

Net-Zero America - indiana state report

2021-03-15

These data underlie graphs and tables presented in the Princeton Net-Zero America study:

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Notes

- These data are all data from the study available at https://netzeroamerica.prince-ton.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 statelevel 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.)
- For Pillar 6 (Land sinks), values shown are maximum carbon storage potentials.

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

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

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

Item	2020	2025	2030	2035	2040	2045	2050
Electricity distribution capital invested -		4.81	4.97	8.01	8.51	7.33	7.63
Cumulative 5-yr (billion \$2018)							

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

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

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

Item	2020	2025	2030	2035	2040	2045	2050
Residential HVAC investment in 2020s vs.		5.74	7.82				
REF - Cumulative 5-yr (billion \$2018)							
Sales of cooking units - Electric	67.6	74.5	95.6	99.8	100	100	100
Resistance (%)							
Sales of cooking units - Gas (%)	32.4	25.5	4.36	0.22	0	0	0
Sales of space heating units - Electric	7.14	16.5	45.4	84.9	91.7	92.1	91.9
Heat Pump (%)							
Sales of space heating units - Electric	18.1	24.2	17.6	8.04	6.29	6.24	6.46
Resistance (%)							
Sales of space heating units - Fossil (%)	6.08	9.3	6.1	2.21	1.58	1.53	1.49
Sales of space heating units - Gas (%)	68.7	49.9	30.9	4.83	0.406	0.132	0.133
Sales of water heating units - Electric	0	2.32	17.1	34.9	37.8	38	38.1
Heat Pump (%)							
Sales of water heating units - Electric	39.3	55.4	55.8	60.8	61.7	61.8	61.7
Resistance (%)							
Sales of water heating units - Gas Furnace	60.6	42.1	26.8	4.14	0.241	0	0
(%)							
Sales of water heating units - Other (%)	0.101	0.202	0.203	0.203	0.201	0.202	0.203

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

Item	2020	2025	2030	2035	2040	2045	2050
Light-duty vehicle capital costs - Cumulative 5-yr (million \$2018)		1,189	3,044	4,939	7,479	8,143	7,762
Public EV charging plugs - DC Fast (1000	0.168		2.17		9.57		15.5
units)							
Public EV charging plugs - L2 (1000 units)	0.43		52.1		230		372
Vehicle sales - Heavy-duty - diesel (%)	97.2	92.1	67	23.3	4.22	0.628	0
Vehicle sales - Heavy-duty - EV (%)	0.588	3.81	19	45.6	57.4	59.6	60
Vehicle sales - Heavy-duty - gasoline (%)	0.227	0.227	0.176	0.066	0.013	0.002	0
Vehicle sales - Heavy-duty - hybrid (%)	0.082	0.09	0.077	0.031	0.007	0.001	0
Vehicle sales - Heavy-duty - hydrogen FC	0.392	2.54	12.7	30.4	38.2	39.7	40
(%)							
Vehicle sales - Heavy-duty - other (%)	1.5	1.23	1.07	0.568	0.163	0.038	0
Vehicle sales - Light-duty - diesel (%)	1.59	1.85	1.27	0.407	0.075	0.013	0
Vehicle sales - Light-duty - EV (%)	3.79	14.8	45.9	81.6	96.3	99.3	100
Vehicle sales - Light-duty - gasoline (%)	90.1	78.4	49.4	16.8	3.32	0.591	0
Vehicle sales - Light-duty - hybrid (%)	4.3	4.45	3.17	1.18	0.287	0.063	0
Vehicle sales - Light-duty - hydrogen FC	0.111	0.342	0.206	0.064	0.013	0.002	0
(%)							
Vehicle sales - Light-duty - other (%)	0.103	0.099	0.065	0.023	0.004	0.001	0
Vehicle sales - Medium-duty - diesel (%)	64.7	59.7	42.3	14.4	2.59	0.384	0
Vehicle sales - Medium-duty - EV (%)	0.784	5.07	25.3	60.8	76.5	79.5	80
Vehicle sales - Medium-duty - gasoline (%)	33.7	33.3	25.5	9.32	1.77	0.277	0
Vehicle sales - Medium-duty - hybrid (%)	0.363	0.402	0.341	0.14	0.03	0.005	0
Vehicle sales - Medium-duty - hydrogen	0.196	1.27	6.33	15.2	19.1	19.9	20
FC (%)	0.050	0.055	0.005	0.000	0.010	0.007	
Vehicle sales - Medium-duty - other (%)	0.253	0.255	0.205	0.083	0.019	0.004	0

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

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	0.006	0.021	0
Capital invested - Biomass w/ccu power plant (billion \$2018)	0	0	0	0	0	0.909	0
Capital invested - Solar PV - Base (billion \$2018)		0.952	13.2	19.6	8.1	2.03	2.42
Capital invested - Solar PV - Constrained (billion \$2018)		1.79	15.2	20	8.27	4.43	1.1
Capital invested - Wind - Base (billion \$2018)		0	28.7	19.6	12.6	0.095	0
Capital invested - Wind - Constrained (billion \$2018)		0	9.95	0	0	0	7.78
Installed renewables - OffshoreWind - Base land use assumptions (MW)	0	0	0	0	0	0	0
Installed renewables - OffshoreWind - Constrained land use assumptions (MW)	0	0	0	0	0	0	0
Installed renewables - Rooftop PV (MW)	98.1	147	195	258	334	421	520
Installed renewables - Solar - Base land use assumptions (MW)	137	969	13,873	34,693	43,817	46,235	49,295
Installed renewables - Solar - Constrained land use assumptions (MW)	20	2,157	22,486	42,286	50,735	52,985	54,054
Installed renewables - Wind - Base land use assumptions (MW)	3,368	3,368	24,947	40,707	51,343	51,428	51,428
Installed renewables - Wind - Constrained land use assumptions (MW)	3,368	3,368	10,841	10,841	10,841	10,841	13,699

Table 7: E	aaanaania	יר מאווזח	Cloan Electrici	tv - Generation
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Item	2020	2025	2030	2035	2040	2045	2050
Biomass power plant (GWh)	0	0	0	0	0	0	0
Biomass w/ccu allam power plant (GWh)	0	0	0	0	6.38	27.4	27.4
Biomass w/ccu power plant (GWh)	0	0	0	0	0	1,020	1,020
OffshoreWind - Base land use	0	0	0	0	0	0	0
assumptions (GWh)							
OffshoreWind - Constrained land use	0	0	0	0	0	0	0
assumptions (GWh)							
Solar - Base land use assumptions (GWh)	245	1,525	21,352	53,256	67,126	70,803	75,356
Solar - Constrained land use assumptions	36.1	3,293	34,491	64,799	77,634	81,001	82,579
(GWh)							
Wind - Base land use assumptions (GWh)	12,511	12,511	82,281	129,936	160,359	160,578	160,578
Wind - Constrained land use assumptions	12,511	12,511	34,458	34,458	34,458	34,458	44,015
(GWh)							

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	531	2,880	2,928
Conversion capital investment -		0	0	0	7,842	34,786	704
Cumulative 5-yr (million \$2018)							
Number of facilities - Allam power w ccu	0	0	0	0	1	2	2
(quantity)							
Number of facilities - Beccs hydrogen	0	0	0	0	9	46	47
(quantity)							
Number of facilities - Diesel (quantity)	0	0	0	0	0	0	0
Number of facilities - Diesel ccu (quantity)	0	0	0	0	1	2	2
Number of facilities - Power (quantity)	0	0	0	0	0	0	0
Number of facilities - Power ccu	0	0	0	0	0	1	1
(quantity)							
Number of facilities - Pyrolysis (quantity)	0	0	0	0	0	0	0
Number of facilities - Pyrolysis ccu	0	0	0	0	1	2	2
(quantity)							
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	1.08	11.5	59.5	60.5
Annual - BECCS (MMT)		0	0	0	10.1	54.7	55.6
Annual - Cement and lime (MMT)		0	0	0	0	3.42	3.53
Annual - NGCC (MMT)		0	0	1.08	1.43	1.45	1.36
Cumulative - All (MMT)		0	0	1.08	12.6	72.1	133
Cumulative - BECCS (MMT)		0	0	0	10.1	64.7	120
Cumulative - Cement and lime (MMT)		0	0	0	0	3.42	6.95
Cumulative - NGCC (MMT)		0	0	1.08	2.51	3.96	5.32

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

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

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

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

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

Item	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - Aggressive							-1,845
deployment - Corn-ethanol to energy							
grasses (1000 tC02e/y)							
Carbon sink potential - Aggressive							-7,474
deployment - Cropland measures (1000							
tCO2e/y)							-234
Carbon sink potential - Aggressive							-234
deployment - Permanent conservation							
cover (1000 tC02e/y)							0.550
Carbon sink potential - Aggressive							-9,552
deployment - Total (1000 tCO2e/y)							10/5
Carbon sink potential - Moderate							-1,845
deployment - Corn-ethanol to energy							
grasses (1000 tC02e/y)							0.007
Carbon sink potential - Moderate							-3,936
deployment - Cropland measures (1000							
tCO2e/y)							447
Carbon sink potential - Moderate							-117
deployment - Permanent conservation							
cover (1000 tC02e/y)							
Carbon sink potential - Moderate							-5,898
deployment - Total (1000 tCO2e/y)							
Land impacted for carbon sink -							808
Aggressive deployment - Corn-ethanol to							
energy grasses (1000 hectares)							
Land impacted for carbon sink -							3,995
Aggressive deployment - Cropland							
measures (1000 hectares)							
Land impacted for carbon sink -							425
Aggressive deployment - Permanent							
conservation cover (1000 hectares)							
Land impacted for carbon sink -							5,228
Aggressive deployment - Total (1000							
hectares)							
Land impacted for carbon sink - Moderate							808
deployment - Corn-ethanol to energy							
grasses (1000 hectares)							
Land impacted for carbon sink - Moderate							2,104
deployment - Cropland measures (1000							
hectares)							
Land impacted for carbon sink - Moderate							213
deployment - Permanent conservation							
cover (1000 hectares)							
Land impacted for carbon sink - Moderate							3,124
deployment - Total (1000 hectares)							

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

Item	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - High - Accelerate							-77.5
regeneration (1000 tCO2e/y)							
Carbon sink potential - High - All (not							-14,566
counting overlap) (1000 tCO2e/y)							
Carbon sink potential - High - Avoid							-1,952
deforestation (1000 tC02e/y)							0.450
Carbon sink potential - High - Extend							-2,158
rotation length (1000 tCO2e/y)							1/0
Carbon sink potential - High - Improve							-168
plantations (1000 tC02e/y)							1.007
Carbon sink potential - High - Increase							-1,834
retention of HWP (1000 tC02e/y)							0.007
Carbon sink potential - High - Increase							-2,006
trees outside forests (1000 tC02e/y)							10//
Carbon sink potential - High - Reforest cropland (1000 tCO2e/y)							-1,264
Carbon sink potential - High - Reforest							-3,822
pasture (1000 tCO2e/y)							-3,022
Carbon sink potential - High - Restore							-1,284
productivity (1000 tC02e/y)							-1,204
Carbon sink potential - Low - Accelerate							-38.8
regeneration (1000 tCO2e/y)							-30.0
Carbon sink potential - Low - All (not							-3,947
counting overlap) (1000 tC02e/y)							-5,741
Carbon sink potential - Low - Avoid							-325
deforestation (1000 tC02e/y)							020
Carbon sink potential - Low - Extend							-829
rotation length (1000 tC02e/y)							027
Carbon sink potential - Low - Improve							-85.6
plantations (1000 tCO2e/y)							00.0
Carbon sink potential - Low - Increase							-611
retention of HWP (1000 tCO2e/y)							• • • • • • • • • • • • • • • • • • • •
Carbon sink potential - Low - Increase							-702
trees outside forests (1000 tCO2e/y)							
Carbon sink potential - Low - Reforest							-632
cropland (1000 tCO2e/y)							
Carbon sink potential - Low - Reforest							-290
pasture (1000 tCO2e/y)							
Carbon sink potential - Low - Restore							-433
productivity (1000 tCO2e/y)							
Carbon sink potential - Mid - Accelerate							-58.2
regeneration (1000 tCO2e/y)							
Carbon sink potential - Mid - All (not							-9,255
counting overlap) (1000 tCO2e/y)							
Carbon sink potential - Mid - Avoid							-1,138
deforestation (1000 tCO2e/y)							
Carbon sink potential - Mid - Extend							-1,493
rotation length (1000 tCO2e/y)							
Carbon sink potential - Mid - Improve							-125
plantations (1000 tCO2e/y)							
Carbon sink potential - Mid - Increase							-1,223
retention of HWP (1000 tCO2e/y)							
Carbon sink potential - Mid - Increase							-1,354
trees outside forests (1000 tCO2e/y)							
Carbon sink potential - Mid - Reforest							-948
cropland (1000 tCO2e/y)							
Carbon sink potential - Mid - Reforest							-2,056
pasture (1000 tC02e/y)							
Carbon sink potential - Mid - Restore							-858
productivity (1000 tCO2e/y)							

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

lable 13: E+ scenario - PILLAR 6: Land sink		·					
Item	2020	2025	2030	2035	2040	2045	2050
Land impacted for carbon sink potential -							12.7
High - Accelerate regeneration (1000							
hectares)							0//
Land impacted for carbon sink potential -							264
High - Avoid deforestation (over 30 years)							
(1000 hectares)							1100
Land impacted for carbon sink potential -							1,100
High - Extend rotation length (1000							
hectares)							
Land impacted for carbon sink potential -							62
High - Improve plantations (1000							
hectares)							
Land impacted for carbon sink potential -							0
High - Increase retention of HWP (1000							
hectares)							
Land impacted for carbon sink potential -							191
High - Increase trees outside forests							
(1000 hectares)							
Land impacted for carbon sink potential -							83.6
High - Reforest cropland (1000 hectares)							
Land impacted for carbon sink potential -							109
High - Reforest pasture (1000 hectares)							
Land impacted for carbon sink potential -							426
High - Restore productivity (1000							
hectares)							
Land impacted for carbon sink potential -							2,248
High - Total impacted (over 30 years)							
(1000 hectares)							
Land impacted for carbon sink potential -							6.34
Low - Accelerate regeneration (1000							
hectares)							
Land impacted for carbon sink potential -							248
Low - Avoid deforestation (over 30 years)							
(1000 hectares)							
Land impacted for carbon sink potential -							422
Low - Extend rotation length (1000							
hectares)							
Land impacted for carbon sink potential -							31
Low - Improve plantations (1000							
hectares)							
Land impacted for carbon sink potential -							0
Low - Increase retention of HWP (1000							
hectares)							
Land impacted for carbon sink potential -							100
Low - Increase trees outside forests							
(1000 hectares)							
Land impacted for carbon sink potential -							41.8
Low - Reforest cropland (1000 hectares)							
Land impacted for carbon sink potential -							18.8
Low - Reforest pasture (1000 hectares)							
Land impacted for carbon sink potential -							258
Low - Restore productivity (1000							
hectares)							
Land impacted for carbon sink potential -							1,125
Low - Total impacted (over 30 years)							
(1000 hectares)							
Land impacted for carbon sink potential -							9.51
Mid - Accelerate regeneration (1000							

					_
Table 13: F+:	scenaria -	PTII AR 6.	I and sinks -	. Forests i	(continued)

Item	2020	2025	2030	2035	2040	2045	2050
Land impacted for carbon sink potential -							256
Mid - Avoid deforestation (over 30 years)							
(1000 hectares)							
Land impacted for carbon sink potential -							761
Mid - Extend rotation length (1000							
hectares)							
Land impacted for carbon sink potential -							46.6
Mid - Improve plantations (1000 hectares)							
Land impacted for carbon sink potential -							0
Mid - Increase retention of HWP (1000							
hectares)							
Land impacted for carbon sink potential -							145
Mid - Increase trees outside forests (1000							
hectares)							
Land impacted for carbon sink potential -							62.7
Mid - Reforest cropland (1000 hectares)							
Land impacted for carbon sink potential -							136
Mid - Reforest pasture (1000 hectares)							
Land impacted for carbon sink potential -							519
Mid - Restore productivity (1000							
hectares)							
Land impacted for carbon sink potential -							1,936
Mid - Total impacted (over 30 years) (1000							
hectares)							

Table 14: E+ scenario - IMPACTS - Fossil fuel industries

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

Table 15: E+ scenario - IMPACTS - Health

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal (million 2019\$)		822	1	0.991	0.866	0.63	0.056
Monetary damages from air pollution - Natural Gas (million 2019\$)		203	153	103	88.6	48	19.9
Monetary damages from air pollution - Transportation (million 2019\$)		1,813	1,690	1,283	740	339	136
Premature deaths from air pollution - Coal (deaths)		92.9	0.113	0.112	0.098	0.071	0.006
Premature deaths from air pollution - Natural Gas (deaths)		22.9	17.2	11.6	10	5.42	2.25
Premature deaths from air pollution - Transportation (deaths)		204	190	144	83.2	38.1	15.3

Table 16: E+ scenario - IMPACTS - Jobs

Item	2020	2025	2030	2035	2040	2045	2050
By economic sector - Agriculture (jobs)		2,024	2,048	1,949	1,792	3,432	2,767
By economic sector - Construction (jobs)		8,136	25,157	36,051	33,704	29,553	28,716
By economic sector - Manufacturing		10,527	13,063	17,489	16,961	14,999	17,931
(jobs)							
By economic sector - Mining (jobs)		3,873	2,301	1,595	1,045	704	486

Table 16: E+ scenario - IMPACTS - Jobs (continued)

Item	Table 16: E+ Scending - IMPACTS - Jubs (cu	-						
By economic sector - Pipeline [jobs] 751 905 555 409 381 291	Item	2020	2025	2030	2035	2040	2045	2050
Sy economic sector - Professional (jobs)								
Sy economic sector - Trade (jobs) 4,346 8,197 11,831 11,692 11,188 11,331 1,692 92 conomic sector - Villities (jobs) 99/31 17,094 25,225 27,186 25,731 25,200 29 direction level - All sectors - 13,562 26,706 38,008 37,704 35,117 35,463 38,501 35,643 38,501 35,643 38,501 35,643 38,501 35,643 38,501 35,643 38,501 35,643 38,501 35,643 38,501 35,643 38,501 35,643 38,501 35,643 38,501 35,643 38,501 35,643 38,501 35,643 35,								
Sy economic sector - Utilities (jobs) 9,913 17,094 25,225 27,186 25,731 25,200								
By deucation level - All sectors - Sectors - Country 13,562 26,706 38,008 37,704 35,117 35,463 38,000 38,000 37,704 35,117 35,463 38,000 38,000 37,704 35,117 35,463 38,000 37,704 37,102								
Associates degree or some college (jobs) By druduation level – All sectors – Doctoral Bachelors degree (jobs) By druduation level – All sectors – Doctoral degree (jobs) By druduation level – All sectors – Doctoral degree (jobs) By druduation level – All sectors – Doctoral degree (jobs) By druduation level – All sectors – High sy druduation level – All sectors – Masters or professional degree (jobs) By druduation level – All sectors – High sy resource sector – Siomass (jobs) By resource sector – Coal (jobs) By resource sector – Natural Gas (jobs) By resource sector – Vindi (jobs) By resourc								
Sy education level - All sectors - Sector - Sectors - Sectors - Doctoral degree (jobs) Sectors - Sector - Sectors - Sector - Sectors			13,562	26,706	38,008	37,704	35,117	35,463
Bachelors degree [jobs] Py education level - All sectors - Doctoral degree (jobs) Py education level - All sectors - High sectors 19,913 36,668 51,006 49,683 47,037 47,162 47,162 47,037 47,162			0.01/.	14 707	22 450	22 751	22.042	22 1/.0
By education level - All sectors - Doctoral degree [jobs] 19,913 36,668 51,006 49,683 47,037 47,162 47,662 59,463 59,50 59,462 59,462 59,462 59,462 59,463 59,50 59,462 59,462 59,463 59,50 59,462 59,462 59,463 59,50 59,462 59,462 59,463 59,50 59,462 59,463 59,50 59,462 59,463 59,463 59,562 59,462 59,463 59,463 59,463 59,562 59,462 59,463 5	•		9,014	10,101	23,650	23,131	22,903	23,140
degree (jobs) 19,713 36,668 51,006 49,683 47,037 47,162 47,162 47,062 47,063 47,			273	629	907	92/	9/.8	035
Sy education level - All sectors - High school (1905) 19913 36,668 51,006 49,683 47,037 47,162 47,162 47,007 47,162 47,007 47,162 47,007 47,162 47,007 47,162 47,007 47,162 47,007 47,162 47,007 47,162 47,007 47,162 47,007			210	027	701	724	740	700
school diploma or less (jobs) 2.096 4,156 5,938 6,031 5,950 5,942 or professional degree (jobs) 2,096 4,156 5,938 6,031 5,950 5,942 by resource sector - Biomass (jobs) 4,782 4,683 4,346 4,688 12,609 12,142 By resource sector - Coal (jobs) 2,88 2,275 376 439 1,369 1,311 By resource sector - Coal (jobs) 10,883 2,48,44 43,681 48,614 46,668 2,728 3,744 2,042 2,042 3,744 2,042			19.913	36,668	51.006	49.683	47.037	47.162
By education level - All sectors - Masters 2,096 4,156 5,938 6,031 5,950 5,942	,		,		0.,000	,	,	,
or professional degree (jobs) By resource sector - Biomass (jobs) Sy resource sector - Gool (jobs) Sy resource sector - Cool (jobs) Sy resource sector - Natural Gas (jobs) Sy resource sector - Nuclear (jobs) Sy resource sector - Nuclear (jobs) Sy resource sector - Solar (jobs) Sy resource sect			2,096	4,156	5,938	6,031	5,950	5,942
By resource sector - CO2 (jobs)							,	•
By resource sector - Coal (jobs)			4,782	4,683	4,346	4,688	12,609	12,142
By resource sector - Grid (jobs) 10,883 24,844 43,681 48,041 46,064 46,682 By resource sector - Natural Gas (jobs) 7,694 6,136 5,869 5,252 3,344 2,042 2,042 998 Sy resource sector - Nuclear (jobs) 0 0 0 0 0 0 0 0 0	By resource sector - CO2 (jobs)		26.8	2,275	376	439	1,369	1,311
By resource sector - Natural Gas (jobs) 7,694 6,136 5,869 5,252 3,344 2,042 By resource sector - Nuclear (jobs) 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	By resource sector - Coal (jobs)		4,776	1,153	227	191	168	148
By resource sector - Nuclear (jobs)	By resource sector - Grid (jobs)		10,883		43,681	48,041	46,064	46,682
By resource sector - Oil (jobs) 4,885 3,582 2,434 1,622 998			7,694	6,136	5,869	5,252	3,344	2,042
By resource sector - Solar (jobs)	,		0	-	-	-	٠ ا	-
By resource sector - Wind (jobs) 5,769 21,376 30,866 33,420 29,305 28,356 Median wages - Annual - All (\$2019 per job) 56,477 57,177 58,000 59,270 60,370 61,031 On-Site or In-Plant Training - Total jobs - 1 7,007 13,782 19,527 19,321 17,988 18,078 To 4 years (jobs) 7,007 13,782 19,527 19,321 17,988 18,078 To 10 years (jobs) 7,125 13,838 19,505 19,290 18,426 18,533 On-Site or In-Plant Training - Total jobs - 1 7,125 13,838 19,505 19,290 18,426 18,533 On-Site or In-Plant Training - Total jobs - 1 7,623 1,067 1,057 981 984 On-Site or In-Plant Training - Total jobs - 27,623 50,713 71,093 70,209 67,012 67,527 Up to 1 year (jobs) 7,748 25,196 24,979 23,201 23,295 Up to 1 year (jobs) 7,748 25,196 24,979 23,201 23,295 Years (jobs) 7,748 7,748 25,196 24,979 23,201 23,295 Years (jobs) 7,748 7,748 7,748 7,748 7,748 On-the-Job Training - All sectors - 4 to 10 2,609 5,792 8,270 8,169 7,537 7,438 Years (jobs) 7,748 7,748 7,748 7,748 7,748 On-the-Job Training - All sectors - Over 10 426 845 1,175 1,130 1,024 1,044 Years (jobs) 7,748 7,748 7,748 7,748 7,748 On-the-Job Training - All sectors - Up to 1 30,525 55,925 78,358 77,451 74,205 74,768 Year (jobs) 7,748 7,749 7,749 7,749 7,749 7,749 Related work experience - All sectors - 4 10,041 19,539 27,638 27,490 25,888 26,035 Related work experience - All sectors - 4 10,041 19,539 27,638 27,490 25,888 26,035 Related work experience - All sectors - 4 10,041 19,539 27,638 27,490 25,888 26,035 Rolated work experience - All sectors - 4 10,041 19,539 27,638 27,490 25,888 26,035 Rolated work experience - All sectors - 9,626 17,855 24,867 24,146 23,007 23,152 Rolated work experience - All sectors - 10 9,626 17,855 24,867 24,146 23,0								
Median wages - Annual - All (\$2019 per job) 56,477 57,177 58,000 59,270 60,370 61,031 50,000 50,000 50,270 60,370 61,031 50,000 50,000 50,270 60,370 61,031 50,000 50,000 50,270 60,370 61,031 50,000 50,000 50,270 60,370 61,031 50,000 50,000 50,270 60,370 61,031 50,000 50,270 60,370 61,031 50,000 50,270 60,370 61,031 50,000 50,270 50,000 50,270								
Job On-Site or In-Plant Training - Total jobs - 1								
On-Site or In-Plant Training - Total jobs - 1	- , , , ,		56,477	57,177	58,000	59,270	60,370	61,031
to 4 years (jobs) 2,728 5,859 8,316 8,215 7,608 7,519 0n-Site or In-Plant Training - Total jobs - None (jobs) 7,125 13,838 19,505 19,290 18,426 18,533 None (jobs) 375 752 1,067 1,057 981 984 On-Site or In-Plant Training - Total jobs - Over 10 years (jobs) 27,623 50,713 71,093 70,209 67,012 67,527 Up to 1 year (jobs) 0n-the-Job Training - All sectors - 1 to 4 years (jobs) 8,896 17,748 25,196 24,979 23,201 23,295 years (jobs) 0n-the-Job Training - All sectors - 4 to 10 years (jobs) 2,609 5,792 8,270 8,169 7,537 7,438 years (jobs) 0n-the-Job Training - All sectors - None (jobs) 2,402 4,634 6,510 6,363 6,047 6,097 (jobs) 0n-the-Job Training - All sectors - Over 10 years (jobs) 426 845 1,175 1,130 1,024 1,044 year (jobs) 10-the-Job Training - All sectors - Up to 1 year (jobs) 30,525 55,925			7,007	13,782	19,527	19,321	17,988	18,078
to 10 years (jobs) On-Site or In-Plant Training - Total jobs - None (jobs) On-Site or In-Plant Training - Total jobs - Over 10 years (jobs) On-Site or In-Plant Training - Total jobs - Over 10 years (jobs) On-Site or In-Plant Training - Total jobs - Over 10 years (jobs) On-Site or In-Plant Training - Total jobs - Up to 1 year (jobs) On-Site or In-Plant Training - Total jobs - Up to 1 year (jobs) On-the-Job Training - All sectors - 1 to 4 Years (jobs) On-the-Job Training - All sectors - 4 to 10 Years (jobs) On-the-Job Training - All sectors - None (jobs) On-the-Job Training - All sectors - Over 10 Years (jobs) On-the-Job Training - All sectors - Up to 1 Years (jobs) On-the-Job Training - All sectors - Up to 1 Years (jobs) On-the-Job Training - All sectors - Up to 1 Years (jobs) On-the-Job Training - All sectors - Up to 1 Years (jobs) Related work experience - All sectors - 1 To 4 years (jobs) Related work experience - All sectors - 4 To 10 years (jobs) Related work experience - All sectors - 4 To 10 years (jobs) Related work experience - All sectors - 4 To 10 years (jobs) Related work experience - All sectors - 4 To 10 years (jobs) Related work experience - All sectors - 4 To 10 years (jobs) Related work experience - All sectors - 4 To 10 years (jobs) Related work experience - All sectors - 4 To 10 years (jobs) Related work experience - All sectors - 4 To 10 years (jobs) Related work experience - All sectors - 4 To 10 years (jobs) Related work experience - All sectors - 4 To 10 years (jobs) Related work experience - All sectors - 4 To 10 years (jobs) Related work experience - All sectors - 4 To 10 years (jobs) Related work experience - All sectors - 4 To 10 years (jobs) Related work experience - All sectors - 4 To 10 years (jobs) Related work experience - All sectors - 4 To 10 years (jobs) Related work experience - All sectors - 4 To 10 years (jobs)	= = =			-				
On-Site or In-Plant Training - Total jobs - None (jobs)	On-Site or In-Plant Training - Total jobs - 4		2,728	5,859	8,316	8,215	7,608	7,519
None (jobs)								
On-Site or In-Plant Training - Total jobs - Over 10 years (jobs)	= = =		7,125	13,838	19,505	19,290	18,426	18,533
Over 10 years (jobs) 27,623 50,713 71,093 70,209 67,012 67,527 Up to 1 year (jobs) 0n-the-Job Training - All sectors - 1 to 4 years (jobs) 8,896 17,748 25,196 24,979 23,201 23,295 On-the-Job Training - All sectors - 4 to 10 years (jobs) 2,609 5,792 8,270 8,169 7,537 7,438 On-the-Job Training - All sectors - None (jobs) 2,402 4,634 6,510 6,363 6,047 6,097 On-the-Job Training - All sectors - Over 10 years (jobs) 426 845 1,175 1,130 1,024 1,044 years (jobs) 30,525 55,925 78,358 77,451 74,205 74,768 Related work experience - All sectors - 1 to 4 years (jobs) 15,860 30,032 42,402 42,159 40,127 40,307 Related work experience - All sectors - 4 to 10 years (jobs) 10,041 19,539 27,638 27,490 25,888 26,035 Related work experience - All sectors - Over 10 years (jobs) 2,744 5,136 7,247 7,202 6,749 6,8								
On-Site or In-Plant Training - Total jobs - Up to 1 year (jobs) 27,623 50,713 71,093 70,209 67,012 67,527 Up to 1 year (jobs) 0n-the-Job Training - All sectors - 1 to 4 years (jobs) 8,896 17,748 25,196 24,979 23,201 23,295 On-the-Job Training - All sectors - 4 to 10 years (jobs) 2,609 5,792 8,270 8,169 7,537 7,438 On-the-Job Training - All sectors - None (jobs) 2,402 4,634 6,510 6,363 6,047 6,097 On-the-Job Training - All sectors - Over 10 years (jobs) 426 845 1,175 1,130 1,024 1,044 Year (jobs) 0n-the-Job Training - All sectors - Up to 1 year (jobs) 30,525 55,925 78,358 77,451 74,205 74,768 Related work experience - All sectors - 1 to 4 years (jobs) 15,860 30,032 42,402 42,159 40,127 40,307 Related work experience - All sectors - 4 to 10 years (jobs) 10,041 19,539 27,638 27,490 25,888 26,035 Related work experience - All sectors - Over 10 years (jobs) 2,7			375	752	1,067	1,057	981	984
Up to 1 year (jobs) On-the-Job Training - All sectors - 1 to 4 years (jobs) On-the-Job Training - All sectors - 4 to 10 years (jobs) On-the-Job Training - All sectors - 4 to 10 years (jobs) On-the-Job Training - All sectors - None (jobs) On-the-Job Training - All sectors - None (jobs) On-the-Job Training - All sectors - Over 10 years (jobs) On-the-Job Training - All sectors - Over 10 years (jobs) On-the-Job Training - All sectors - Up to 1 year (jobs) Related work experience - All sectors - 1 to 4 years (jobs) Related work experience - All sectors - 4 to 10 years (jobs) Related work experience - All sectors - 4 Related work experience - All sectors - 4 None (jobs) Related work experience - All sectors - 0 Year (jobs) Related work experience - All sectors - 0 Year (jobs) Related work experience - All sectors - 0 Year (jobs) Related work experience - All sectors - 0 Year (jobs) Related work experience - All sectors - 0 Year (jobs) Related work experience - All sectors - 0 Year (jobs) Related work experience - All sectors - 0 Year (jobs) Related work experience - All sectors - 0 Year (jobs) Related work experience - All sectors - 0 Year (jobs) Related work experience - All sectors - 0 Year (jobs) Related work experience - All sectors - 0 Year (jobs) Related work experience - All sectors - 0 Year (jobs) Related work experience - All sectors - 0 Year (jobs) Related work experience - All sectors - 0 Year (jobs)								
On-the-Job Training - All sectors - 1 to 4 years (jobs) 8,896 17,748 25,196 24,979 23,201 23,295 On-the-Job Training - All sectors - 4 to 10 years (jobs) 2,609 5,792 8,270 8,169 7,537 7,438 On-the-Job Training - All sectors - None (jobs) 2,402 4,634 6,510 6,363 6,047 6,097 On-the-Job Training - All sectors - Over 10 years (jobs) 426 845 1,175 1,130 1,024 1,044 Years (jobs) 30,525 55,925 78,358 77,451 74,205 74,768 Related work experience - All sectors - 1 to 4 years (jobs) 15,860 30,032 42,402 42,159 40,127 40,307 Related work experience - All sectors - 4 to 10 years (jobs) 10,041 19,539 27,638 27,490 25,888 26,035 Related work experience - All sectors - Over 10 years (jobs) 6,587 12,383 17,356 17,095 16,244 16,290 Related work experience - All sectors - Over 10 years (jobs) 9,626 17,855 24,867 24,146 23,007 <			27,623	50,713	71,093	70,209	67,012	67,527
years (jobs) 2,609 5,792 8,270 8,169 7,537 7,438 years (jobs) 0n-the-Job Training - All sectors - None (jobs) 2,402 4,634 6,510 6,363 6,047 6,097 (jobs) 0n-the-Job Training - All sectors - Over 10 years (jobs) 426 845 1,175 1,130 1,024 1,044 years (jobs) 0n-the-Job Training - All sectors - Up to 1 years (jobs) 30,525 55,925 78,358 77,451 74,205 74,768 Related work experience - All sectors - 1 to 4 years (jobs) 15,860 30,032 42,402 42,159 40,127 40,307 Related work experience - All sectors - 4 to 10 years (jobs) 10,041 19,539 27,638 27,490 25,888 26,035 Related work experience - All sectors - Mone (jobs) 6,587 12,383 17,356 17,095 16,244 16,290 Related work experience - All sectors - Over 10 years (jobs) 2,744 5,136 7,247 7,202 6,749 6,859 Related work experience - All sectors - Up to 1 year (jobs) 9,626 17,855			0.007	177/0	05.107	04.070	00.001	
On-the-Job Training - All sectors - 4 to 10 2,609 5,792 8,270 8,169 7,537 7,438 years (jobs) On-the-Job Training - All sectors - None (jobs) 2,402 4,634 6,510 6,363 6,047 6,097 (jobs) On-the-Job Training - All sectors - Over 10 years (jobs) 426 845 1,175 1,130 1,024 1,044 years (jobs) On-the-Job Training - All sectors - Up to 1 years (jobs) 30,525 55,925 78,358 77,451 74,205 74,768 Related work experience - All sectors - 1 to 4 years (jobs) 15,860 30,032 42,402 42,159 40,127 40,307 Related work experience - All sectors - 4 to 10 years (jobs) 10,041 19,539 27,638 27,490 25,888 26,035 Related work experience - All sectors - Mone (jobs) 6,587 12,383 17,356 17,095 16,244 16,290 Related work experience - All sectors - Over 10 years (jobs) 2,744 5,136 7,247 7,202 6,749 6,859 Related work experience - All sectors - Up to 1 year (jobs) 9,626			8,896	17,748	25,196	24,979	23,201	23,295
years (jobs) 2,402 4,634 6,510 6,363 6,047 6,097 (jobs) On-the-Job Training - All sectors - Over 10 years (jobs) 426 845 1,175 1,130 1,024 1,044 years (jobs) On-the-Job Training - All sectors - Up to 1 year (jobs) 30,525 55,925 78,358 77,451 74,205 74,768 year (jobs) Related work experience - All sectors - 1 to 4 years (jobs) 15,860 30,032 42,402 42,159 40,127 40,307 to 4,907 to 4			0.400	E 700	0.070	0.1/0	7 5 9 7	7/20
On-the-Job Training - All sectors - None (jobs) 2,402 4,634 6,510 6,363 6,047 6,097 (jobs) On-the-Job Training - All sectors - Over 10 years (jobs) 426 845 1,175 1,130 1,024 1,044 years (jobs) On-the-Job Training - All sectors - Up to 1 years (jobs) 30,525 55,925 78,358 77,451 74,205 74,768 year (jobs) Related work experience - All sectors - 1 to 4 years (jobs) 15,860 30,032 42,402 42,159 40,127 40,307 to 4,930 to 10 years (jobs) Related work experience - All sectors - 4 to 10 years (jobs) 10,041 19,539 27,638 27,490 25,888 26,035 to 10 years (jobs) Related work experience - All sectors - None (jobs) 6,587 12,383 17,356 17,095 16,244 16,290 None (jobs) Related work experience - All sectors - Over 10 years (jobs) 2,744 5,136 7,247 7,202 6,749 6,859 Related work experience - All sectors - Up to 1 year (jobs) 9,626 17,855 24,867 24,146 23,007 23,152			2,009	5,192	8,210	0,109	1,531	1,436
Contens Cont			2 402	4 634	6 510	6 363	6.047	6.097
On-the-Job Training - All sectors - Over 10 years (jobs) 426 845 1,175 1,130 1,024 1,044 On-the-Job Training - All sectors - Up to 1 year (jobs) 30,525 55,925 78,358 77,451 74,205 74,768 Related work experience - All sectors - 1 to 4 years (jobs) 15,860 30,032 42,402 42,159 40,127 40,307 Related work experience - All sectors - 4 to 10 years (jobs) 10,041 19,539 27,638 27,490 25,888 26,035 Related work experience - All sectors - None (jobs) 6,587 12,383 17,356 17,095 16,244 16,290 Related work experience - All sectors - Over 10 years (jobs) 2,744 5,136 7,247 7,202 6,749 6,859 Related work experience - All sectors - Up to 1 year (jobs) 9,626 17,855 24,867 24,146 23,007 23,152	_		2,402	4,004	0,010	0,000	0,041	0,071
years (jobs) 30,525 55,925 78,358 77,451 74,205 74,768 year (jobs) Related work experience - All sectors - 1 to 4 years (jobs) 15,860 30,032 42,402 42,159 40,127 40,307 Related work experience - All sectors - 4 to 10 years (jobs) 10,041 19,539 27,638 27,490 25,888 26,035 Related work experience - All sectors - None (jobs) 6,587 12,383 17,356 17,095 16,244 16,290 Related work experience - All sectors - Over 10 years (jobs) 2,744 5,136 7,247 7,202 6,749 6,859 Related work experience - All sectors - Up to 1 year (jobs) 9,626 17,855 24,867 24,146 23,007 23,152			426	845	1.175	1.130	1.024	1.044
On-the-Job Training - All sectors - Up to 1 year (jobs) 30,525 55,925 78,358 77,451 74,205 74,768 Related work experience - All sectors - 1 to 4 years (jobs) 15,860 30,032 42,402 42,159 40,127 40,307 Related work experience - All sectors - 4 to 10 years (jobs) 10,041 19,539 27,638 27,490 25,888 26,035 Related work experience - All sectors - None (jobs) 6,587 12,383 17,356 17,095 16,244 16,290 Related work experience - All sectors - Over 10 years (jobs) 2,744 5,136 7,247 7,202 6,749 6,859 Related work experience - All sectors - Up to 1 year (jobs) 9,626 17,855 24,867 24,146 23,007 23,152					,,	,,	,,,,,	.,
year (jobs) Related work experience - All sectors - 1 to 4 years (jobs) 15,860 30,032 42,402 42,159 40,127 40,307 to 40,307			30,525	55,925	78,358	77,451	74,205	74,768
to 4 years (jobs) Related work experience - All sectors - 4 to 10 years (jobs) Related work experience - All sectors - 6,587								•
Related work experience - All sectors - 4 to 10 years (jobs) 10,041 19,539 27,638 27,490 25,888 26,035 Related work experience - All sectors - None (jobs) 6,587 12,383 17,356 17,095 16,244 16,290 Related work experience - All sectors - Over 10 years (jobs) 2,744 5,136 7,247 7,202 6,749 6,859 Related work experience - All sectors - Up to 1 year (jobs) 9,626 17,855 24,867 24,146 23,007 23,152			15,860	30,032	42,402	42,159	40,127	40,307
to 10 years (jobs) Related work experience - All sectors -	to 4 years (jobs)							
Related work experience - All sectors - None (jobs) 6,587 12,383 17,356 17,095 16,244 16,290 Related work experience - All sectors - Over 10 years (jobs) 2,744 5,136 7,247 7,202 6,749 6,859 Related work experience - All sectors - Up to 1 year (jobs) 9,626 17,855 24,867 24,146 23,007 23,152	Related work experience - All sectors - 4		10,041	19,539	27,638	27,490	25,888	26,035
None (jobs) 2,744 5,136 7,247 7,202 6,749 6,859 Over 10 years (jobs) Related work experience - All sectors - Up to 1 year (jobs) 9,626 17,855 24,867 24,146 23,007 23,152								
Related work experience - All sectors - Over 10 years (jobs) 2,744 5,136 7,247 7,202 6,749 6,859 Related work experience - All sectors - Up to 1 year (jobs) 9,626 17,855 24,867 24,146 23,007 23,152	-		6,587	12,383	17,356	17,095	16,244	16,290
Over 10 years (jobs) 9,626 17,855 24,867 24,146 23,007 23,152 to 1 year (jobs) 10,855								
Related work experience - All sectors - Up 9,626 17,855 24,867 24,146 23,007 23,152 to 1 year (jobs)			2,744	5,136	7,247	7,202	6,749	6,859
to 1 year (jobs)								
	· · · · · · · · · · · · · · · · · · ·		9,626	17,855	24,867	24,146	23,007	23,152
wage income - All [million \$2019] 2,534 4,857 6,932 7,000 6,763 6,875			0.507	/ 057	(000	7000	(7/0	/ 075
	wage income - All (million \$2019)		2,534	4,857	6,932	7,000	6,/63	6,875

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

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

Table 18: E- scenario - PILLAR 1: Efficiency/Electrification - Electricity demand

Item	2020	2025	2030	2035	2040	2045	2050
Electricity distribution capital invested -		4.04	4.11	5.15	5.33	7.04	7.41
Cumulative 5-yr (billion \$2018)							

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

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Commercial (PJ)	190	187	183	179	172	164	155
Final energy use - Industry (PJ)	680	693	708	728	762	777	784
Final energy use - Residential (PJ)	311	289	273	257	238	214	188
Final energy use - Transportation (PJ)	653	615	559	514	480	439	392

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

Item	2020	2025	2030	2035	2040	2045	2050
Residential HVAC investment in 2020s vs.		5.71	7.71				
REF - Cumulative 5-yr (billion \$2018)							
Sales of cooking units - Electric	67.5	68.3	71.3	79.1	90.1	96.8	99.1
Resistance (%)							
Sales of cooking units - Gas (%)	32.5	31.7	28.7	20.9	9.94	3.21	0.863
Sales of space heating units - Electric	7.14	13.6	16.9	27.4	49.2	73	86
Heat Pump (%)							
Sales of space heating units - Electric	18.1	24.8	24	21.6	16.2	10.6	7.72
Resistance (%)							
Sales of space heating units - Fossil (%)	6.08	9.67	9.33	8.18	5.9	3.46	2.13
Sales of space heating units - Gas (%)	68.7	51.9	49.7	42.9	28.7	12.9	4.2
Sales of water heating units - Electric	0	0.608	2.31	7.59	18.2	29.3	35.3
Heat Pump (%)							
Sales of water heating units - Electric	39.3	55.7	55.6	55.8	57.2	59.4	61
Resistance (%)							
Sales of water heating units - Gas Furnace	60.6	43.5	41.9	36.4	24.4	11	3.54
(%)							
Sales of water heating units - Other (%)	0.101	0.202	0.203	0.204	0.204	0.204	0.204

 ${\bf Table~21:}~{\it E-scenario-PILLAR~1:}~{\it Efficiency/Electrification-Transportation}$

Item	2020	2025	2030	2035	2040	2045	2050
Light-duty vehicle capital costs -		0	192	404	1,364	4,297	6,258
Cumulative 5-yr (million \$2018)							
Public EV charging plugs - DC Fast (1000	0.168		0.662		3.54		9.92
units)							
Public EV charging plugs - L2 (1000 units)	0.43		15.9		85.2		238
Vehicle sales - Heavy-duty - diesel (%)	97.4	96	91.3	79.8	58.2	32.1	13.7
Vehicle sales - Heavy-duty - EV (%)	0.498	1.45	4.11	10.8	23.6	39.5	51
Vehicle sales - Heavy-duty - gasoline (%)	0.228	0.236	0.239	0.225	0.179	0.109	0.051
Vehicle sales - Heavy-duty - hybrid (%)	0.083	0.094	0.104	0.107	0.092	0.06	0.03
Vehicle sales - Heavy-duty - hydrogen FC	0.332	0.969	2.74	7.17	15.7	26.3	34
(%)							
Vehicle sales - Heavy-duty - other (%)	1.5	1.28	1.46	1.95	2.25	1.96	1.14
Vehicle sales - Light-duty - diesel (%)	1.6	2	2.06	1.64	1.05	0.542	0.232
Vehicle sales - Light-duty - EV (%)	1.85	4.59	11.7	25.5	48	71.8	87.5
Vehicle sales - Light-duty - gasoline (%)	91.9	87.6	79.9	67.1	46.6	25.1	11.1
Vehicle sales - Light-duty - hybrid (%)	4.46	5.27	5.93	5.42	4.08	2.42	1.18
Vehicle sales - Light-duty - hydrogen FC	0.113	0.381	0.328	0.251	0.179	0.099	0.046
(%)							
Vehicle sales - Light-duty - other (%)	0.105	0.108	0.098	0.086	0.062	0.034	0.016
Vehicle sales - Medium-duty - diesel (%)	64.8	62.2	57.7	49.4	35.6	19.6	8.37
Vehicle sales - Medium-duty - EV (%)	0.664	1.94	5.49	14.3	31.4	52.6	68
Vehicle sales - Medium-duty - gasoline (%)	33.8	34.7	34.7	31.9	24.4	14.2	6.33
Vehicle sales - Medium-duty - hybrid (%)	0.363	0.418	0.464	0.478	0.414	0.275	0.141
Vehicle sales - Medium-duty - hydrogen	0.166	0.485	1.37	3.58	7.86	13.2	17
FC (%)							
Vehicle sales - Medium-duty - other (%)	0.253	0.266	0.279	0.286	0.258	0.184	0.102

Table 22: E- scenario - PILLAR 6: Land sinks - Agriculture

Item	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - Aggressive							-1,845
deployment - Corn-ethanol to energy							
grasses (1000 tCO2e/y)							
Carbon sink potential - Aggressive							-7,474
deployment - Cropland measures (1000							
tCO2e/y)							
Carbon sink potential - Aggressive							-234
deployment - Permanent conservation							
cover (1000 tCO2e/y)							
Carbon sink potential - Aggressive							-9,552
deployment - Total (1000 tC02e/y)							
Carbon sink potential - Moderate							-1,845
deployment - Corn-ethanol to energy							
grasses (1000 tCO2e/y)							
Carbon sink potential - Moderate							-3,936
deployment - Cropland measures (1000							
tCO2e/y)							
Carbon sink potential - Moderate							-117
deployment - Permanent conservation							
cover (1000 tCO2e/y)							
Carbon sink potential - Moderate							-5,898
deployment - Total (1000 tC02e/y)							
Land impacted for carbon sink -							808
Aggressive deployment - Corn-ethanol to							
energy grasses (1000 hectares)							
Land impacted for carbon sink -							3,995
Aggressive deployment - Cropland							
measures (1000 hectares)							
Land impacted for carbon sink -						\Box	425
Aggressive deployment - Permanent							
conservation cover (1000 hectares)							

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

Item	2020	2025	2030	2035	2040	2045	2050
Land impacted for carbon sink -							5,228
Aggressive deployment - Total (1000							
hectares)							
Land impacted for carbon sink - Moderate							808
deployment - Corn-ethanol to energy							
grasses (1000 hectares)							
Land impacted for carbon sink - Moderate							2,104
deployment - Cropland measures (1000							
hectares)							
Land impacted for carbon sink - Moderate							213
deployment - Permanent conservation							
cover (1000 hectares)							
Land impacted for carbon sink - Moderate							3,124
deployment - Total (1000 hectares)							

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

Item	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - High - Accelerate							-77.5
regeneration (1000 tCO2e/y)							
Carbon sink potential - High - All (not							-14,566
counting overlap) (1000 tCO2e/y)							
Carbon sink potential - High - Avoid							-1,952
deforestation (1000 tCO2e/y)							
Carbon sink potential - High - Extend							-2,158
rotation length (1000 tCO2e/y)							
Carbon sink potential - High - Improve							-168
plantations (1000 tCO2e/y)							
Carbon sink potential - High - Increase							-1,834
retention of HWP (1000 tCO2e/y)							
Carbon sink potential - High - Increase							-2,006
trees outside forests (1000 tCO2e/y)							
Carbon sink potential - High - Reforest							-1,264
cropland (1000 tCO2e/y)							
Carbon sink potential - High - Reforest							-3,822
pasture (1000 tC02e/y)							
Carbon sink potential - High - Restore							-1,284
productivity (1000 tCO2e/y)							
Carbon sink potential - Low - Accelerate							-38.8
regeneration (1000 tCO2e/y)							
Carbon sink potential - Low - All (not							-3,947
counting overlap) (1000 tCO2e/y)							
Carbon sink potential - Low - Avoid							-325
deforestation (1000 tCO2e/y)							
Carbon sink potential - Low - Extend							-829
rotation length (1000 tCO2e/y)							
Carbon sink potential - Low - Improve							-85.6
plantations (1000 tCO2e/y)							
Carbon sink potential - Low - Increase							-611
retention of HWP (1000 tCO2e/y)							
Carbon sink potential - Low - Increase							-702
trees outside forests (1000 tC02e/y)							
Carbon sink potential - Low - Reforest							-632
cropland (1000 tCO2e/y)							
Carbon sink potential - Low - Reforest							-290
pasture (1000 tC02e/y)							
Carbon sink potential - Low - Restore							-433
productivity (1000 tCO2e/y)							
Carbon sink potential - Mid - Accelerate							-58.2
regeneration (1000 tCO2e/y)							

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

Item Carbon sink potential - Mid - All (not	2020	2025	2030	2035	2040	2045	2050 -9,255
counting overlap) (1000 tCO2e/y)							
Carbon sink potential - Mid - Avoid deforestation (1000 tCO2e/y)							-1,138
Carbon sink potential - Mid - Extend rotation length (1000 tCO2e/y)							-1,493
Carbon sink potential - Mid - Improve plantations (1000 tCO2e/y)							-125
Carbon sink potential - Mid - Increase retention of HWP (1000 tC02e/y)							-1,223
Carbon sink potential - Mid - Increase trees outside forests (1000 tC02e/y)							-1,354
Carbon sink potential - Mid - Reforest							-948
cropland (1000 tCO2e/y) Carbon sink potential - Mid - Reforest pasture (1000 tCO2e/y)							-2,056
Carbon sink potential - Mid - Restore							-858
productivity (1000 tCO2e/y) Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)							12.7
Land impacted for carbon sink potential - High - Avoid deforestation (over 30 years) (1000 hectares)							264
Land impacted for carbon sink potential - High - Extend rotation length (1000 hectares)							1,100
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)							62
Land impacted for carbon sink potential - High - Increase retention of HWP (1000 hectares)							0
Land impacted for carbon sink potential - High - Increase trees outside forests (1000 hectares)							191
Land impacted for carbon sink potential - High - Reforest cropland (1000 hectares)							83.6
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)							109
Land impacted for carbon sink potential - High - Restore productivity (1000							426
hectares) Land impacted for carbon sink potential - High - Total impacted (over 30 years) (1000 hectares)							2,248
Land impacted for carbon sink potential - Low - Accelerate regeneration (1000 hectares)							6.34
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)							248
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)							422
Land impacted for carbon sink potential - Low - Improve plantations (1000 hectares)							31
Land impacted for carbon sink potential - Low - Increase retention of HWP (1000 hectares)							0

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

Low - Increase trees outside forests [1000 hectares] Land impacted for carbon sink potential - Low - Reforest cropland [1000 hectares] Land impacted for carbon sink potential - Low - Reforest pasture [1000 hectares] Land impacted for carbon sink potential - Low - Restore productivity [1000 hectares] Land impacted for carbon sink potential - Low - Total impacted (over 30 years) [1000 hectares] Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares) Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) [1000 hectares] Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) [1000 hectares] Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares) Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares) Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares) Land impacted for carbon sink potential - Mid - Increase retention of HWP (1000 hectares)	Item	2020	2025	2030	2035	2040	2045	2050
Common test Common test	Land impacted for carbon sink potential -							100
Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares) Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares) Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares) Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares) Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares) Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares) Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares) Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares) Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares) Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares) Land impacted for carbon sink potential - Mid - Increase retention of HWP (1000 hectares)	Low - Increase trees outside forests							
Low - Reforest cropland (1000 hectares) Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares) Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares) Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares) Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares) Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares) Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares) Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares) Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares) Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares) Land impacted for carbon sink potential - Mid - Increase retention of HWP (1000 hectares)	(1000 hectares)							
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares) Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares) Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares) Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares) Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares) Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares) Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares) Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares) Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares) Land impacted for carbon sink potential - Mid - Increase retention of HWP (1000 hectares)	Land impacted for carbon sink potential -							41.8
Low - Reforest pasture (1000 hectares) Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares) Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares) Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares) Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares) Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares) Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares) Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares) Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares) Land impacted for carbon sink potential - Mid - Increase retention of HWP (1000 hectares)	Low - Reforest cropland (1000 hectares)							
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares) Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares) Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares) Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares) Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares) Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares) Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares) Land impacted for carbon sink potential - Mid - Increase retention of HWP (1000 hectares)	Land impacted for carbon sink potential -							18.8
Low - Restore productivity (1000 hectares) Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares) Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares) Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares) Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares) Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares) Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares) Land impacted for carbon sink potential - Mid - Increase retention of HWP (1000 hectares)	Low - Reforest pasture (1000 hectares)							
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares) Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares) Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares) Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares) Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares) Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares) Land impacted for carbon sink potential - Mid - Increase retention of HWP (1000 hectares)	Land impacted for carbon sink potential -							258
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) [1000 hectares] Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares) Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) [1000 hectares] Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares) Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares) Land impacted for carbon sink potential - Mid - Increase retention of HWP (1000 hectares)	Low - Restore productivity (1000							
Low - Total impacted (over 30 years) [1000 hectares] Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares) Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) [1000 hectares] Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares) Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares) Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares) Land impacted for carbon sink potential - Mid - Increase retention of HWP (1000 hectares)	hectares)							
(1000 hectares) Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares) Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares) Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares) Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares) Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares) Land impacted for carbon sink potential - Mid - Increase retention of HWP (1000 hectares)	Land impacted for carbon sink potential -							1,125
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares) Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares) Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares) Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares) Land impacted for carbon sink potential - Mid - Increase retention of HWP (1000 hectares)	Low - Total impacted (over 30 years)							
Mid - Accelerate regeneration (1000 hectares) Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares) Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares) Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares) Land impacted for carbon sink potential - Mid - Increase retention of HWP (1000 hectares)								
hectares) Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares) Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares) Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares) Land impacted for carbon sink potential - Mid - Increase retention of HWP (1000 hectares)	Land impacted for carbon sink potential -							9.51
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) [1000 hectares) Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares) Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares) Land impacted for carbon sink potential - Mid - Increase retention of HWP (1000 hectares)	Mid - Accelerate regeneration (1000							
Mid - Avoid deforestation (over 30 years) [1000 hectares] Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares) Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares) Land impacted for carbon sink potential - Mid - Increase retention of HWP (1000 hectares)	hectares)							
(1000 hectares) Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares) Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares) Land impacted for carbon sink potential - Mid - Increase retention of HWP (1000 hectares)								256
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares) Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares) Land impacted for carbon sink potential - Mid - Increase retention of HWP (1000 hectares)	Mid - Avoid deforestation (over 30 years)							
Mid - Extend rotation length (1000 hectares) Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares) Land impacted for carbon sink potential - Mid - Increase retention of HWP (1000 hectares)								
hectares) Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares) Land impacted for carbon sink potential - Mid - Increase retention of HWP (1000 hectares)	Land impacted for carbon sink potential -							761
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares) Land impacted for carbon sink potential - Mid - Increase retention of HWP (1000 hectares)								
Mid - Improve plantations (1000 hectares) Land impacted for carbon sink potential - Mid - Increase retention of HWP (1000 hectares)								
Land impacted for carbon sink potential - Mid - Increase retention of HWP (1000 hectares)								46.6
Mid - Increase retention of HWP (1000 hectares)								
hectares)	Land impacted for carbon sink potential -							0
	Mid - Increase retention of HWP (1000							
Land imported for corbon sink notantial	•							
•	Land impacted for carbon sink potential -							145
Mid - Increase trees outside forests (1000	Mid - Increase trees outside forests (1000							
hectares)	•							
								62.7
Mid - Reforest cropland (1000 hectares)								
								136
Mid - Reforest pasture (1000 hectares)								
								519
Mid - Restore productivity (1000	Mid - Restore productivity (1000							
hectares)								
Land impacted for carbon sink potential - 1,936	Land impacted for carbon sink potential -							1,936
Mid - Total impacted (over 30 years) (1000								
hectares)	hectares)							

Table 24: E- scenario - IMPACTS - Health

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution -		822	1	0.991	0.866	0.63	0.056
Coal (million 2019\$)							
Monetary damages from air pollution -		213	138	58.6	27	9.17	6.15
Natural Gas (million 2019\$)							
Monetary damages from air pollution -		1,843	1,859	1,807	1,625	1,292	887
Transportation (million 2019\$)							
Premature deaths from air pollution -		92.9	0.113	0.112	0.098	0.071	0.006
Coal (deaths)							
Premature deaths from air pollution -		24.1	15.6	6.61	3.05	1.03	0.695
Natural Gas (deaths)							
Premature deaths from air pollution -		207	209	203	183	145	99.7
Transportation (deaths)							

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

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

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

Item	2020	2025	2030	2035	2040	2045	2050
Electricity distribution capital invested -		4.81	4.97	8.01	8.51	7.33	7.63
Cumulative 5-yr (billion \$2018)							

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

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

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

Item	2020	2025	2030	2035	2040	2045	2050
Residential HVAC investment in 2020s vs.		5.74	7.82				
REF - Cumulative 5-yr (billion \$2018)							
Sales of cooking units - Electric	67.6	74.5	95.6	99.8	100	100	100
Resistance (%)							
Sales of cooking units - Gas (%)	32.4	25.5	4.36	0.22	0	0	0
Sales of space heating units - Electric	7.14	16.5	45.4	84.9	91.7	92.1	91.9
Heat Pump (%)							
Sales of space heating units - Electric	18.1	24.2	17.6	8.04	6.29	6.24	6.46
Resistance (%)							
Sales of space heating units - Fossil (%)	6.08	9.3	6.1	2.21	1.58	1.53	1.49
Sales of space heating units - Gas (%)	68.7	49.9	30.9	4.83	0.406	0.132	0.133
Sales of water heating units - Electric	0	2.32	17.1	34.9	37.8	38	38.1
Heat Pump (%)							
Sales of water heating units - Electric	39.3	55.4	55.8	60.8	61.7	61.8	61.7
Resistance (%)							
Sales of water heating units - Gas Furnace	60.6	42.1	26.8	4.14	0.241	0	0
(%)							
Sales of water heating units - Other (%)	0.101	0.202	0.203	0.203	0.201	0.202	0.203

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

Item	2020	2025	2030	2035	2040	2045	2050
Light-duty vehicle capital costs -		1,189	3,044	4,939	7,479	8,143	7,762
Cumulative 5-yr (million \$2018)							
Public EV charging plugs - DC Fast (1000	0.168		2.17		9.57		15.5
units)							
Public EV charging plugs - L2 (1000 units)	0.43		52.1		230		372
Vehicle sales - Heavy-duty - diesel (%)	97.2	92.1	67	23.3	4.22	0.628	0
Vehicle sales - Heavy-duty - EV (%)	0.588	3.81	19	45.6	57.4	59.6	60
Vehicle sales - Heavy-duty - gasoline (%)	0.227	0.227	0.176	0.066	0.013	0.002	0
Vehicle sales - Heavy-duty - hybrid (%)	0.082	0.09	0.077	0.031	0.007	0.001	0
Vehicle sales - Heavy-duty - hydrogen FC	0.392	2.54	12.7	30.4	38.2	39.7	40
(%)							
Vehicle sales - Heavy-duty - other (%)	1.5	1.23	1.07	0.568	0.163	0.038	0
Vehicle sales - Light-duty - diesel (%)	1.59	1.85	1.27	0.407	0.075	0.013	0
Vehicle sales - Light-duty - EV (%)	3.79	14.8	45.9	81.6	96.3	99.3	100
Vehicle sales - Light-duty - gasoline (%)	90.1	78.4	49.4	16.8	3.32	0.591	0
Vehicle sales - Light-duty - hybrid (%)	4.3	4.45	3.17	1.18	0.287	0.063	0
Vehicle sales - Light-duty - hydrogen FC	0.111	0.342	0.206	0.064	0.013	0.002	0
(%)							
Vehicle sales - Light-duty - other (%)	0.103	0.099	0.065	0.023	0.004	0.001	0
Vehicle sales - Medium-duty - diesel (%)	64.7	59.7	42.3	14.4	2.59	0.384	0
Vehicle sales - Medium-duty - EV (%)	0.784	5.07	25.3	60.8	76.5	79.5	80
Vehicle sales - Medium-duty - gasoline (%)	33.7	33.3	25.5	9.32	1.77	0.277	0
Vehicle sales - Medium-duty - hybrid (%)	0.363	0.402	0.341	0.14	0.03	0.005	0
Vehicle sales - Medium-duty - hydrogen	0.196	1.27	6.33	15.2	19.1	19.9	20
FC (%)							
Vehicle sales - Medium-duty - other (%)	0.253	0.255	0.205	0.083	0.019	0.004	0

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

Item	2020	2025	2030	2035	2040	2045	2050
Capital invested - Solar PV - Base (billion		6.9	19.5	15.4	2.85	5.57	54.9
\$2018)							
Capital invested - Wind - Base (billion		0	36.8	24.1	1.13	0	0
\$2018)							
Installed renewables - OffshoreWind -	0	0	0	0	0	0	0
Base land use assumptions (MW)							
Installed renewables - OffshoreWind -	0	0	0	0	0	0	0
Constrained land use assumptions (MW)							
Installed renewables - Solar - Base land	137	6,167	25,277	41,657	44,863	51,506	120,941
use assumptions (MW)							
Installed renewables - Solar -	274	15,507	36,432	52,159	58,977	64,062	247,248
Constrained land use assumptions (MW)							
Installed renewables - Wind - Base land	3,368	3,368	31,037	50,472	51,428	51,428	51,428
use assumptions (MW)							
Installed renewables - Wind - Constrained	6,736	6,736	21,682	21,682	21,682	21,682	114,424
land use assumptions (MW)							

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

Item	2020	2025	2030	2035	2040	2045	2050
OffshoreWind - Base land use	0	0	0	0	0	0	0
assumptions (GWh)							
OffshoreWind - Constrained land use	0	0	0	0	0	0	0
assumptions (GWh)							
Solar - Base land use assumptions (GWh)	245	9,523	38,883	63,943	68,733	78,425	184,855
Solar - Constrained land use assumptions	491	23,929	56,058	79,805	89,783	97,144	378,054
(GWh)							
Wind - Base land use assumptions (GWh)	12,511	12,511	100,983	158,008	160,578	160,578	160,578
Wind - Constrained land use assumptions	25,021	25,021	68,916	68,916	68,916	68,916	355,481
(GWh)							

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

Item	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - Aggressive							-1,845
deployment - Corn-ethanol to energy							
grasses (1000 tCO2e/y)							
Carbon sink potential - Aggressive							-7,474
deployment - Cropland measures (1000							
tCO2e/y)							
Carbon sink potential - Aggressive							-234
deployment - Permanent conservation							
cover (1000 tCO2e/y)							
Carbon sink potential - Aggressive							-9,552
deployment - Total (1000 tCO2e/y)							
Carbon sink potential - Moderate							-1,845
deployment - Corn-ethanol to energy							
grasses (1000 tCO2e/y)							
Carbon sink potential - Moderate							-3,936
deployment - Cropland measures (1000							
tCO2e/y)							
Carbon sink potential - Moderate							-117
deployment - Permanent conservation							
cover (1000 tCO2e/y)							
Carbon sink potential - Moderate							-5,898
deployment - Total (1000 tCO2e/y)							•
Land impacted for carbon sink -							808
Aggressive deployment - Corn-ethanol to							
energy grasses (1000 hectares)							
Land impacted for carbon sink -							3,995
Aggressive deployment - Cropland							-,
measures (1000 hectares)							
Land impacted for carbon sink -							425
Aggressive deployment - Permanent							
conservation cover (1000 hectares)							
Land impacted for carbon sink -							5,228
Aggressive deployment - Total (1000							0,220
hectares)							
Land impacted for carbon sink - Moderate							808
deployment - Corn-ethanol to energy							000
grasses (1000 hectares)							
Land impacted for carbon sink - Moderate							2,104
deployment - Cropland measures (1000							2,104
hectares)							
Land impacted for carbon sink - Moderate		+					213
deployment - Permanent conservation							210
cover (1000 hectares)							
Land impacted for carbon sink - Moderate		-					3,124
deployment - Total (1000 hectares)							3,124
deployment - rotal (1000 nectales)							

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

Item	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - High - Accelerate							-77.5
regeneration (1000 tCO2e/y)							
Carbon sink potential - High - All (not							-14,566
counting overlap) (1000 tCO2e/y)							
Carbon sink potential - High - Avoid							-1,952
deforestation (1000 tCO2e/y)							
Carbon sink potential - High - Extend							-2,158
rotation length (1000 tCO2e/y)							
Carbon sink potential - High - Improve							-168
plantations (1000 tCO2e/y)							
Carbon sink potential - High - Increase							-1,834
retention of HWP (1000 tCO2e/y)							

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

Item	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - High - Increase							-2,006
trees outside forests (1000 tC02e/y)							
Carbon sink potential - High - Reforest							-1,264
cropland (1000 tCO2e/y)							0.000
Carbon sink potential - High - Reforest							-3,822
pasture (1000 tCO2e/y)							
Carbon sink potential - High - Restore							-1,284
productivity (1000 tCO2e/y)							
Carbon sink potential - Low - Accelerate							-38.8
regeneration (1000 tCO2e/y)							
Carbon sink potential - Low - All (not							-3,947
counting overlap) (1000 tCO2e/y)							
Carbon sink potential - Low - Avoid							-325
deforestation (1000 tCO2e/y)							
Carbon sink potential - Low - Extend							-829
rotation length (1000 tCO2e/y)							
Carbon sink potential - Low - Improve							-85.6
plantations (1000 tCO2e/y)							
Carbon sink potential - Low - Increase							-611
retention of HWP (1000 tCO2e/y)							
Carbon sink potential - Low - Increase							-702
trees outside forests (1000 tCO2e/y)							
Carbon sink potential - Low - Reforest							-632
cropland (1000 tCO2e/y)							
Carbon sink potential - Low - Reforest							-290
pasture (1000 tCO2e/y)							
Carbon sink potential - Low - Restore							-433
productivity (1000 tCO2e/y)							
Carbon sink potential - Mid - Accelerate							-58.2
regeneration (1000 tCO2e/y)							
Carbon sink potential - Mid - All (not							-9,255
counting overlap) (1000 tCO2e/y)							,
Carbon sink potential - Mid - Avoid							-1,138
deforestation (1000 tCO2e/y)							.,
Carbon sink potential - Mid - Extend							-1,493
rotation length (1000 tCO2e/y)							., ., .
Carbon sink potential - Mid - Improve							-125
plantations (1000 tCO2e/y)							120
Carbon sink potential - Mid - Increase							-1,223
retention of HWP (1000 tCO2e/y)							1,220
Carbon sink potential - Mid - Increase				+			-1,354
trees outside forests (1000 tC02e/y)							-1,004
Carbon sink potential - Mid - Reforest							-948
cropland (1000 tCO2e/y)							-740
Carbon sink potential - Mid - Reforest							-2,056
pasture (1000 tC02e/y)							-2,036
Carbon sink potential - Mid - Restore							-858
							-858
productivity (1000 tC02e/y)							10.7
Land impacted for carbon sink potential -							12.7
High - Accelerate regeneration (1000							
hectares)							2//
Land impacted for carbon sink potential -							264
High - Avoid deforestation (over 30 years)							
(1000 hectares)							
Land impacted for carbon sink potential -	T						1,100
High - Extend rotation length (1000							
hectares)							
Land impacted for carbon sink potential -							62
High - Improve plantations (1000							
hectares)							

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

Land impacted for carbon sink potential -	2020	2025	2030	2035	2040	2045	2050
High - Increase retention of HWP (1000							(
hectares)							
Land impacted for carbon sink potential -							19
High - Increase trees outside forests							
(1000 hectares)							
Land impacted for carbon sink potential -							83.6
High - Reforest cropland (1000 hectares)							
Land impacted for carbon sink potential -							109
High - Reforest pasture (1000 hectares)							
Land impacted for carbon sink potential -							426
High - Restore productivity (1000							
hectares)							0.01
Land impacted for carbon sink potential -							2,248
High - Total impacted (over 30 years)							
(1000 hectares) Land impacted for carbon sink potential -							6.34
Low - Accelerate regeneration (1000							0.34
hectares)							
Land impacted for carbon sink potential -							248
Low - Avoid deforestation (over 30 years)							240
(1000 hectares)							
Land impacted for carbon sink potential -							425
Low - Extend rotation length (1000							
hectares)							
Land impacted for carbon sink potential -							3
Low - Improve plantations (1000							
hectares)							
Land impacted for carbon sink potential -							(
Low - Increase retention of HWP (1000							
hectares)							
Land impacted for carbon sink potential -							100
Low - Increase trees outside forests							
(1000 hectares)							/1.0
Land impacted for carbon sink potential -							41.8
Low - Reforest cropland (1000 hectares) Land impacted for carbon sink potential -							18.8
Low - Reforest pasture (1000 hectares)							10.0
Land impacted for carbon sink potential -							258
Low - Restore productivity (1000							200
hectares)							
Land impacted for carbon sink potential -							1,12
Low - Total impacted (over 30 years)							-,
(1000 hectares)							
Land impacted for carbon sink potential -							9.5
Mid - Accelerate regeneration (1000							
hectares)							
Land impacted for carbon sink potential -							25
Mid - Avoid deforestation (over 30 years)							
(1000 hectares)							
Land impacted for carbon sink potential -							76
Mid - Extend rotation length (1000							
hectares)							
Land impacted for carbon sink potential -							46.
Mid - Improve plantations (1000 hectares)							
Land impacted for carbon sink potential -							
Mid - Increase retention of HWP (1000							
hectares)							47
Land impacted for carbon sink potential - Mid - Increase trees outside forests (1000							14.
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Table 33: <i>E+RE+</i>	scenario -	DTII AR 6.	I and sinks -	Forests	(continued)
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Item	2020	2025	2030	2035	2040	2045	2050
Land impacted for carbon sink potential -							62.7
Mid - Reforest cropland (1000 hectares)							
Land impacted for carbon sink potential -							136
Mid - Reforest pasture (1000 hectares)							
Land impacted for carbon sink potential -							519
Mid - Restore productivity (1000							
hectares)							
Land impacted for carbon sink potential -							1,936
Mid - Total impacted (over 30 years) (1000							
hectares)							

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

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution -		822	1	0.991	0.866	0.63	0.056
Coal (million 2019\$)							
Monetary damages from air pollution -		210	143	83.1	57.1	19.8	5.12
Natural Gas (million 2019\$)							
Monetary damages from air pollution -		1,813	1,690	1,283	740	339	136
Transportation (million 2019\$)							
Premature deaths from air pollution -		92.9	0.113	0.112	0.098	0.071	0.006
Coal (deaths)							
Premature deaths from air pollution -		23.7	16.1	9.39	6.45	2.23	0.578
Natural Gas (deaths)							
Premature deaths from air pollution -		204	190	144	83.2	38.1	15.3
Transportation (deaths)							

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

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

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

Item	2020	2025	2030	2035	2040	2045	2050
Electricity distribution capital invested -		4.81	4.97	8.01	8.51	7.33	7.63
Cumulative 5-yr (billion \$2018)							

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

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Commercial (PJ)	190	187	179	166	151	140	135

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

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

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

Item	2020	2025	2030	2035	2040	2045	2050
Residential HVAC investment in 2020s vs.		5.74	7.82				
REF - Cumulative 5-yr (billion \$2018)							
Sales of cooking units - Electric	67.6	74.5	95.6	99.8	100	100	100
Resistance (%)							
Sales of cooking units - Gas (%)	32.4	25.5	4.36	0.22	0	0	0
Sales of space heating units - Electric	7.14	16.5	45.4	84.9	91.7	92.1	91.9
Heat Pump (%)							
Sales of space heating units - Electric	18.1	24.2	17.6	8.04	6.29	6.24	6.46
Resistance (%)							
Sales of space heating units - Fossil (%)	6.08	9.3	6.1	2.21	1.58	1.53	1.49
Sales of space heating units - Gas (%)	68.7	49.9	30.9	4.83	0.406	0.132	0.133
Sales of water heating units - Electric	0	2.32	17.1	34.9	37.8	38	38.1
Heat Pump (%)							
Sales of water heating units - Electric	39.3	55.4	55.8	60.8	61.7	61.8	61.7
Resistance (%)							
Sales of water heating units - Gas Furnace	60.6	42.1	26.8	4.14	0.241	0	0
(%)							
Sales of water heating units - Other (%)	0.101	0.202	0.203	0.203	0.201	0.202	0.203

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

Item	2020	2025	2030	2035	2040	2045	2050
Light-duty vehicle capital costs -		1,189	3,044	4,939	7,479	8,143	7,762
Cumulative 5-yr (million \$2018)							
Public EV charging plugs - DC Fast (1000	0.168		2.17		9.57		15.5
units)							
Public EV charging plugs - L2 (1000 units)	0.43		52.1		230		372
Vehicle sales - Heavy-duty - diesel (%)	97.2	92.1	67	23.3	4.22	0.628	0
Vehicle sales - Heavy-duty - EV (%)	0.588	3.81	19	45.6	57.4	59.6	60
Vehicle sales - Heavy-duty - gasoline (%)	0.227	0.227	0.176	0.066	0.013	0.002	0
Vehicle sales - Heavy-duty - hybrid (%)	0.082	0.09	0.077	0.031	0.007	0.001	0
Vehicle sales - Heavy-duty - hydrogen FC	0.392	2.54	12.7	30.4	38.2	39.7	40
(%)							
Vehicle sales - Heavy-duty - other (%)	1.5	1.23	1.07	0.568	0.163	0.038	0
Vehicle sales - Light-duty - diesel (%)	1.59	1.85	1.27	0.407	0.075	0.013	0
Vehicle sales - Light-duty - EV (%)	3.79	14.8	45.9	81.6	96.3	99.3	100
Vehicle sales - Light-duty - gasoline (%)	90.1	78.4	49.4	16.8	3.32	0.591	0
Vehicle sales - Light-duty - hybrid (%)	4.3	4.45	3.17	1.18	0.287	0.063	0
Vehicle sales - Light-duty - hydrogen FC	0.111	0.342	0.206	0.064	0.013	0.002	0
(%)							
Vehicle sales - Light-duty - other (%)	0.103	0.099	0.065	0.023	0.004	0.001	0
Vehicle sales - Medium-duty - diesel (%)	64.7	59.7	42.3	14.4	2.59	0.384	0
Vehicle sales - Medium-duty - EV (%)	0.784	5.07	25.3	60.8	76.5	79.5	80
Vehicle sales - Medium-duty - gasoline (%)	33.7	33.3	25.5	9.32	1.77	0.277	0
Vehicle sales - Medium-duty - hybrid (%)	0.363	0.402	0.341	0.14	0.03	0.005	0
Vehicle sales - Medium-duty - hydrogen	0.196	1.27	6.33	15.2	19.1	19.9	20
FC (%)							
Vehicle sales - Medium-duty - other (%)	0.253	0.255	0.205	0.083	0.019	0.004	0

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	2.53	5.35	4.05	2.84	0.454
Capital invested - Solar PV - Constrained (billion \$2018)		0	3.23	5.34	3.48	4.56	0.08
Capital invested - Wind - Base (billion \$2018)		0.955	10.4	0	2.02	0.645	0.849
Capital invested - Wind - Constrained (billion \$2018)		0	2.48	0	1.74	0.35	0.394
Installed renewables - OffshoreWind - Base land use assumptions (MW)	0	0	0	0	0	0	0
Installed renewables - OffshoreWind - Constrained land use assumptions (MW)	0	0	0	0	0	0	0
Installed renewables - Solar - Base land use assumptions (MW)	137	137	2,612	8,293	12,861	16,247	16,821
Installed renewables - Solar - Constrained land use assumptions (MW)	137	137	3,298	8,968	12,883	18,328	18,429
Installed renewables - Wind - Base land use assumptions (MW)	3,368	4,017	11,852	11,852	13,557	14,132	14,934
Installed renewables - Wind - Constrained land use assumptions (MW)	3,368	3,368	5,233	5,233	6,705	7,018	7,390

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

Item	2020	2025	2030	2035	2040	2045	2050
OffshoreWind - Base land use	0	0	0	0	0	0	0
assumptions (GWh)							
OffshoreWind - Constrained land use	0	0	0	0	0	0	0
assumptions (GWh)							
Solar - Base land use assumptions (GWh)	245	245	4,015	12,746	19,768	24,951	25,821
Solar - Constrained land use assumptions	245	245	5,081	13,773	19,781	28,134	28,289
(GWh)							
Wind - Base land use assumptions (GWh)	12,511	14,691	40,509	40,509	46,016	47,863	50,422
Wind - Constrained land use assumptions	12,511	12,511	18,200	18,200	22,602	23,538	24,627
(GWh)							

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

Item	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - Aggressive							-1,845
deployment - Corn-ethanol to energy							
grasses (1000 tCO2e/y)							
Carbon sink potential - Aggressive							-7,474
deployment - Cropland measures (1000							
tCO2e/y)							
Carbon sink potential - Aggressive							-234
deployment - Permanent conservation							
cover (1000 tCO2e/y)							
Carbon sink potential - Aggressive							-9,552
deployment - Total (1000 tCO2e/y)							
Carbon sink potential - Moderate							-1,845
deployment - Corn-ethanol to energy							
grasses (1000 tCO2e/y)							
Carbon sink potential - Moderate							-3,936
deployment - Cropland measures (1000							
tCO2e/y)							
Carbon sink potential - Moderate							-117
deployment - Permanent conservation							
cover (1000 tCO2e/y)							
Carbon sink potential - Moderate							-5,898
deployment - Total (1000 tCO2e/y)							

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

Item	2020	2025	2030	2035	2040	2045	2050
Land impacted for carbon sink -							808
Aggressive deployment - Corn-ethanol to							
energy grasses (1000 hectares)							
Land impacted for carbon sink -							3,995
Aggressive deployment - Cropland							
measures (1000 hectares)							
Land impacted for carbon sink -							425
Aggressive deployment - Permanent							
conservation cover (1000 hectares)							
Land impacted for carbon sink -							5,228
Aggressive deployment - Total (1000							
hectares)							
Land impacted for carbon sink - Moderate							808
deployment - Corn-ethanol to energy							
grasses (1000 hectares)							
Land impacted for carbon sink - Moderate							2,104
deployment - Cropland measures (1000							
hectares)							
Land impacted for carbon sink - Moderate							213
deployment - Permanent conservation							
cover (1000 hectares)							
Land impacted for carbon sink - Moderate							3,124
deployment - Total (1000 hectares)							

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

Item	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - High - Accelerate							-77.5
regeneration (1000 tCO2e/y)							
Carbon sink potential - High - All (not							-14,566
counting overlap) (1000 tCO2e/y)							
Carbon sink potential - High - Avoid							-1,952
deforestation (1000 tCO2e/y)							
Carbon sink potential - High - Extend							-2,158
rotation length (1000 tCO2e/y)							
Carbon sink potential - High - Improve							-168
plantations (1000 tCO2e/y)							
Carbon sink potential - High - Increase							-1,834
retention of HWP (1000 tCO2e/y)							
Carbon sink potential - High - Increase							-2,006
trees outside forests (1000 tCO2e/y)							
Carbon sink potential - High - Reforest							-1,264
cropland (1000 tCO2e/y)							
Carbon sink potential - High - Reforest							-3,822
pasture (1000 tCO2e/y)							
Carbon sink potential - High - Restore							-1,284
productivity (1000 tCO2e/y)							
Carbon sink potential - Low - Accelerate							-38.8
regeneration (1000 tCO2e/y)							
Carbon sink potential - Low - All (not							-3,947
counting overlap) (1000 tCO2e/y)							
Carbon sink potential - Low - Avoid							-325
deforestation (1000 tCO2e/y)							
Carbon sink potential - Low - Extend							-829
rotation length (1000 tCO2e/y)							
Carbon sink potential - Low - Improve							-85.6
plantations (1000 tCO2e/y)							
Carbon sink potential - Low - Increase							-611
retention of HWP (1000 tCO2e/y)							
Carbon sink potential - Low - Increase							-702
trees outside forests (1000 tC02e/y)							

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

Item	2020	2025	2030	2035	2040	2045	205
Carbon sink potential - Low - Reforest							-63
cropland (1000 tCO2e/y)							
Carbon sink potential - Low - Reforest							-29
pasture (1000 tC02e/y)							
Carbon sink potential - Low - Restore							-43
productivity (1000 tC02e/y)							
Carbon sink potential - Mid - Accelerate							-58.
regeneration (1000 tCO2e/y)							0.05
Carbon sink potential - Mid - All (not							-9,25
counting overlap) (1000 tCO2e/y)							
Carbon sink potential - Mid - Avoid							-1,13
deforestation (1000 tC02e/y)							
Carbon sink potential - Mid - Extend							-1,49
rotation length (1000 tCO2e/y)							
Carbon sink potential - Mid - Improve							-12
plantations (1000 tCO2e/y)							
Carbon sink potential - Mid - Increase							-1,22
retention of HWP (1000 tCO2e/y)							
Carbon sink potential - Mid - Increase							-1,35
trees outside forests (1000 tCO2e/y)							
Carbon sink potential - Mid - Reforest							-94
cropland (1000 tCO2e/y)							
Carbon sink potential - Mid - Reforest							-2,05
pasture (1000 tCO2e/y)							
Carbon sink potential - Mid - Restore							-85
productivity (1000 tCO2e/y)							
Land impacted for carbon sink potential -							12
High - Accelerate regeneration (1000							
hectares)							
Land impacted for carbon sink potential -							26
High - Avoid deforestation (over 30 years)							
(1000 hectares)							
Land impacted for carbon sink potential -							1,10
High - Extend rotation length (1000							
hectares)							
Land impacted for carbon sink potential -							6
High - Improve plantations (1000							
hectares)							
Land impacted for carbon sink potential -							
High - Increase retention of HWP (1000							
nectares)							
Land impacted for carbon sink potential -							19
High - Increase trees outside forests							•
(1000 hectares)							
Land impacted for carbon sink potential -							83.
High - Reforest cropland (1000 hectares)							00.
Land impacted for carbon sink potential -							10
High - Reforest pasture (1000 hectares)							10
Land impacted for carbon sink potential -							42
High - Restore productivity (1000							42
nectares)							
and impacted for carbon sink potential -							2,24
High - Total impacted (over 30 years)							2,24
(1000 hectares)							, ,
and impacted for carbon sink potential -							6.3
Low - Accelerate regeneration (1000							
nectares)							<u> </u>
Land impacted for carbon sink potential -							24
Low - Avoid deforestation (over 30 years)							
(1000 hectares)							

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

Item	2020	2025	2030	2035	2040	2045	2050
Land impacted for carbon sink potential -							422
Low - Extend rotation length (1000							
hectares)							
Land impacted for carbon sink potential -							31
Low - Improve plantations (1000							
hectares)							
Land impacted for carbon sink potential -							0
Low - Increase retention of HWP (1000							
hectares)							
Land impacted for carbon sink potential -							100
Low - Increase trees outside forests							
(1000 hectares)							
Land impacted for carbon sink potential -							41.8
Low - Reforest cropland (1000 hectares)							
Land impacted for carbon sink potential -							18.8
Low - Reforest pasture (1000 hectares)							
Land impacted for carbon sink potential -							258
Low - Restore productivity (1000							
hectares)							
Land impacted for carbon sink potential -							1,125
Low - Total impacted (over 30 years)							, -
(1000 hectares)							
Land impacted for carbon sink potential -							9.51
Mid - Accelerate regeneration (1000							
hectares)							
Land impacted for carbon sink potential -	+		+				256
Mid - Avoid deforestation (over 30 years)							
(1000 hectares)							
Land impacted for carbon sink potential -			+				761
Mid - Extend rotation length (1000							101
hectares)							
Land impacted for carbon sink potential -							46.6
Mid - Improve plantations (1000 hectares)							10.0
Land impacted for carbon sink potential -							0
Mid - Increase retention of HWP (1000							U
hectares)							
Land impacted for carbon sink potential -			+				145
Mid - Increase trees outside forests (1000							140
hectares)							
Land impacted for carbon sink potential -	+						62.7
Mid - Reforest cropland (1000 hectares)							02.1
Land impacted for carbon sink potential -							136
							130
Mid - Reforest pasture (1000 hectares) Land impacted for carbon sink potential -							F10
•							519
Mid - Restore productivity (1000							
hectares)							1001
Land impacted for carbon sink potential -							1,936
Mid - 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 -		822	1	0.991	0.866	0.63	0.056
Coal (million 2019\$)							
Monetary damages from air pollution -		188	118	140	103	35.4	11.2
Natural Gas (million 2019\$)							
Monetary damages from air pollution -		1,813	1,690	1,283	740	339	136
Transportation (million 2019\$)							
Premature deaths from air pollution -		92.9	0.113	0.112	0.098	0.071	0.006
Coal (deaths)							

Table 44: E+RE- scenario - IMPACTS - Health (continued)

Item	2020	2025	2030	2035	2040	2045	2050
Premature deaths from air pollution -		21.2	13.3	15.8	11.6	3.99	1.26
Natural Gas (deaths)							
Premature deaths from air pollution -		204	190	144	83.2	38.1	15.3
Transportation (deaths)							

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

	110011011 00					
2020	2025	2030	2035	2040	2045	2050
	19,992	21,841				
41	45.8	49.8	60.5	75.4	84.5	87.7
59	54.2	50.2	39.5	24.6	15.5	12.3
2.05	6.96	10.3	20.9	43.5	68.9	83
6.04	3.45	3.62	4.3	5.98	8.09	9.31
3.02	2.68	2.47	1.87	0.951	0.308	0.081
88.9	86.9	83.6	72.9	49.6	22.7	7.57
0.622	1.14	3.37	10.3	24.6	40.1	48.5
5.71	3.86	5.44	10.7	22.3	35.9	43.7
93.3	94.8	91	78.8	52.9	23.8	7.64
0.34	0.189	0.189	0.191	0.19	0.19	0.19
	41 59 2.05 6.04 3.02 88.9 0.622 5.71 93.3	19,992 41 45.8 59 54.2 2.05 6.96 6.04 3.45 3.02 2.68 88.9 86.9 0.622 1.14 5.71 3.86 93.3 94.8	19,992 21,841 41 45.8 49.8 59 54.2 50.2 2.05 6.96 10.3 6.04 3.45 3.62 3.02 2.68 2.47 88.9 86.9 83.6 0.622 1.14 3.37 5.71 3.86 5.44 93.3 94.8 91	19,992 21,841 41 45.8 49.8 60.5 59 54.2 50.2 39.5 2.05 6.96 10.3 20.9 6.04 3.45 3.62 4.3 3.02 2.68 2.47 1.87 88.9 86.9 83.6 72.9 0.622 1.14 3.37 10.3 5.71 3.86 5.44 10.7 93.3 94.8 91 78.8	19,992 21,841 41 45.8 49.8 60.5 75.4 59 54.2 50.2 39.5 24.6 2.05 6.96 10.3 20.9 43.5 6.04 3.45 3.62 4.3 5.98 3.02 2.68 2.47 1.87 0.951 88.9 86.9 83.6 72.9 49.6 0.622 1.14 3.37 10.3 24.6 5.71 3.86 5.44 10.7 22.3 93.3 94.8 91 78.8 52.9	19,992 21,841 41 45.8 49.8 60.5 75.4 84.5 59 54.2 50.2 39.5 24.6 15.5 2.05 6.96 10.3 20.9 43.5 68.9 6.04 3.45 3.62 4.3 5.98 8.09 3.02 2.68 2.47 1.87 0.951 0.308 88.9 86.9 83.6 72.9 49.6 22.7 0.622 1.14 3.37 10.3 24.6 40.1 5.71 3.86 5.44 10.7 22.3 35.9 93.3 94.8 91 78.8 52.9 23.8

Table 46: E-B+ scenario - PILLAR 1: Efficiency/Electrification - Electricity demand

Item	2020	2025	2030	2035	2040	2045	2050
Electricity distribution capital invested -		4.04	4.11	5.15	5.33	7.04	7.41
Cumulative 5-yr (billion \$2018)							

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

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Commercial (PJ)	190	187	183	179	172	164	155
Final energy use - Industry (PJ)	680	693	708	728	762	777	784
Final energy use - Residential (PJ)	311	289	273	257	238	214	188
Final energy use - Transportation (PJ)	653	615	559	514	480	439	392

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

Item	2020	2025	2030	2035	2040	2045	2050
Residential HVAC investment in 2020s vs.		5.71	7.71				
REF - Cumulative 5-yr (billion \$2018)							
Sales of cooking units - Electric	67.5	68.3	71.3	79.1	90.1	96.8	99.1
Resistance (%)							
Sales of cooking units - Gas (%)	32.5	31.7	28.7	20.9	9.94	3.21	0.863
Sales of space heating units - Electric	7.14	13.6	16.9	27.4	49.2	73	86
Heat Pump (%)							
Sales of space heating units - Electric	18.1	24.8	24	21.6	16.2	10.6	7.72
Resistance (%)							
Sales of space heating units - Fossil (%)	6.08	9.67	9.33	8.18	5.9	3.46	2.13
Sales of space heating units - Gas (%)	68.7	51.9	49.7	42.9	28.7	12.9	4.2
Sales of water heating units - Electric	0	0.608	2.31	7.59	18.2	29.3	35.3
Heat Pump (%)							
Sales of water heating units - Electric	39.3	55.7	55.6	55.8	57.2	59.4	61
Resistance (%)							

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

The state of the s	-	-	•	-			
Item	2020	2025	2030	2035	2040	2045	2050
Sales of water heating units - Gas Furnace (%)	60.6	43.5	41.9	36.4	24.4	11	3.54
Sales of water heating units - Other (%)	0.101	0.202	0.203	0.204	0.204	0.204	0.204

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

Item	2020	2025	2030	2035	2040	2045	2050
Light-duty vehicle capital costs -		0	192	404	1,364	4,297	6,258
Cumulative 5-yr (million \$2018)							
Public EV charging plugs - DC Fast (1000	0.168		0.662		3.54		9.92
units)							
Public EV charging plugs - L2 (1000 units)	0.43		15.9		85.2		238
Vehicle sales - Heavy-duty - diesel (%)	97.4	96	91.3	79.8	58.2	32.1	13.7
Vehicle sales - Heavy-duty - EV (%)	0.498	1.45	4.11	10.8	23.6	39.5	51
Vehicle sales - Heavy-duty - gasoline (%)	0.228	0.236	0.239	0.225	0.179	0.109	0.051
Vehicle sales - Heavy-duty - hybrid (%)	0.083	0.094	0.104	0.107	0.092	0.06	0.03
Vehicle sales - Heavy-duty - hydrogen FC	0.332	0.969	2.74	7.17	15.7	26.3	34
(%)							
Vehicle sales - Heavy-duty - other (%)	1.5	1.28	1.46	1.95	2.25	1.96	1.14
Vehicle sales - Light-duty - diesel (%)	1.6	2	2.06	1.64	1.05	0.542	0.232
Vehicle sales - Light-duty - EV (%)	1.85	4.59	11.7	25.5	48	71.8	87.5
Vehicle sales - Light-duty - gasoline (%)	91.9	87.6	79.9	67.1	46.6	25.1	11.1
Vehicle sales - Light-duty - hybrid (%)	4.46	5.27	5.93	5.42	4.08	2.42	1.18
Vehicle sales - Light-duty - hydrogen FC	0.113	0.381	0.328	0.251	0.179	0.099	0.046
(%)							
Vehicle sales - Light-duty - other (%)	0.105	0.108	0.098	0.086	0.062	0.034	0.016
Vehicle sales - Medium-duty - diesel (%)	64.8	62.2	57.7	49.4	35.6	19.6	8.37
Vehicle sales - Medium-duty - EV (%)	0.664	1.94	5.49	14.3	31.4	52.6	68
Vehicle sales - Medium-duty - gasoline (%)	33.8	34.7	34.7	31.9	24.4	14.2	6.33
Vehicle sales - Medium-duty - hybrid (%)	0.363	0.418	0.464	0.478	0.414	0.275	0.141
Vehicle sales - Medium-duty - hydrogen	0.166	0.485	1.37	3.58	7.86	13.2	17
FC (%)							
Vehicle sales - Medium-duty - other (%)	0.253	0.266	0.279	0.286	0.258	0.184	0.102

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

Item	2020	2025	2030	2035	2040	2045	2050
Capital invested - Biomass power plant	0	0	0	0	0	0	0
(billion \$2018)							
Capital invested - Biomass w/ccu allam	0	0	0	0	0.009	0	0
power plant (billion \$2018)							
Capital invested - Biomass w/ccu power	0	0	0	0	0.001	0	0
plant (billion \$2018)							

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

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

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

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

Table 52: E-B+ scenario -	DTII AD 2: Cloan	tuale Diagnapayi	loontinuedl
1 abic 32. E-D+ Scellul 10 -	PILLAR J. GIEUII	iueis - Diueilei uv i	COMMINUEUR

Item	2020	2025	2030	2035	2040	2045	2050
Number of facilities - Beccs hydrogen	0	0	0	19	52	105	105
(quantity)							
Number of facilities - Diesel (quantity)	0	0	0	0	0	0	0
Number of facilities - Diesel ccu (quantity)	0	0	0	0	1	1	1
Number of facilities - Power (quantity)	0	0	0	0	0	0	0
Number of facilities - Power ccu	0	0	0	0	1	1	1
(quantity)							
Number of facilities - Pyrolysis (quantity)	0	0	0	0	0	0	0
Number of facilities - Pyrolysis ccu	0	0	0	0	1	1	1
(quantity)							
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	20.8	57.7	120	120
Annual - BECCS (MMT)		0	0	20.8	57.7	117	117
Annual - Cement and lime (MMT)		0	0	0	0	3.42	3.53
Annual - NGCC (MMT)		0	0	0	0	0	0
Cumulative - All (MMT)		0	0	20.8	78.5	199	319
Cumulative - BECCS (MMT)		0	0	20.8	78.5	195	312
Cumulative - Cement and lime (MMT)		0	0	0	0	3.42	6.95
Cumulative - NGCC (MMT)		0	0	0	0	0	0

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

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

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

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

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

Item	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - Aggressive							-2,302
deployment - Corn-ethanol to energy							
grasses (1000 tCO2e/y)							
Carbon sink potential - Aggressive							-6,796
deployment - Cropland measures (1000							
tCO2e/y)							
Carbon sink potential - Aggressive							0
deployment - Cropland to woody energy							
crops (1000 tCO2e/y)							

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

Item	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - Aggressive							0
deployment - Pasture to energy crops							
(1000 tCO2e/y)							011
Carbon sink potential - Aggressive							-211
deployment - Permanent conservation							
cover (1000 tC02e/y)							0.000
Carbon sink potential - Aggressive							-9,309
deployment - Total (1000 tCO2e/y)							0.000
Carbon sink potential - Moderate							-2,302
deployment - Corn-ethanol to energy							
grasses (1000 tC02e/y)							0.570
Carbon sink potential - Moderate							-3,578
deployment - Cropland measures (1000							
tCO2e/y)							
Carbon sink potential - Moderate							0
deployment - Cropland to woody energy							
crops (1000 tC02e/y)							
Carbon sink potential - Moderate							0
deployment - Pasture to energy crops							
(1000 tC02e/y)							
Carbon sink potential - Moderate							-105
deployment - Permanent conservation							
cover (1000 tCO2e/y)							
Carbon sink potential - Moderate							-5,986
deployment - Total (1000 tCO2e/y)							
Land impacted for carbon sink -							1,204
Aggressive deployment - Corn-ethanol to							
energy grasses (1000 hectares)							
Land impacted for carbon sink -							8,939
Aggressive deployment - Cropland							
measures (1000 hectares)							
Land impacted for carbon sink -							400
Aggressive deployment - Cropland to							
woody energy crops (1000 hectares)							
Land impacted for carbon sink -							67.8
Aggressive deployment - Pasture to							
energy crops (1000 hectares)							
Land impacted for carbon sink -							383
Aggressive deployment - Permanent							
conservation cover (1000 hectares)							
Land impacted for carbon sink -							10,994
Aggressive deployment - Total (1000							
hectares)							
Land impacted for carbon sink - Moderate							1,204
deployment - Corn-ethanol to energy							
grasses (1000 hectares)							
Land impacted for carbon sink - Moderate							1,906
deployment - Cropland measures (1000							.,
hectares)							
Land impacted for carbon sink - Moderate							400
deployment - Cropland to woody energy							
crops (1000 hectares)							
Land impacted for carbon sink - Moderate							67.8
deployment - Pasture to energy crops							01.0
(1000 hectares)							
Land impacted for carbon sink - Moderate							192
deployment - Permanent conservation							172
cover (1000 hectares)							
Land impacted for carbon sink - Moderate							3,769
							3,109
deployment - Total (1000 hectares)							

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

Iable 57: E-B+ scenario - PILLAR 6: Land s Item	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - High - Accelerate							-77.5
regeneration (1000 tCO2e/y)							
Carbon sink potential - High - All (not							-14,566
counting overlap) (1000 tCO2e/y)							
Carbon sink potential - High - Avoid							-1,952
deforestation (1000 tCO2e/y)							
Carbon sink potential - High - Extend							-2,158
rotation length (1000 tCO2e/y)							
Carbon sink potential - High - Improve							-168
plantations (1000 tCO2e/y)							
Carbon sink potential - High - Increase							-1,834
retention of HWP (1000 tCO2e/y)							.,
Carbon sink potential - High - Increase							-2,006
trees outside forests (1000 tCO2e/y)							_,000
Carbon sink potential - High - Reforest							-1,264
cropland (1000 tCO2e/y)							1,204
Carbon sink potential - High - Reforest							-3,822
pasture (1000 tC02e/y)							-5,022
Carbon sink potential - High - Restore							-1,284
productivity (1000 tC02e/y)							-1,204
Carbon sink potential - Low - Accelerate							-38.8
							-30.0
regeneration (1000 tC02e/y)							0.07
Carbon sink potential - Low - All (not							-3,947
counting overlap) (1000 tCO2e/y)							205
Carbon sink potential - Low - Avoid							-325
deforestation (1000 tCO2e/y)							
Carbon sink potential - Low - Extend							-829
rotation length (1000 tCO2e/y)							
Carbon sink potential - Low - Improve							-85.6
plantations (1000 tCO2e/y)							
Carbon sink potential - Low - Increase							-611
retention of HWP (1000 tCO2e/y)							
Carbon sink potential - Low - Increase							-702
trees outside forests (1000 tCO2e/y)							
Carbon sink potential - Low - Reforest							-632
cropland (1000 tCO2e/y)							
Carbon sink potential - Low - Reforest							-290
pasture (1000 tCO2e/y)							
Carbon sink potential - Low - Restore							-433
productivity (1000 tCO2e/y)							
Carbon sink potential - Mid - Accelerate							-58.2
regeneration (1000 tCO2e/y)							
Carbon sink potential - Mid - All (not							-9,255
counting overlap) (1000 tCO2e/y)							,
Carbon sink potential - Mid - Avoid							-1,138
deforestation (1000 tCO2e/y)							,
Carbon sink potential - Mid - Extend							-1,493
rotation length (1000 tCO2e/y)							., ., .
Carbon sink potential - Mid - Improve							-125
plantations (1000 tCO2e/y)							120
Carbon sink potential - Mid - Increase							-1,223
retention of HWP (1000 tCO2e/y)							-1,220
Carbon sink potential - Mid - Increase							-1,354
							-1,354
trees outside forests (1000 tC02e/y)							-948
Carbon sink potential - Mid - Reforest							-948
cropland (1000 tC02e/y)							0.051
				1			-2,056
Carbon sink potential - Mid - Reforest							2,000
pasture (1000 tCO2e/y)							
· ·							-858

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

Item	2020	2025	2030	2035	2040	2045	2050
Land impacted for carbon sink potential - High - Accelerate regeneration (1000							12.7
hectares)							
Land impacted for carbon sink potential - High - Avoid deforestation (over 30 years)							264
(1000 hectares)							
Land impacted for carbon sink potential - High - Extend rotation length (1000							1,100
hectares)							
Land impacted for carbon sink potential -							62
High - Improve plantations (1000 hectares)							
Land impacted for carbon sink potential -							0
High - Increase retention of HWP (1000							
hectares)							
Land impacted for carbon sink potential -							191
High - Increase trees outside forests (1000 hectares)							
Land impacted for carbon sink potential -							83.6
High - Reforest cropland (1000 hectares)							
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)							109
Land impacted for carbon sink potential -							426
High - Restore productivity (1000							120
hectares)							
Land impacted for carbon sink potential -							2,248
High - Total impacted (over 30 years)							
(1000 hectares)							
Land impacted for carbon sink potential -							6.34
Low - Accelerate regeneration (1000							
hectares)							0/0
Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years)							248
(1000 hectares)							
Land impacted for carbon sink potential -							422
Low - Extend rotation length (1000							422
hectares)							
Land impacted for carbon sink potential -							31
Low - Improve plantations (1000							· .
hectares)							
Land impacted for carbon sink potential -							0
Low - Increase retention of HWP (1000							
hectares)							
Land impacted for carbon sink potential -							100
Low - Increase trees outside forests							
(1000 hectares)							
Land impacted for carbon sink potential -							41.8
Low - Reforest cropland (1000 hectares)							
Land impacted for carbon sink potential -							18.8
Low - Reforest pasture (1000 hectares)							
Land impacted for carbon sink potential -							258
Low - Restore productivity (1000							
hectares)							1105
Land impacted for carbon sink potential -							1,125
Low - Total impacted (over 30 years)							
(1000 hectares)							0.51
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000							9.51
	1				1		

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

Item	2020	2025	2030	2035	2040	2045	2050
Land impacted for carbon sink potential -							256
Mid - Avoid deforestation (over 30 years)							
(1000 hectares)							
Land impacted for carbon sink potential -							761
Mid - Extend rotation length (1000							
hectares)							
Land impacted for carbon sink potential -							46.6
Mid - Improve plantations (1000 hectares)							
Land impacted for carbon sink potential -							0
Mid - Increase retention of HWP (1000							
hectares)							
Land impacted for carbon sink potential -							145
Mid - Increase trees outside forests (1000							
hectares)							
Land impacted for carbon sink potential -							62.7
Mid - Reforest cropland (1000 hectares)							
Land impacted for carbon sink potential -							136
Mid - Reforest pasture (1000 hectares)							
Land impacted for carbon sink potential -							519
Mid - Restore productivity (1000							
hectares)							
Land impacted for carbon sink potential -							1,936
Mid - Total impacted (over 30 years) (1000							
hectares)							

Table 58: E-B+ scenario - IMPACTS - Health

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution -		822	1	0.991	0.866	0.63	0.056
Coal (million 2019\$)							
Monetary damages from air pollution -		222	127	73.6	51.7	26.7	8.73
Natural Gas (million 2019\$)							
Monetary damages from air pollution -		1,843	1,859	1,807	1,625	1,292	887
Transportation (million 2019\$)							
Premature deaths from air pollution -		92.9	0.113	0.112	0.098	0.071	0.006
Coal (deaths)							
Premature deaths from air pollution -		25.1	14.4	8.31	5.84	3.01	0.985
Natural Gas (deaths)							
Premature deaths from air pollution -		207	209	203	183	145	99.7
Transportation (deaths)							

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

Item	2020	2025	2030	2035	2040	2045	2050
Commercial HVAC investment in 2020s -		19,774	20,475				
Cumulative 5-yr (million \$2018)							
Sales of cooking units - Electric	41	44.2	44.3	44.3	44.3	44.4	44.5
Resistance (%)							
Sales of cooking units - Gas (%)	59	55.8	55.7	55.7	55.7	55.6	55.5
Sales of space heating units - Electric	2.05	13.1	45	71.1	75.4	75.9	75.9
Heat Pump (%)							
Sales of space heating units - Electric	6.04	4.34	8.93	17.2	22.8	23.7	23.7
Resistance (%)							
Sales of space heating units - Fossil (%)	3.02	2.48	1.25	0.221	0.025	0.001	0
Sales of space heating units - Gas Furnace	88.9	80.1	44.8	11.5	1.77	0.439	0.36
(%)							
Sales of water heating units - Electric	0.622	0.346	0.35	0.35	0.344	0.346	0.347
Heat Pump (%)							
Sales of water heating units - Electric	5.71	3.27	3.23	3.24	3.22	3.2	3.2
Resistance (%)							

Table 59: REF scenario - PILLAR 1: Efficiency/Electrification - Commercial (continued)

•••			•	•			
Item	2020	2025	2030	2035	2040	2045	2050
Sales of water heating units - Gas Furnace (%)	93.3	96.2	96.2	96.2	96.3	96.3	96.3
Sales of water heating units - Other (%)	0.34	0.189	0.189	0.191	0.19	0.19	0.19

Table 60: REF scenario - PILLAR 1: Efficiency/Electrification - Electricity demand

Item	2020	2025	2030	2035	2040	2045	2050
Electricity distribution capital invested -		4.26	4.35	4.69	4.81	5.72	5.94
Cumulative 5-yr (billion \$2018)							

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

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Commercial (PJ)	190	190	188	184	179	179	183
Final energy use - Industry (PJ)	681	703	718	717	727	733	738
Final energy use - Residential (PJ)	311	289	277	269	264	262	259
Final energy use - Transportation (PJ)	653	615	563	533	532	548	569

Table 62: REF scenario - PILLAR 1: Efficiency/Electrification - Residential

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

Table 63: REF scenario - PILLAR 1: Efficiency/Electrification - Transportation

Item	2020	2025	2030	2035	2040	2045	2050
Vehicle sales - Heavy-duty - diesel (%)	98.1	98.2	97.9	97	95.6	93.5	91.6
Vehicle sales - Heavy-duty - EV (%)	0	0	0	0	0	0	0
Vehicle sales - Heavy-duty - gasoline (%)	0.229	0.242	0.257	0.274	0.294	0.317	0.343
Vehicle sales - Heavy-duty - hybrid (%)	0.083	0.096	0.112	0.13	0.15	0.174	0.202
Vehicle sales - Heavy-duty - hydrogen FC	0.119	0.138	0.16	0.186	0.216	0.25	0.29
(%)							
Vehicle sales - Heavy-duty - other (%)	1.51	1.31	1.57	2.37	3.69	5.71	7.57
Vehicle sales - Light-duty - diesel (%)	1.59	2	2.19	2.04	1.84	1.71	1.63
Vehicle sales - Light-duty - EV (%)	3.44	5.44	6.21	7.63	9.3	10.8	12
Vehicle sales - Light-duty - gasoline (%)	90.4	86.9	84.8	83	81	79	77.4
Vehicle sales - Light-duty - hybrid (%)	4.32	5.17	6.34	6.91	7.48	8.08	8.56
Vehicle sales - Light-duty - hydrogen FC	0.111	0.378	0.348	0.31	0.307	0.308	0.319
(%)							
Vehicle sales - Light-duty - other (%)	0.104	0.108	0.104	0.105	0.104	0.103	0.106
Vehicle sales - Medium-duty - diesel (%)	65.2	63.5	61.6	59.6	58	56.5	55.2
Vehicle sales - Medium-duty - EV (%)	0.027	0.105	0.329	0.671	0.895	0.973	0.993
Vehicle sales - Medium-duty - gasoline (%)	34	35.5	37	38.5	39.7	40.8	41.7

Table 63: REF scenario - PILLAR 1: Efficiency/Electrification - Transportation (continued)

Item	2020	2025	2030	2035	2040	2045	2050
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 64: REF scenario - PILLAR 6: Land sinks - Forests

Item	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - High - Accelerate							-77.5
regeneration (1000 tCO2e/y)							
Carbon sink potential - High - All (not							-14,566
counting overlap) (1000 tCO2e/y)							
Carbon sink potential - High - Avoid							-1,952
deforestation (1000 tCO2e/y)							
Carbon sink potential - High - Extend							-2,158
rotation length (1000 tCO2e/y)							
Carbon sink potential - High - Improve							-168
plantations (1000 tCO2e/y)							
Carbon sink potential - High - Increase							-1,834
retention of HWP (1000 tCO2e/y)							
Carbon sink potential - High - Increase							-2,006
trees outside forests (1000 tCO2e/y)							•
Carbon sink potential - High - Reforest							-1,264
cropland (1000 tCO2e/y)							·
Carbon sink potential - High - Reforest							-3,822
pasture (1000 tC02e/y)							-,
Carbon sink potential - High - Restore							-1,284
productivity (1000 tCO2e/y)							.,
Carbon sink potential - Low - Accelerate							-38.8
regeneration (1000 tCO2e/y)							00.0
Carbon sink potential - Low - All (not							-3,94
counting overlap) (1000 tCO2e/y)							0,74
Carbon sink potential - Low - Avoid							-32
deforestation (1000 tC02e/y)							02
Carbon sink potential - Low - Extend							-829
rotation length (1000 tCO2e/y)							-02
Carbon sink potential - Low - Improve							-85.6
plantations (1000 tCO2e/y)							-00.0
Carbon sink potential - Low - Increase							-61
retention of HWP (1000 tC02e/y)							-01
Carbon sink potential - Low - Increase							-702
trees outside forests (1000 tCO2e/y)							-102
Carbon sink potential - Low - Reforest							-63
cropland (1000 tCO2e/y)							-03.
							-290
Carbon sink potential - Low - Reforest							-290
pasture (1000 tC02e/y)							/ 0/
Carbon sink potential - Low - Restore							-43
productivity (1000 tC02e/y)							F0.
Carbon sink potential - Mid - Accelerate							-58.
regeneration (1000 tC02e/y)							0.051
Carbon sink potential - Mid - All (not							-9,25
counting overlap) (1000 tC02e/y)							440
Carbon sink potential - Mid - Avoid							-1,138
deforestation (1000 tC02e/y)							4.00
Carbon sink potential - Mid - Extend							-1,493
rotation length (1000 tCO2e/y)							
Carbon sink potential - Mid - Improve							-125
plantations (1000 tCO2e/y)							
Carbon sink potential - Mid - Increase						T	-1,223
retention of HWP (1000 tCO2e/y)							

Table 64: REF scenario - PILLAR 6: Land sinks - Forests (continued)

2020	2025	2030	2035	2040	2045	2050
						-1,354
						0/.0
						-948
						0.05/
						-2,056
						0.50
						-858
						12.7
						12.7
						264
						204
					-	1,100
						1,100
						62
						02
						0
						U
						191
						191
						83.6
						03.0
						109
						109
						426
						420
						2,248
						2,240
						6.34
						0.34
						248
						240
						422
						422
						31
						31
						0
						U
						100
						100
						/1.0
						41.8
						40.0
						18.8
						258
	[
		2020 2025			2020 2025 2030 2035 2040	2020 2025 2030 2035 2040 2045

Table 64: REF scenario - PILLAR 6: Land sinks - Forests (continued)

Item	2020	2025	2030	2035	2040	2045	2050
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)							1,125
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)							9.51
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)							256
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)							761
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)							46.6
Land impacted for carbon sink potential - Mid - Increase retention of HWP (1000 hectares)							0
Land impacted for carbon sink potential - Mid - Increase trees outside forests (1000 hectares)							145
Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares)							62.7
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)							136
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)							519
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)							1,936

Table 65: REF scenario - PILLAR 6: Land sinks - Forests - REF only

Item	2020	2025	2030	2035	2040	2045	2050
Business-as-usual carbon sink - Natural uptake (Mt CO2e/y)	-6.5		-4.24				-3.79
Business-as-usual carbon sink - Retained in Hardwood Products (Mt CO2e/y)	-0.499		-0.898				-0.933
Business-as-usual carbon sink - Total (Mt CO2e/y)	-7		-5.14				-4.73

Table 66: REF scenario - IMPACTS - Health

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution -		2,667	1,763	1,360	1,160	1,089	1,064
Coal (million 2019\$)							
Monetary damages from air pollution -		202	233	287	306	265	235
Natural Gas (million 2019\$)							
Monetary damages from air pollution -		1,842	1,885	1,926	1,975	2,025	2,076
Transportation (million 2019\$)							
Premature deaths from air pollution -		301	199	154	131	123	120
Coal (deaths)							
Premature deaths from air pollution -		22.8	26.3	32.3	34.5	29.9	26.5
Natural Gas (deaths)							
Premature deaths from air pollution -		207	212	217	222	228	234
Transportation (deaths)							