Net-Zero America - georgia state report

Larson et al. 2020

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

Notes

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

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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	8.06	8.87	0	0	0	0
Cumulative 5-yr (billion \$2018)							
Sales of cooking units - Electric Resistance (%)	66.9	74	95.5	99.8	100	100	100
Sales of cooking units - Gas (%)	33.1	26	4.45	0.224	0	0	0
Sales of space heating units - Electric Heat Pump	25.4	45	81.3	89.4	89.8	89.7	89.7
(%)							
Sales of space heating units - Electric Resistance	18.4	19.7	8.27	5.67	5.52	5.61	5.63
(%)							
Sales of space heating units - Fossil (%)	4.42	5.56	2.13	1.36	1.33	1.31	1.31
Sales of space heating units - Gas (%)	51.8	29.7	8.3	3.54	3.35	3.36	3.35
Sales of water heating units - Electric Heat Pump	0	11.6	61.4	72.5	73	72.9	72.9
(%)							
Sales of water heating units - Electric Resistance	47.2	57.2	31	25.2	24.9	24.9	24.9
(%)							
Sales of water heating units - Gas Furnace (%)	50	29.1	5.49	0.232	0	0	0
Sales of water heating units - Other (%)	2.84	2.09	2.1	2.11	2.12	2.14	2.15

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

Item	2020	2025	2030	2035	2040	2045	2050
Light-duty vehicle capital costs - Cumulative 5-yr	0	1,609	4,204	6,681	10,172	11,015	10,532
(million \$2018)							
Public EV charging plugs - DC Fast (1000 units)	0.376	0	3.15	0	12.8	0	20.6
Public EV charging plugs - L2 (1000 units)	2.43	0	75.7	0	308	0	494
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 (%)	1.47	1.74	1.22	0.391	0.073	0.013	0
Vehicle sales - Light-duty - EV (%)	4.2	16.1	47.7	82.3	96.4	99.3	100
Vehicle sales - Light-duty - gasoline (%)	89.4	77	47.5	16	3.22	0.588	0
Vehicle sales - Light-duty - hybrid (%)	4.69	4.74	3.31	1.22	0.298	0.066	0
Vehicle sales - Light-duty - hydrogen FC (%)	0.11	0.335	0.196	0.061	0.012	0.002	0
Vehicle sales - Light-duty - other (%)	0.098	0.094	0.06	0.021	0.004	0.001	0
Vehicle sales - Medium-duty - diesel (%)	64.7	59.7	42.3	14.4	2.59	0.384	0
Vehicle sales - Medium-duty - EV (%)	0.784	5.07	25.3	60.8	76.5	79.5	80
Vehicle sales - Medium-duty - gasoline (%)	33.7	33.3	25.5	9.32	1.77	0.277	0
Vehicle sales - Medium-duty - hybrid (%)	0.363	0.402	0.341	0.14	0.03	0.005	0
Vehicle sales - Medium-duty - hydrogen FC (%)	0.196	1.27	6.33	15.2	19.1	19.9	20
Vehicle sales - Medium-duty - other (%)	0.253	0.255	0.205	0.083	0.019	0.004	0

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

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Commercial (PJ)	252	253	245	233	223	221	224
Final energy use - Industry (PJ)	420	427	428	425	426	427	431
Final energy use - Residential (PJ)	362	344	319	286	259	244	240
Final energy use - Transportation (PJ)	1,057	990	878	740	614	535	499

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

Item	2020	2025	2030	2035	2040	2045	2050
Commercial HVAC investment in 2020s -	0	34,949	38,935	0	0	0	0
Cumulative 5-yr (million \$2018)							
Sales of cooking units - Electric Resistance (%)	32	46	79.9	86.5	86.9	86.9	86.9
Sales of cooking units - Gas (%)	68	54	20.1	13.5	13.1	13.1	13.1
Sales of space heating units - Electric Heat Pump (%)	7.3	27.4	70.6	84	85.3	85.4	85.4
Sales of space heating units - Electric Resistance (%)	6.68	8.23	10.2	12.3	12.7	12.7	12.7
Sales of space heating units - Fossil (%)	0	3.85	0.732	0.031	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 (%)	86	60.5	18.4	3.67	2	1.95	1.94
Sales of water heating units - Electric Heat Pump (%)	0.221	10.5	54.6	64.4	64.8	64.8	64.8
Sales of water heating units - Electric Resistance (%)	5.5	10.9	28.4	32.3	32.5	32.5	32.5
Sales of water heating units - Gas Furnace (%)	92.1	74.6	14.1	0.594	0	0	0
Sales of water heating units - Other (%)	2.13	3.93	2.95	2.7	2.71	2.7	2.7

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

Item	2020	2025	2030	2035	2040	2045	2050
Electricity distribution capital invested -	0	7.03	7.31	10.9	11.6	9.14	9.44
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	0.034	0	0	0.013
plant (billion \$2018)							
Capital invested - Biomass w/ccu power plant	0	0	0	0.007	6.93	0.666	0.001
(billion \$2018)							
Capital invested - Solar PV - Base (billion \$2018)	0	0	6.5	23.3	14.7	31.2	25.3
Capital invested - Solar PV - Constrained (billion	0	1.41	10.8	26.5	21	26.4	28.1
\$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	33.7	33.7	33.7	47
Biomass w/ccu power plant (GWh)	0	0	0	8.06	7,781	8,528	8,529
Solar - Base land use assumptions (GWh)	2,538	0	10,709	41,457	27,660	62,310	53,596
Solar - Constrained land use assumptions (GWh)	2,371	0	10,193	27,292	42,821	55,930	49,132

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

Item	2020	2025	2030	2035	2040	2045	2050
Biomass purchases (million \$2018/year)	0	0	0	18.6	628	1,015	1,134
Conversion capital investment - Cumulative 5-yr	0	0	0	408	13,059	7,815	2,416
(million \$2018)							
Number of facilities - Allam power w ccu	0	0	0	1	1	1	2
(quantity)							
Number of facilities - Beccs hydrogen (quantity)	0	0	0	1	6	14	16
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	0	1	6	7	8
Number of facilities - Pyrolysis (quantity)	0	0	0	0	0	0	0
Number of facilities - Pyrolysis ccu (quantity)	0	0	0	1	1	1	2
Number of facilities - Sng (quantity)	0	0	0	0	0	0	0
Number of facilities - Sng ccu (quantity)	0	0	0	0	0	0	0

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

Item	2020	2025	2030	2035	2040	2045	2050
Annual - All (MMT)	0	0	0	0.55	18.4	25.9	31.9
Annual - BECCS (MMT)	0	0	0	0.47	16.5	25.8	28.8
Annual - Cement and lime (MMT)	0	0	0	0	0	0	0
Annual - NGCC (MMT)	0	0	0	0.08	1.93	0.05	3.05
Cumulative - All (MMT)	0	0	0	0.55	19	44.8	76.7

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

Item	2020	2025	2030	2035	2040	2045	2050
Cumulative - BECCS (MMT)	0	0	0	0.47	17	42.8	71.6
Cumulative - Cement and lime (MMT)	0	0	0	0	0	0	0
Cumulative - NGCC (MMT)	0	0	0	0.08	2.01	2.06	5.11

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

Item	2020	2025	2030	2035	2040	2045	2050
CO2 storage (MMT)	0	0	0	5.28	7.23	12.1	16.8
Injection wells (wells)	0	0	4	18	30	52	66
Resource characterization, appraisal, permitting	0	101	277	379	379	379	379
costs (million \$2020)							
Wells and facilities construction costs (million	0	0	135	528	941	1,573	1,953
\$2020)							

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

Item	2020	2025	2030	2035	2040	2045	2050
All (km)	0	0	570	1,282	2,064	3,105	3,550
Cumulative investment - All (million \$2018)	0	0	2,891	5,025	5,797	6,725	7,046
Cumulative investment - Spur (million \$2018)	0	0	0	206	978	1,906	2,226
Cumulative investment - Trunk (million \$2018)	0	0	2,891	4,819	4,819	4,819	4,819
Spur (km)	0	0	0	376	1,159	2,199	2,645
Trunk (km)	0	0	570	906	906	906	906

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

Item	2020	2025	2050
Carbon sink potential - Aggressive deployment -	0	0	-66
Corn-ethanol to energy grasses (1000 tC02e/y)			
Carbon sink potential - Aggressive deployment -	0	0	-3,806
Cropland measures (1000 tCO2e/y)			
Carbon sink potential - Aggressive deployment -	0	0	-67.7
Permanent conservation cover (1000 tCO2e/y)			
Carbon sink potential - Aggressive deployment -	0	0	-3,940
Total (1000 tC02e/y)			
Carbon sink potential - Moderate deployment -	0	0	-66
Corn-ethanol to energy grasses (1000 tC02e/y)			
Carbon sink potential - Moderate deployment -	0	0	-1,975
Cropland measures (1000 tCO2e/y)			
Carbon sink potential - Moderate deployment -	0	0	-33.9
Permanent conservation cover (1000 tCO2e/y)			
Carbon sink potential - Moderate deployment -	0	0	-2,075
Total (1000 tC02e/y)			
Land impacted for carbon sink - Aggressive	0	0	38.6
deployment - Corn-ethanol to energy grasses			
(1000 hectares)			
Land impacted for carbon sink - Aggressive	0	0	1,609
deployment - Cropland measures (1000			
hectares)			
Land impacted for carbon sink - Aggressive	0	0	123
deployment - Permanent conservation cover			
(1000 hectares)			
Land impacted for carbon sink - Aggressive	0	0	1,771
deployment - Total (1000 hectares)			
Land impacted for carbon sink - Moderate	0	0	38.6
deployment - Corn-ethanol to energy grasses			
(1000 hectares)			
Land impacted for carbon sink - Moderate	0	0	835
deployment - Cropland measures (1000			
hectares)			
Land impacted for carbon sink - Moderate	0	0	61.6
deployment - Permanent conservation cover			
(1000 hectares)			

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

Item	2020	2025	2050
Land impacted for carbon sink - Moderate	0	0	935
deployment - Total (1000 hectares)			

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

Tierra			
Item	2020	2025	2050
Carbon sink potential - High - Accelerate	0	0	781
regeneration (1000 tCO2e/y)			
Carbon sink potential - High - All (not counting	0	0	61,940
overlap) (1000 tCO2e/y)			
Carbon sink potential - High - Avoid deforestation	0	0	2,764
(1000 tCO2e/y)			
Carbon sink potential - High - Extend rotation	0	0	12,001
length (1000 tC02e/y)			
Carbon sink potential - High - Improve	0	0	6,449
plantations (1000 tCO2e/y)			
Carbon sink potential - High - Increase retention	0	0	25,469
of HWP (1000 tCO2e/y)			-
Carbon sink potential - High - Increase trees	0	0	1,000
outside forests (1000 tCO2e/y)			•
Carbon sink potential - High - Reforest cropland	0	0	1,887
(1000 tC02e/y)			,,
Carbon sink potential - High - Reforest pasture	0	0	5,666
(1000 tC02e/y)			3,333
Carbon sink potential - High - Restore	0	0	5,922
productivity (1000 tCO2e/y)		0	0,722
Carbon sink potential - Low - Accelerate	0	0	391
regeneration (1000 tCO2e/y)	0	0	371
Carbon sink potential - Low - All (not counting	0	0	20,952
overlap) (1000 tC02e/y)	0	0	20,732
Carbon sink potential - Low - Avoid deforestation	0	0	461
(1000 tCO2e/y)	U	0	401
	0	0	/ /10
Carbon sink potential - Low - Extend rotation	0	0	4,610
length (1000 tC02e/y)	0	0	0.001
Carbon sink potential - Low - Improve	0	0	3,281
plantations (1000 tC02e/y)		-	0.400
Carbon sink potential - Low - Increase retention	0	0	8,490
of HWP (1000 tC02e/y)			050
Carbon sink potential - Low - Increase trees	0	0	350
outside forests (1000 tC02e/y)	_	_	
Carbon sink potential - Low - Reforest cropland	0	0	944
(1000 tC02e/y)	_	_	
Carbon sink potential - Low - Reforest pasture	0	0	429
(1000 tC02e/y)			
Carbon sink potential - Low - Restore	0	0	1,996
productivity (1000 tCO2e/y)			
Carbon sink potential - Mid - Accelerate	0	0	586
regeneration (1000 tCO2e/y)			
Carbon sink potential - Mid - All (not counting	0	0	41,389
overlap) (1000 tC02e/y)			
Carbon sink potential - Mid - Avoid deforestation	0	0	1,612
(1000 tC02e/y)			
Carbon sink potential - Mid - Extend rotation	0	0	8,306
length (1000 tCO2e/y)			
Carbon sink potential - Mid - Improve plantations	0	0	4,808
(1000 tC02e/y)			•
Carbon sink potential - Mid - Increase retention	0	0	16,980
of HWP (1000 tC02e/y)		-	
Carbon sink potential - Mid - Increase trees	0	0	675
outside forests (1000 tC02e/y)			2.0
Carbon sink potential - Mid - Reforest cropland	0	0	1,415
(1000 tCO2e/y)	Ŭ		1, 410
Carbon sink potential - Mid - Reforest pasture	0	0	3,047
(1000 tCO2e/y)	ŭ		5,041
(1000 10020/1)			

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

Item	2020	2025	2050
Carbon sink potential - Mid - Restore	0	0	3,959
productivity (1000 tCO2e/y)			
Land impacted for carbon sink potential - High -	0	0	128
Accelerate regeneration (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	374
Avoid deforestation (over 30 years) (1000			
hectares)			
Land impacted for carbon sink potential - High -	0	0	6,120
Extend rotation length (1000 hectares)			•
Land impacted for carbon sink potential - High -	0	0	2,376
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	95
Increase trees outside forests (1000 hectares)	0	0	75
Land impacted for carbon sink potential - High -	0	0	125
Reforest cropland (1000 hectares)	o	0	123
Land impacted for carbon sink potential - High -	0	0	1/1
	0	0	161
Reforest pasture (1000 hectares)	0		10/0
Land impacted for carbon sink potential - High -	0	0	1,963
Restore productivity (1000 hectares)			44.07.0
Land impacted for carbon sink potential - High -	0	0	11,342
Total impacted (over 30 years) (1000 hectares)	_		
Land impacted for carbon sink potential - Low -	0	0	63.9
Accelerate regeneration (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	351
Avoid deforestation (over 30 years) (1000			
hectares)			
Land impacted for carbon sink potential - Low -	0	0	2,345
Extend rotation length (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	1,188
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	50
Increase trees outside forests (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	62.4
Reforest cropland (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	27.9
Reforest pasture (1000 hectares)			,
Land impacted for carbon sink potential - Low -	0	0	1,188
Restore productivity (1000 hectares)	0	0	1,100
Land impacted for carbon sink potential - Low -	0	0	5,276
	o	0	5,210
Total impacted (over 30 years) (1000 hectares)	0		05.0
Land impacted for carbon sink potential - Mid -	0	0	95.8
Accelerate regeneration (1000 hectares)			0.40
Land impacted for carbon sink potential - Mid -	0	0	363
Avoid deforestation (over 30 years) (1000			
hectares)			
Land impacted for carbon sink potential - Mid -	0	0	4,232
Extend rotation length (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	1,788
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	72.5
Increase trees outside forests (1000 hectares)			_
Land impacted for carbon sink potential - Mid -	0	0	93.6
Reforest cropland (1000 hectares)	Ŭ	ŭ	70.0
Land impacted for carbon sink potential - Mid -	0	0	202
Reforest pasture (1000 hectares)	0	U	202
Land impacted for carbon sink potential - Mid -	0	0	ე ეიი
Restore productivity (1000 hectares)	U	U	2,392
RESIDEE DEDUTEDIVITY FILITIFI DECLARACI	1		

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

Item	2020	2025	2050
Land impacted for carbon sink potential - Mid -	0	0	9,239
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 (million 2019\$)	0	461	0.845	0.766	0.539	0.355	0.029
Monetary damages from air pollution - Natural Gas (million 2019\$)	0	310	291	175	133	67.2	25.4
Monetary damages from air pollution - Transportation (million 2019\$)	0	3,449	3,336	2,621	1,565	731	289
Premature deaths from air pollution - Coal (deaths)	0	51.7	0.095	0.086	0.06	0.04	0.003
Premature deaths from air pollution - Natural Gas (deaths)	0	35	32.8	19.8	15	7.59	2.87
Premature deaths from air pollution - Transportation (deaths)	0	388	375	295	176	82.2	32.5

Table 15: E+ scenario - IMPACTS - Jobs

Table 15. E+ Scellul 10 - IMPACTS - Jubs							
Item	2020	2025	2030	2035	2040	2045	2050
By economic sector - Agriculture (jobs)	477	518	841	481	1,473	1,714	1,546
By economic sector - Construction (jobs)	9,812	8,017	13,649	25,968	24,743	36,486	43,167
By economic sector - Manufacturing (jobs)	8,304	13,877	25,461	25,847	21,005	24,522	20,768
By economic sector - Mining (jobs)	4,533	3,112	2,251	1,494	912	602	360
By economic sector - Other (jobs)	810	579	1,616	4,570	4,627	8,156	10,212
By economic sector - Pipeline (jobs)	750	733	929	757	444	412	396
By economic sector - Professional (jobs)	5,717	4,605	6,026	10,432	11,691	17,726	21,767
By economic sector - Trade (jobs)	4,710	3,315	4,064	7,122	7,274	11,466	14,462
By economic sector - Utilities (jobs)	14,307	12,277	14,692	19,695	20,934	26,102	31,429
By education level - All sectors - Associates degree or some college (jobs)	15,284	14,596	21,930	30,902	29,700	40,706	46,413
By education level - All sectors - Bachelors degree (jobs)	10,625	10,049	14,015	18,743	18,146	24,630	27,889
By education level - All sectors - Doctoral degree (jobs)	342	295	385	582	602	869	1,026
By education level - All sectors - High school diploma or less (jobs)	20,637	19,782	30,088	41,798	40,316	54,974	61,812
By education level - All sectors - Masters or professional degree (jobs)	2,533	2,309	3,112	4,341	4,339	6,007	6,967
By resource sector - Biomass (jobs)	1,621	1,824	2,220	1,246	4,360	6,262	6,637
By resource sector - CO2 (jobs)	0	54.7	2,697	2,528	1,044	1,978	2,463
By resource sector - Coal (jobs)	4,143	1,328	0	0	0	0	0
By resource sector - Grid (jobs)	15,328	13,098	16,979	28,948	32,373	45,105	57,917
By resource sector - Natural Gas (jobs)	7,947	7,360	6,976	5,694	6,745	4,317	3,553
By resource sector - Nuclear (jobs)	3,202	3,150	3,100	2,705	2,175	1,690	605
By resource sector - Oil (jobs)	8,486	7,190	5,570	3,788	2,362	1,358	666
By resource sector - Solar (jobs)	8,688	12,993	31,052	50,735	41,815	60,787	64,464
By resource sector - Wind (jobs)	6.73	33.8	933	720	2,229	5,690	7,803
Median wages - Annual - All (\$2019 per job)	56,581	56,677	55,664	55,966	57,160	57,723	58,897
On-Site or In-Plant Training - Total jobs - 1 to 4 years (jobs)	7,953	7,516	11,176	15,784	15,180	20,750	23,661
On-Site or In-Plant Training - Total jobs - 4 to 10 years (jobs)	3,200	2,807	4,041	6,176	6,059	8,443	9,921
On-Site or In-Plant Training - Total jobs - None (jobs)	7,953	7,660	11,410	15,790	15,238	20,886	23,555
On-Site or In-Plant Training - Total jobs - Over 10 years (jobs)	404	381	570	824	802	1,102	1,275
On-Site or In-Plant Training - Total jobs - Up to 1 year (jobs)	29,912	28,669	42,332	57,791	55,824	76,006	85,696
On-the-Job Training - All sectors - 1 to 4 years (jobs)	10,215	9,621	14,270	20,250	19,483	26,638	30,450

Table 15:	E+ scenario	- IMPACTS -	Inhs i	(continued)

Item	2020	2025	2030	2035	2040	2045	2050
On-the-Job Training - All sectors - 4 to 10 years	3,077	2,670	3,893	6,097	6,004	8,423	9,951
(jobs)							
On-the-Job Training - All sectors - None (jobs)	2,686	2,524	3,690	5,212	5,023	6,978	7,930
On-the-Job Training - All sectors - Over 10 years (jobs)	465	478	755	1,028	943	1,275	1,393
On-the-Job Training - All sectors - Up to 1 year (jobs)	32,977	31,738	46,921	63,779	61,649	83,873	94,384
Related work experience - All sectors - 1 to 4 years (jobs)	17,962	16,928	24,699	34,161	33,101	45,188	51,334
Related work experience - All sectors - 4 to 10 years (jobs)	11,526	10,896	15,900	22,109	21,297	29,042	33,061
Related work experience - All sectors - None (jobs)	7,077	6,707	9,946	13,923	13,558	18,587	21,169
Related work experience - All sectors - Over 10 years (jobs)	3,117	3,075	4,541	6,069	5,750	7,728	8,636
Related work experience - All sectors - Up to 1 year (jobs)	9,739	9,425	14,443	20,104	19,397	26,641	29,908
Wage income - All (million \$2019)	2,796	2,666	3,870	5,394	5,322	7,343	8,489

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

Item	2020	2025	2030	2035	2040	2045	2050
Natural gas consumption - Annual (tcf)	564	572	482	387	291	183	127
Natural gas consumption - Cumulative (tcf)	0	0	0	0	0	0	11,650
Natural gas production - Annual (tcf)	0	0	0	0	0	0	0
Oil consumption - Annual (million bbls)	174	162	137	101	67.5	41.5	21.7
Oil consumption - Cumulative (million bbls)	0	0	0	0	0	0	3,127
Oil production - Annual (million bbls)	0	0	0	0	0	0	0

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

Item	2020	2025	2030	2035	2040	2045	2050
Residential HVAC investment in 2020s vs. REF -	0	7.98	8.75	0	0	0	0
Cumulative 5-yr (billion \$2018)							
Sales of cooking units - Electric Resistance (%)	66.8	67.7	70.7	78.7	89.9	96.7	99.1
Sales of cooking units - Gas (%)	33.2	32.3	29.3	21.3	10.1	3.27	0.881
Sales of space heating units - Electric Heat Pump	25.4	38	42.2	54.2	72.4	84.2	88.3
(%)							
Sales of space heating units - Electric Resistance	18.4	21.9	20.5	16.6	10.8	7.24	5.98
(%)							
Sales of space heating units - Fossil (%)	4.42	6.22	5.88	4.75	3	1.86	1.47
Sales of space heating units - Gas (%)	51.8	33.9	31.4	24.5	13.8	6.68	4.21
Sales of water heating units - Electric Heat Pump	0	1.99	7.66	24	49	65.3	70.9
(%)							
Sales of water heating units - Electric Resistance	47.2	62.3	59.3	50.6	37.5	28.9	26
(%)							
Sales of water heating units - Gas Furnace (%)	50	33.6	30.9	23.3	11.4	3.65	0.952
Sales of water heating units - Other (%)	2.84	2.09	2.1	2.12	2.13	2.14	2.15
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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	274	545	1,871	5,792	8,472
(million \$2018)							
Public EV charging plugs - DC Fast (1000 units)	0.376	0	1.11	0	4.86	0	13.2
Public EV charging plugs - L2 (1000 units)	2.43	0	26.7	0	117	0	316
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 (%)	1.48	1.9	2.04	1.62	1.03	0.527	0.226

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

Item	2020	2025	2030	2035	2040	2045	2050
Vehicle sales - Light-duty - EV (%)	1.99	4.9	12.3	26.6	49.1	72.5	87.8
Vehicle sales - Light-duty - gasoline (%)	91.5	87.1	78.9	65.8	45.4	24.3	10.8
Vehicle sales - Light-duty - hybrid (%)	4.87	5.66	6.33	5.72	4.25	2.48	1.2
Vehicle sales - Light-duty - hydrogen FC (%)	0.112	0.378	0.321	0.243	0.172	0.095	0.044
Vehicle sales - Light-duty - other (%)	0.099	0.103	0.093	0.081	0.058	0.032	0.015
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)	252	254	251	248	242	237	235
Final energy use - Industry (PJ)	420	427	430	431	435	436	439
Final energy use - Residential (PJ)	362	345	337	326	309	288	268
Final energy use - Transportation (PJ)	1,059	999	916	848	794	730	654

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

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Item	2020	2025	2030	2035	2040	2045	2050
Commercial HVAC investment in 2020s -	0	34,927	38,922	0	0	0	0
Cumulative 5-yr (million \$2018)							
Sales of cooking units - Electric Resistance (%)	32	36.2	40.9	53.4	71	81.7	85.5
Sales of cooking units - Gas (%)	68	63.8	59.1	46.6	29	18.3	14.5
Sales of space heating units - Electric Heat Pump	7.3	19.2	24.1	38.5	61	76.9	83
(%)							
Sales of space heating units - Electric Resistance	6.68	7.92	8.16	8.87	10.2	11.6	12.4
(%)							
Sales of space heating units - Fossil (%)	0	4.46	4.13	3.1	1.52	0.487	0.128
Sales of space heating units - Gas Furnace (%)	86	68.4	63.6	49.6	27.2	11	4.45
Sales of water heating units - Electric Heat Pump	0.221	2.04	7.05	21.5	43.6	58	63
(%)							
Sales of water heating units - Electric Resistance	5.5	7.53	9.45	15.2	24	29.8	31.8
(%)							
Sales of water heating units - Gas Furnace (%)	92.1	86.3	79.4	59.6	29.1	9.31	2.42
Sales of water heating units - Other (%)	2.13	4.12	4.13	3.73	3.23	2.87	2.75

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

		,					
Item	2020	2025	2030	2035	2040	2045	2050
Electricity distribution capital invested -	0	5.72	5.83	7.6	7.92	9.61	10.1
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	-66
Corn-ethanol to energy grasses (1000 tCO2e/y)			
Carbon sink potential - Aggressive deployment -	0	0	-3,806
Cropland measures (1000 tCO2e/y)			
Carbon sink potential - Aggressive deployment -	0	0	-67.7
Permanent conservation cover (1000 tCO2e/y)			
Carbon sink potential - Aggressive deployment -	0	0	-3,940
Total (1000 tC02e/y)			
Carbon sink potential - Moderate deployment -	0	0	-66
Corn-ethanol to energy grasses (1000 tCO2e/y)			
Carbon sink potential - Moderate deployment -	0	0	-1,975
Cropland measures (1000 tCO2e/y)			
Carbon sink potential - Moderate deployment -	0	0	-33.9
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 - Total (1000 tCO2e/y)	0	0	-2,075
Land impacted for carbon sink - Aggressive deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	38.6
Land impacted for carbon sink - Aggressive deployment - Cropland measures (1000 hectares)	0	0	1,609
Land impacted for carbon sink - Aggressive deployment - Permanent conservation cover (1000 hectares)	0	0	123
Land impacted for carbon sink - Aggressive deployment - Total (1000 hectares)	0	0	1,771
Land impacted for carbon sink - Moderate deployment - Corn-ethanol to energy grasses (1000 hectares)	0	0	38.6
Land impacted for carbon sink - Moderate deployment - Cropland measures (1000 hectares)	0	0	835
Land impacted for carbon sink - Moderate deployment - Permanent conservation cover (1000 hectares)	0	0	61.6
Land impacted for carbon sink - Moderate deployment - Total (1000 hectares)	0	0	935

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

Table 23: E- scenario - PILLAR 6: Land sinks - Fo			
Item	2020	2025	2050
Carbon sink potential - High - Accelerate	0	0	781
regeneration (1000 tCO2e/y)			
Carbon sink potential - High - All (not counting	0	0	61,940
overlap) (1000 tCO2e/y)			
Carbon sink potential - High - Avoid deforestation	0	0	2,764
(1000 tC02e/y)			
Carbon sink potential - High - Extend rotation	0	0	12,001
length (1000 tCO2e/y)			
Carbon sink potential - High - Improve	0	0	6,449
plantations (1000 tCO2e/y)			
Carbon sink potential - High - Increase retention	0	0	25,469
of HWP (1000 tCO2e/y)			
Carbon sink potential - High - Increase trees	0	0	1,000
outside forests (1000 tCO2e/y)			
Carbon sink potential - High - Reforest cropland	0	0	1,887
(1000 tC02e/y)			
Carbon sink potential - High - Reforest pasture	0	0	5,666
(1000 tCO2e/y)			
Carbon sink potential - High - Restore	0	0	5,922
productivity (1000 tCO2e/y)			
Carbon sink potential - Low - Accelerate	0	0	391
regeneration (1000 tCO2e/y)			
Carbon sink potential - Low - All (not counting	0	0	20,952
overlap) (1000 tCO2e/y)			
Carbon sink potential - Low - Avoid deforestation	0	0	461
(1000 tC02e/y)			
Carbon sink potential - Low - Extend rotation	0	0	4,610
length (1000 tCO2e/y)			
Carbon sink potential - Low - Improve	0	0	3,281
plantations (1000 tCO2e/y)			
Carbon sink potential - Low - Increase retention	0	0	8,490
of HWP (1000 tCO2e/y)			
Carbon sink potential - Low - Increase trees	0	0	350
outside forests (1000 tCO2e/y)			
Carbon sink potential - Low - Reforest cropland	0	0	944
(1000 tC02e/y)			
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Table 23: E- scenario - PILLAR 6: Land sinks - Forests (continued)

Table 23: E- scenario - PILLAR 6: Land sinks - Fo	rests (contin	uedJ	
Item	2020	2025	2050
Carbon sink potential - Low - Reforest pasture	0	0	429
(1000 tCO2e/y)			
Carbon sink potential - Low - Restore	0	0	1,996
productivity (1000 tCO2e/y)			
Carbon sink potential - Mid - Accelerate	0	0	586
regeneration (1000 tCO2e/y)			
Carbon sink potential - Mid - All (not counting	0	0	41,389
overlap) (1000 tCO2e/y)			
Carbon sink potential - Mid - Avoid deforestation	0	0	1,612
(1000 tC02e/y)			
Carbon sink potential - Mid - Extend rotation	0	0	8,306
length (1000 tCO2e/y)			
Carbon sink potential - Mid - Improve plantations	0	0	4,808
(1000 tC02e/y)			
Carbon sink potential - Mid - Increase retention	0	0	16,980
of HWP (1000 tC02e/y)			•
Carbon sink potential - Mid - Increase trees	0	0	675
outside forests (1000 tCO2e/y)			
Carbon sink potential - Mid - Reforest cropland	0	0	1,415
(1000 tC02e/y)			.,
Carbon sink potential - Mid - Reforest pasture	0	0	3,047
(1000 tC02e/y)		<u> </u>	0,041
Carbon sink potential - Mid - Restore	0	0	3,959
productivity (1000 tCO2e/y)		0	0,707
Land impacted for carbon sink potential - High -	0	0	128
Accelerate regeneration (1000 hectares)		0	120
Land impacted for carbon sink potential - High -	0	0	374
Avoid deforestation (over 30 years) (1000		0	314
hectares)			
Land impacted for carbon sink potential - High -	0	0	6,120
		0	0,120
Extend rotation length (1000 hectares)	0	0	0.07/
Land impacted for carbon sink potential - High -		0	2,376
Improve plantations (1000 hectares)		0	
Land impacted for carbon sink potential - High -	0	0	0
Increase retention of HWP (1000 hectares)			0.5
Land impacted for carbon sink potential - High -	0	0	95
Increase trees outside forests (1000 hectares)			105
Land impacted for carbon sink potential - High -	0	0	125
Reforest cropland (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	161
Reforest pasture (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	1,963
Restore productivity (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	11,342
Total impacted (over 30 years) (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	63.9
Accelerate regeneration (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	351
Avoid deforestation (over 30 years) (1000			
hectares)			
Land impacted for carbon sink potential - Low -	0	0	2,345
Extend rotation length (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	1,188
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	50
Increase trees outside forests (1000 hectares)			00
Land impacted for carbon sink potential - Low -	0	0	62.4
Reforest cropland (1000 hectares)		0	52.7
Land impacted for carbon sink potential - Low -	0	0	27.9
Reforest pasture (1000 hectares)		١	21.7
Moror out pastar o (1000 ficulai co)			

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

Item	2020	2025	2050
Land impacted for carbon sink potential - Low -	0	0	1,188
Restore productivity (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	5,276
Total impacted (over 30 years) (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	95.8
Accelerate regeneration (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	363
Avoid deforestation (over 30 years) (1000			
hectares)			
Land impacted for carbon sink potential - Mid -	0	0	4,232
Extend rotation length (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	1,788
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	72.5
Increase trees outside forests (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	93.6
Reforest cropland (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	202
Reforest pasture (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	2,392
Restore productivity (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	9,239
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	461	0.845	0.766	0.539	0.355	0.029
Monetary damages from air pollution - Natural Gas (million 2019\$)	0	308	210	87.8	29.9	9.21	5.25
Monetary damages from air pollution - Transportation (million 2019\$)	0	3,513	3,692	3,720	3,460	2,838	1,999
Premature deaths from air pollution - Coal (deaths)	0	51.7	0.095	0.086	0.06	0.04	0.003
Premature deaths from air pollution - Natural Gas (deaths)	0	34.8	23.7	9.91	3.38	1.04	0.593
Premature deaths from air pollution - Transportation (deaths)	0	395	415	418	389	319	225

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

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2020	2025	2030	2035	2040	2045	2050
0	8.06	8.87	0	0	0	0
66.9	74	95.5	99.8	100	100	100
33.1	26	4.45	0.224	0	0	0
25.4	45	81.3	89.4	89.8	89.7	89.7
18.4	19.7	8.27	5.67	5.52	5.61	5.63
4.42	5.56	2.13	1.36	1.33	1.31	1.31
51.8	29.7	8.3	3.54	3.35	3.36	3.35
0	11.6	61.4	72.5	73	72.9	72.9
47.2	57.2	31	25.2	24.9	24.9	24.9
50	29.1	5.49	0.232	0	0	0
2.84	2.09	2.1	2.11	2.12	2.14	2.15
	0 66.9 33.1 25.4 18.4 4.42 51.8 0 47.2	0 8.06 66.9 74 33.1 26 25.4 45 18.4 19.7 4.42 5.56 51.8 29.7 0 11.6 47.2 57.2	0 8.06 8.87 66.9 74 95.5 33.1 26 4.45 25.4 45 81.3 18.4 19.7 8.27 4.42 5.56 2.13 51.8 29.7 8.3 0 11.6 61.4 47.2 57.2 31 50 29.1 5.49	0 8.06 8.87 0 66.9 74 95.5 99.8 33.1 26 4.45 0.224 25.4 45 81.3 89.4 18.4 19.7 8.27 5.67 4.42 5.56 2.13 1.36 51.8 29.7 8.3 3.54 0 11.6 61.4 72.5 47.2 57.2 31 25.2 50 29.1 5.49 0.232	0 8.06 8.87 0 0 66.9 74 95.5 99.8 100 33.1 26 4.45 0.224 0 25.4 45 81.3 89.4 89.8 18.4 19.7 8.27 5.67 5.52 4.42 5.56 2.13 1.36 1.33 51.8 29.7 8.3 3.54 3.35 0 11.6 61.4 72.5 73 47.2 57.2 31 25.2 24.9 50 29.1 5.49 0.232 0	0 8.06 8.87 0 0 0 66.9 74 95.5 99.8 100 100 33.1 26 4.45 0.224 0 0 25.4 45 81.3 89.4 89.8 89.7 18.4 19.7 8.27 5.67 5.52 5.61 4.42 5.56 2.13 1.36 1.33 1.31 51.8 29.7 8.3 3.54 3.35 3.36 0 11.6 61.4 72.5 73 72.9 47.2 57.2 31 25.2 24.9 24.9 50 29.1 5.49 0.232 0 0

Table 26: Er DEr	coonanio DII	I AD 1. Efficie	nov/Electrification	n - Transportation
18018 70: E+KE+	SCENOLIO - PIL	LAR I: EIIICIE	ncv/Electrinconoi	ı - Transaortation

Item	2020	2025	2030	2035	2040	2045	2050
Light-duty vehicle capital costs - Cumulative 5-yr	0	1,609	4,204	6,681	10,172	11,015	10,532
(million \$2018)							
Public EV charging plugs - DC Fast (1000 units)	0.376	0	3.15	0	12.8	0	20.6
Public EV charging plugs - L2 (1000 units)	2.43	0	75.7	0	308	0	494
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 (%)	1.47	1.74	1.22	0.391	0.073	0.013	0
Vehicle sales - Light-duty - EV (%)	4.2	16.1	47.7	82.3	96.4	99.3	100
Vehicle sales - Light-duty - gasoline (%)	89.4	77	47.5	16	3.22	0.588	0
Vehicle sales - Light-duty - hybrid (%)	4.69	4.74	3.31	1.22	0.298	0.066	0
Vehicle sales - Light-duty - hydrogen FC (%)	0.11	0.335	0.196	0.061	0.012	0.002	0
Vehicle sales - Light-duty - other (%)	0.098	0.094	0.06	0.021	0.004	0.001	0
Vehicle sales - Medium-duty - diesel (%)	64.7	59.7	42.3	14.4	2.59	0.384	0
Vehicle sales - Medium-duty - EV (%)	0.784	5.07	25.3	60.8	76.5	79.5	80
Vehicle sales - Medium-duty - gasoline (%)	33.7	33.3	25.5	9.32	1.77	0.277	0
Vehicle sales - Medium-duty - hybrid (%)	0.363	0.402	0.341	0.14	0.03	0.005	0
Vehicle sales - Medium-duty - hydrogen FC (%)	0.196	1.27	6.33	15.2	19.1	19.9	20
Vehicle sales - Medium-duty - other (%)	0.253	0.255	0.205	0.083	0.019	0.004	0

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

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Commercial (PJ)	252	253	245	233	223	221	224
Final energy use - Industry (PJ)	420	427	428	425	426	427	431
Final energy use - Residential (PJ)	362	344	319	286	259	244	240
Final energy use - Transportation (PJ)	1,057	990	878	740	614	535	499

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

2020	2025	2030	2035	2040	2045	2050
0	34,949	38,935	0	0	0	0
32	46	79.9	86.5	86.9	86.9	86.9
68	54	20.1	13.5	13.1	13.1	13.1
7.3	27.4	70.6	84	85.3	85.4	85.4
6.68	8.23	10.2	12.3	12.7	12.7	12.7
0	3.85	0.732	0.031	0	0	0
86	60.5	18.4	3.67	2	1.95	1.94
0.221	10.5	54.6	64.4	64.8	64.8	64.8
5.5	10.9	28.4	32.3	32.5	32.5	32.5
92.1	74.6	14.1	0.594	0	0	0
2.13	3.93	2.95	2.7	2.71	2.7	2.7
	0 32 68 7.3 6.68 0 86 0.221 5.5	0 34,949 32 46 68 54 7.3 27.4 6.68 8.23 0 3.85 86 60.5 0.221 10.5 5.5 10.9	0 34,949 38,935 32 46 79.9 68 54 20.1 7.3 27.4 70.6 6.68 8.23 10.2 0 3.85 0.732 86 60.5 18.4 0.221 10.5 54.6 5.5 10.9 28.4 92.1 74.6 14.1	0 34,949 38,935 0 32 46 79.9 86.5 68 54 20.1 13.5 7.3 27.4 70.6 84 6.68 8.23 10.2 12.3 0 3.85 0.732 0.031 86 60.5 18.4 3.67 0.221 10.5 54.6 64.4 5.5 10.9 28.4 32.3 92.1 74.6 14.1 0.594	0 34,949 38,935 0 0 32 46 79.9 86.5 86.9 68 54 20.1 13.5 13.1 7.3 27.4 70.6 84 85.3 6.68 8.23 10.2 12.3 12.7 0 3.85 0.732 0.031 0 86 60.5 18.4 3.67 2 0.221 10.5 54.6 64.4 64.8 5.5 10.9 28.4 32.3 32.5 92.1 74.6 14.1 0.594 0	0 34,949 38,935 0 0 0 32 46 79.9 86.5 86.9 86.9 68 54 20.1 13.5 13.1 13.1 7.3 27.4 70.6 84 85.3 85.4 6.68 8.23 10.2 12.3 12.7 12.7 0 3.85 0.732 0.031 0 0 86 60.5 18.4 3.67 2 1.95 0.221 10.5 54.6 64.4 64.8 64.8 5.5 10.9 28.4 32.3 32.5 32.5 92.1 74.6 14.1 0.594 0 0

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

Item	2020	2025	2030	2035	2040	2045	2050
Electricity distribution capital invested -	0	7.03	7.31	10.9	11.6	9.14	9.44
Cumulative 5-yr (billion \$2018)							

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

Item	2020	2025	2030	2035	2040	2045	2050
Capital invested - Offshore Wind - Base (billion \$2018)	0	0	0	0	0	0.214	18.5
Capital invested - Solar PV - Base (billion \$2018)	0	0.849	8.24	44	39.1	25.6	31.1

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

Item	2020	2025	2030	2035	2040	2045	2050
OffshoreWind - Base land use assumptions (GWh)	0	0	0	0	0	514	52,411
OffshoreWind - Constrained land use	0	0	0	0	0	0	51,557
assumptions (GWh)							
Solar - Base land use assumptions (GWh)	2,538	1,249	13,510	78,330	73,909	51,434	66,150
Solar - Constrained land use assumptions (GWh)	2,538	3,247	29,534	65,148	69,596	69,056	66,359

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

Table 32: E+RE+ Scenurio - PILLAR 6: Lunu Sinks	•		
Item	2020	2025	2050
Carbon sink potential - Aggressive deployment -	0	0	-66
Corn-ethanol to energy grasses (1000 tCO2e/y)			
Carbon sink potential - Aggressive deployment -	0	0	-3,806
Cropland measures (1000 tCO2e/y)			
Carbon sink potential - Aggressive deployment -	0	0	-67.7
Permanent conservation cover (1000 tCO2e/y)			
Carbon sink potential - Aggressive deployment -	0	0	-3,940
Total (1000 tC02e/y)			
Carbon sink potential - Moderate deployment -	0	0	-66
Corn-ethanol to energy grasses (1000 tCO2e/y)			
Carbon sink potential - Moderate deployment -	0	0	-1,975
Cropland measures (1000 tC02e/y)			
Carbon sink potential - Moderate deployment -	0	0	-33.9
Permanent conservation cover (1000 tC02e/y)			
Carbon sink potential - Moderate deployment -	0	0	-2,075
Total (1000 tC02e/y)			
Land impacted for carbon sink - Aggressive	0	0	38.6
deployment - Corn-ethanol to energy grasses			
(1000 hectares)			
Land impacted for carbon sink - Aggressive	0	0	1,609
deployment - Cropland measures (1000			,
hectares)			
Land impacted for carbon sink - Aggressive	0	0	123
deployment - Permanent conservation cover			
(1000 hectares)			
Land impacted for carbon sink - Aggressive	0	0	1,771
deployment - Total (1000 hectares)			.,
Land impacted for carbon sink - Moderate	0	0	38.6
deployment - Corn-ethanol to energy grasses			00.0
(1000 hectares)			
Land impacted for carbon sink - Moderate	0	0	835
deployment - Cropland measures (1000			000
hectares)			
Land impacted for carbon sink - Moderate	0	0	61.6
deployment - Permanent conservation cover	"	0	01.0
(1000 hectares)			
Land impacted for carbon sink - Moderate	0	0	935
	"	U	733
deployment - Total (1000 hectares)			

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

145.0 00.12 : 112 : 000.141.10	, , 0, 0010		
Item	2020	2025	2050
Carbon sink potential - High - Accelerate	0	0	781
regeneration (1000 tCO2e/y)			
Carbon sink potential - High - All (not counting	0	0	61,940
overlap) (1000 tCO2e/y)			
Carbon sink potential - High - Avoid deforestation	0	0	2,764
(1000 tC02e/y)			
Carbon sink potential - High - Extend rotation	0	0	12,001
length (1000 tCO2e/y)			
Carbon sink potential - High - Improve	0	0	6,449
plantations (1000 tCO2e/y)			
Carbon sink potential - High - Increase retention	0	0	25,469
of HWP (1000 tCO2e/y)			

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

Table 33: E+RE+ scenario - PILLAR 6: Land sinks	: - Forests (c	ontinued)	
Item	2020	2025	2050
Carbon sink potential - High - Increase trees	0	0	1,000
outside forests (1000 tCO2e/y)			
Carbon sink potential - High - Reforest cropland	0	0	1,887
(1000 tCO2e/y)			
Carbon sink potential - High - Reforest pasture	0	0	5,666
(1000 tCO2e/y)			
Carbon sink potential - High - Restore	0	0	5,922
productivity (1000 tCO2e/y)			
Carbon sink potential - Low - Accelerate	0	0	391
regeneration (1000 tCO2e/y)			
Carbon sink potential - Low - All (not counting	0	0	20,952
overlap) (1000 tCO2e/y)			
Carbon sink potential - Low - Avoid deforestation	0	0	461
(1000 tC02e/y)			
Carbon sink potential - Low - Extend rotation	0	0	4,610
length (1000 tC02e/y)			
Carbon sink potential - Low - Improve	0	0	3,281
plantations (1000 tCO2e/y)			
Carbon sink potential - Low - Increase retention	0	0	8,490
of HWP (1000 tCO2e/y)			
Carbon sink potential - Low - Increase trees	0	0	350
outside forests (1000 tCO2e/y)			
Carbon sink potential - Low - Reforest cropland	0	0	944
(1000 tC02e/y)	-		
Carbon sink potential - Low - Reforest pasture	0	0	429
(1000 tC02e/y)			,
Carbon sink potential - Low - Restore	0	0	1,996
productivity (1000 tCO2e/y)			.,,,,,
Carbon sink potential - Mid - Accelerate	0	0	586
regeneration (1000 tCO2e/y)			
Carbon sink potential - Mid - All (not counting	0	0	41,389
overlap) (1000 tCO2e/y)			11,007
Carbon sink potential - Mid - Avoid deforestation	0	0	1,612
(1000 tC02e/y)			1,012
Carbon sink potential - Mid - Extend rotation	0	0	8,306
length (1000 tCO2e/y)			0,000
Carbon sink potential - Mid - Improve plantations	0	0	4,808
(1000 tC02e/y)	0	<u> </u>	4,000
Carbon sink potential - Mid - Increase retention	0	0	16,980
of HWP (1000 tCO2e/y)			10,700
Carbon sink potential - Mid - Increase trees	0	0	675
outside forests (1000 tCO2e/y)	0	0	013
Carbon sink potential - Mid - Reforest cropland	0	0	1,415
(1000 tC02e/y)	0	0	1,410
Carbon sink potential - Mid - Reforest pasture	0	0	3,047
(1000 tC02e/y)	U	0	3,041
Carbon sink potential - Mid - Restore	0	0	3,959
•	U	U	3,959
productivity (1000 tC02e/y)	0	0	100
Land impacted for carbon sink potential - High -	0	0	128
Accelerate regeneration (1000 hectares)	0	0	07/
Land impacted for carbon sink potential - High -	0	0	374
Avoid deforestation (over 30 years) (1000			
hectares)	0	0	/ 100
Land impacted for carbon sink potential - High -	0	0	6,120
Extend rotation length (1000 hectares)			0.07/
Land impacted for carbon sink potential - High -	0	0	2,376
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	95
Increase trees outside forests (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	125
Reforest cropland (1000 hectares)			

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

Table 33: E+RE+ Scenurio - Pillar 6: Lunu Sinks		continueuj	
Item	2020	2025	2050
Land impacted for carbon sink potential - High -	0	0	161
Reforest pasture (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	1,963
Restore productivity (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	11,342
Total impacted (over 30 years) (1000 hectares)			•
Land impacted for carbon sink potential - Low -	0	0	63.9
Accelerate regeneration (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	351
Avoid deforestation (over 30 years) (1000		-	-
hectares)			
Land impacted for carbon sink potential - Low -	0	0	2,345
Extend rotation length (1000 hectares)			2,0 .0
Land impacted for carbon sink potential - Low -	0	0	1,188
Improve plantations (1000 hectares)		0	1,100
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	50
Increase trees outside forests (1000 hectares)		0	50
Land impacted for carbon sink potential - Low -	0	0	62.4
Reforest cropland (1000 hectares)	0	U	62.4
		0	070
Land impacted for carbon sink potential - Low -	0	0	27.9
Reforest pasture (1000 hectares)		0	1100
Land impacted for carbon sink potential - Low -	0	0	1,188
Restore productivity (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	5,276
Total impacted (over 30 years) (1000 hectares)	_	_	
Land impacted for carbon sink potential - Mid -	0	0	95.8
Accelerate regeneration (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	363
Avoid deforestation (over 30 years) (1000			
hectares)			
Land impacted for carbon sink potential - Mid -	0	0	4,232
Extend rotation length (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	1,788
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	72.5
Increase trees outside forests (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	93.6
Reforest cropland (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	202
Reforest pasture (1000 hectares)		-	<u>-</u>
Land impacted for carbon sink potential - Mid -	0	0	2,392
Restore productivity (1000 hectares)		ı	2,072
Land impacted for carbon sink potential - Mid -	0	0	9,239
Total impacted (over 30 years) (1000 hectares)		۱ -	7,207
rotal impactod (over 50 years) (1000 neetal 63)			

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

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal (million 2019\$)	0	461	0.845	0.766	0.539	0.355	0.029
Monetary damages from air pollution - Natural Gas (million 2019\$)	0	329	278	137	81.3	18.7	6.69
Monetary damages from air pollution - Transportation (million 2019\$)	0	3,449	3,336	2,621	1,565	731	289
Premature deaths from air pollution - Coal (deaths)	0	51.7	0.095	0.086	0.06	0.04	0.003
Premature deaths from air pollution - Natural Gas (deaths)	0	37.1	31.4	15.5	9.18	2.11	0.755
Premature deaths from air pollution - Transportation (deaths)	0	388	375	295	176	82.2	32.5

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	8.06	8.87	0	0	0	0
Cumulative 5-yr (billion \$2018)							
Sales of cooking units - Electric Resistance (%)	66.9	74	95.5	99.8	100	100	100
Sales of cooking units - Gas (%)	33.1	26	4.45	0.224	0	0	0
Sales of space heating units - Electric Heat Pump	25.4	45	81.3	89.4	89.8	89.7	89.7
(%)							
Sales of space heating units - Electric Resistance	18.4	19.7	8.27	5.67	5.52	5.61	5.63
(%)							
Sales of space heating units - Fossil (%)	4.42	5.56	2.13	1.36	1.33	1.31	1.31
Sales of space heating units - Gas (%)	51.8	29.7	8.3	3.54	3.35	3.36	3.35
Sales of water heating units - Electric Heat Pump	0	11.6	61.4	72.5	73	72.9	72.9
(%)							
Sales of water heating units - Electric Resistance	47.2	57.2	31	25.2	24.9	24.9	24.9
(%)							
Sales of water heating units - Gas Furnace (%)	50	29.1	5.49	0.232	0	0	0
Sales of water heating units - Other (%)	2.84	2.09	2.1	2.11	2.12	2.14	2.15

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

Item	2020	2025	2030	2035	2040	2045	2050
Light-duty vehicle capital costs - Cumulative 5-yr	0	1,609	4,204	6,681	10,172	11,015	10,532
(million \$2018)							
Public EV charging plugs - DC Fast (1000 units)	0.376	0	3.15	0	12.8	0	20.6
Public EV charging plugs - L2 (1000 units)	2.43	0	75.7	0	308	0	494
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 (%)	1.47	1.74	1.22	0.391	0.073	0.013	0
Vehicle sales - Light-duty - EV (%)	4.2	16.1	47.7	82.3	96.4	99.3	100
Vehicle sales - Light-duty - gasoline (%)	89.4	77	47.5	16	3.22	0.588	0
Vehicle sales - Light-duty - hybrid (%)	4.69	4.74	3.31	1.22	0.298	0.066	0
Vehicle sales - Light-duty - hydrogen FC (%)	0.11	0.335	0.196	0.061	0.012	0.002	0
Vehicle sales - Light-duty - other (%)	0.098	0.094	0.06	0.021	0.004	0.001	0
Vehicle sales - Medium-duty - diesel (%)	64.7	59.7	42.3	14.4	2.59	0.384	0
Vehicle sales - Medium-duty - EV (%)	0.784	5.07	25.3	60.8	76.5	79.5	80
Vehicle sales - Medium-duty - gasoline (%)	33.7	33.3	25.5	9.32	1.77	0.277	0
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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)	252	253	245	233	223	221	224
Final energy use - Industry (PJ)	420	427	428	425	426	427	431
Final energy use - Residential (PJ)	362	344	319	286	259	244	240
Final energy use - Transportation (PJ)	1,057	990	878	740	614	535	499

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

Item	2020	2025	2030	2035	2040	2045	2050
Commercial HVAC investment in 2020s -	0	34,949	38,935	0	0	0	0
Cumulative 5-yr (million \$2018)							
Sales of cooking units - Electric Resistance (%)	32	46	79.9	86.5	86.9	86.9	86.9
Sales of cooking units - Gas (%)	68	54	20.1	13.5	13.1	13.1	13.1
Sales of space heating units - Electric Heat Pump (%)	7.3	27.4	70.6	84	85.3	85.4	85.4
Sales of space heating units - Electric Resistance (%)	6.68	8.23	10.2	12.3	12.7	12.7	12.7
Sales of space heating units - Fossil (%)	0	3.85	0.732	0.031	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 (%)	86	60.5	18.4	3.67	2	1.95	1.94
Sales of water heating units - Electric Heat Pump (%)	0.221	10.5	54.6	64.4	64.8	64.8	64.8
Sales of water heating units - Electric Resistance (%)	5.5	10.9	28.4	32.3	32.5	32.5	32.5
Sales of water heating units - Gas Furnace (%)	92.1	74.6	14.1	0.594	0	0	0
Sales of water heating units - Other (%)	2.13	3.93	2.95	2.7	2.71	2.7	2.7

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

Item	2020	2025	2030	2035	2040	2045	2050
Electricity distribution capital invested -	0	7.03	7.31	10.9	11.6	9.14	9.44
Cumulative 5-yr (billion \$2018)							

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

	-		-				
Item	2020	2025	2030	2035	2040	2045	2050
Capital invested - Solar PV - Base (billion \$2018)	0	0.592	1.02	4.63	8.35	15	1.17
Capital invested - Solar PV - Constrained (billion	0	0	0	7.72	9.68	11.9	0.605
\$2018)							

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

Item	2020	2025	2030	2035	2040	2045	2050
Solar - Base land use assumptions (GWh)	2,538	872	1,690	8,238	15,763	30,094	2,482
Solar - Constrained land use assumptions (GWh)	2,538	0	0	13,732	18,280	23,667	1,279

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

Table 42. LTNL- Scenario - FILLAN O. Lana Sinns	•		
Item	2020	2025	2050
Carbon sink potential - Aggressive deployment -	0	0	-66
Corn-ethanol to energy grasses (1000 tCO2e/y)			
Carbon sink potential - Aggressive deployment -	0	0	-3,806
Cropland measures (1000 tCO2e/y)			
Carbon sink potential - Aggressive deployment -	0	0	-67.7
Permanent conservation cover (1000 tC02e/y)			
Carbon sink potential - Aggressive deployment -	0	0	-3,940
Total (1000 tC02e/y)			
Carbon sink potential - Moderate deployment -	0	0	-66
Corn-ethanol to energy grasses (1000 tC02e/y)			
Carbon sink potential - Moderate deployment -	0	0	-1,975
Cropland measures (1000 tC02e/y)			,
Carbon sink potential - Moderate deployment -	0	0	-33.9
Permanent conservation cover (1000 tC02e/y)			
Carbon sink potential - Moderate deployment -	0	0	-2,075
Total (1000 tC02e/y)			, -
Land impacted for carbon sink - Aggressive	0	0	38.6
deployment - Corn-ethanol to energy grasses			
(1000 hectares)			
Land impacted for carbon sink - Aggressive	0	0	1,609
deployment - Cropland measures (1000			,
hectares)			
Land impacted for carbon sink - Aggressive	0	0	123
deployment - Permanent conservation cover			_
(1000 hectares)			
Land impacted for carbon sink - Aggressive	0	0	1,771
deployment - Total (1000 hectares)			.,
Land impacted for carbon sink - Moderate	0	0	38.6
deployment - Corn-ethanol to energy grasses			
(1000 hectares)			
Land impacted for carbon sink - Moderate	0	0	835
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	61.6
deployment - Permanent conservation cover (1000 hectares)			
Land impacted for carbon sink - Moderate	0	0	935
deployment - Total (1000 hectares)			,00

Item	- Forests 2020	2025	2050
Carbon sink potential - High - Accelerate regeneration (1000 tCO2e/y)	0	0	78′
Carbon sink potential - High - All (not counting overlap) (1000 tC02e/y)	0	0	61,940
Carbon sink potential - High - Avoid deforestation (1000 tC02e/y)	0	0	2,764
Carbon sink potential - High - Extend rotation length (1000 tC02e/y)	0	0	12,00
Carbon sink potential - High - Improve plantations (1000 tCO2e/y)	0	0	6,449
Carbon sink potential - High - Increase retention of HWP (1000 tC02e/y)	0	0	25,469
Carbon sink potential - High - Increase trees outside forests (1000 tCO2e/y)	0	0	1,000
Carbon sink potential - High - Reforest cropland (1000 tC02e/y)	0	0	1,887
Carbon sink potential - High - Reforest pasture (1000 tCO2e/y)	0	0	5,666
Carbon sink potential - High - Restore productivity (1000 tC02e/y)	0	0	5,922
Carbon sink potential - Low - Accelerate regeneration (1000 tCO2e/y)	0	0	39
Carbon sink potential - Low - All (not counting overlap) (1000 tC02e/y)	0	0	20,952
Carbon sink potential - Low - Avoid deforestation (1000 tCO2e/y)	0	0	46
Carbon sink potential - Low - Extend rotation length (1000 tCO2e/y)	0	0	4,610
Carbon sink potential - Low - Improve plantations (1000 tCO2e/y)	0	0	3,28
Carbon sink potential - Low - Increase retention of HWP (1000 tC02e/y)	0	0	8,490
Carbon sink potential - Low - Increase trees outside forests (1000 tCO2e/y)	0	0	350
Carbon sink potential - Low - Reforest cropland (1000 tCO2e/y)	0	0	944
Carbon sink potential - Low - Reforest pasture (1000 tC02e/y)	0	0	429
Carbon sink potential - Low - Restore productivity (1000 tC02e/y)	0	0	1,996
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO2e/y)	0	0	586
Carbon sink potential - Mid - All (not counting	0	0	41,389
overlap) (1000 tC02e/y) Carbon sink potential - Mid - Avoid deforestation	0	0	1,61
(1000 tC02e/y) Carbon sink potential - Mid - Extend rotation	0	0	8,306
length (1000 tC02e/y) Carbon sink potential - Mid - Improve plantations	0	0	4,808
(1000 tC02e/y) Carbon sink potential - Mid - Increase retention	0	0	16,980
of HWP (1000 tC02e/y) Carbon sink potential - Mid - Increase trees outside forests (1000 tC02e/y)	0	0	67

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

Table 43: E+RE- scenario - PILLAR 6: Land sinks	- Forests (co	пипиеиј	
Item	2020	2025	2050
Carbon sink potential - Mid - Reforest cropland	0	0	1,415
(1000 tCO2e/y)			
Carbon sink potential - Mid - Reforest pasture	0	0	3,047
(1000 tC02e/y)			
Carbon sink potential - Mid - Restore	0	0	3,959
productivity (1000 tCO2e/y)			•
Land impacted for carbon sink potential - High -	0	0	128
Accelerate regeneration (1000 hectares)			0
Land impacted for carbon sink potential - High -	0	0	374
Avoid deforestation (over 30 years) (1000			0, 1
hectares)			
Land impacted for carbon sink potential - High -	0	0	6,120
Extend rotation length (1000 hectares)	0	0	0,120
Land impacted for carbon sink potential - High -	0	0	2,376
Improve plantations (1000 hectares)	0	0	2,310
	0	0	0
Land impacted for carbon sink potential - High -	0	0	U
Increase retention of HWP (1000 hectares)	0	0	0.5
Land impacted for carbon sink potential - High -	0	0	95
Increase trees outside forests (1000 hectares)			405
Land impacted for carbon sink potential - High -	0	0	125
Reforest cropland (1000 hectares)		_	
Land impacted for carbon sink potential - High -	0	0	161
Reforest pasture (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	1,963
Restore productivity (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	11,342
Total impacted (over 30 years) (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	63.9
Accelerate regeneration (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	351
Avoid deforestation (over 30 years) (1000			
hectares)			
Land impacted for carbon sink potential - Low -	0	0	2,345
Extend rotation length (1000 hectares)			,
Land impacted for carbon sink potential - Low -	0	0	1,188
Improve plantations (1000 hectares)			.,
Land impacted for carbon sink potential - Low -	0	0	0
Increase retention of HWP (1000 hectares)	0	0	U
Land impacted for carbon sink potential - Low -	0	0	50
Increase trees outside forests (1000 hectares)	0	0	30
Land impacted for carbon sink potential - Low -	0	0	62.4
·	U	0	62.4
Reforest cropland (1000 hectares)	0	0	070
Land impacted for carbon sink potential - Low -	0	0	27.9
Reforest pasture (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	1,188
Restore productivity (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	5,276
Total impacted (over 30 years) (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	95.8
Accelerate regeneration (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	363
Avoid deforestation (over 30 years) (1000			
hectares)			
Land impacted for carbon sink potential - Mid -	0	0	4,232
Extend rotation length (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	1,788
Improve plantations (1000 hectares)	-	-	,
Land impacted for carbon sink potential - Mid -	0	0	0
Increase retention of HWP (1000 hectares)	Ŭ	ŭ	J
Land impacted for carbon sink potential - Mid -	0	0	72.5
Increase trees outside forests (1000 hectares)	9	0	12.0
Land impacted for carbon sink potential - Mid -	0	0	93.6
Reforest cropland (1000 hectares)	١ -	0	75.0
Refutest cropianu (1000 nectares)			

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

Item	2020	2025	2050
Land impacted for carbon sink potential - Mid -	0	0	202
Reforest pasture (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	2,392
Restore productivity (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	9,239
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	461	0.845	0.766	0.539	0.355	0.029
Monetary damages from air pollution - Natural Gas (million 2019\$)	0	314	293	303	239	81.4	25.1
Monetary damages from air pollution - Transportation (million 2019\$)	0	3,449	3,336	2,621	1,565	731	289
Premature deaths from air pollution - Coal (deaths)	0	51.7	0.095	0.086	0.06	0.04	0.003
Premature deaths from air pollution - Natural Gas (deaths)	0	35.5	33.1	34.3	27	9.2	2.83
Premature deaths from air pollution - Transportation (deaths)	0	388	375	295	176	82.2	32.5

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	7.98	8.75	0	0	0	0
Cumulative 5-yr (billion \$2018)							
Sales of cooking units - Electric Resistance (%)	66.8	67.7	70.7	78.7	89.9	96.7	99.1
Sales of cooking units - Gas (%)	33.2	32.3	29.3	21.3	10.1	3.27	0.881
Sales of space heating units - Electric Heat Pump	25.4	38	42.2	54.2	72.4	84.2	88.3
(%)							
Sales of space heating units - Electric Resistance	18.4	21.9	20.5	16.6	10.8	7.24	5.98
(%)							
Sales of space heating units - Fossil (%)	4.42	6.22	5.88	4.75	3	1.86	1.47
Sales of space heating units - Gas (%)	51.8	33.9	31.4	24.5	13.8	6.68	4.21
Sales of water heating units - Electric Heat Pump	0	1.99	7.66	24	49	65.3	70.9
(%)							
Sales of water heating units - Electric Resistance	47.2	62.3	59.3	50.6	37.5	28.9	26
(%)							
Sales of water heating units - Gas Furnace (%)	50	33.6	30.9	23.3	11.4	3.65	0.952
Sales of water heating units - Other (%)	2.84	2.09	2.1	2.12	2.13	2.14	2.15

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	274	545	1,871	5,792	8,472
(million \$2018)							
Public EV charging plugs - DC Fast (1000 units)	0.376	0	1.11	0	4.86	0	13.2
Public EV charging plugs - L2 (1000 units)	2.43	0	26.7	0	117	0	316
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 (%)	1.48	1.9	2.04	1.62	1.03	0.527	0.226
Vehicle sales - Light-duty - EV (%)	1.99	4.9	12.3	26.6	49.1	72.5	87.8
Vehicle sales - Light-duty - gasoline (%)	91.5	87.1	78.9	65.8	45.4	24.3	10.8
Vehicle sales - Light-duty - hybrid (%)	4.87	5.66	6.33	5.72	4.25	2.48	1.2
Vehicle sales - Light-duty - hydrogen FC (%)	0.112	0.378	0.321	0.243	0.172	0.095	0.044
Vehicle sales - Light-duty - other (%)	0.099	0.103	0.093	0.081	0.058	0.032	0.015
Vehicle sales - Medium-duty - diesel (%)	64.8	62.2	57.7	49.4	35.6	19.6	8.37

Item	2020	ı - Transpoi 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	ectrification	- Overview	,				
Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Commercial (PJ)	252	254	251	248	242	237	235
Final energy use - Industry (PJ)	420	427	430	431	435	436	439
Final energy use - Residential (PJ)	362	345	337	326	309	288	268
Final energy use - Transportation (PJ)	1,059	999	916	848	794	730	654
Table 48: E-B+ scenario - PILLAR 1: Efficiency/Ele	2020	2025	2030	2035	2040	2045	2050
Commercial HVAC investment in 2020s - Cumulative 5-yr (million \$2018)	0	34,927	38,922	0	0	0	0
Sales of cooking units - Electric Resistance (%)	32	36.2	40.9	53.4	71	81.7	85.5
Sales of cooking units - Gas (%) Sales of space heating units - Electric Heat Pump	68 7.3	63.8 19.2	59.1	46.6	29	18.3 76.9	14.5 83
(%) Sales of space heating units - Electric Heat Pullip (%) Sales of space heating units - Electric Resistance	6.68	7.92	8.16	38.5 8.87	10.2	11.6	12.4
[%]	0.00	1.72	0.10	0.01	10.2	11.0	12.4
Sales of space heating units - Fossil (%)	0	4.46	4.13	3.1	1.52	0.487	0.128
Sales of space heating units - Gas Furnace (%)	86	68.4	63.6	49.6	27.2	11	4.45
Sales of water heating units - Electric Heat Pump	0.221	2.04	7.05	21.5	43.6	58	63
(%) Sales of water heating units - Electric Resistance	5.5	7.53	9.45	15.2	24	29.8	31.8
(%)							
Sales of water heating units - Gas Furnace (%)	92.1	86.3	79.4	59.6	29.1	9.31	2.42
Sales of water heating units - Other (%)	2.13	4.12	4.13	3.73	3.23	2.87	2.75
Table 49: E-B+ scenario - PILLAR 1: Efficiency/Ele	ectrification	- Electricit	ry demand				
Item	2020	2025	2030	2035	2040	2045	2050
Electricity distribution capital invested - Cumulative 5-yr (billion \$2018)	0	5.72	5.83	7.6	7.92	9.61	10.1
Table 50: <i>E-B+ scenario - PILLAR 2: Clean Electr</i>	-		-				
Item	2020	2025	2030	2035	2040	2045	2050
Capital invested - Biomass power plant (billion \$2018)	0	0	0	0	0	0	0
Capital invested - Biomass w/ccu allam power plant (billion \$2018)	0	0	0	0	0	0	0
Capital invested - Biomass w/ccu power plant (billion \$2018)	0	0	0	20.6	13.5	0	0
Table 51: E-B+ scenario - PILLAR 2: Clean Electri							
Item	2020	2025	2030	2035	2040	2045	2050
Biomass power plant (GWh)	0	0	0	0	0	0	0
Biomass w/ccu allam power plant (GWh)	0	0	0	0 000	0 100	0 100	00100
Biomass w/ccu power plant (GWh)	0	0	0	23,083	38,180	38,180	38,180
Table 52: E-B+ scenario - PILLAR 3: Clean fuels -		225= 1	225-				
Item	2020	2025	2030	2035	2040	2045	2050
Biomass purchases (million \$2018/year)	0	0	0	1,341	2,217	2,884	2,939

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	0	18,864	12,338	8,109	678
(million \$2018)							
Number of facilities - Allam power w ccu	0	0	0	0	0	0	0
(quantity)							
Number of facilities - Beccs hydrogen (quantity)	0	0	0	0	0	9	10
Number of facilities - Diesel (quantity)	0	0	0	0	0	0	0
Number of facilities - Diesel ccu (quantity)	0	0	0	0	0	0	0
Number of facilities - Power (quantity)	0	0	0	0	0	0	0
Number of facilities - Power ccu (quantity)	0	0	0	18	30	30	30
Number of facilities - Pyrolysis (quantity)	0	0	0	0	0	0	0
Number of facilities - Pyrolysis ccu (quantity)	0	0	0	0	0	0	0
Number of facilities - Sng (quantity)	0	0	0	0	0	0	0
Number of facilities - Sng ccu (quantity)	0	0	0	0	0	0	0

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

Item	2020	2025	2030	2035	2040	2045	2050
Annual - All (MMT)	0	0	0	22.9	37.8	48.2	48.1
Annual - BECCS (MMT)	0	0	0	22.8	37.8	48.2	48.1
Annual - Cement and lime (MMT)	0	0	0	0	0	0	0
Annual - NGCC (MMT)	0	0	0	0.07	0.05	0.05	0.04
Cumulative - All (MMT)	0	0	0	22.9	60.7	109	157
Cumulative - BECCS (MMT)	0	0	0	22.8	60.6	109	157
Cumulative - Cement and lime (MMT)	0	0	0	0	0	0	0
Cumulative - NGCC (MMT)	0	0	0	0.07	0.12	0.17	0.21

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

Item	2020	2025	2030	2035	2040	2045	2050
CO2 storage (MMT)	0	0	0	6.42	11.9	15.8	16.7
Injection wells (wells)	0	0	4	18	32	54	68
Resource characterization, appraisal, permitting costs (million \$2020)	0	101	292	404	404	404	404
Wells and facilities construction costs (million \$2020)	0	0	141	548	976	1,633	2,027

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

Item	2020	2025	2030	2035	2040	2045	2050
All (km)	0	0	570	2,000	2,851	3,430	4,050
Cumulative investment - All (million \$2018)	0	0	2,891	6,153	7,284	8,156	8,572
Cumulative investment - Spur (million \$2018)	0	0	0	1,333	2,272	3,144	3,560
Cumulative investment - Trunk (million \$2018)	0	0	2,891	4,819	5,012	5,012	5,012
Spur (km)	0	0	0	1,095	1,945	2,525	3,144
Trunk (km)	0	0	570	906	906	906	906

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

Item	2020	2025	2050
Carbon sink potential - Aggressive deployment -	0	0	-306
Corn-ethanol to energy grasses (1000 tCO2e/y)			
Carbon sink potential - Aggressive deployment -	0	0	-3,445
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	-58.6
Permanent conservation cover (1000 tCO2e/y)			
Carbon sink potential - Aggressive deployment -	0	0	-3,810
Total (1000 tC02e/y)			
Carbon sink potential - Moderate deployment -	0	0	-306
Corn-ethanol to energy grasses (1000 tCO2e/y)			
	•		

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

Iable 56: <i>E-B+ scenario - PILLAR 6: Lana sinks -</i> Item	2020	2025	2050
Carbon sink potential - Moderate deployment -	0	0	-1,784
Cropland measures (1000 tC02e/y)		-	.,
Carbon sink potential - Moderate deployment -	0	0	0
Cropland to woody energy crops (1000 tC02e/y)			·
Carbon sink potential - Moderate deployment -	0	0	0
Pasture to energy crops (1000 tCO2e/y)		-	_
Carbon sink potential - Moderate deployment -	0	0	-29.3
Permanent conservation cover (1000 tCO2e/y)		-	
Carbon sink potential - Moderate deployment -	0	0	-2,120
Total (1000 tC02e/y)			,
Land impacted for carbon sink - Aggressive	0	0	191
deployment - Corn-ethanol to energy grasses			
(1000 hectares)			
Land impacted for carbon sink - Aggressive	0	0	3,605
deployment - Cropland measures (1000			,
hectares)			
Land impacted for carbon sink - Aggressive	0	0	85.3
deployment - Cropland to woody energy crops			
(1000 hectares)			
Land impacted for carbon sink - Aggressive	0	0	147
deployment - Pasture to energy crops (1000			
hectares)			
Land impacted for carbon sink - Aggressive	0	0	107
deployment - Permanent conservation cover			
(1000 hectares)			
Land impacted for carbon sink - Aggressive	0	0	4,135
deployment - Total (1000 hectares)			
Land impacted for carbon sink - Moderate	0	0	191
deployment - Corn-ethanol to energy grasses			
(1000 hectares)			
Land impacted for carbon sink - Moderate	0	0	757
deployment - Cropland measures (1000			
hectares)			
Land impacted for carbon sink - Moderate	0	0	85.3
deployment - Cropland to woody energy crops			
(1000 hectares)			
Land impacted for carbon sink - Moderate	0	0	147
deployment - Pasture to energy crops (1000			
hectares)			
Land impacted for carbon sink - Moderate	0	0	53.3
deployment - Permanent conservation cover			
(1000 hectares)			
Land impacted for carbon sink - Moderate	0	0	1,233
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	781
regeneration (1000 tCO2e/y)			
Carbon sink potential - High - All (not counting	0	0	61,940
overlap) (1000 tCO2e/y)			
Carbon sink potential - High - Avoid deforestation	0	0	2,764
(1000 tC02e/y)			
Carbon sink potential - High - Extend rotation	0	0	12,001
length (1000 tCO2e/y)			
Carbon sink potential - High - Improve	0	0	6,449
plantations (1000 tCO2e/y)			
Carbon sink potential - High - Increase retention	0	0	25,469
of HWP (1000 tCO2e/y)			
Carbon sink potential - High - Increase trees	0	0	1,000
outside forests (1000 tCO2e/y)			
Carbon sink potential - High - Reforest cropland	0	0	1,887
(1000 tC02e/y)			

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

Γable 57: E-B+ scenario - PILLAR 6: Land sinks -	Forests (con	tinued)	
Item	2020	2025	2050
Carbon sink potential - High - Reforest pasture	0	0	5,666
(1000 tC02e/y)			
Carbon sink potential - High - Restore	0	0	5,922
productivity (1000 tCO2e/y)			
Carbon sink potential - Low - Accelerate	0	0	391
regeneration (1000 tCO2e/y)			
Carbon sink potential - Low - All (not counting	0	0	20,952
overlap) (1000 tCO2e/y)			
Carbon sink potential - Low - Avoid deforestation	0	0	461
(1000 tCO2e/y)			
Carbon sink potential - Low - Extend rotation	0	0	4,610
length (1000 tCO2e/y)			
Carbon sink potential - Low - Improve	0	0	3,281
plantations (1000 tCO2e/y)			
Carbon sink potential - Low - Increase retention	0	0	8,490
of HWP (1000 tCO2e/y)			
Carbon sink potential - Low - Increase trees	0	0	350
outside forests (1000 tC02e/y)			
Carbon sink potential - Low - Reforest cropland	0	0	944
(1000 tC02e/y)			
Carbon sink potential - Low - Reforest pasture	0	0	429
(1000 tC02e/y)			
Carbon sink potential - Low - Restore	0	0	1,996
productivity (1000 tCO2e/y)			•
Carbon sink potential - Mid - Accelerate	0	0	586
regeneration (1000 tCO2e/y)			
Carbon sink potential - Mid - All (not counting	0	0	41,389
overlap) (1000 tCO2e/y)			11,007
Carbon sink potential - Mid - Avoid deforestation	0	0	1,612
(1000 tC02e/y)		0	1,012
Carbon sink potential - Mid - Extend rotation	0	0	8,306
length (1000 tC02e/y)		0	0,500
Carbon sink potential - Mid - Improve plantations	0	0	4,808
(1000 tC02e/y)		0	4,000
Carbon sink potential - Mid - Increase retention	0	0	16,980
of HWP (1000 tC02e/y)		0	10,700
Carbon sink potential - Mid - Increase trees	0	0	675
outside forests (1000 tC02e/y)	"	0	613
Carbon sink potential - Mid - Reforest cropland	0	0	1 / 1E
·	0	0	1,415
(1000 tC02e/y)		0	0.07
Carbon sink potential - Mid - Reforest pasture	0	0	3,047
(1000 tC02e/y)			0.050
Carbon sink potential - Mid - Restore	0	0	3,959
productivity (1000 tCO2e/y)			
Land impacted for carbon sink potential - High -	0	0	128
Accelerate regeneration (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	374
Avoid deforestation (over 30 years) (1000			
hectares)			
Land impacted for carbon sink potential - High -	0	0	6,120
Extend rotation length (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	2,376
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	95
Increase trees outside forests (1000 hectares)		-	_
Land impacted for carbon sink potential - High -	0	0	125
Reforest cropland (1000 hectares)			120
Land impacted for carbon sink potential - High -	0	0	161
		٦	101
Reforest pasture (1000 hectares) Land impacted for carbon sink potential - High -	0	0	1,963

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

Table 57: E-B+ Scenario - PILLAR 6: Lana Sinks -			6075
Item	2020	2025	2050
Land impacted for carbon sink potential - High -	0	0	11,342
Total impacted (over 30 years) (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	63.9
Accelerate regeneration (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	351
Avoid deforestation (over 30 years) (1000			
hectares)			
Land impacted for carbon sink potential - Low -	0	0	2,345
Extend rotation length (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	1,188
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	50
Increase trees outside forests (1000 hectares)		ŭ	
Land impacted for carbon sink potential - Low -	0	0	62.4
Reforest cropland (1000 hectares)		O	02.4
Land impacted for carbon sink potential - Low -	0	0	27.9
Reforest pasture (1000 hectares)		O	21.7
Land impacted for carbon sink potential - Low -	0	0	1,188
Restore productivity (1000 hectares)		U	1,100
Land impacted for carbon sink potential - Low -	0	0	5,276
Total impacted (over 30 years) (1000 hectares)		U	5,216
Land impacted for carbon sink potential - Mid -	0	0	95.8
		U	95.8
Accelerate regeneration (1000 hectares)	0	0	0/0
Land impacted for carbon sink potential - Mid -	0	0	363
Avoid deforestation (over 30 years) (1000			
hectares)			, , , , , ,
Land impacted for carbon sink potential - Mid -	0	0	4,232
Extend rotation length (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	1,788
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	72.5
Increase trees outside forests (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	93.6
Reforest cropland (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	202
Reforest pasture (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	2,392
Restore productivity (1000 hectares)			,
Land impacted for carbon sink potential - Mid -	0	0	9,239
Total impacted (over 30 years) (1000 hectares)			

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

Item	2020	2025	2030	2035	2040	2045	2050
Residential HVAC investment in 2020s vs. REF -	0	7.85	7.66	0	0	0	0
Cumulative 5-yr (billion \$2018)							
Sales of cooking units - Electric Resistance (%)	66.5	66.5	66.5	66.5	66.5	66.5	66.5
Sales of cooking units - Gas (%)	33.5	33.5	33.5	33.5	33.5	33.5	33.5
Sales of space heating units - Electric Heat Pump	23.1	53.2	54.3	56	57.1	58.3	60.1
(%)							
Sales of space heating units - Electric Resistance	19	17.4	17.2	16.5	15.9	14.8	12.9
(%)							
Sales of space heating units - Fossil (%)	4.53	3.7	3.73	3.74	3.7	3.7	3.74
Sales of space heating units - Gas (%)	53.4	25.6	24.8	23.8	23.3	23.2	23.3
Sales of water heating units - Electric Heat Pump	0	0	0	0	0	0	0
(%)							
Sales of water heating units - Electric Resistance	47.2	63.3	63.3	63.2	63.1	63	63
(%)							
Sales of water heating units - Gas Furnace (%)	50	34.6	34.6	34.7	34.8	34.8	34.9
Sales of water heating units - Other (%)	2.84	2.09	2.1	2.12	2.13	2.15	2.16

Table 59: REF scenario - PILLAR 1: Efficiency/Electrification - Transportation

Item	2020	2025	2030	2035	2040	2045	2050
Vehicle sales - Heavy-duty - diesel (%)	98.1	98.2	97.9	97	95.6	93.5	91.6
Vehicle sales - Heavy-duty - EV (%)	0	0	0	0	0	0	0
Vehicle sales - Heavy-duty - gasoline (%)	0.229	0.242	0.257	0.274	0.294	0.317	0.343
Vehicle sales - Heavy-duty - hybrid (%)	0.083	0.096	0.112	0.13	0.15	0.174	0.202
Vehicle sales - Heavy-duty - hydrogen FC (%)	0.119	0.138	0.16	0.186	0.216	0.25	0.29
Vehicle sales - Heavy-duty - other (%)	1.51	1.31	1.57	2.37	3.69	5.71	7.57
Vehicle sales - Light-duty - diesel (%)	1.47	1.9	2.17	2.02	1.82	1.69	1.61
Vehicle sales - Light-duty - EV (%)	3.84	5.96	6.76	8.33	10.1	11.6	12.8
Vehicle sales - Light-duty - gasoline (%)	89.8	86.1	83.9	81.9	79.8	77.9	76.3
Vehicle sales - Light-duty - hybrid (%)	4.71	5.54	6.77	7.33	7.87	8.41	8.81
Vehicle sales - Light-duty - hydrogen FC (%)	0.11	0.374	0.341	0.302	0.298	0.298	0.308
Vehicle sales - Light-duty - other (%)	0.098	0.102	0.098	0.099	0.098	0.097	0.099
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)	252	257	260	262	266	276	290
Final energy use - Industry (PJ)	420	441	459	477	500	522	549
Final energy use - Residential (PJ)	362	345	342	342	347	357	368
Final energy use - Transportation (PJ)	1,058	1,005	938	900	906	935	973

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

Item	2020	2025	2030	2035	2040	2045	2050
Commercial HVAC investment in 2020s -	0	34,430	35,753	0	0	0	0
Cumulative 5-yr (million \$2018)							
Sales of cooking units - Electric Resistance (%)	32	34.3	34.3	34.3	34.4	34.3	34.3
Sales of cooking units - Gas (%)	68	65.7	65.7	65.7	65.6	65.7	65.7
Sales of space heating units - Electric Heat Pump (%)	7.3	29.1	63.5	71.8	72.4	72.4	72.4
Sales of space heating units - Electric Resistance (%)	6.68	9.42	14.6	20.2	24.8	25.6	25.6
Sales of space heating units - Fossil (%)	0	4.09	2.54	1.21	0.181	0.016	0
Sales of space heating units - Gas Furnace (%)	86	57.4	19.3	6.83	2.61	2	1.94
Sales of water heating units - Electric Heat Pump (%)	0.221	0.279	0.274	0.275	0.276	0.274	0.275
Sales of water heating units - Electric Resistance (%)	5.5	6.83	6.74	6.75	6.78	6.74	6.75
Sales of water heating units - Gas Furnace (%)	92.1	88.7	88.7	88.7	88.7	88.7	88.7
Sales of water heating units - Other (%)	2.13	4.16	4.3	4.23	4.29	4.32	4.3

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

Item	2020	2025	2030	2035	2040	2045	2050
Electricity distribution capital invested -	0	7.5	7.83	10.5	11.1	9.45	9.79
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	-11.1	0	-19	-15.4
(Mt CO2e/y)				
Business-as-usual carbon sink - Retained in	-6.93	0	-11.6	-12.2
Hardwood Products (Mt CO2e/y)				
Business-as-usual carbon sink - Total (Mt CO2e/y)	-18	0	-30.5	-27.5
Carbon sink potential - High - Accelerate	0	0	0	781
regeneration (1000 tCO2e/y)				

Table 63: REF scenario - PILLAR 6: Land sinks - F	orests (coi	ntinued)		
Item	2020	2025	2030	2050
Carbon sink potential - High - All (not counting overlap) (1000 tC02e/y)	0	0	0	61,940
Carbon sink potential - High - Avoid deforestation (1000 tCO2e/y)	0	0	0	2,764
Carbon sink potential - High - Extend rotation length (1000 tC02e/y)	0	0	0	12,001
Carbon sink potential - High - Improve plantations (1000 tCO2e/y)	0	0	0	6,449
Carbon sink potential - High - Increase retention of HWP (1000 tC02e/y)	0	0	0	25,469
Carbon sink potential - High - Increase trees outside forests (1000 tCO2e/y)	0	0	0	1,000
Carbon sink potential - High - Reforest cropland (1000 tCO2e/y)	0	0	0	1,887
Carbon sink potential - High - Reforest pasture (1000 tC02e/y)	0	0	0	5,666
Carbon sink potential - High - Restore productivity (1000 tC02e/y)	0	0	0	5,922
Carbon sink potential - Low - Accelerate regeneration (1000 tC02e/y)	0	0	0	391
Carbon sink potential - Low - All (not counting overlap) (1000 tC02e/y)	0	0	0	20,952
Carbon sink potential - Low - Avoid deforestation (1000 tC02e/y)	0	0	0	461
Carbon sink potential - Low - Extend rotation length (1000 tCO2e/y)	0	0	0	4,610
Carbon sink potential - Low - Improve plantations (1000 tC02e/y)	0	0	0	3,281
Carbon sink potential - Low - Increase retention of HWP (1000 tC02e/y)	0	0	0	8,490
Carbon sink potential - Low - Increase trees outside forests (1000 tCO2e/y)	0	0	0	350
Carbon sink potential - Low - Reforest cropland (1000 tC02e/y)	0	0	0	944
Carbon sink potential - Low - Reforest pasture (1000 tC02e/y)	0	0	0	429
Carbon sink potential - Low - Restore productivity (1000 tC02e/y)	0	0	0	1,996
Carbon sink potential - Mid - Accelerate regeneration (1000 tC02e/y)	0	0	0	586
Carbon sink potential - Mid - All (not counting overlap) (1000 tC02e/y)	0	0	0	41,389
Carbon sink potential - Mid - Avoid deforestation (1000 tCO2e/y)	0	0	0	1,612
Carbon sink potential - Mid - Extend rotation length (1000 tCO2e/y)	0	0	0	8,306
Carbon sink potential - Mid - Improve plantations (1000 tC02e/y)	0	0	0	4,808
Carbon sink potential - Mid - Increase retention of HWP (1000 tC02e/y)	0	0	0	16,980
Carbon sink potential - Mid - Increase trees outside forests (1000 tCO2e/y)	0	0	0	675
Carbon sink potential - Mid - Reforest cropland (1000 tC02e/y)	0	0	0	1,415
Carbon sink potential - Mid - Reforest pasture (1000 tC02e/y)	0	0	0	3,047
Carbon sink potential - Mid - Restore productivity (1000 tC02e/y)	0	0	0	3,959
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)	0	0	0	128
Land impacted for carbon sink potential - High - Avoid deforestation (over 30 years) (1000 hectares)	0	0	0	374

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

Teten	Table 63: REF scenario - PILLAR 6: Land sinks - I	Forests (con			
Extend rotation length (1000 hectares) Land impacted for carbon sink potential - High - Improve plantations (1000 hectares) Land impacted for carbon sink potential - High - Increase retention of HWP (1000 hectares) Land impacted for carbon sink potential - High - Increase research of carbon sink potential - High - Increase tress outside forests (1000 hectares) Land impacted for carbon sink potential - High - Reforest coppland (1000 hectares) Land impacted for carbon sink potential - High - Reforest corpland (1000 hectares) Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares) Land impacted for carbon sink potential - High - Restorest productivity (1000 hectares) Land impacted for carbon sink potential - High - Restore productivity (1000 hectares) Land impacted for carbon sink potential - Ligh - Total impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares) Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares) Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares) Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares) Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares) Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares) Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares) Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares) Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares) Land impacted for carbon sink potential - Low - Restorest corpland (1000 hectares) Land impacted for carbon sink potential - Low - Restorest corpland (1000 hectares) Land impacted for carbon sink potential - Low - Restorest productivity (1000 hectares) Land impacted for carbon sink potential - Low - Restorest productivity (1000 hectares) Land impacted for carbon sink potential - Mid -		2020	2025	2030	2050
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares) Land impacted for carbon sink potential - High - Increase retention of HWP (1000 hectares) Land impacted for carbon sink potential - High - Increase retention of HWP (1000 hectares) Land impacted for carbon sink potential - High - Increase trees outside forests (1000 hectares) Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares) Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares) Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares) Land impacted for carbon sink potential - High - Improved the potential - Low - Improved plantations (note) - Move the potential - Low - Improved plantations (nover 30 years) (1000 hectares) Land impacted for carbon sink potential - Low - Improved plantations (1000 hectares) Land impacted for carbon sink potential - Low - Improved plantations (1000 hectares) Land impacted for carbon sink potential - Low - Improved plantations (1000 hectares) Land impacted for carbon sink potential - Low - Improved plantations (1000 hectares) Land impacted for carbon sink potential - Low - Improved plantations (1000 hectares) Land impacted for carbon sink potential - Low - Improved plantations (1000 hectares) Land impacted for carbon sink potential - Low - Increase retention of HWP (1000 hectares) Land impacted for carbon sink potential - Low - Increase trees outside forests (1000 hectares) Land impacted for carbon sink potential - Low - Improved plantations (1000 hectares) Land impacted for carbon sink potential - Low - Improved plantations (1000 hectares) Land impacted for carbon		0	0	0	6,120
Improve plantations (1000 hectares) Land impacted for carbon sink potential - High - Increase retention of HWP (1000 hectares) Land impacted for carbon sink potential - High - Increase trees outside forests (1000 hectares) Land impacted for carbon sink potential - High - Reforest croppland (1000 hectares) Land impacted for carbon sink potential - High - Reforest croppland (1000 hectares) Land impacted for carbon sink potential - High - Reforest propagation of the Reforest possible for earbon sink potential - High - Reforest pasture (1000 hectares) Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares) Land impacted for carbon sink potential - High - O					
Land impacted for carbon sink potential - High - Increase retention of HWP (1000 hectares)		0	0	0	2,376
Land impacted for carbon sink potential - High - Increase retention of HWP (1000 hectares) Land impacted for carbon sink potential - High - Increase trees outside forests (1000 hectares) Land impacted for carbon sink potential - High - Reforest croppland (1000 hectares) Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares) Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares) Land impacted for carbon sink potential - High - Restore productivity (1000 hectares) Land impacted for carbon sink potential - High - Increase responsible to the productivity (1000 hectares) Land impacted for carbon sink potential - Low - Increase responsible to the productivity (1000 hectares) Land impacted for carbon sink potential - Low - Increase responsible to the productivity (1000 hectares) Land impacted for carbon sink potential - Low - Increase responsible to the productivity (1000 hectares) Land impacted for carbon sink potential - Low - Increase retention of HWP (1000 hectares) Land impacted for carbon sink potential - Low - Increase retention of HWP (1000 hectares) Land impacted for carbon sink potential - Low - Increase retention of HWP (1000 hectares) Land impacted for carbon sink potential - Low - Increase retention of HWP (1000 hectares) Land impacted for carbon sink potential - Low - Increase retention of HWP (1000 hectares) Land impacted for carbon sink potential - Low - Increase retention of HWP (1000 hectares) Land impacted for carbon sink potential - Low - Increase retention of HWP (1000 hectares) Land impacted for carbon sink potential - Low - Increase retention of HWP (1000 hectares) Land impacted for carbon sink potential - Low - Increase retention of HWP (1000 hectares) Land impacted for carbon sink potential - Low - Increase retention of HWP (1000 hectares) Land impacted for carbon sink potential - Low - Increase retention of HWP (1000 hectares) Land impacted for carbon sink potential - Mid - Increase retention of	Improve plantations (1000 hectares)				
Land impacted for carbon sink potential - High - Notation Nota	Land impacted for carbon sink potential - High -	0	0	0	0
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares) Land impacted for carbon sink potential - High - Reforest pature (1000 hectares) Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares) Land impacted for carbon sink potential - High - Restore productivity (1000 hectares) Land impacted for carbon sink potential - High - December 1000 December 1000 hectares Land impacted for carbon sink potential - High - December 1000 December 1000 hectares Land impacted for carbon sink potential - Low - December 1000 December 1000 hectares Land impacted for carbon sink potential - Low - December 1000 December 1000 hectares Land impacted for carbon sink potential - Low - December 1000 hectares Land impacted for carbon sink potential - Low - December 1000 hectares Land impacted for carbon sink potential - Low - December 1000 hectares Land impacted for carbon sink potential - Low - December 1000 hectares Land impacted for carbon sink potential - Low - December 1000 hectares Land impacted for carbon sink potential - Low - December 1000 hectares Land impacted for carbon sink potential - Low - December 1000 hectares Land impacted for carbon sink potential - Low - December 1000 hectares Land impacted for carbon sink potential - Low - December 1000 hectares Land impacted for carbon sink potential - Low - December 1000 hectares Land impacted for carbon sink potential - Low - December 1000 hectares Land impacted for carbon sink potential - Low - December 1000 hectares Land impacted for carbon sink potential - Low - December 1000 hectares Land impacted for carbon sink potential - Low - December 1000 hectares Land impacted for carbon sink potential - Low - December 1000 hectares Land impacted for carbon sink potential - Low - December 1000 hectares Land impacted for carbon sink potential - Mid - December 1000 hectares Land impacted for carbon sink potential - Mid - December 1000 hectares Land impacted for carbon sink po	Increase retention of HWP (1000 hectares)				
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares) Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares) Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares) Land impacted for carbon sink potential - High - Restore productivity (1000 hectares) Land impacted for carbon sink potential - High - Description of the pasture (1000 hectares) Land impacted for carbon sink potential - High - Description of the pasture for carbon sink potential - Low - Description of the pasture for carbon sink potential - Description of the pasture for carbon sink potential - Mid - Description of the pasture for carbon sin	Land impacted for carbon sink potential - High -	0	0	0	95
Reforest cropland [1000 hectares]					
Reforest cropland [1000 hectares]	Land impacted for carbon sink potential - High -	0	0	0	125
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares) Compared to the carbon sink potential - High - Restore productivity (1000 hectares) Compared to the carbon sink potential - High - Compared to the carbon sink potential - High - Compared to the carbon sink potential - High - Compared to the carbon sink potential - Low - Compared to the carbon sink potential - Mid - Compared to the carbon sink potential - Mid - Compared to the carbon sink pot	Reforest cropland (1000 hectares)				
Reforest pasture (1000 hectares) Land impacted for carbon sink potential - High - Restore productivity (1000 hectares) Land impacted for carbon sink potential - High - Total impacted for carbon sink potential - High - Total impacted for carbon sink potential - Low -		0	0	0	161
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Total impacted (over 30 years) (1000 hectares)		0	0	0	9,239
	Total impacted (over 30 years) (1000 hectares)				

Table 64: REF scenario - IMPACTS - Health

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal (million 2019\$)	0	1,971	1,339	1,087	984	941	932
Monetary damages from air pollution - Natural Gas (million 2019\$)	0	306	381	399	439	482	526
Monetary damages from air pollution - Transportation (million 2019\$)	0	3,505	3,734	3,959	4,203	4,447	4,695
Premature deaths from air pollution - Coal (deaths)	0	221	150	122	110	106	105
Premature deaths from air pollution - Natural Gas (deaths)	0	34.5	43	45.1	49.6	54.5	59.4
Premature deaths from air pollution - Transportation (deaths)	0	394	420	445	473	500	528