035	2040	2045	2050
0	0.514	0.598	0	0	0	0
80.2	84.4	97.3	99.9	100	100	100
19.8	15.6	2.66	0.134	0	0	0
8.4	12.9	25.9	58.5	84	88	87.9
28.4	34.1	30.9	19.4	10.1	8.76	8.9
13.7	18.3	14.3	8.01	3.29	2.43	2.5
49.5	34.6	28.9	14.1	2.65	0.854	0.684
0	0.203	3.49	14.3	21.9	23	23.1
52.4	66.9	67.7	71.6	76.1	76.8	76.8
47.6	32.8	28.8	14	2.01	0.152	0
0.036	0.035	0.035	0.035	0.035	0.035	0.035
	80.2 19.8 8.4 28.4 13.7 49.5 0	0 0.514  80.2 84.4  19.8 15.6  8.4 12.9  28.4 34.1  13.7 18.3  49.5 34.6  0 0.203  52.4 66.9  47.6 32.8	0     0.514     0.598       80.2     84.4     97.3       19.8     15.6     2.66       8.4     12.9     25.9       28.4     34.1     30.9       13.7     18.3     14.3       49.5     34.6     28.9       0     0.203     3.49       52.4     66.9     67.7       47.6     32.8     28.8	0     0.514     0.598     0       80.2     84.4     97.3     99.9       19.8     15.6     2.66     0.134       8.4     12.9     25.9     58.5       28.4     34.1     30.9     19.4       13.7     18.3     14.3     8.01       49.5     34.6     28.9     14.1       0     0.203     3.49     14.3       52.4     66.9     67.7     71.6       47.6     32.8     28.8     14	0     0.514     0.598     0     0       80.2     84.4     97.3     99.9     100       19.8     15.6     2.66     0.134     0       8.4     12.9     25.9     58.5     84       28.4     34.1     30.9     19.4     10.1       13.7     18.3     14.3     8.01     3.29       49.5     34.6     28.9     14.1     2.65       0     0.203     3.49     14.3     21.9       52.4     66.9     67.7     71.6     76.1       47.6     32.8     28.8     14     2.01	0     0.514     0.598     0     0     0       80.2     84.4     97.3     99.9     100     100       19.8     15.6     2.66     0.134     0     0       8.4     12.9     25.9     58.5     84     88       28.4     34.1     30.9     19.4     10.1     8.76       13.7     18.3     14.3     8.01     3.29     2.43       49.5     34.6     28.9     14.1     2.65     0.854       0     0.203     3.49     14.3     21.9     23       52.4     66.9     67.7     71.6     76.1     76.8       47.6     32.8     28.8     14     2.01     0.152

Table 1/ L F. DF Laggrapia	PILLAR 1. Efficiency/Electrification -	Transportation
IANIE 76. F+RF+ SCENALIO -	PILLAR I. FAILIBUL///FIBLILILILULIUU =	Irangnartatian

Item	2020	2025	2030	2035	2040	2045	2050
Light-duty vehicle capital costs - Cumulative 5-yr	0	173	442	719	1,088	1,186	1,130
(million \$2018)							
Public EV charging plugs - DC Fast (1000 units)	0.024	0	0.353	0	1.57	0	2.54
Public EV charging plugs - L2 (1000 units)	0.043	0	8.49	0	37.8	0	61.2
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 (%)	1.96	2.17	1.42	0.461	0.082	0.013	0
Vehicle sales - Light-duty - EV (%)	2.56	11.1	39.9	79.2	96	99.3	100
Vehicle sales - Light-duty - gasoline (%)	92.2	82.7	55.6	19.2	3.64	0.601	0
Vehicle sales - Light-duty - hybrid (%)	3.1	3.59	2.75	1.07	0.251	0.052	0
Vehicle sales - Light-duty - hydrogen FC (%)	0.113	0.363	0.237	0.075	0.015	0.002	0
Vehicle sales - Light-duty - other (%)	0.12	0.116	0.081	0.029	0.005	0.001	0
Vehicle sales - Medium-duty - diesel (%)	64.7	59.7	42.3	14.4	2.59	0.384	0
Vehicle sales - Medium-duty - EV (%)	0.784	5.07	25.3	60.8	76.5	79.5	80
Vehicle sales - Medium-duty - gasoline (%)	33.7	33.3	25.5	9.32	1.77	0.277	0
Vehicle sales - Medium-duty - hybrid (%)	0.363	0.402	0.341	0.14	0.03	0.005	0
Vehicle sales - Medium-duty - hydrogen FC (%)	0.196	1.27	6.33	15.2	19.1	19.9	20
Vehicle sales - Medium-duty - other (%)	0.253	0.255	0.205	0.083	0.019	0.004	0

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

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Commercial (PJ)	25.2	24.8	24	22.9	21.6	20.3	19.5
Final energy use - Industry (PJ)	124	130	131	130	129	129	130
Final energy use - Residential (PJ)	38.3	36.3	34.5	31.9	28.4	25	22.3
Final energy use - Transportation (PJ)	104	97.6	88.2	76.6	66	59.6	57.2

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

Item	2020	2025	2030	2035	2040	2045	2050
Commercial HVAC investment in 2020s -	0	2,165	2,361	0	0	0	0
Cumulative 5-yr (million \$2018)							
Sales of cooking units - Electric Resistance (%)	44.8	57.1	84	89.3	89.6	89.6	89.6
Sales of cooking units - Gas (%)	55.2	42.9	16	10.7	10.4	10.4	10.4
Sales of space heating units - Electric Heat Pump	6.09	4.46	15.5	53	81.8	86.3	86.7
(%)							
Sales of space heating units - Electric Resistance	9.99	5.81	8.04	12	12.9	12.9	12.9
(%)							
Sales of space heating units - Fossil (%)	9.8	2.42	0.475	0.02	0	0	0
Sales of space heating units - Gas Furnace (%)	74.1	87.3	76	35	5.3	0.843	0.483
Sales of water heating units - Electric Heat Pump	1.62	1.17	6.88	27.5	44	46.5	46.7
(%)							
Sales of water heating units - Electric Resistance	13.6	7.49	13.1	33.4	49.8	52.4	52.6
(%)							
Sales of water heating units - Gas Furnace (%)	82.1	90.4	79.3	38.4	5.51	0.416	0
Sales of water heating units - Other (%)	2.67	0.964	0.742	0.696	0.692	0.695	0.695

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

Item	2020	2025	2030	2035	2040	2045	2050
Electricity distribution capital invested -	0	0.777	0.801	1.5	1.61	1.57	1.66
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 - Wind - Base (billion \$2018)	0	0	0	0.709	3.37	14.5	34.2

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

Item	2020	2025	2030	2035	2040	2045	2050
Wind - Base land use assumptions (GWh)	19,216	0	0	1,979	10,111	45,398	109,133
Wind - Constrained land use assumptions (GWh)	19,216	0	5,101	17,283	87,977	331,379	126,597

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

Item	2020	2025	2050
Carbon sink potential - Aggressive deployment -	0	0	-551
Corn-ethanol to energy grasses (1000 tC02e/y)		U	-331
Carbon sink potential - Aggressive deployment -	0	0	-10,108
Cropland measures (1000 tC02e/y)		_	,
Carbon sink potential - Aggressive deployment -	0	0	-660
Permanent conservation cover (1000 tC02e/y)			
Carbon sink potential - Aggressive deployment -	0	0	-11,319
Total (1000 tC02e/y)			
Carbon sink potential - Moderate deployment -	0	0	-551
Corn-ethanol to energy grasses (1000 tC02e/y)			
Carbon sink potential - Moderate deployment -	0	0	-5,330
Cropland measures (1000 tCO2e/y)			
Carbon sink potential - Moderate deployment -	0	0	-330
Permanent conservation cover (1000 tCO2e/y)			
Carbon sink potential - Moderate deployment -	0	0	-6,211
Total (1000 tC02e/y)			
Land impacted for carbon sink - Aggressive	0	0	300
deployment - Corn-ethanol to energy grasses			
(1000 hectares)			
Land impacted for carbon sink - Aggressive	0	0	9,928
deployment - Cropland measures (1000			
hectares)			
Land impacted for carbon sink - Aggressive	0	0	1,092
deployment - Permanent conservation cover			
(1000 hectares)			11 000
Land impacted for carbon sink - Aggressive	0	0	11,320
deployment - Total (1000 hectares)	0		000
Land impacted for carbon sink - Moderate	0	0	300
deployment - Corn-ethanol to energy grasses (1000 hectares)			
Land impacted for carbon sink - Moderate	0	0	5,237
deployment - Cropland measures (1000	"	U	5,237
hectares)			
Land impacted for carbon sink - Moderate	0	0	546
deployment - Permanent conservation cover	"	U	540
(1000 hectares)			
Land impacted for carbon sink - Moderate	0	0	6,083
deployment - Total (1000 hectares)		3	5,000
200.07			

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

Item	2020	2025	2050
Carbon sink potential - High - Accelerate	0	0	38.5
regeneration (1000 tCO2e/y)			
Carbon sink potential - High - All (not counting	0	0	23,528
overlap) (1000 tCO2e/y)			
Carbon sink potential - High - Avoid deforestation	0	0	821
(1000 tC02e/y)			
Carbon sink potential - High - Extend rotation	0	0	414
length (1000 tCO2e/y)			
Carbon sink potential - High - Improve	0	0	20.6
plantations (1000 tCO2e/y)			
Carbon sink potential - High - Increase retention	0	0	41.5
of HWP (1000 tCO2e/y)			
Carbon sink potential - High - Increase trees	0	0	3,342
outside forests (1000 tCO2e/y)			
Carbon sink potential - High - Reforest cropland	0	0	13,386
(1000 tC02e/y)			

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

		ontinued)	
	2020	2025	2050
Carbon sink potential - High - Reforest pasture	0	0	5,274
(1000 tCO2e/y)			
Carbon sink potential - High - Restore	0	0	191
productivity (1000 tCO2e/y)			
Carbon sink potential - Low - Accelerate	0	0	19.3
regeneration (1000 tCO2e/y)			
Carbon sink potential - Low - All (not counting	0	0	8,666
overlap) (1000 tCO2e/y)			
Carbon sink potential - Low - Avoid deforestation	0	0	137
(1000 tC02e/y)			
Carbon sink potential - Low - Extend rotation	0	0	159
length (1000 tC02e/y)			
Carbon sink potential - Low - Improve	0	0	10.5
plantations (1000 tCO2e/y)			
Carbon sink potential - Low - Increase retention	0	0	13.8
of HWP (1000 tC02e/y)			
Carbon sink potential - Low - Increase trees	0	0	1,170
outside forests (1000 tCO2e/y)			.
Carbon sink potential - Low - Reforest cropland	0	0	6,693
(1000 tCO2e/y)			,
Carbon sink potential - Low - Reforest pasture	0	0	400
(1000 tC02e/y)			
Carbon sink potential - Low - Restore	0	0	64.3
productivity (1000 tCO2e/y)			
Carbon sink potential - Mid - Accelerate	0	0	28.9
regeneration (1000 tCO2e/y)			
Carbon sink potential - Mid - All (not counting	0	0	16,097
overlap) (1000 tC02e/y)			-,-
Carbon sink potential - Mid - Avoid deforestation	0	0	479
(1000 tCO2e/y)			,
Carbon sink potential - Mid - Extend rotation	0	0	286
length (1000 tCO2e/y)			
Carbon sink potential - Mid - Improve plantations	0	0	15.4
(1000 tCO2e/y)			
Carbon sink potential - Mid - Increase retention	0	0	27.6
of HWP (1000 tC02e/y)			
Carbon sink potential - Mid - Increase trees	0	0	2,256
outside forests (1000 tC02e/y)		0	2,200
Carbon sink potential - Mid - Reforest cropland	0	0	10,039
(1000 tCO2e/y)			10,007
Carbon sink potential - Mid - Reforest pasture	0	0	2,837
(1000 tCO2e/y)	0	0	2,001
Carbon sink potential - Mid - Restore	0	0	127
productivity (1000 tC02e/y)	0	0	121
Land impacted for carbon sink potential - High -	0	0	6.3
Accelerate regeneration (1000 hectares)	0	0	0.5
Land impacted for carbon sink potential - High -	0	0	111
Avoid deforestation (over 30 years) (1000	0	0	'''
hectares)			
Land impacted for carbon sink potential - High -	0	0	211
Extend rotation length (1000 hectares)	0	0	۷۱۱
Land impacted for carbon sink potential - High -	0	0	7.59
Improve plantations (1000 hectares)	3	0	1.07
Land impacted for carbon sink potential - High -	0	0	0
Increase retention of HWP (1000 hectares)	0	0	U
Land impacted for carbon sink potential - High -	0	0	317
Increase trees outside forests (1000 hectares)	U	υ	311
	0		005
Land impacted for carbon sink potential - High -	U	0	885
Reforest cropland (1000 hectares)	0		150
Land impacted for carbon sink potential - High -	0	0	150
Reforest pasture (1000 hectares)			/00
Land impacted for carbon sink potential - High -	0	0	63.2
Restore productivity (1000 hectares)			

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

Table 33: E+RE+ scenario - PILLAR 6: Land sink		ntinueaj	
Item	2020	2025	2050
Land impacted for carbon sink potential - High -	0	0	1,752
Total impacted (over 30 years) (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	3.15
Accelerate regeneration (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	104
Avoid deforestation (over 30 years) (1000			
hectares)			
Land impacted for carbon sink potential - Low -	0	0	80.8
Extend rotation length (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	3.79
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	167
Increase trees outside forests (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	443
Reforest cropland (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	26
Reforest pasture (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	38.2
Restore productivity (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	866
Total impacted (over 30 years) (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	4.72
Accelerate regeneration (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	108
Avoid deforestation (over 30 years) (1000			
hectares)			
Land impacted for carbon sink potential - Mid -	0	0	146
Extend rotation length (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	5.71
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	242
Increase trees outside forests (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	664
Reforest cropland (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	188
Reforest pasture (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	77
Restore productivity (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	1,435
Total impacted (over 30 years) (1000 hectares)			

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

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal	0	25.1	0.018	0.018	0.013	0.008	0
(million 2019\$)							
Monetary damages from air pollution - Natural	0	5.51	2.94	1.21	0.905	0.477	0.264
Gas (million 2019\$)							
Monetary damages from air pollution -	0	24.3	22.3	16.7	9.47	4.22	1.6
Transportation (million 2019\$)							
Premature deaths from air pollution - Coal	0	2.82	0.002	0.002	0.001	0.001	0
(deaths)							
Premature deaths from air pollution - Natural	0	0.623	0.332	0.136	0.102	0.054	0.03
Gas (deaths)							
Premature deaths from air pollution -	0	2.73	2.51	1.88	1.06	0.474	0.179
Transportation (deaths)							

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

Item	2020	2025	2030	2035	2040	2045	2050
Residential HVAC investment in 2020s vs. REF -	0	0.514	0.598	0	0	0	0
Cumulative 5-yr (billion \$2018)							
Sales of cooking units - Electric Resistance (%)	80.2	84.4	97.3	99.9	100	100	100
Sales of cooking units - Gas (%)	19.8	15.6	2.66	0.134	0	0	0
Sales of space heating units - Electric Heat Pump	8.4	12.9	25.9	58.5	84	88	87.9
(%)							
Sales of space heating units - Electric Resistance	28.4	34.1	30.9	19.4	10.1	8.76	8.9
(%)							
Sales of space heating units - Fossil (%)	13.7	18.3	14.3	8.01	3.29	2.43	2.5
Sales of space heating units - Gas (%)	49.5	34.6	28.9	14.1	2.65	0.854	0.684
Sales of water heating units - Electric Heat Pump	0	0.203	3.49	14.3	21.9	23	23.1
(%)							
Sales of water heating units - Electric Resistance	52.4	66.9	67.7	71.6	76.1	76.8	76.8
(%)							
Sales of water heating units - Gas Furnace (%)	47.6	32.8	28.8	14	2.01	0.152	0
Sales of water heating units - Other (%)	0.036	0.035	0.035	0.035	0.035	0.035	0.035

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	173	442	719	1,088	1,186	1,130
(million \$2018)							
Public EV charging plugs - DC Fast (1000 units)	0.024	0	0.353	0	1.57	0	2.54
Public EV charging plugs - L2 (1000 units)	0.043	0	8.49	0	37.8	0	61.2
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 (%)	1.96	2.17	1.42	0.461	0.082	0.013	0
Vehicle sales - Light-duty - EV (%)	2.56	11.1	39.9	79.2	96	99.3	100
Vehicle sales - Light-duty - gasoline (%)	92.2	82.7	55.6	19.2	3.64	0.601	0
Vehicle sales - Light-duty - hybrid (%)	3.1	3.59	2.75	1.07	0.251	0.052	0
Vehicle sales - Light-duty - hydrogen FC (%)	0.113	0.363	0.237	0.075	0.015	0.002	0
Vehicle sales - Light-duty - other (%)	0.12	0.116	0.081	0.029	0.005	0.001	0
Vehicle sales - Medium-duty - diesel (%)	64.7	59.7	42.3	14.4	2.59	0.384	0
Vehicle sales - Medium-duty - EV (%)	0.784	5.07	25.3	60.8	76.5	79.5	80
Vehicle sales - Medium-duty - gasoline (%)	33.7	33.3	25.5	9.32	1.77	0.277	0
Vehicle sales - Medium-duty - hybrid (%)	0.363	0.402	0.341	0.14	0.03	0.005	0
Vehicle sales - Medium-duty - hydrogen FC (%)	0.196	1.27	6.33	15.2	19.1	19.9	20
Vehicle sales - Medium-duty - other (%)	0.253	0.255	0.205	0.083	0.019	0.004	0

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

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Commercial (PJ)	25.2	24.8	24	22.9	21.6	20.3	19.5
Final energy use - Industry (PJ)	124	130	131	130	129	129	130
Final energy use - Residential (PJ)	38.3	36.3	34.5	31.9	28.4	25	22.3
Final energy use - Transportation (PJ)	104	97.6	88.2	76.6	66	59.6	57.2

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

Item	2020	2025	2030	2035	2040	2045	2050
Commercial HVAC investment in 2020s -	0	2,165	2,361	0	0	0	0
Cumulative 5-yr (million \$2018)							
Sales of cooking units - Electric Resistance (%)	44.8	57.1	84	89.3	89.6	89.6	89.6
Sales of cooking units - Gas (%)	55.2	42.9	16	10.7	10.4	10.4	10.4
Sales of space heating units - Electric Heat Pump (%)	6.09	4.46	15.5	53	81.8	86.3	86.7
Sales of space heating units - Electric Resistance (%)	9.99	5.81	8.04	12	12.9	12.9	12.9
Sales of space heating units - Fossil (%)	9.8	2.42	0.475	0.02	0	0	0

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

Item	2020	2025	2030	2035	2040	2045	2050
Sales of space heating units - Gas Furnace (%)	74.1	87.3	76	35	5.3	0.843	0.483
Sales of water heating units - Electric Heat Pump (%)	1.62	1.17	6.88	27.5	44	46.5	46.7
Sales of water heating units - Electric Resistance (%)	13.6	7.49	13.1	33.4	49.8	52.4	52.6
Sales of water heating units - Gas Furnace (%)	82.1	90.4	79.3	38.4	5.51	0.416	0
Sales of water heating units - Other (%)	2.67	0.964	0.742	0.696	0.692	0.695	0.695

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

Item	2020	2025	2030	2035	2040	2045	2050
Electricity distribution capital invested -	0	0.777	0.801	1.5	1.61	1.57	1.66
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 - Wind - Base (billion \$2018)	0	0	0	0	0.232	0.325	0
Capital invested - Wind - Constrained (billion \$2018)	0	0	0.248	1.04	2.61	3.33	0.033

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

Item	2020	2025	2030	2035	2040	2045	2050
Wind - Base land use assumptions (GWh)	19,216	0	0	0	679	1,013	0
Wind - Constrained land use assumptions (GWh)	19,216	0	659	2,950	7,822	10,362	106

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

Table 42. ETRE Section 10 TIEE/IN 6. Earla Siliko	rigilicalital		
Item	2020	2025	2050
Carbon sink potential - Aggressive deployment -	0	0	-551
Corn-ethanol to energy grasses (1000 tCO2e/y)			
Carbon sink potential - Aggressive deployment -	0	0	-10,108
Cropland measures (1000 tCO2e/y)			
Carbon sink potential - Aggressive deployment -	0	0	-660
Permanent conservation cover (1000 tCO2e/y)			
Carbon sink potential - Aggressive deployment -	0	0	-11,319
Total (1000 tCO2e/y)			
Carbon sink potential - Moderate deployment -	0	0	-551
Corn-ethanol to energy grasses (1000 tC02e/y)			
Carbon sink potential - Moderate deployment -	0	0	-5,330
Cropland measures (1000 tC02e/y)			
Carbon sink potential - Moderate deployment -	0	0	-330
Permanent conservation cover (1000 tC02e/y)			
Carbon sink potential - Moderate deployment -	0	0	-6,211
Total (1000 tC02e/y)			
Land impacted for carbon sink - Aggressive	0	0	300
deployment - Corn-ethanol to energy grasses			
(1000 hectares)			
Land impacted for carbon sink - Aggressive	0	0	9,928
deployment - Cropland measures (1000			
hectares)			
Land impacted for carbon sink - Aggressive	0	0	1,092
deployment - Permanent conservation cover			
(1000 hectares)			
Land impacted for carbon sink - Aggressive	0	0	11,320
deployment - Total (1000 hectares)			
Land impacted for carbon sink - Moderate	0	0	300
deployment - Corn-ethanol to energy grasses			
(1000 hectares)			
Land impacted for carbon sink - Moderate	0	0	5,237
deployment - Cropland measures (1000			
hectares)			

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

Item	2020	2025	2050
Land impacted for carbon sink - Moderate	0	0	546
deployment - Permanent conservation cover (1000 hectares)			
Land impacted for carbon sink - Moderate	0	0	6,083
deployment - Total (1000 hectares)			

Table 43: E+RE- scenario - PILLAR 6: Land sinks	- Forests		
Item	2020	2025	2050
Carbon sink potential - High - Accelerate regeneration (1000 tCO2e/y)	0	0	38.5
Carbon sink potential - High - All (not counting overlap) (1000 tCO2e/y)	0	0	23,528
Carbon sink potential - High - Avoid deforestation (1000 tCO2e/y)	0	0	821
Carbon sink potential - High - Extend rotation length (1000 tC02e/y)	0	0	414
Carbon sink potential - High - Improve plantations (1000 tCO2e/y)	0	0	20.6
Carbon sink potential - High - Increase retention	0	0	41.5
of HWP (1000 tC02e/y)  Carbon sink potential - High - Increase trees	0	0	3,342
outside forests (1000 tC02e/y)  Carbon sink potential - High - Reforest cropland	0	0	13,386
(1000 tC02e/y)  Carbon sink potential - High - Reforest pasture	0	0	5,274
(1000 tCO2e/y)  Carbon sink potential - High - Restore	0	0	191
productivity (1000 tC02e/y) Carbon sink potential - Low - Accelerate	0	0	19.3
regeneration (1000 tCO2e/y)  Carbon sink potential - Low - All (not counting	0	0	8,666
overlap) (1000 tCO2e/y) Carbon sink potential - Low - Avoid deforestation	0	0	137
(1000 tCO2e/y)  Carbon sink potential - Low - Extend rotation	0	0	159
length (1000 tC02e/y) Carbon sink potential - Low - Improve	0	0	10.5
plantations (1000 tC02e/y)  Carbon sink potential - Low - Increase retention	0	0	13.8
of HWP (1000 tCO2e/y)  Carbon sink potential - Low - Increase trees	0	0	1,170
outside forests (1000 tC02e/y)  Carbon sink potential - Low - Reforest cropland	0	0	6,693
(1000 tCO2e/y)  Carbon sink potential - Low - Reforest pasture	0	0	400
(1000 tCO2e/y)  Carbon sink potential - Low - Restore	0	0	64.3
productivity (1000 tCO2e/y)			
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO2e/y)	0	0	28.9
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO2e/y)	0	0	16,097
Carbon sink potential - Mid - Avoid deforestation (1000 tCO2e/y)	0	0	479
Carbon sink potential - Mid - Extend rotation length (1000 tCO2e/y)	0	0	286
Carbon sink potential - Mid - Improve plantations (1000 tCO2e/y)	0	0	15.4
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO2e/y)	0	0	27.6
Carbon sink potential - Mid - Increase trees outside forests (1000 tC02e/y)	0	0	2,256

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

Table 43: E+RE- scenario - PILLAR 6: Land sinks	: - Forests (co	ntinued)	
Item	2020	2025	2050
Carbon sink potential - Mid - Reforest cropland	0	0	10,039
(1000 tCO2e/y)			
Carbon sink potential - Mid - Reforest pasture	0	0	2,837
(1000 tC02e/y)			
Carbon sink potential - Mid - Restore	0	0	127
productivity (1000 tCO2e/y)			
Land impacted for carbon sink potential - High -	0	0	6.3
Accelerate regeneration (1000 hectares)		•	0.0
Land impacted for carbon sink potential - High -	0	0	111
Avoid deforestation (over 30 years) (1000		•	
hectares)			
Land impacted for carbon sink potential - High -	0	0	211
Extend rotation length (1000 hectares)		0	211
Land impacted for carbon sink potential - High -	0	0	7.59
	"	0	1.39
Improve plantations (1000 hectares)		0	
Land impacted for carbon sink potential - High -	0	0	0
Increase retention of HWP (1000 hectares)			0.47
Land impacted for carbon sink potential - High -	0	0	317
Increase trees outside forests (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	885
Reforest cropland (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	150
Reforest pasture (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	63.2
Restore productivity (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	1,752
Total impacted (over 30 years) (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	3.15
Accelerate regeneration (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	104
Avoid deforestation (over 30 years) (1000			
hectares)			
Land impacted for carbon sink potential - Low -	0	0	80.8
Extend rotation length (1000 hectares)			00.0
Land impacted for carbon sink potential - Low -	0	0	3.79
Improve plantations (1000 hectares)		•	0.17
Land impacted for carbon sink potential - Low -	0	0	0
Increase retention of HWP (1000 hectares)		0	U
Land impacted for carbon sink potential - Low -	0	0	167
	0	0	101
Increase trees outside forests (1000 hectares)		0	/ / 0
Land impacted for carbon sink potential - Low -	0	0	443
Reforest cropland (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	26
Reforest pasture (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	38.2
Restore productivity (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	866
Total impacted (over 30 years) (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	4.72
Accelerate regeneration (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	108
Avoid deforestation (over 30 years) (1000			
hectares)			
Land impacted for carbon sink potential - Mid -	0	0	146
Extend rotation length (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	5.71
Improve plantations (1000 hectares)			J
Land impacted for carbon sink potential - Mid -	0	0	0
Increase retention of HWP (1000 hectares)		٦	3
Land impacted for carbon sink potential - Mid -	0	0	242
	"	U	242
Increase trees outside forests (1000 hectares)		0	<u> </u>
Land impacted for carbon sink potential - Mid -	0	0	664
Reforest cropland (1000 hectares)			

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

Item	2020	2025	2050
Land impacted for carbon sink potential - Mid -	0	0	188
Reforest pasture (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	77
Restore productivity (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	1,435
Total impacted (over 30 years) (1000 hectares)			

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

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal (million 2019\$)	0	25.1	0.018	0.018	0.013	0.008	0
Monetary damages from air pollution - Natural Gas (million 2019\$)	0	6.1	3.38	3.33	3.08	1.42	0.481
Monetary damages from air pollution - Transportation (million 2019\$)	0	24.3	22.3	16.7	9.47	4.22	1.6
Premature deaths from air pollution - Coal (deaths)	0	2.82	0.002	0.002	0.001	0.001	0
Premature deaths from air pollution - Natural Gas (deaths)	0	0.689	0.381	0.376	0.348	0.16	0.054
Premature deaths from air pollution - Transportation (deaths)	0	2.73	2.51	1.88	1.06	0.474	0.179

# Table 45: E-B+ scenario - PILLAR 1: Efficiency/Electrification - Residential

Item	2020	2025	2030	2035	2040	2045	2050
Residential HVAC investment in 2020s vs. REF -	0	0.511	0.578	0	0	0	0
Cumulative 5-yr (billion \$2018)							
Sales of cooking units - Electric Resistance (%)	80.2	80.7	82.5	87.3	93.9	98	99.5
Sales of cooking units - Gas (%)	19.8	19.3	17.5	12.7	6.06	1.96	0.527
Sales of space heating units - Electric Heat Pump	8.4	11.6	12.7	15.6	22.9	33.8	43
(%)							
Sales of space heating units - Electric Resistance	28.4	34.3	33.8	33	30.5	26.9	23.9
(%)							
Sales of space heating units - Fossil (%)	13.7	19	18.9	18	16.1	13.6	12
Sales of space heating units - Gas (%)	49.5	35.1	34.6	33.4	30.5	25.7	21.2
Sales of water heating units - Electric Heat Pump	0	0.054	0.328	1.13	3.24	6.62	9.51
(%)							
Sales of water heating units - Electric Resistance	52.4	66.9	67	67.1	67.8	69.2	70.5
(%)							
Sales of water heating units - Gas Furnace (%)	47.6	33	32.6	31.8	29	24.2	19.9
Sales of water heating units - Other (%)	0.036	0.035	0.035	0.035	0.035	0.035	0.035

# 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	27.7	58.9	198	626	911
(million \$2018)							
Public EV charging plugs - DC Fast (1000 units)	0.024	0	0.106	0	0.58	0	1.63
Public EV charging plugs - L2 (1000 units)	0.043	0	2.55	0	14	0	39.2
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 (%)	1.96	2.3	2.13	1.72	1.14	0.593	0.252
Vehicle sales - Light-duty - EV (%)	1.41	3.65	9.65	22.3	44.4	69.4	86.5
Vehicle sales - Light-duty - gasoline (%)	93.2	89.4	83.1	71.2	50.7	27.7	12.1
Vehicle sales - Light-duty - hybrid (%)	3.19	4.09	4.66	4.44	3.53	2.2	1.11
Vehicle sales - Light-duty - hydrogen FC (%)	0.114	0.392	0.35	0.276	0.203	0.115	0.053
Vehicle sales - Light-duty - other (%)	0.121	0.124	0.116	0.102	0.075	0.042	0.019
Vehicle sales - Medium-duty - diesel (%)	64.8	62.2	57.7	49.4	35.6	19.6	8.37

Table 46: E-B+ scenario - PILLAR 1: Efficiency/El	ectrification	n - Transpo	rtation (coi	ntinued)			
Item	2020	2025	2030	2035	2040	2045	2050
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/Ele Item Final energy use - Commercial (PJ) Final energy use - Industry (PJ) Final energy use - Residential (PJ) Final energy use - Transportation (PJ)	2020 25.2 124 38.3 104	2025 24.8 130 36.3 98.2	2030 24.2 132 34.8 91.1	2035 23.7 133 33.5 85.7	2040 23.1 133 32.4 81.6	2045 22.6 134 31.2 76.8	2050 22.2 134 29.7 71
Table 48: E-B+ scenario - PILLAR 1: Efficiency/El	lectrification	n - Commer	rcial				
Item	2020	2025	2030	2035	2040	2045	2050
Commercial HVAC investment in 2020s -	2020	2,165	2,363	0	2040	2045	2050
Cumulative 5-yr (million \$2018)	_			-			
Sales of cooking units - Electric Resistance (%)	44.8	49.3	53.1	63	76.9	85.5	88.5
Sales of cooking units - Gas (%)	55.2	50.7	46.9	37	23.1	14.5	11.5
Sales of space heating units - Electric Heat Pump (%)	6.09	3.87	4.9	7.61	14.7	26.5	37
Sales of space heating units - Electric Resistance (%)	9.99	5.53	5.63	6.05	7.05	8.18	8.82
Sales of space heating units - Fossil (%)	9.8	2.84	2.83	2.55	2.12	1.71	1.57
Sales of space heating units - Gas Furnace (%)	74.1	87.8	86.6	83.8	76.1	63.6	52.6
Sales of water heating units - Electric Heat Pump (%)	1.62	0.913	1.44	2.92	6.86	13.4	19.4
Sales of water heating units - Electric Resistance (%)	13.6	7.24	7.77	9.19	13.1	19.6	25.5
Sales of water heating units - Gas Furnace (%)	82.1	90.8	89.8	86.9	79.2	66.1	54.3
Sales of water heating units - Other (%)	2.67	1.01	0.99	0.955	0.899	0.868	0.856
Table 49: E-B+ scenario - PILLAR 1: Efficiency/El	ectrification	n - Electricii	ty demand				
Item	2020	2025	2030	2035	2040	2045	2050
Electricity distribution capital invested - Cumulative 5-yr (billion \$2018)	0	0.635	0.643	0.813	0.84	1.28	1.36
Table 50: <i>E-B+ scenario - PILLAR 2: Clean Electr</i> Item	ricity - Gene 2020	rating capa 2025	city 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	0.025	0	0	0
plant (billion \$2018) Capital invested - Biomass w/ccu power plant	0	0	0.093	0	0	0	0
(billion \$2018)							
Table 51: E-B+ scenario - PILLAR 2: Clean Electri	icity - Gener	ration					
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	25.4	25.4	25.4	25.4
Biomass w/ccu power plant (GWh)	0	0	104	104	104	104	104
Table 52: E-B+ scenario - PILLAR 3: Clean fuels -	- Bioenergy						
Item	2020	2025	2030	2035	2040	2045	2050
Biomass purchases (million \$2018/year)	0	0	7.15	1,263	1,720	2,728	2,728

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

Item	2020	2025	2030	2035	2040	2045	2050
Conversion capital investment - Cumulative 5-yr	0	0	85.5	14,002	5,075	11,208	0
(million \$2018)							
Number of facilities - Allam power w ccu	0	0	0	1	1	1	1
(quantity)							
Number of facilities - Beccs hydrogen (quantity)	0	0	0	15	19	32	32
Number of facilities - Diesel (quantity)	0	0	0	0	0	0	0
Number of facilities - Diesel ccu (quantity)	0	0	0	1	1	1	1
Number of facilities - Power (quantity)	0	0	0	0	0	0	0
Number of facilities - Power ccu (quantity)	0	0	1	1	1	1	1
Number of facilities - Pyrolysis (quantity)	0	0	0	0	0	0	0
Number of facilities - Pyrolysis ccu (quantity)	0	0	0	1	1	1	1
Number of facilities - Sng (quantity)	0	0	0	0	0	0	0
Number of facilities - Sng ccu (quantity)	0	0	1	1	1	1	1

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

Item	2020	2025	2030	2035	2040	2045	2050
Annual - All (MMT)	0	0	0.11	18.1	24.6	39	39
Annual - BECCS (MMT)	0	0	0.11	18	24.6	39	39
Annual - Cement and lime (MMT)	0	0	0	0	0	0	0
Annual - NGCC (MMT)	0	0	0	0.02	0.02	0.01	0.01
Cumulative - All (MMT)	0	0	0.11	18.2	42.8	81.8	121
Cumulative - BECCS (MMT)	0	0	0.11	18.1	42.7	81.7	121
Cumulative - Cement and lime (MMT)	0	0	0	0	0	0	0
Cumulative - NGCC (MMT)	0	0	0	0.02	0.04	0.05	0.06

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

Item	2020	2025	2030	2035	2040	2045	2050
CO2 storage (MMT)	0	0	4.62	20.3	40.4	56.1	58.5
Injection wells (wells)	0	0	10	38	68	113	141
Resource characterization, appraisal, permitting costs (million \$2020)	0	135	623	975	975	975	975
Wells and facilities construction costs (million \$2020)	0	0	293	1,142	2,035	3,403	4,225

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

Item	2020	2025	2030	2035	2040	2045	2050
All (km)	0	0	455	2,328	2,992	3,878	3,913
Cumulative investment - All (million \$2018)	0	0	366	3,445	3,929	5,013	5,032
Cumulative investment - Spur (million \$2018)	0	0	166	1,623	2,107	3,191	3,210
Cumulative investment - Trunk (million \$2018)	0	0	199	1,822	1,822	1,822	1,822
Spur (km)	0	0	317	1,882	2,546	3,432	3,467
Trunk (km)	0	0	138	446	446	446	446

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

	5	-	
Item	2020	2025	2050
Carbon sink potential - Aggressive deployment -	0	0	-1,265
Corn-ethanol to energy grasses (1000 tCO2e/y)			
Carbon sink potential - Aggressive deployment -	0	0	-9,446
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	-619
Permanent conservation cover (1000 tCO2e/y)			
Carbon sink potential - Aggressive deployment -	0	0	-11,329
Total (1000 tC02e/y)			
Carbon sink potential - Moderate deployment -	0	0	-1,265
Corn-ethanol to energy grasses (1000 tCO2e/y)			

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

Table 56: E-B+ Scenario - PILLAR 6: Lana Sinks -	•	•	•
Item	2020	2025	2050
Carbon sink potential - Moderate deployment -	0	0	-4,981
Cropland measures (1000 tCO2e/y)			
Carbon sink potential - Moderate deployment -	0	0	0
Cropland to woody energy crops (1000 tCO2e/y)			
Carbon sink potential - Moderate deployment -	0	0	0
Pasture to energy crops (1000 tCO2e/y)			
Carbon sink potential - Moderate deployment -	0	0	-309
Permanent conservation cover (1000 tCO2e/y)			
Carbon sink potential - Moderate deployment -	0	0	-6,555
Total (1000 tC02e/y)			
Land impacted for carbon sink - Aggressive	0	0	925
deployment - Corn-ethanol to energy grasses			
(1000 hectares)			
Land impacted for carbon sink - Aggressive	0	0	22,983
deployment - Cropland measures (1000			
hectares)			
Land impacted for carbon sink - Aggressive	0	0	63.5
deployment - Cropland to woody energy crops			
(1000 hectares)			
Land impacted for carbon sink - Aggressive	0	0	0
deployment - Pasture to energy crops (1000			
hectares)			
Land impacted for carbon sink - Aggressive	0	0	1,024
deployment - Permanent conservation cover			
(1000 hectares)			
Land impacted for carbon sink - Aggressive	0	0	24,995
deployment - Total (1000 hectares)			
Land impacted for carbon sink - Moderate	0	0	925
deployment - Corn-ethanol to energy grasses			
(1000 hectares)			
Land impacted for carbon sink - Moderate	0	0	4,910
deployment - Cropland measures (1000			
hectares)			
Land impacted for carbon sink - Moderate	0	0	63.5
deployment - Cropland to woody energy crops			
(1000 hectares)			
Land impacted for carbon sink - Moderate	0	0	0
deployment - Pasture to energy crops (1000			
hectares)			
Land impacted for carbon sink - Moderate	0	0	512
deployment - Permanent conservation cover			
(1000 hectares)			
Land impacted for carbon sink - Moderate	0	0	6,411
deployment - Total (1000 hectares)			

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

Item	2020	2025	2050
Carbon sink potential - High - Accelerate	0	0	38.5
regeneration (1000 tCO2e/y)			
Carbon sink potential - High - All (not counting	0	0	23,528
overlap) (1000 tCO2e/y)			
Carbon sink potential - High - Avoid deforestation	0	0	821
(1000 tC02e/y)			
Carbon sink potential - High - Extend rotation	0	0	414
length (1000 tCO2e/y)			
Carbon sink potential - High - Improve	0	0	20.6
plantations (1000 tCO2e/y)			
Carbon sink potential - High - Increase retention	0	0	41.5
of HWP (1000 tCO2e/y)			
Carbon sink potential - High - Increase trees	0	0	3,342
outside forests (1000 tCO2e/y)			
Carbon sink potential - High - Reforest cropland	0	0	13,386
(1000 tC02e/y)			

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

Table 57: E-B+ scenario - PILLAR 6: Land sinks -	Forests (con		
Item	2020	2025	2050
Carbon sink potential - High - Reforest pasture	0	0	5,274
(1000 tCO2e/y)			
Carbon sink potential - High - Restore	0	0	191
productivity (1000 tCO2e/y)			
Carbon sink potential - Low - Accelerate	0	0	19.3
regeneration (1000 tCO2e/y)			
Carbon sink potential - Low - All (not counting	0	0	8,666
overlap) (1000 tCO2e/y)			
Carbon sink potential - Low - Avoid deforestation	0	0	137
(1000 tCO2e/y)			
Carbon sink potential - Low - Extend rotation	0	0	159
length (1000 tCO2e/y)			
Carbon sink potential - Low - Improve	0	0	10.5
plantations (1000 tCO2e/y)			
Carbon sink potential - Low - Increase retention	0	0	13.8
of HWP (1000 tCO2e/y)			
Carbon sink potential - Low - Increase trees	0	0	1,170
outside forests (1000 tCO2e/y)			.
Carbon sink potential - Low - Reforest cropland	0	0	6,693
(1000 tC02e/y)			, l
Carbon sink potential - Low - Reforest pasture	0	0	400
(1000 tC02e/y)		-	
Carbon sink potential - Low - Restore	0	0	64.3
productivity (1000 tCO2e/y)			00
Carbon sink potential - Mid - Accelerate	0	0	28.9
regeneration (1000 tC02e/y)		ı	20.7
Carbon sink potential - Mid - All (not counting	0	0	16,097
overlap) (1000 tCO2e/y)			10,071
Carbon sink potential - Mid - Avoid deforestation	0	0	479
(1000 tCO2e/y)		0	717
Carbon sink potential - Mid - Extend rotation	0	0	286
length (1000 tCO2e/y)		0	200
Carbon sink potential - Mid - Improve plantations	0	0	15.4
(1000 tC02e/y)		0	13.4
Carbon sink potential - Mid - Increase retention	0	0	27.6
of HWP (1000 tCO2e/y)		0	21.0
Carbon sink potential - Mid - Increase trees	0	0	2,256
outside forests (1000 tCO2e/y)	"	0	2,230
	0	0	10.020
Carbon sink potential - Mid - Reforest cropland	"	0	10,039
(1000 tC02e/y)	0	0	0.007
Carbon sink potential - Mid - Reforest pasture	0	0	2,837
(1000 tC02e/y)			107
Carbon sink potential - Mid - Restore	0	0	127
productivity (1000 tC02e/y)			
Land impacted for carbon sink potential - High -	0	0	6.3
Accelerate regeneration (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	111
Avoid deforestation (over 30 years) (1000			
hectares)			
Land impacted for carbon sink potential - High -	0	0	211
Extend rotation length (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	7.59
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	317
Increase trees outside forests (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	885
Reforest cropland (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	150
Reforest pasture (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	63.2
Restore productivity (1000 hectares)		-	33.2

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

Table 57: E-B+ Scenario - PILLAR 6: Lana Sinks -			
Item	2020	2025	2050
Land impacted for carbon sink potential - High -	0	0	1,752
Total impacted (over 30 years) (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	3.15
Accelerate regeneration (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	104
Avoid deforestation (over 30 years) (1000			
hectares)			
Land impacted for carbon sink potential - Low -	0	0	80.8
Extend rotation length (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	3.79
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	167
Increase trees outside forests (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	443
Reforest cropland (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	26
Reforest pasture (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	38.2
Restore productivity (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	866
Total impacted (over 30 years) (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	4.72
Accelerate regeneration (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	108
Avoid deforestation (over 30 years) (1000			
hectares)			
Land impacted for carbon sink potential - Mid -	0	0	146
Extend rotation length (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	5.71
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	242
Increase trees outside forests (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	664
Reforest cropland (1000 hectares)		ŭ	
Land impacted for carbon sink potential - Mid -	0	0	188
Reforest pasture (1000 hectares)		J	.00
Land impacted for carbon sink potential - Mid -	0	0	77
Restore productivity (1000 hectares)		O	''
Land impacted for carbon sink potential - Mid -	0	0	1,435
		O	1,-00
Total impacted (over 30 years) (1000 hectares)			., .55

 ${\it Table 58: REF \, scenario - PILLAR \, 1: \, Efficiency/Electrification - Residential}$ 

Item	2020	2025	2030	2035	2040	2045	2050
Residential HVAC investment in 2020s vs. REF -	0	0.501	0.505	0	0	0	0
Cumulative 5-yr (billion \$2018)							
Sales of cooking units - Electric Resistance (%)	80	80	80	80	80	80	80
Sales of cooking units - Gas (%)	20	20	20	20	20	20	20
Sales of space heating units - Electric Heat Pump	8.16	12.8	12.9	13.2	13.6	14.2	14.8
(%)							
Sales of space heating units - Electric Resistance	28.5	33.8	33.6	33.4	32.8	32.4	31.9
(%)							
Sales of space heating units - Fossil (%)	13.8	18.3	17.1	16.2	15.9	15.6	15.8
Sales of space heating units - Gas (%)	49.6	35.1	36.3	37.2	37.7	37.8	37.6
Sales of water heating units - Electric Heat Pump	0	0	0	0	0	0	0
(%)							
Sales of water heating units - Electric Resistance	52.4	66.9	66.9	66.7	66.7	66.6	66.5
(%)							
Sales of water heating units - Gas Furnace (%)	47.6	33.1	33.1	33.3	33.3	33.4	33.4
Sales of water heating units - Other (%)	0.036	0.035	0.035	0.035	0.035	0.035	0.035

Table 59: REF scenario	PTI I AR 1. Efficie	ncv/Flectrification	- Transportation
Table 07. NET Section to	1 1 L L A N 1. L I I I C I C	HICV/ LICCLI HICULIOH	ii aiioboi tatioii

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 (%)	1.96	2.31	2.26	2.09	1.9	1.78	1.69
Vehicle sales - Light-duty - EV (%)	2.22	3.88	4.45	5.36	6.61	7.88	8.97
Vehicle sales - Light-duty - gasoline (%)	92.5	89.3	87.8	86.5	84.8	82.9	81.2
Vehicle sales - Light-duty - hybrid (%)	3.11	4.04	4.96	5.55	6.2	6.95	7.69
Vehicle sales - Light-duty - hydrogen FC (%)	0.113	0.391	0.37	0.335	0.337	0.341	0.353
Vehicle sales - Light-duty - other (%)	0.12	0.124	0.122	0.123	0.124	0.123	0.127
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)	25.2	25.4	25.5	25.4	25.2	25.4	26
Final energy use - Industry (PJ)	124	133	138	143	148	154	160
Final energy use - Residential (PJ)	38.3	36.6	35.5	34.8	34.5	34.4	34.4
Final energy use - Transportation (PJ)	104	98.2	91.8	88.1	88.4	90.8	94

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

Item	2020	2025	2030	2035	2040	2045	2050
Commercial HVAC investment in 2020s -	0	2,141	2,215	0	0	0	0
Cumulative 5-yr (million \$2018)							
Sales of cooking units - Electric Resistance (%)	44.8	47.8	47.9	47.8	47.9	47.9	48
Sales of cooking units - Gas (%)	55.2	52.2	52.1	52.2	52.1	52.1	52
Sales of space heating units - Electric Heat Pump (%)	6.09	9.24	32.5	59.3	67.6	69.1	69.4
Sales of space heating units - Electric Resistance (%)	9.99	6.97	13.8	23.6	29.3	30.1	30.1
Sales of space heating units - Fossil (%)	9.8	2.76	2.28	1.06	0.17	0.016	0
Sales of space heating units - Gas Furnace (%)	74.1	81	51.4	16	2.93	0.762	0.485
Sales of water heating units - Electric Heat Pump (%)	1.62	0.827	0.827	0.829	0.828	0.824	0.82
Sales of water heating units - Electric Resistance (%)	13.6	7.16	7.17	7.13	7.14	7.14	7.13
Sales of water heating units - Gas Furnace (%)	82.1	91	91	91	91	91	91
Sales of water heating units - Other (%)	2.67	1.01	1.01	1.01	1	1.01	1.01

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

Item	2020	2025	2030	2035	2040	2045	2050
Electricity distribution capital invested -	0	0.725	0.744	0.892	0.926	0.943	0.974
Cumulative 5-yr (billion \$2018)							

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

Item	2020	2025	2030	2050
Business-as-usual carbon sink - Natural uptake	-1.19	0	0.158	0.045
(Mt CO2e/y)				
Business-as-usual carbon sink - Retained in	-0.011	0	-0.023	-0.025
Hardwood Products (Mt CO2e/y)				
Business-as-usual carbon sink - Total (Mt CO2e/y)	-1.2	0	0.135	0.021
Carbon sink potential - High - Accelerate	0	0	0	38.5
regeneration (1000 tCO2e/y)				

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

Carbon sink potential - High - All (not counting overlap) (1000 tCO2e/y)	2050 3,528 821 414 20.6 41.5 3,342 3,386 5,274 191 19.3 8,666 137 159
overlap) (1000 tCO2e/y)         0         0         0           Carbon sink potential - High - Avoid deforestation (1000 tCO2e/y)         0         0         0           Carbon sink potential - High - Extend rotation length (1000 tCO2e/y)         0         0         0         0           Carbon sink potential - High - Improve plantations (1000 tCO2e/y)         0	821 414 20.6 41.5 3,342 3,386 5,274 191 19.3 8,666 137
Carbon sink potential - High - Avoid deforestation (1000 tCO2e/y)  Carbon sink potential - High - Extend rotation 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	414 20.6 41.5 3,342 3,386 5,274 191 19.3 8,666 137
Carbon sink potential - High - Extend rotation   O   O   O     length (1000 tC02e/y)	414 20.6 41.5 3,342 3,386 5,274 191 19.3 8,666 137
Carbon sink potential - High - Extend rotation length (1000 tCO2e/y) Carbon sink potential - High - Improve plantations (1000 tCO2e/y) Carbon sink potential - High - Increase retention of HWP (1000 tCO2e/y) Carbon sink potential - High - Increase trees of the potential - High - Increase trees of the potential - High - Increase trees of the potential - High - Reforest cropland of the potential - High - Reforest cropland of the potential - High - Reforest cropland of the potential - High - Reforest pasture of the productivity (1000 tCO2e/y) Carbon sink potential - High - Restore productivity (1000 tCO2e/y) Carbon sink potential - Low - Accelerate of the productivity (1000 tCO2e/y) Carbon sink potential - Low - All (not counting of the potential - Low - All (not counting of the potential - Low - Avoid deforestation of the potential - Low - Avoid deforestation of the potential - Low - Extend rotation of the potential - Low - Improve of the potential - Low - Increase retention of the potential - Low - Increase retention of the potential - Low - Increase retention of the potential - Low - Increase trees of the potential - Low - Reforest cropland of the potential - Low - Reforest cro	20.6 41.5 3,342 3,386 5,274 191 19.3 8,666 137
Length (1000 tC02e/y)	20.6 41.5 3,342 3,386 5,274 191 19.3 8,666 137
Carbon sink potential - High - Improve plantations (1000 tC02e/y)  Carbon sink potential - High - Increase retention of HWP (1000 tC02e/y)  Carbon sink potential - High - Increase trees outside forests (1000 tC02e/y)  Carbon sink potential - High - Reforest cropland (1000 tC02e/y)  Carbon sink potential - High - Reforest pasture (1000 tC02e/y)  Carbon sink potential - High - Restore productivity (1000 tC02e/y)  Carbon sink potential - Low - Accelerate pregeneration (1000 tC02e/y)  Carbon sink potential - Low - All (not counting overlap) (1000 tC02e/y)  Carbon sink potential - Low - Avoid deforestation (1000 tC02e/y)  Carbon sink potential - Low - Avoid deforestation outloot conductivity (1000 tC02e/y)  Carbon sink potential - Low - Extend rotation outloof toode (1000 tC02e/y)  Carbon sink potential - Low - Increase retention outloof HWP (1000 tC02e/y)  Carbon sink potential - Low - Increase trees outside forests (1000 tC02e/y)  Carbon sink potential - Low - Increase trees outside forests (1000 tC02e/y)  Carbon sink potential - Low - Increase trees outside forests (1000 tC02e/y)  Carbon sink potential - Low - Increase trees outside forests (1000 tC02e/y)  Carbon sink potential - Low - Increase trees outside forests (1000 tC02e/y)  Carbon sink potential - Low - Increase trees outside forests (1000 tC02e/y)	41.5 3,342 3,386 5,274 191 19.3 8,666 137
plantations (1000 tCO2e/y)  Carbon sink potential - High - Increase retention of HWP (1000 tCO2e/y)  Carbon sink potential - High - Increase trees outside forests (1000 tCO2e/y)  Carbon sink potential - High - Reforest cropland (1000 tCO2e/y)  Carbon sink potential - High - Reforest pasture (1000 tCO2e/y)  Carbon sink potential - High - Reforest pasture (1000 tCO2e/y)  Carbon sink potential - High - Restore opland (1000 tCO2e/y)  Carbon sink potential - Low - Accelerate opland (1000 tCO2e/y)  Carbon sink potential - Low - All (not counting operation (1000 tCO2e/y)  Carbon sink potential - Low - All (not counting operation (1000 tCO2e/y)  Carbon sink potential - Low - Avoid deforestation (1000 tCO2e/y)  Carbon sink potential - Low - Extend rotation oplength (1000 tCO2e/y)  Carbon sink potential - Low - Increase retention oplength (1000 tCO2e/y)  Carbon sink potential - Low - Increase retention oplength (1000 tCO2e/y)  Carbon sink potential - Low - Increase retention oplength (1000 tCO2e/y)  Carbon sink potential - Low - Increase retention oplength (1000 tCO2e/y)  Carbon sink potential - Low - Increase retention oplength (1000 tCO2e/y)  Carbon sink potential - Low - Increase trees oplength (1000 tCO2e/y)  Carbon sink potential - Low - Increase trees oplength (1000 tCO2e/y)  Carbon sink potential - Low - Increase trees oplength (1000 tCO2e/y)  Carbon sink potential - Low - Increase trees oplength (1000 tCO2e/y)  Carbon sink potential - Low - Increase trees oplength (1000 tCO2e/y)  Carbon sink potential - Low - Increase trees oplength (1000 tCO2e/y)	41.5 3,342 3,386 5,274 191 19.3 8,666 137
plantations (1000 tCO2e/y)  Carbon sink potential - High - Increase retention of HWP (1000 tCO2e/y)  Carbon sink potential - High - Increase trees outside forests (1000 tCO2e/y)  Carbon sink potential - High - Reforest cropland (1000 tCO2e/y)  Carbon sink potential - High - Reforest pasture (1000 tCO2e/y)  Carbon sink potential - High - Reforest pasture (1000 tCO2e/y)  Carbon sink potential - High - Restore opland (1000 tCO2e/y)  Carbon sink potential - Low - Accelerate opland (1000 tCO2e/y)  Carbon sink potential - Low - All (not counting operation (1000 tCO2e/y)  Carbon sink potential - Low - All (not counting operation (1000 tCO2e/y)  Carbon sink potential - Low - Avoid deforestation (1000 tCO2e/y)  Carbon sink potential - Low - Extend rotation oplength (1000 tCO2e/y)  Carbon sink potential - Low - Increase retention oplength (1000 tCO2e/y)  Carbon sink potential - Low - Increase retention oplength (1000 tCO2e/y)  Carbon sink potential - Low - Increase retention oplength (1000 tCO2e/y)  Carbon sink potential - Low - Increase retention oplength (1000 tCO2e/y)  Carbon sink potential - Low - Increase retention oplength (1000 tCO2e/y)  Carbon sink potential - Low - Increase trees oplength (1000 tCO2e/y)  Carbon sink potential - Low - Increase trees oplength (1000 tCO2e/y)  Carbon sink potential - Low - Increase trees oplength (1000 tCO2e/y)  Carbon sink potential - Low - Increase trees oplength (1000 tCO2e/y)  Carbon sink potential - Low - Increase trees oplength (1000 tCO2e/y)  Carbon sink potential - Low - Increase trees oplength (1000 tCO2e/y)	3,342 3,386 5,274 191 19.3 8,666 137
Carbon sink potential - High - Increase retention of HWP (1000 tCO2e/y)  Carbon sink potential - High - Increase trees outside forests (1000 tCO2e/y)  Carbon sink potential - High - Reforest cropland (1000 tCO2e/y)  Carbon sink potential - High - Reforest pasture (1000 tCO2e/y)  Carbon sink potential - High - Restore productivity (1000 tCO2e/y)  Carbon sink potential - Low - Accelerate outside forestial (1000 tCO2e/y)  Carbon sink potential - Low - Accelerate outside forestial (1000 tCO2e/y)  Carbon sink potential - Low - All (not counting outside forestalial outside forestalial outside forests (1000 tCO2e/y)  Carbon sink potential - Low - Extend rotation outside forestial outside forests (1000 tCO2e/y)  Carbon sink potential - Low - Improve outside forests (1000 tCO2e/y)  Carbon sink potential - Low - Increase retention outside forests (1000 tCO2e/y)  Carbon sink potential - Low - Increase trees outside forests (1000 tCO2e/y)  Carbon sink potential - Low - Increase trees outside forests (1000 tCO2e/y)  Carbon sink potential - Low - Reforest cropland outside forests (1000 tCO2e/y)	3,342 3,386 5,274 191 19.3 8,666 137
of HWP (1000 tCO2e/y)  Carbon sink potential - High - Increase trees	3,342 3,386 5,274 191 19.3 8,666 137
Carbon sink potential - High - Increase trees outside forests (1000 tC02e/y)  Carbon sink potential - High - Reforest cropland (1000 tC02e/y)  Carbon sink potential - High - Reforest pasture (1000 tC02e/y)  Carbon sink potential - High - Restore productivity (1000 tC02e/y)  Carbon sink potential - Low - Accelerate regeneration (1000 tC02e/y)  Carbon sink potential - Low - All (not counting overlap) (1000 tC02e/y)  Carbon sink potential - Low - Avoid deforestation (1000 tC02e/y)  Carbon sink potential - Low - Extend rotation length (1000 tC02e/y)  Carbon sink potential - Low - Improve plantations (1000 tC02e/y)  Carbon sink potential - Low - Increase retention of HWP (1000 tC02e/y)  Carbon sink potential - Low - Increase trees of outside forests (1000 tC02e/y)  Carbon sink potential - Low - Increase trees outside forests (1000 tC02e/y)  Carbon sink potential - Low - Increase trees outside forests (1000 tC02e/y)  Carbon sink potential - Low - Increase trees outside forests (1000 tC02e/y)  Carbon sink potential - Low - Reforest cropland	3,386  5,274  191  19.3  8,666  137
outside forests (1000 tCO2e/y)  Carbon sink potential - High - Reforest cropland (1000 tCO2e/y)  Carbon sink potential - High - Reforest pasture (1000 tCO2e/y)  Carbon sink potential - High - Restore productivity (1000 tCO2e/y)  Carbon sink potential - Low - Accelerate pregeneration (1000 tCO2e/y)  Carbon sink potential - Low - All (not counting poverlap) (1000 tCO2e/y)  Carbon sink potential - Low - Avoid deforestation (1000 tCO2e/y)  Carbon sink potential - Low - Avoid deforestation (1000 tCO2e/y)  Carbon sink potential - Low - Extend rotation pound (1000 tCO2e/y)  Carbon sink potential - Low - Extend rotation pound (1000 tCO2e/y)  Carbon sink potential - Low - Improve plantations (1000 tCO2e/y)  Carbon sink potential - Low - Increase retention pound (1000 tCO2e/y)  Carbon sink potential - Low - Increase retention pound (1000 tCO2e/y)  Carbon sink potential - Low - Increase trees pound (1000 tCO2e/y)  Carbon sink potential - Low - Increase trees pound (1000 tCO2e/y)  Carbon sink potential - Low - Increase trees pound (1000 tCO2e/y)  Carbon sink potential - Low - Increase trees pound (1000 tCO2e/y)  Carbon sink potential - Low - Increase trees pound (1000 tCO2e/y)  Carbon sink potential - Low - Increase trees pound (1000 tCO2e/y)	3,386  5,274  191  19.3  8,666  137
Carbon sink potential - High - Reforest cropland [1000 tC02e/y]  Carbon sink potential - High - Reforest pasture [1000 tC02e/y]  Carbon sink potential - High - Restore productivity (1000 tC02e/y)  Carbon sink potential - Low - Accelerate regeneration (1000 tC02e/y)  Carbon sink potential - Low - All (not counting overlap) (1000 tC02e/y)  Carbon sink potential - Low - Avoid deforestation [1000 tC02e/y]  Carbon sink potential - Low - Extend rotation length (1000 tC02e/y)  Carbon sink potential - Low - Improve plantations (1000 tC02e/y)  Carbon sink potential - Low - Increase retention of HWP (1000 tC02e/y)  Carbon sink potential - Low - Increase trees outside forests (1000 tC02e/y)  Carbon sink potential - Low - Increase trees outside forests (1000 tC02e/y)  Carbon sink potential - Low - Increase trees outside forests (1000 tC02e/y)  Carbon sink potential - Low - Reforest cropland	5,274 191 19.3 8,666 137
(1000 tC02e/y)000Carbon sink potential - High - Reforest pasture (1000 tC02e/y)000Carbon sink potential - High - Restore productivity (1000 tC02e/y)000Carbon sink potential - Low - Accelerate regeneration (1000 tC02e/y)000Carbon sink potential - Low - All (not counting overlap) (1000 tC02e/y)000Carbon sink potential - Low - Avoid deforestation (1000 tC02e/y)000Carbon sink potential - Low - Extend rotation length (1000 tC02e/y)000Carbon sink potential - Low - Improve plantations (1000 tC02e/y)000Carbon sink potential - Low - Increase retention of HWP (1000 tC02e/y)000Carbon sink potential - Low - Increase trees outside forests (1000 tC02e/y)000Carbon sink potential - Low - Reforest cropland000	5,274 191 19.3 8,666 137
Carbon sink potential - High - Reforest pasture (1000 tCO2e/y)  Carbon sink potential - High - Restore productivity (1000 tCO2e/y)  Carbon sink potential - Low - Accelerate regeneration (1000 tCO2e/y)  Carbon sink potential - Low - All (not counting overlap) (1000 tCO2e/y)  Carbon sink potential - Low - Avoid deforestation (1000 tCO2e/y)  Carbon sink potential - Low - Extend rotation length (1000 tCO2e/y)  Carbon sink potential - Low - Improve plantations (1000 tCO2e/y)  Carbon sink potential - Low - Increase retention of HWP (1000 tCO2e/y)  Carbon sink potential - Low - Increase trees outside forests (1000 tCO2e/y)  Carbon sink potential - Low - Increase trees outside forests (1000 tCO2e/y)  Carbon sink potential - Low - Reforest cropland  O  O  O  O  O  O  O  O  O  O  O  O  O	191 19.3 8,666 137
Carbon sink potential - High - Restore productivity (1000 tCO2e/y)  Carbon sink potential - Low - Accelerate regeneration (1000 tCO2e/y)  Carbon sink potential - Low - All (not counting overlap) (1000 tCO2e/y)  Carbon sink potential - Low - Avoid deforestation (1000 tCO2e/y)  Carbon sink potential - Low - Avoid deforestation (1000 tCO2e/y)  Carbon sink potential - Low - Extend rotation (1000 tCO2e/y)  Carbon sink potential - Low - Improve plantations (1000 tCO2e/y)  Carbon sink potential - Low - Increase retention of HWP (1000 tCO2e/y)  Carbon sink potential - Low - Increase retention of HWP (1000 tCO2e/y)  Carbon sink potential - Low - Increase trees outside forests (1000 tCO2e/y)  Carbon sink potential - Low - Reforest cropland oo	191 19.3 8,666 137
Carbon sink potential - High - Restore productivity (1000 tCO2e/y)  Carbon sink potential - Low - Accelerate regeneration (1000 tCO2e/y)  Carbon sink potential - Low - All (not counting overlap) (1000 tCO2e/y)  Carbon sink potential - Low - Avoid deforestation (1000 tCO2e/y)  Carbon sink potential - Low - Extend rotation of length (1000 tCO2e/y)  Carbon sink potential - Low - Improve plantations (1000 tCO2e/y)  Carbon sink potential - Low - Increase retention of HWP (1000 tCO2e/y)  Carbon sink potential - Low - Increase trees of the MPP (1000 tCO2e/y)  Carbon sink potential - Low - Increase trees of the MPP (1000 tCO2e/y)  Carbon sink potential - Low - Increase trees of the MPP (1000 tCO2e/y)  Carbon sink potential - Low - Increase trees of the MPP (1000 tCO2e/y)  Carbon sink potential - Low - Reforest cropland of the MPP (1000 tCO2e/y)	19.3 8,666 137 159
productivity (1000 tCO2e/y)  Carbon sink potential - Low - Accelerate regeneration (1000 tCO2e/y)  Carbon sink potential - Low - All (not counting overlap) (1000 tCO2e/y)  Carbon sink potential - Low - Avoid deforestation (1000 tCO2e/y)  Carbon sink potential - Low - Extend rotation overlap (1000 tCO2e/y)  Carbon sink potential - Low - Extend rotation overlap (1000 tCO2e/y)  Carbon sink potential - Low - Improve overlap (1000 tCO2e/y)  Carbon sink potential - Low - Increase retention overlap (1000 tCO2e/y)  Carbon sink potential - Low - Increase retention overlap (1000 tCO2e/y)  Carbon sink potential - Low - Increase trees overlap (1000 tCO2e/y)  Carbon sink potential - Low - Increase trees overlap (1000 tCO2e/y)  Carbon sink potential - Low - Reforest cropland overlap (1000 tCO2e/y)	19.3 8,666 137 159
Carbon sink potential - Low - Accelerate regeneration (1000 tC02e/y)  Carbon sink potential - Low - All (not counting overlap) (1000 tC02e/y)  Carbon sink potential - Low - Avoid deforestation (1000 tC02e/y)  Carbon sink potential - Low - Extend rotation length (1000 tC02e/y)  Carbon sink potential - Low - Improve plantations (1000 tC02e/y)  Carbon sink potential - Low - Increase retention of HWP (1000 tC02e/y)  Carbon sink potential - Low - Increase trees outside forests (1000 tC02e/y)  Carbon sink potential - Low - Increase trees outside forests (1000 tC02e/y)  Carbon sink potential - Low - Reforest cropland output  Outp	8,666 137 159
regeneration (1000 tCO2e/y)  Carbon sink potential - Low - All (not counting overlap) (1000 tCO2e/y)  Carbon sink potential - Low - Avoid deforestation (1000 tCO2e/y)  Carbon sink potential - Low - Extend rotation overlaph (1000 tCO2e/y)  Carbon sink potential - Low - Improve overlaph (1000 tCO2e/y)  Carbon sink potential - Low - Improve overlaph (1000 tCO2e/y)  Carbon sink potential - Low - Increase retention overlaph (1000 tCO2e/y)  Carbon sink potential - Low - Increase trees overlaph (1000 tCO2e/y)  Carbon sink potential - Low - Increase trees overlaph (1000 tCO2e/y)  Carbon sink potential - Low - Reforest cropland overlaph (1000 tCO2e/y)	8,666 137 159
Carbon sink potential - Low - All (not counting overlap) (1000 tCO2e/y)  Carbon sink potential - Low - Avoid deforestation (1000 tCO2e/y)  Carbon sink potential - Low - Extend rotation overlaph (1000 tCO2e/y)  Carbon sink potential - Low - Improve overlaph (1000 tCO2e/y)  Carbon sink potential - Low - Improve overlaph (1000 tCO2e/y)  Carbon sink potential - Low - Increase retention overlaph (1000 tCO2e/y)  Carbon sink potential - Low - Increase trees overlaph (1000 tCO2e/y)  Carbon sink potential - Low - Increase trees overlaph (1000 tCO2e/y)  Carbon sink potential - Low - Increase trees overlaph (1000 tCO2e/y)  Carbon sink potential - Low - Reforest cropland overlaph (1000 tCO2e/y)	137 159
overlap) (1000 tCO2e/y)  Carbon sink potential - Low - Avoid deforestation (1000 tCO2e/y)  Carbon sink potential - Low - Extend rotation 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	137 159
Carbon sink potential - Low - Avoid deforestation (1000 tC02e/y)  Carbon sink potential - Low - Extend rotation 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	159
(1000 tCO2e/y)       0	159
Carbon sink potential - Low - Extend rotation length (1000 tCO2e/y)  Carbon sink potential - Low - Improve plantations (1000 tCO2e/y)  Carbon sink potential - Low - Increase retention of HWP (1000 tCO2e/y)  Carbon sink potential - Low - Increase trees outside forests (1000 tCO2e/y)  Carbon sink potential - Low - Reforest cropland  O O O O O O O O O O O O O O O O O O	
length (1000 tCO2e/y)  Carbon sink potential - Low - Improve plantations (1000 tCO2e/y)  Carbon sink potential - Low - Increase retention of HWP (1000 tCO2e/y)  Carbon sink potential - Low - Increase trees o o outside forests (1000 tCO2e/y)  Carbon sink potential - Low - Reforest cropland o o o	
Carbon sink potential - Low - Improve plantations (1000 tC02e/y)  Carbon sink potential - Low - Increase retention of HWP (1000 tC02e/y)  Carbon sink potential - Low - Increase trees o o outside forests (1000 tC02e/y)  Carbon sink potential - Low - Reforest cropland o o o	10.5
plantations (1000 tC02e/y)  Carbon sink potential - Low - Increase retention 0 0 0 0 0 of HWP (1000 tC02e/y)  Carbon sink potential - Low - Increase trees 0 0 0 0 outside forests (1000 tC02e/y)  Carbon sink potential - Low - Reforest cropland 0 0 0	10.5
Carbon sink potential - Low - Increase retention of HWP (1000 tC02e/y)  Carbon sink potential - Low - Increase trees of the control of the co	
of HWP (1000 tC02e/y)  Carbon sink potential - Low - Increase trees 0 0 0 0 outside forests (1000 tC02e/y)  Carbon sink potential - Low - Reforest cropland 0 0 0	
Carbon sink potential - Low - Increase trees 0 0 0 0 outside forests (1000 tC02e/y)  Carbon sink potential - Low - Reforest cropland 0 0 0	13.8
outside forests (1000 tC02e/y)  Carbon sink potential - Low - Reforest cropland  0 0 0	
Carbon sink potential - Low - Reforest cropland 0 0 0	1,170
(1000 tCO2e/y)	6,693
Carbon sink potential - Low - Reforest pasture 0 0 0	400
(1000 tC02e/y)	
Carbon sink potential - Low - Restore 0 0 0	64.3
productivity (1000 tCO2e/y)	
Carbon sink potential - Mid - Accelerate 0 0 0	28.9
regeneration (1000 tC02e/y)	
Carbon sink potential - Mid - All (not counting 0 0 10	6,097
overlap) (1000 tC02e/y)	
Carbon sink potential - Mid - Avoid deforestation 0 0 0	479
(1000 tC02e/y)	
Carbon sink potential - Mid - Extend rotation 0 0 0	286
length (1000 tC02e/y)	
Carbon sink potential - Mid - Improve plantations 0 0 0	15.4
(1000 tCO2e/y)	.0
Carbon sink potential - Mid - Increase retention 0 0 0	27.6
of HWP (1000 tCO2e/y)	21.0
	2,256
outside forests (1000 tC02e/y)	2,200
	0,039
(1000 tCO2e/y)	0,037
	0 007
	2,837
(1000 tC02e/y)	
Carbon sink potential - Mid - Restore 0 0 0	407
productivity (1000 tCO2e/y)	127
Land impacted for carbon sink potential - High - 0 0 0	
Accelerate regeneration (1000 hectares)	127
	6.3
Land impacted for carbon sink potential - High - 0 0 0	
	6.3

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

Table 63: REF scenario - PILLAR 6: Land sinks - I	Forests (con			
Item	2020	2025	2030	2050
Land impacted for carbon sink potential - High -	0	0	0	211
Extend rotation length (1000 hectares)				
Land impacted for carbon sink potential - High -	0	0	0	7.59
Improve plantations (1000 hectares)				
Land impacted for carbon sink potential - High -	0	0	0	0
Increase retention of HWP (1000 hectares)				
Land impacted for carbon sink potential - High -	0	0	0	317
Increase trees outside forests (1000 hectares)				
Land impacted for carbon sink potential - High -	0	0	0	885
Reforest cropland (1000 hectares)				
Land impacted for carbon sink potential - High -	0	0	0	150
Reforest pasture (1000 hectares)				
Land impacted for carbon sink potential - High -	0	0	0	63.2
Restore productivity (1000 hectares)				
Land impacted for carbon sink potential - High -	0	0	0	1,752
Total impacted (over 30 years) (1000 hectares)				.,. 52
Land impacted for carbon sink potential - Low -	0	0	0	3.15
Accelerate regeneration (1000 hectares)				0.10
Land impacted for carbon sink potential - Low -	0	0	0	104
Avoid deforestation (over 30 years) (1000			ı ı	104
hectares)				
Land impacted for carbon sink potential - Low -	0	0	0	80.8
Extend rotation length (1000 hectares)			ı ı	00.0
Land impacted for carbon sink potential - Low -	0	0	0	3.79
Improve plantations (1000 hectares)		0	0	0.17
Land impacted for carbon sink potential - Low -	0	0	0	0
Increase retention of HWP (1000 hectares)		0	0	0
Land impacted for carbon sink potential - Low -	0	0	0	167
Increase trees outside forests (1000 hectares)	0	0	0	101
Land impacted for carbon sink potential - Low -	0	0	0	443
Reforest cropland (1000 hectares)	0	0	0	443
Land impacted for carbon sink potential - Low -	0	0	0	26
	0	0	0	20
Reforest pasture (1000 hectares)  Land impacted for carbon sink potential - Low -	0	0	0	38.2
	U	U	U	38.2
Restore productivity (1000 hectares)	0	0	0	0//
Land impacted for carbon sink potential - Low -	0	0	0	866
Total impacted (over 30 years) (1000 hectares)	0	0		/ 70
Land impacted for carbon sink potential - Mid -	0	0	0	4.72
Accelerate regeneration (1000 hectares)	0	0	0	100
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000	0	U	U	108
hectares)				
	0	0		1//
Land impacted for carbon sink potential - Mid -	0	0	0	146
Extend rotation length (1000 hectares)				F 74
Land impacted for carbon sink potential - Mid -	0	0	0	5.71
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	242
Increase trees outside forests (1000 hectares)				
Land impacted for carbon sink potential - Mid -	0	0	0	664
Reforest cropland (1000 hectares)				
Land impacted for carbon sink potential - Mid -	0	0	0	188
Reforest pasture (1000 hectares)				
Land impacted for carbon sink potential - Mid -	0	0	0	77
Restore productivity (1000 hectares)				
Land impacted for carbon sink potential - Mid -	0	0	0	1,435
Total impacted (over 30 years) (1000 hectares)				

Table 64: REF scenario - IMPACTS - Health

Item	2020	2025	2030	2035	2040	2045	2050
	2020						
Monetary damages from air pollution - Coal	0	77.9	35.8	21.9	17.2	15	14.3
(million 2019\$)							
Monetary damages from air pollution - Natural	0	6.77	6.13	6.34	4.48	3.82	3.17
Gas (million 2019\$)							
Monetary damages from air pollution -	0	24.6	24.8	25	25.3	25.7	26.1
Transportation (million 2019\$)							
Premature deaths from air pollution - Coal	0	8.74	4.02	2.45	1.93	1.68	1.61
(deaths)							
Premature deaths from air pollution - Natural	0	0.764	0.693	0.716	0.506	0.431	0.358
Gas (deaths)							
Premature deaths from air pollution -	0	2.77	2.79	2.81	2.85	2.89	2.93
Transportation (deaths)							