

Net-Zero America - california state report

2021-03-18

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

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

Notes

- These data are 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 -		120,478	131,958				
Cumulative 5-yr (million \$2018)							
Sales of cooking units - Electric	27.5	41.7	78.2	85.4	85.8	85.8	85.8
Resistance (%)							
Sales of cooking units - Gas (%)	72.5	58.3	21.8	14.6	14.2	14.2	14.2
Sales of space heating units - Electric	1.74	20.9	62.9	75.6	76.7	76.7	76.7
Heat Pump (%)							
Sales of space heating units - Electric	11.4	14.3	19.6	22.2	22.6	22.6	22.6
Resistance (%)							
Sales of space heating units - Fossil (%)	0	0	0	0	0	0	0
Sales of space heating units - Gas Furnace	86.9	64.8	17.5	2.29	0.731	0.685	0.683
(%)							
Sales of water heating units - Electric	0.63	11.5	57.5	68	68.5	68.5	68.5
Heat Pump (%)							
Sales of water heating units - Electric	2.03	6.87	26.2	30.7	30.9	30.9	30.9
Resistance (%)							
Sales of water heating units - Gas Furnace	96.8	81	15.7	0.718	0.005	0	0
(%)							
Sales of water heating units - Other (%)	0.501	0.619	0.623	0.624	0.623	0.624	0.625

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

Item	2020	2025	2030	2035	2040	2045	2050
Electricity distribution capital invested -		12.6	13	29.3	31.6	24.6	25.8
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)	793	798	775	732	700	692	702
Final energy use - Industry (PJ)	1,021	1,057	1,074	1,125	1,184	1,218	1,259
Final energy use - Residential (PJ)	878	820	708	579	478	418	385
Final energy use - Transportation (PJ)	3,056	2,945	2,657	2,291	1,958	1,742	1,635

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

Item	2020	2025	2030	2035	2040	2045	2050
Residential HVAC investment in 2020s vs.		27.7	36.5				
REF - Cumulative 5-yr (billion \$2018)							
Sales of cooking units - Electric	40	52.8	91.9	99.6	100	100	100
Resistance (%)							
Sales of cooking units - Gas (%)	60	47.2	8.07	0.406	0	0	0
Sales of space heating units - Electric	5.99	23.4	70.8	81.7	82.3	82.2	82.2
Heat Pump (%)							
Sales of space heating units - Electric	16.4	23.7	15.2	13.3	13.2	13.3	13.4
Resistance (%)							
Sales of space heating units - Fossil (%)	3.33	5.85	3.58	3.05	3	2.95	2.91
Sales of space heating units - Gas (%)	74.3	47	10.3	1.95	1.53	1.52	1.52
Sales of water heating units - Electric	0	11.2	59.4	70.3	70.8	70.8	70.8
Heat Pump (%)							
Sales of water heating units - Electric	17.5	31.3	27.2	26.4	26.4	26.4	26.4
Resistance (%)							
Sales of water heating units - Gas Furnace	79.8	54.8	10.6	0.486	0.003	0	0
(%)							
Sales of water heating units - Other (%)	2.7	2.75	2.76	2.79	2.8	2.82	2.83

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

Item	2020	2025	2030	2035	2040	2045	2050
Light-duty vehicle capital costs -		5,550	15,540	23,053	35,766	38,007	36,736
Cumulative 5-yr (million \$2018)							
Public EV charging plugs - DC Fast (1000	4.35		11.9		38.9		60.4
units)							
Public EV charging plugs - L2 (1000 units)	21.5		285		934		1,452
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 (%)	1.18	1.49	1.11	0.353	0.069	0.013	0
Vehicle sales - Light-duty - EV (%)	5.15	19	52	84	96.6	99.3	100
Vehicle sales - Light-duty - gasoline (%)	87.8	73.7	43	14.3	3	0.581	0
Vehicle sales - Light-duty - hybrid (%)	5.63	5.42	3.61	1.3	0.323	0.072	0
Vehicle sales - Light-duty - hydrogen FC	0.108	0.318	0.174	0.052	0.011	0.002	0
(%)							
Vehicle sales - Light-duty - other (%)	0.085	0.08	0.049	0.017	0.003	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 6: E+ scenario - PILLAR 2: Clean Electricity - Generating capacity

Item	2020	2025	2030	2035	2040	2045	2050
Capital invested - Biomass power plant	0	0.007	0.811	0	0.169	0	0
(billion \$2018)							
Capital invested - Biomass w/ccu allam	0	0	0	0.073	0.003	0.003	0.022
power plant (billion \$2018)							
Capital invested - Biomass w/ccu power	0	0	0.556	0.001	0	0	0
plant (billion \$2018)							
Capital invested - Offshore Wind - Base		0.292	0	0	0.987	1.09	7.32
(billion \$2018)							
Capital invested - Offshore Wind -		0.153	0	0.119	0.769	1.26	6.35
Constrained (billion \$2018)							
Capital invested - Solar PV - Base (billion		4.1	10.5	19.8	29.2	38.6	39.9
\$2018)							
Capital invested - Solar PV - Constrained		13.6	9.2	26.8	27.8	30.2	38.8
(billion \$2018)							
Capital invested - Wind - Base (billion		0	0	0	0.06	0.103	0
\$2018)							
Capital invested - Wind - Constrained		0.068	0	0.657	1.24	0.43	0.3
(billion \$2018)							
Installed renewables - OffshoreWind -	0	76.3	76.3	76.3	563	1,229	6,753
Base land use assumptions (MW)							
Installed renewables - OffshoreWind -	0	76.3	76.3	76.3	563	1,229	6,753
Constrained land use assumptions (MW)						.	·
Installed renewables - Rooftop PV (MW)	10,012	15,483	20,658	26,842	34,107	42,472	52,234
Installed renewables - Solar - Base land	27,682	31,271	41,520	62,501	95,382	141,409	191,884
use assumptions (MW)							
Installed renewables - Solar -	26,547	28,482	37,106	59,388	100,979	136,923	189,743
Constrained land use assumptions (MW)							•
Installed renewables - Wind - Base land	7,083	7,083	7,083	7,083	7,123	7,193	7,193
use assumptions (MW)							
Installed renewables - Wind - Constrained	7,217	7,252	7,252	7,903	8,613	8,866	10,363
land use assumptions (MW)	, ,	,	,	,	-,	-,	-,

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	13.5	1,606	1,606	1,952	1,952	1,952
Biomass w/ccu allam power plant (GWh)	0	0	0	72.5	75.5	78.9	101
Biomass w/ccu power plant (GWh)	0	0	624	625	625	625	625
OffshoreWind - Base land use	0	418	418	418	3,109	6,763	37,067
assumptions (GWh)							
OffshoreWind - Constrained land use	0	418	418	418	3,109	6,763	37,067
assumptions (GWh)							
Solar - Base land use assumptions (GWh)	66,975	74,628	96,427	139,989	204,029	291,499	388,310
Solar - Constrained land use assumptions	64,339	68,428	86,888	131,184	210,139	277,511	377,239
(GWh)							
Wind - Base land use assumptions (GWh)	28,124	28,124	28,124	28,124	28,259	28,498	28,498
Wind - Constrained land use assumptions	28,240	28,364	28,364	30,135	31,893	32,448	35,314
(GWh)							

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

Item	2020	2025	2030	2035	2040	2045	2050
Biomass purchases (million \$2018/year)		8.07	113	386	525	652	722
Conversion capital investment -		7.67	1,415	7,867	3,886	3,650	2,020
Cumulative 5-yr (million \$2018)							
Number of facilities - Allam power w ccu	0	0	0	4	5	6	7
(quantity)							
Number of facilities - Beccs hydrogen	0	0	0	8	14	18	21
(quantity)							
Number of facilities - Diesel (quantity)	0	0	0	1	1	1	1
Number of facilities - Diesel ccu (quantity)	0	0	0	4	6	7	8
Number of facilities - Power (quantity)	0	1	1	1	2	2	2
Number of facilities - Power ccu	0	0	4	6	6	6	6
(quantity)							
Number of facilities - Pyrolysis (quantity)	0	0	0	1	1	1	1
Number of facilities - Pyrolysis ccu	0	0	0	4	6	7	8
(quantity)							
Number of facilities - Sng (quantity)	0	1	1	1	1	1	1
Number of facilities - Sng ccu (quantity)	0	0	4	4	4	4	4

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

Item	2020	2025	2030	2035	2040	2045	2050
Annual - All (MMT)		0	0.75	26.1	37.5	49.8	57.6
Annual - BECCS (MMT)		0	0.62	10.6	15.3	20	22.5
Annual - Cement and lime (MMT)		0	0	6.71	9.95	13.7	14.1
Annual - NGCC (MMT)		0	0.13	8.85	12.3	16.2	21
Cumulative - All (MMT)		0	0.75	26.9	64.4	114	172
Cumulative - BECCS (MMT)		0	0.62	11.2	26.5	46.5	69
Cumulative - Cement and lime (MMT)		0	0	6.71	16.7	30.4	44.5
Cumulative - NGCC (MMT)		0	0.13	8.98	21.3	37.4	58.4

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

Item	2020	2025	2030	2035	2040	2045	2050
All (km)		0	2,083	4,688	5,992	6,553	7,748
Cumulative investment - All (million \$2018)		0	5,343	7,698	8,531	8,996	9,769
Cumulative investment - Spur (million \$2018)		0	423	2,013	2,845	3,310	4,083
Cumulative investment - Trunk (million \$2018)		0	4,920	5,686	5,686	5,686	5,686
Spur (km)		0	798	3,159	4,463	5,023	6,219
Trunk (km)		0	1,285	1,529	1,529	1,529	1,529

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

Item	2020	2025	2030	2035	2040	2045	2050
CO2 storage (MMT)		0	0	28.2	41.6	53.4	80.1
Injection wells (wells)		0	0	62	92	122	174
Resource characterization, appraisal, permitting costs (million \$2020)		250	900	1,370	1,370	1,370	1,370
Wells and facilities construction costs (million \$2020)		0	0	1,860	2,760	3,660	5,220

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

Table 12: E+ Scenario - PILLAR 6: Land Sink	3020 2020	ture 2025	2030	2035	2040	2045	2050
Item Carbon sink potential - Aggressive	2020	2025	2030	2035	2040	2045	2050 0
							U
deployment - Corn-ethanol to energy							
grasses (1000 tC02e/y)							-4,034
Carbon sink potential - Aggressive							-4,034
deployment - Cropland measures (1000							
tCO2e/y)							-47.2
Carbon sink potential - Aggressive							-41.2
deployment - Permanent conservation							
cover (1000 tC02e/y)							/ 000
Carbon sink potential - Aggressive							-4,082
deployment - Total (1000 tCO2e/y)							
Carbon sink potential - Moderate							0
deployment - Corn-ethanol to energy							
grasses (1000 tC02e/y)							
Carbon sink potential - Moderate							-2,030
deployment - Cropland measures (1000							
tCO2e/y)							
Carbon sink potential - Moderate							-23.6
deployment - Permanent conservation							
cover (1000 tCO2e/y)							
Carbon sink potential - Moderate							-2,054
deployment - Total (1000 tCO2e/y)							
Land impacted for carbon sink -							0
Aggressive deployment - Corn-ethanol to							
energy grasses (1000 hectares)							
Land impacted for carbon sink -							3,813
Aggressive deployment - Cropland							
measures (1000 hectares)							
Land impacted for carbon sink -							73.8
Aggressive deployment - Permanent							
conservation cover (1000 hectares)							
Land impacted for carbon sink -							3,887
Aggressive deployment - Total (1000							
hectares)							
Land impacted for carbon sink - Moderate							0
deployment - Corn-ethanol to energy							
grasses (1000 hectares)							
Land impacted for carbon sink - Moderate							1,925
deployment - Cropland measures (1000							·
hectares)							
Land impacted for carbon sink - Moderate							36.9
deployment - Permanent conservation							00.7
cover (1000 hectares)							
Land impacted for carbon sink - Moderate							1,962
deployment - Total (1000 hectares)							1,702
aspisymone rotal (1000 motal 60)							

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

Item	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - High - Accelerate							-3,748
regeneration (1000 tCO2e/y)							
Carbon sink potential - High - All (not							-43,341
counting overlap) (1000 tCO2e/y)							
Carbon sink potential - High - Avoid							-5,255
deforestation (1000 tC02e/y)							40.57.5
Carbon sink potential - High - Extend							-13,545
rotation length (1000 tCO2e/y)							1.000
Carbon sink potential - High - Improve							-1,299
plantations (1000 tCO2e/y)							/ 5/0
Carbon sink potential - High - Increase							-6,568
retention of HWP (1000 tC02e/y)							0.000
Carbon sink potential - High - Increase							-2,022
trees outside forests (1000 tC02e/y) Carbon sink potential - High - Reforest							-288
cropland (1000 tCO2e/y)							-200
Carbon sink potential - High - Reforest							-2,778
pasture (1000 tCO2e/y)							-2,110
Carbon sink potential - High - Restore							-7,838
productivity (1000 tC02e/y)							-1,030
Carbon sink potential - Low - Accelerate							-1,878
regeneration (1000 tCO2e/y)							-1,010
Carbon sink potential - Low - All (not							-14,511
counting overlap) (1000 tC02e/y)							-14,511
Carbon sink potential - Low - Avoid							-876
deforestation (1000 tC02e/y)							0.0
Carbon sink potential - Low - Extend							-5,203
rotation length (1000 tC02e/y)							0,200
Carbon sink potential - Low - Improve							-661
plantations (1000 tCO2e/y)							
Carbon sink potential - Low - Increase							-2,189
retention of HWP (1000 tCO2e/y)							•
Carbon sink potential - Low - Increase							-708
trees outside forests (1000 tCO2e/y)							
Carbon sink potential - Low - Reforest							-144
cropland (1000 tCO2e/y)							
Carbon sink potential - Low - Reforest							-210
pasture (1000 tCO2e/y)							
Carbon sink potential - Low - Restore							-2,642
productivity (1000 tCO2e/y)							
Carbon sink potential - Mid - Accelerate							-2,813
regeneration (1000 tCO2e/y)							
Carbon sink potential - Mid - All (not							-28,914
counting overlap) (1000 tCO2e/y)							
Carbon sink potential - Mid - Avoid							-3,065
deforestation (1000 tCO2e/y)							
Carbon sink potential - Mid - Extend							-9,374
rotation length (1000 tCO2e/y)							
Carbon sink potential - Mid - Improve							-968
plantations (1000 tCO2e/y)							
Carbon sink potential - Mid - Increase							-4,379
retention of HWP (1000 tCO2e/y)							
Carbon sink potential - Mid - Increase							-1,365
trees outside forests (1000 tC02e/y)							
Carbon sink potential - Mid - Reforest							-216
cropland (1000 tCO2e/y)							
Carbon sink potential - Mid - Reforest							-1,494
pasture (1000 tC02e/y)							
Carbon sink potential - Mid - Restore							-5,240
productivity (1000 tCO2e/y)							

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

Table 13: E+ scenario - PILLAR 6: Land sini							
Item	2020	2025	2030	2035	2040	2045	2050
Land impacted for carbon sink potential -							613
High - Accelerate regeneration (1000							
hectares)							
Land impacted for carbon sink potential -							711
High - Avoid deforestation (over 30 years)							
(1000 hectares)							
Land impacted for carbon sink potential -							6,907
High - Extend rotation length (1000							
hectares)							
Land impacted for carbon sink potential -							479
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 -							192
High - Increase trees outside forests							1/2
(1000 hectares)							
•							19
Land impacted for carbon sink potential -							19
High - Reforest cropland (1000 hectares)							70.0
Land impacted for carbon sink potential -							78.9
High - Reforest pasture (1000 hectares)							
Land impacted for carbon sink potential -							2,598
High - Restore productivity (1000							
hectares)							
Land impacted for carbon sink potential -							11,598
High - Total impacted (over 30 years)							
(1000 hectares)							
Land impacted for carbon sink potential -							307
Low - Accelerate regeneration (1000							
hectares)							
Land impacted for carbon sink potential -							668
Low - Avoid deforestation (over 30 years)							
(1000 hectares)							
Land impacted for carbon sink potential -							2,646
Low - Extend rotation length (1000							
hectares)							
Land impacted for carbon sink potential -							239
Low - Improve plantations (1000							
hectares)							
Land impacted for carbon sink potential -							0
Low - Increase retention of HWP (1000							Ū
hectares)							
Land impacted for carbon sink potential -							101
Low - Increase trees outside forests							101
(1000 hectares)							
•							0.51
Land impacted for carbon sink potential -							9.51
Low - Reforest cropland (1000 hectares)							40.7
Land impacted for carbon sink potential -							13.7
Low - Reforest pasture (1000 hectares)							
Land impacted for carbon sink potential -							1,572
Low - Restore productivity (1000							
hectares)							
Land impacted for carbon sink potential -							5,556
T-1-11-1							
Low - Total impacted (over 30 years)		1	J.				
(1000 hectares)							
							460
(1000 hectares)							460

Tahla 12. Fx	econario -	DILLAD 6.	Land sinks -	Enrecte	(continued)
Table 15. Et	SCEIIUI 10 -	PILLAK O.	LUIIU SIIIKS -	. คบา ยอเอา	COHUHUEUT

2020	2025	2030	2035	2040	2045	2050
						690
						4,777
						360
						0
						147
						14.3
						98.9
						3,166
						9,712
	2020	2020 2025	2020 2025 2030	2020 2025 2030 2035	2020 2025 2030 2035 2040	2020 2025 2030 2035 2040 2045

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

Item	2020	2025	2030	2035	2040	2045	2050
Natural gas consumption - Annual (tcf)		1,654	1,394	1,118	842	530	367
Natural gas consumption - Cumulative							33,681
(tcf)							
Natural gas production - Annual (tcf)		236	223	194	164	130	101
Oil consumption - Annual (million bbls)		546	474	371	277	202	142
Oil consumption - Cumulative (million							11,511
bbls)							
Oil production - Annual (million bbls)		222	223	223	177	143	95.5

Table 15: E+ scenario - IMPACTS - Health

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal (million 2019\$)		251	0.33	0.328	0.172	0.099	0
Monetary damages from air pollution - Natural Gas (million 2019\$)		2,148	1,204	1,078	930	524	234
Monetary damages from air pollution - Transportation (million 2019\$)		31,487	29,710	22,808	13,295	6,015	2,235
Premature deaths from air pollution - Coal (deaths)		28.3	0.037	0.037	0.019	0.011	0
Premature deaths from air pollution - Natural Gas (deaths)		242	136	122	105	59.2	26.4
Premature deaths from air pollution - Transportation (deaths)		3,541	3,341	2,565	1,495	676	251

Table 16: E+ scenario - IMPACTS - Jobs

2020	2025	2030	2035	2040	2045	2050
	807	1,386	1,883	1,859	1,653	1,456
	58,143	61,482	76,374	88,452	98,058	134,483
	45,728	65,320	80,973	73,649	64,840	72,019
	32,912	26,356	20,984	13,552	9,002	5,320
	2020	807 58,143 45,728	807 1,386 58,143 61,482 45,728 65,320	807 1,386 1,883 58,143 61,482 76,374 45,728 65,320 80,973	807 1,386 1,883 1,859 58,143 61,482 76,374 88,452 45,728 65,320 80,973 73,649	807 1,386 1,883 1,859 1,653 58,143 61,482 76,374 88,452 98,058 45,728 65,320 80,973 73,649 64,840

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

Table 16: E+ scenario - IMPACTS - Jobs (co	ntinueaj						
Item	2020	2025	2030	2035	2040	2045	2050
By economic sector - Other (jobs)		7,993	9,224	12,621	16,586	20,593	33,114
By economic sector - Pipeline (jobs)		2,738	3,005	2,338	1,855	1,425	1,184
By economic sector - Professional (jobs)		27,553	28,474	35,760	40,983	46,258	64,799
By economic sector - Trade (jobs)		23,488	23,021	26,403	29,088	32,630	46,719
By economic sector - Utilities (jobs)		32,003	34,620	51,426	61,771	69,870	89,340
By education level - All sectors -		70,243	77,778	96,475	103,858	110,069	144,679
Associates degree or some college (jobs)							
By education level - All sectors -		50,531	53,560	63,482	65,655	68,043	87,443
Bachelors degree (jobs)							
By education level - All sectors - Doctoral		1,724	1,739	2,039	2,180	2,344	3,146
degree (jobs)							
By education level - All sectors - High		96,899	107,379	131,958	140,501	147,387	191,596
school diploma or less (jobs)							
By education level - All sectors - Masters		11,968	12,431	14,808	15,603	16,484	21,570
or professional degree (jobs)							
By resource sector - Biomass (jobs)		2,736	3,641	5,139	5,465	6,045	6,279
By resource sector - CO2 (jobs)		127	5,222	3,730	3,209	3,425	4,510
By resource sector - Coal (jobs)		21.8	7.3	0	0	0	0
By resource sector - Grid (jobs)		43,985	50,184	87,779	109,695	127,593	169,013
By resource sector - Natural Gas (jobs)		24,459	18,978	17,499	16,093	13,996	11,074
By resource sector - Nuclear (jobs)		691	0	0	0	0	0
By resource sector - Oil (jobs)		74,368	64,969	55,609	40,007	29,393	18,443
By resource sector - Solar (jobs)		68,196	77,935	106,739	126,628	145,178	216,773
By resource sector - Wind (jobs)		16,781	31,953	32,267	26,700	18,699	22,341
Median wages - Annual - All (\$2019 per		69,497	69,307	70,110	71,266	72,596	73,492
job)		07, 17.	07,001	. 5,5	,	,0 / 0	. 0, . , _
On-Site or In-Plant Training - Total jobs - 1		37,209	40,698	50,024	53,579	56,579	73,861
to 4 years (jobs)			,		00,011		
On-Site or In-Plant Training - Total jobs - 4		14,870	15,777	19,442	21,444	23,178	30,715
to 10 years (jobs)		,	,	,	,		
On-Site or In-Plant Training - Total jobs -		37,707	41,275	50,239	53,265	55,918	73,204
None (jobs)		- 1,1 - 1	,		55,255		
On-Site or In-Plant Training - Total jobs -		1,828	2,029	2,555	2,796	2,995	3,942
Over 10 years (jobs)		.,020	_,0_,	2,000	_,. , o	_,,,,	3/7
On-Site or In-Plant Training - Total jobs -		139,752	153,108	186,502	196,711	205,658	266,711
Up to 1 year (jobs)		.07,.02	100,100	.00,002	., 0,,	200,000	200,
On-the-Job Training - All sectors - 1 to 4		47,534	51,906	63,890	68,631	72,629	94,966
years (jobs)		,00 .	0.,,00	00,070	00,001	. 2,02	, 1,,00
On-the-Job Training - All sectors - 4 to 10		14,161	15,087	18,811	21,043	22,953	30,703
years (jobs)		,	10,001	10,011	21,010	22,700	00,.00
On-the-Job Training - All sectors - None		12,946	13,902	16,732	17,755	18,731	24,717
(jobs)		12,740	10,702	10,102	11,100	10,101	2-7,111
On-the-Job Training - All sectors - Over 10		2,389	2,670	3,210	3,335	3,424	4,419
years (jobs)		2,007	2,010	0,210	0,000	0,424	7,717
On-the-Job Training - All sectors - Up to 1		154,335	169,324	206,119	217,032	226,592	293,629
year (jobs)		104,000	107,024	200,117	211,002	220,072	270,027
Related work experience - All sectors - 1		84,169	91,353	111,035	117,537	123,350	160,232
to 4 years (jobs)		04,107	71,000	111,000	111,001	120,000	100,202
Related work experience - All sectors - 4		53,830	58,408	71,122	75,508	79,360	103,194
to 10 years (jobs)		33,030	30,400	11,122	13,300	19,500	103,174
Related work experience - All sectors -		32,643	35,839	44,108	47,296	50,040	65,548
None (jobs)		32,043	33,637	44,100	41,270	30,040	05,540
Related work experience - All sectors -		14,741	16,179	19,619	20,444	21,152	27,138
		14,741	10,179	לוס,לו	∠∪,444	21,152	۷۱,۱۵۵
Over 10 years (jobs) Related work experience - All sectors - Up		45,982	E1 10 0	62,878	∠7 ∩11	70 / OF	92,321
· · · · · · · · · · · · · · · · · · ·		45,782	51,108	02,818	67,011	70,425	72,321
to 1 year (jobs) Wage income - All (million \$2019)		14 001	17,529	01 / E 0	99 977	25,001	32,962
waye income - All (Illillion \$2019)		16,081	11,529	21,650	23,364	25,001	32,762

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

Item	2020	2025	2030	2035	2040	2045	2050
Commercial HVAC investment in 2020s -		120,137	130,140				
Cumulative 5-yr (million \$2018)							
Sales of cooking units - Electric	27.5	31	36.1	49.7	68.6	80.2	84.3
Resistance (%)							
Sales of cooking units - Gas (%)	72.5	69	63.9	50.3	31.4	19.8	15.7
Sales of space heating units - Electric	1.74	13	17.8	31.6	53.4	68.7	74.5
Heat Pump (%)							
Sales of space heating units - Electric	11.4	13.3	14	15.8	18.8	21.2	22.2
Resistance (%)							
Sales of space heating units - Fossil (%)	0	0	0	0	0	0	0
Sales of space heating units - Gas Furnace	86.9	73.7	68.3	52.6	27.8	10.2	3.31
(%)							
Sales of water heating units - Electric	0.63	2.65	7.89	23	46.1	61.3	66.6
Heat Pump (%)							
Sales of water heating units - Electric	2.03	3.16	5.36	11.7	21.4	27.8	30.1
Resistance (%)							
Sales of water heating units - Gas Furnace	96.8	93.6	86.1	64.7	31.8	10.2	2.7
(%)							
Sales of water heating units - Other (%)	0.501	0.619	0.623	0.624	0.623	0.624	0.625

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

Item	2020	2025	2030	2035	2040	2045	2050
Electricity distribution capital invested -		9.31	9.32	16.2	17	25.6	27.3
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)	793	800	806	802	788	770	759
Final energy use - Industry (PJ)	1,021	1,058	1,081	1,146	1,217	1,253	1,293
Final energy use - Residential (PJ)	878	825	766	706	626	537	459
Final energy use - Transportation (PJ)	3,060	2,970	2,767	2,590	2,445	2,267	2,054

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

Item	2020	2025	2030	2035	2040	2045	2050
Residential HVAC investment in 2020s vs.		27.5	36.2				
REF - Cumulative 5-yr (billion \$2018)							
Sales of cooking units - Electric	39.8	41.4	46.9	61.4	81.6	94.1	98.4
Resistance (%)							
Sales of cooking units - Gas (%)	60.2	58.6	53.1	38.6	18.4	5.94	1.6
Sales of space heating units - Electric	5.99	14.3	19.7	35.3	59.2	74.8	80.3
Heat Pump (%)							
Sales of space heating units - Electric	16.4	25.3	24.3	21.5	17.3	14.5	13.6
Resistance (%)							
Sales of space heating units - Fossil (%)	3.33	6.29	6.05	5.3	4.13	3.36	3.07
Sales of space heating units - Gas (%)	74.3	54.1	50	38	19.4	7.29	3.04
Sales of water heating units - Electric	0	1.93	7.42	23.2	47.5	63.3	68.9
Heat Pump (%)							
Sales of water heating units - Electric	17.5	32.1	31.6	30.2	28.2	26.9	26.5
Resistance (%)							
Sales of water heating units - Gas Furnace	79.8	63.2	58.2	43.8	21.5	6.93	1.83
(%)							
Sales of water heating units - Other (%)	2.7	2.75	2.76	2.78	2.8	2.81	2.83

Table 21: E- scenario - PILLAR 1: Efficiency/Electrification - Transportation

Item	2020	2025	2030	2035	2040	2045	2050
Light-duty vehicle capital costs - Cumulative 5-yr (million \$2018)		0	1,128	1,859	6,771	19,756	29,318
Public EV charging plugs - DC Fast (1000 units)	4.35		5.46		15.8		38.7
Public EV charging plugs - L2 (1000 units)	21.5		131		380		930
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 (%)	1.19	1.67	1.99	1.57	0.974	0.494	0.213
Vehicle sales - Light-duty - EV (%)	2.32	5.65	13.7	28.9	51.7	74.1	88.4
Vehicle sales - Light-duty - gasoline (%)	90.4	85.6	76.6	62.8	42.5	22.7	10.1
Vehicle sales - Light-duty - hybrid (%)	5.86	6.61	7.25	6.42	4.63	2.63	1.24
Vehicle sales - Light-duty - hydrogen FC (%)	0.112	0.369	0.305	0.225	0.155	0.085	0.04
Vehicle sales - Light-duty - other (%)	0.087	0.09	0.08	0.069	0.049	0.026	0.012
Vehicle sales - Medium-duty - diesel (%)	64.8	62.2	57.7	49.4	35.6	19.6	8.37
Vehicle sales - Medium-duty - EV (%)	0.664	1.94	5.49	14.3	31.4	52.6	68
Vehicle sales - Medium-duty - gasoline (%)	33.8	34.7	34.7	31.9	24.4	14.2	6.33
Vehicle sales - Medium-duty - hybrid (%)	0.363	0.418	0.464	0.478	0.414	0.275	0.141
Vehicle sales - Medium-duty - hydrogen FC (%)	0.166	0.485	1.37	3.58	7.86	13.2	17
Vehicle sales - Medium-duty - other (%)	0.253	0.266	0.279	0.286	0.258	0.184	0.102

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

Item	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - Aggressive							0
deployment - Corn-ethanol to energy							
grasses (1000 tCO2e/y)							
Carbon sink potential - Aggressive							-4,034
deployment - Cropland measures (1000							
tCO2e/y)							
Carbon sink potential - Aggressive							-47.2
deployment - Permanent conservation							
cover (1000 tCO2e/y)							
Carbon sink potential - Aggressive							-4,082
deployment - Total (1000 tCO2e/y)							
Carbon sink potential - Moderate							0
deployment - Corn-ethanol to energy							
grasses (1000 tCO2e/y)							
Carbon sink potential - Moderate							-2,030
deployment - Cropland measures (1000							
tCO2e/y)							
Carbon sink potential - Moderate							-23.6
deployment - Permanent conservation							
cover (1000 tCO2e/y)							
Carbon sink potential - Moderate							-2,054
deployment - Total (1000 tCO2e/y)							
Land impacted for carbon sink -							0
Aggressive deployment - Corn-ethanol to							
energy grasses (1000 hectares)							
Land impacted for carbon sink -							3,813
Aggressive deployment - Cropland							
measures (1000 hectares)							
Land impacted for carbon sink -							73.8
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 -							3,887
Aggressive deployment - Total (1000							
hectares)							
Land impacted for carbon sink - Moderate							0
deployment - Corn-ethanol to energy							
grasses (1000 hectares)							
Land impacted for carbon sink - Moderate							1,925
deployment - Cropland measures (1000							
hectares)							
Land impacted for carbon sink - Moderate							36.9
deployment - Permanent conservation							
cover (1000 hectares)							
Land impacted for carbon sink - Moderate							1,962
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							-3,748
regeneration (1000 tCO2e/y)							
Carbon sink potential - High - All (not							-43,341
counting overlap) (1000 tCO2e/y)							
Carbon sink potential - High - Avoid							-5,255
deforestation (1000 tCO2e/y)							
Carbon sink potential - High - Extend							-13,545
rotation length (1000 tCO2e/y)							
Carbon sink potential - High - Improve							-1,299
plantations (1000 tCO2e/y)							
Carbon sink potential - High - Increase							-6,568
retention of HWP (1000 tCO2e/y)							
Carbon sink potential - High - Increase							-2,022
trees outside forests (1000 tCO2e/y)							
Carbon sink potential - High - Reforest							-288
cropland (1000 tCO2e/y)							
Carbon sink potential - High - Reforest							-2,778
pasture (1000 tC02e/y)							•
Carbon sink potential - High - Restore							-7,838
productivity (1000 tCO2e/y)							•
Carbon sink potential - Low - Accelerate							-1,878
regeneration (1000 tC02e/y)							•
Carbon sink potential - Low - All (not							-14,511
counting overlap) (1000 tCO2e/y)							,
Carbon sink potential - Low - Avoid							-876
deforestation (1000 tCO2e/y)							
Carbon sink potential - Low - Extend							-5,203
rotation length (1000 tCO2e/y)							
Carbon sink potential - Low - Improve							-661
plantations (1000 tCO2e/y)							
Carbon sink potential - Low - Increase							-2,189
retention of HWP (1000 tCO2e/y)							, -
Carbon sink potential - Low - Increase							-708
trees outside forests (1000 tC02e/y)							
Carbon sink potential - Low - Reforest							-144
cropland (1000 tCO2e/y)							
Carbon sink potential - Low - Reforest							-210
pasture (1000 tC02e/y)							
Carbon sink potential - Low - Restore							-2,642
productivity (1000 tC02e/y)							_,0 12
Carbon sink potential - Mid - Accelerate		+					-2,813
regeneration (1000 tC02e/y)							2,010

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

Item Carbon sink potential - Mid - All (not	2020	2025	2030	2035	2040	2045	2050 -28,914
counting overlap) (1000 tCO2e/y)							•
Carbon sink potential - Mid - Avoid							-3,065
deforestation (1000 tCO2e/y) Carbon sink potential - Mid - Extend							-9,374
rotation length (1000 tCO2e/y)							-7,314
Carbon sink potential - Mid - Improve plantations (1000 tC02e/y)							-968
Carbon sink potential - Mid - Increase retention of HWP (1000 tC02e/y)							-4,379
Carbon sink potential - Mid - Increase							-1,365
trees outside forests (1000 tC02e/y)							01/
Carbon sink potential - Mid - Reforest cropland (1000 tCO2e/y)							-216
Carbon sink potential - Mid - Reforest pasture (1000 tCO2e/y)							-1,494
Carbon sink potential - Mid - Restore							-5,240
productivity (1000 tCO2e/y) Land impacted for carbon sink potential -							613
High - Accelerate regeneration (1000 hectares)							010
Land impacted for carbon sink potential - High - Avoid deforestation (over 30 years)							711
(1000 hectares)							
Land impacted for carbon sink potential -							6,907
High - Extend rotation length (1000 hectares)							
Land impacted for carbon sink potential -							479
High - Improve plantations (1000							
hectares)							0
Land impacted for carbon sink potential - High - Increase retention of HWP (1000 hectares)							0
Land impacted for carbon sink potential -							192
High - Increase trees outside forests (1000 hectares)							
Land impacted for carbon sink potential -							19
High - Reforest cropland (1000 hectares)							70.0
Land impacted for carbon sink potential - High - Reforest pasture (1000 hectares)							78.9
Land impacted for carbon sink potential -							2,598
High - Restore productivity (1000							
hectares) Land impacted for carbon sink potential -							11,598
High - Total impacted (over 30 years)							11,390
(1000 hectares)							
Land impacted for carbon sink potential -							307
Low - Accelerate regeneration (1000 hectares)							
Land impacted for carbon sink potential -							668
Low - Avoid deforestation (over 30 years) (1000 hectares)							
Land impacted for carbon sink potential -							2,646
Low - Extend rotation length (1000							
hectares) Land impacted for carbon sink potential -							239
Low - Improve plantations (1000							207
hectares)							
Land impacted for carbon sink potential -							0
Low - Increase retention of HWP (1000 hectares)							

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

			101
		I	
			9.51
			13.7
			1,572
			5,556
			460
			690
			4,777
			•
			360
			0
			147
			14.3
			98.9
			3,166
			-7
			9,712
			· /· ·-

Table 24: E- scenario - IMPACTS - Health

Table 24. L- Scenario - IMPACIO - Health							
Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution -		251	0.33	0.328	0.172	0.099	0
Coal (million 2019\$)							
Monetary damages from air pollution -		2,037	1,010	587	227	70.7	31.3
Natural Gas (million 2019\$)							
Monetary damages from air pollution -		32,107	32,984	32,552	29,690	23,875	16,465
Transportation (million 2019\$)							
Premature deaths from air pollution -		28.3	0.037	0.037	0.019	0.011	0
Coal (deaths)							
Premature deaths from air pollution -		230	114	66.3	25.6	7.98	3.54
Natural Gas (deaths)							
Premature deaths from air pollution -		3,611	3,710	3,661	3,339	2,685	1,852
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 -		120,478	131,958	1000		20.0	
Cumulative 5-yr (million \$2018)		0, 0	.0.,,,				
Sales of cooking units - Electric	27.5	41.7	78.2	85.4	85.8	85.8	85.8
Resistance (%)							
Sales of cooking units - Gas (%)	72.5	58.3	21.8	14.6	14.2	14.2	14.2
Sales of space heating units - Electric	1.74	20.9	62.9	75.6	76.7	76.7	76.7
Heat Pump (%)							
Sales of space heating units - Electric	11.4	14.3	19.6	22.2	22.6	22.6	22.6
Resistance (%)							
Sales of space heating units - Fossil (%)	0	0	0	0	0	0	0
Sales of space heating units - Gas Furnace	86.9	64.8	17.5	2.29	0.731	0.685	0.683
(%)							
Sales of water heating units - Electric	0.63	11.5	57.5	68	68.5	68.5	68.5
Heat Pump (%)							
Sales of water heating units - Electric	2.03	6.87	26.2	30.7	30.9	30.9	30.9
Resistance (%)							
Sales of water heating units - Gas Furnace	96.8	81	15.7	0.718	0.005	0	0
(%)							
Sales of water heating units - Other (%)	0.501	0.619	0.623	0.624	0.623	0.624	0.625

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

Item	2020	2025	2030	2035	2040	2045	2050
Electricity distribution capital invested -		12.6	13	29.3	31.6	24.6	25.8
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)	793	798	775	732	700	692	702
Final energy use - Industry (PJ)	1,021	1,057	1,074	1,125	1,184	1,218	1,259
Final energy use - Residential (PJ)	878	820	708	579	478	418	385
Final energy use - Transportation (PJ)	3,056	2,945	2,657	2,291	1,958	1,742	1,635

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

Item	2020	2025	2030	2035	2040	2045	2050
Residential HVAC investment in 2020s vs.		27.7	36.5				
REF - Cumulative 5-yr (billion \$2018)							
Sales of cooking units - Electric	40	52.8	91.9	99.6	100	100	100
Resistance (%)							
Sales of cooking units - Gas (%)	60	47.2	8.07	0.406	0	0	0
Sales of space heating units - Electric	5.99	23.4	70.8	81.7	82.3	82.2	82.2
Heat Pump (%)							
Sales of space heating units - Electric	16.4	23.7	15.2	13.3	13.2	13.3	13.4
Resistance (%)							
Sales of space heating units - Fossil (%)	3.33	5.85	3.58	3.05	3	2.95	2.91
Sales of space heating units - Gas (%)	74.3	47	10.3	1.95	1.53	1.52	1.52
Sales of water heating units - Electric	0	11.2	59.4	70.3	70.8	70.8	70.8
Heat Pump (%)							
Sales of water heating units - Electric	17.5	31.3	27.2	26.4	26.4	26.4	26.4
Resistance (%)							
Sales of water heating units - Gas Furnace	79.8	54.8	10.6	0.486	0.003	0	0
(%)							
Sales of water heating units - Other (%)	2.7	2.75	2.76	2.79	2.8	2.82	2.83

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

Item	2020	2025	2030	2035	2040	2045	2050
Light-duty vehicle capital costs -		5,550	15,540	23,053	35,766	38,007	36,736
Cumulative 5-yr (million \$2018)							
Public EV charging plugs - DC Fast (1000	4.35		11.9		38.9		60.4
units)							
Public EV charging plugs - L2 (1000 units)	21.5		285		934		1,452
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 (%)	1.18	1.49	1.11	0.353	0.069	0.013	0
Vehicle sales - Light-duty - EV (%)	5.15	19	52	84	96.6	99.3	100
Vehicle sales - Light-duty - gasoline (%)	87.8	73.7	43	14.3	3	0.581	0
Vehicle sales - Light-duty - hybrid (%)	5.63	5.42	3.61	1.3	0.323	0.072	0
Vehicle sales - Light-duty - hydrogen FC	0.108	0.318	0.174	0.052	0.011	0.002	0
(%)							
Vehicle sales - Light-duty - other (%)	0.085	0.08	0.049	0.017	0.003	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 - Offshore Wind - Base		0.292	0	0	1.57	9.82	13.5
(billion \$2018)							
Capital invested - Solar PV - Base (billion		13.7	13.4	28.6	46.9	44.6	58.4
\$2018)							
Capital invested - Wind - Base (billion		0	0	0.063	0.24	0.154	0.11
\$2018)							
Installed renewables - OffshoreWind -	0	76.3	76.3	76.3	852	6,847	17,034
Base land use assumptions (MW)							
Installed renewables - OffshoreWind -	0	79.8	79.8	175	1,796	12,529	34,826
Constrained land use assumptions (MW)							
Installed renewables - Solar - Base land	27,682	39,652	52,780	83,157	135,954	189,133	262,972
use assumptions (MW)							
Installed renewables - Solar -	55,364	72,449	100,842	159,295	283,562	396,211	524,506
Constrained land use assumptions (MW)							
Installed renewables - Wind - Base land	7,083	7,083	7,083	7,123	7,279	7,385	7,465
use assumptions (MW)							
Installed renewables - Wind - Constrained	14,434	14,505	14,610	16,859	18,576	20,725	26,310
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	418	418	418	4,696	37,533	86,533
assumptions (GWh)							
OffshoreWind - Constrained land use	0	438	438	953	9,850	64,792	175,138
assumptions (GWh)							
Solar - Base land use assumptions (GWh)	66,975	92,334	119,520	180,379	282,184	383,350	523,234
Solar - Constrained land use assumptions	133,950	170,119	229,275	341,268	574,837	786,552	1,025,722
(GWh)							
Wind - Base land use assumptions (GWh)	28,124	28,124	28,124	28,259	28,777	29,112	29,351

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

Item	2020	2025	2030	2035	2040	2045	2050
Wind - Constrained land use assumptions (GWh)	56,479	56,727	57,022	62,932	66,635	70,629	82,299

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

Item	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - Aggressive							0
deployment - Corn-ethanol to energy							
grasses (1000 tCO2e/y)							
Carbon sink potential - Aggressive							-4,034
deployment - Cropland measures (1000							
tCO2e/y)							
Carbon sink potential - Aggressive							-47.2
deployment - Permanent conservation							
cover (1000 tC02e/y)							
Carbon sink potential - Aggressive							-4,082
deployment - Total (1000 tC02e/y)							,
Carbon sink potential - Moderate							0
deployment - Corn-ethanol to energy							Ū
grasses (1000 tC02e/y)							
Carbon sink potential - Moderate		-					-2,030
deployment - Cropland measures (1000							-2,030
tCO2e/y)							
							-23.6
Carbon sink potential - Moderate							-23.6
deployment - Permanent conservation							
cover (1000 tC02e/y)							
Carbon sink potential - Moderate							-2,054
deployment - Total (1000 tCO2e/y)							
Land impacted for carbon sink -							0
Aggressive deployment - Corn-ethanol to							
energy grasses (1000 hectares)							
Land impacted for carbon sink -							3,813
Aggressive deployment - Cropland							
measures (1000 hectares)							
Land impacted for carbon sink -							73.8
Aggressive deployment - Permanent							
conservation cover (1000 hectares)							
Land impacted for carbon sink -							3,887
Aggressive deployment - Total (1000							-,
hectares)							
Land impacted for carbon sink - Moderate							0
deployment - Corn-ethanol to energy							Ū
grasses (1000 hectares)							
Land impacted for carbon sink - Moderate							1,925
							1,925
deployment - Cropland measures (1000							
hectares)							0/0
Land impacted for carbon sink - Moderate							36.9
deployment - Permanent conservation							
cover (1000 hectares)							
Land impacted for carbon sink - Moderate							1,962
deployment - Total (1000 hectares)							

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

Item	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - High - Accelerate regeneration (1000 tCO2e/y)							-3,748
Carbon sink potential - High - All (not counting overlap) (1000 tCO2e/y)							-43,341
Carbon sink potential - High - Avoid deforestation (1000 tCO2e/y)							-5,255

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

Item	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - High - Extend							-13,545
rotation length (1000 tCO2e/y)							1 000
Carbon sink potential - High - Improve							-1,299
plantations (1000 tC02e/y) Carbon sink potential - High - Increase							-6,568
							-0,508
retention of HWP (1000 tCO2e/y)							0.000
Carbon sink potential - High - Increase							-2,022
trees outside forests (1000 tC02e/y)							-288
Carbon sink potential - High - Reforest cropland (1000 tCO2e/y)							-200
Carbon sink potential - High - Reforest							0.770
							-2,778
pasture (1000 tC02e/y) Carbon sink potential - High - Restore							7,000
							-7,838
productivity (1000 tC02e/y)							1.070
Carbon sink potential - Low - Accelerate							-1,878
regeneration (1000 tCO2e/y)							1/ 511
Carbon sink potential - Low - All (not							-14,511
counting overlap) (1000 tC02e/y)							
Carbon sink potential - Low - Avoid							-876
deforestation (1000 tC02e/y)							
Carbon sink potential - Low - Extend							-5,203
rotation length (1000 tCO2e/y)							
Carbon sink potential - Low - Improve							-661
plantations (1000 tCO2e/y)							
Carbon sink potential - Low - Increase							-2,189
retention of HWP (1000 tCO2e/y)							
Carbon sink potential - Low - Increase							-708
trees outside forests (1000 tCO2e/y)							
Carbon sink potential - Low - Reforest							-144
cropland (1000 tCO2e/y)							
Carbon sink potential - Low - Reforest							-210
pasture (1000 tCO2e/y)							
Carbon sink potential - Low - Restore							-2,642
productivity (1000 tCO2e/y)							
Carbon sink potential - Mid - Accelerate							-2,813
regeneration (1000 tC02e/y)							
Carbon sink potential - Mid - All (not							-28,914
counting overlap) (1000 tCO2e/y)							
Carbon sink potential - Mid - Avoid							-3,065
deforestation (1000 tCO2e/y)							-,
Carbon sink potential - Mid - Extend							-9,374
rotation length (1000 tCO2e/y)							.,
Carbon sink potential - Mid - Improve							-968
plantations (1000 tCO2e/y)							700
Carbon sink potential - Mid - Increase							-4,379
retention of HWP (1000 tCO2e/y)							1,017
Carbon sink potential - Mid - Increase		+					-1,365
trees outside forests (1000 tC02e/y)							1,000
Carbon sink potential - Mid - Reforest		+					-216
cropland (1000 tCO2e/y)							-210
Carbon sink potential - Mid - Reforest							-1,494
							-1,494
pasture (1000 tC02e/y)							-5,240
Carbon sink potential - Mid - Restore							-5,240
productivity (1000 tC02e/y)							/40
Land impacted for carbon sink potential -							613
High - Accelerate regeneration (1000							
hectares)							
Land impacted for carbon sink potential -	Γ						711
High - Avoid deforestation (over 30 years)							
(1000 hectares)							

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

Item	2020	2025	2030	2035	2040	2045	2050 6,907
Land impacted for carbon sink potential - High - Extend rotation length (1000 hectares)							6,907
Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)							479
Land impacted for carbon sink potential - High - Increase retention of HWP (1000							0
hectares) Land impacted for carbon sink potential - High - Increase trees outside forests (1000 hectares)							192
Land impacted for carbon sink potential -							19
High - Reforest cropland (1000 hectares) Land impacted for carbon sink potential -							78.9
High - Reforest pasture (1000 hectares) Land impacted for carbon sink potential - High - Restore productivity (1000							2,598
hectares) Land impacted for carbon sink potential - High - Total impacted (over 30 years)							11,598
(1000 hectares) Land impacted for carbon sink potential - Low - Accelerate regeneration (1000							307
hectares) Land impacted for carbon sink potential - Low - Avoid deforestation (over 30 years) (1000 hectares)							668
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)							2,646
Land impacted for carbon sink potential - Low - Improve plantations (1000							239
hectares) Land impacted for carbon sink potential - Low - Increase retention of HWP (1000 hectares)							0
Land impacted for carbon sink potential - Low - Increase trees outside forests (1000 hectares)							101
Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares)							9.51
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)							13.7
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)							1,572
Land impacted for carbon sink potential - Low - Total impacted (over 30 years)							5,556
(1000 hectares) Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000							460
hectares) Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years)							690
(1000 hectares) Land impacted for carbon sink potential - Mid - Extend rotation length (1000							4,777
hectares) Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)							360

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

Item	2020	2025	2030	2035	2040	2045	2050
Land impacted for carbon sink potential -							0
Mid - Increase retention of HWP (1000							
hectares)							
Land impacted for carbon sink potential -							147
Mid - Increase trees outside forests (1000							
hectares)							
Land impacted for carbon sink potential -							14.3
Mid - Reforest cropland (1000 hectares)							
Land impacted for carbon sink potential -							98.9
Mid - Reforest pasture (1000 hectares)							
Land impacted for carbon sink potential -							3,166
Mid - Restore productivity (1000							
hectares)							
Land impacted for carbon sink potential -							9,712
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 -		251	0.33	0.328	0.172	0.099	0
Coal (million 2019\$)							
Monetary damages from air pollution -		1,498	1,137	581	320	121	25.6
Natural Gas (million 2019\$)							
Monetary damages from air pollution -		31,487	29,710	22,808	13,295	6,015	2,235
Transportation (million 2019\$)							
Premature deaths from air pollution -		28.3	0.037	0.037	0.019	0.011	0
Coal (deaths)							
Premature deaths from air pollution -		169	128	65.5	36.1	13.7	2.89
Natural Gas (deaths)							
Premature deaths from air pollution -		3,541	3,341	2,565	1,495	676	251
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 -		120,478	131,958				
Cumulative 5-yr (million \$2018)							
Sales of cooking units - Electric	27.5	41.7	78.2	85.4	85.8	85.8	85.8
Resistance (%)							
Sales of cooking units - Gas (%)	72.5	58.3	21.8	14.6	14.2	14.2	14.2
Sales of space heating units - Electric	1.74	20.9	62.9	75.6	76.7	76.7	76.7
Heat Pump (%)							
Sales of space heating units - Electric	11.4	14.3	19.6	22.2	22.6	22.6	22.6
Resistance (%)							
Sales of space heating units - Fossil (%)	0	0	0	0	0	0	0
Sales of space heating units - Gas Furnace	86.9	64.8	17.5	2.29	0.731	0.685	0.683
(%)							
Sales of water heating units - Electric	0.63	11.5	57.5	68	68.5	68.5	68.5
Heat Pump (%)							
Sales of water heating units - Electric	2.03	6.87	26.2	30.7	30.9	30.9	30.9
Resistance (%)							
Sales of water heating units - Gas Furnace	96.8	81	15.7	0.718	0.005	0	0
(%)							
Sales of water heating units - Other (%)	0.501	0.619	0.623	0.624	0.623	0.624	0.625

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

Item	2020	2025	2030	2035	2040	2045	2050
Electricity distribution capital invested -		12.6	13	29.3	31.6	24.6	25.8
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)	793	798	775	732	700	692	702
Final energy use - Industry (PJ)	1,021	1,057	1,074	1,125	1,184	1,218	1,259
Final energy use - Residential (PJ)	878	820	708	579	478	418	385
Final energy use - Transportation (PJ)	3,056	2,945	2,657	2,291	1,958	1,742	1,635

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

Item	2020	2025	2030	2035	2040	2045	2050
Residential HVAC investment in 2020s vs.		27.7	36.5				
REF - Cumulative 5-yr (billion \$2018)							
Sales of cooking units - Electric	40	52.8	91.9	99.6	100	100	100
Resistance (%)							
Sales of cooking units - Gas (%)	60	47.2	8.07	0.406	0	0	0
Sales of space heating units - Electric	5.99	23.4	70.8	81.7	82.3	82.2	82.2
Heat Pump (%)							
Sales of space heating units - Electric	16.4	23.7	15.2	13.3	13.2	13.3	13.4
Resistance (%)							
Sales of space heating units - Fossil (%)	3.33	5.85	3.58	3.05	3	2.95	2.91
Sales of space heating units - Gas (%)	74.3	47	10.3	1.95	1.53	1.52	1.52
Sales of water heating units - Electric	0	11.2	59.4	70.3	70.8	70.8	70.8
Heat Pump (%)							
Sales of water heating units - Electric	17.5	31.3	27.2	26.4	26.4	26.4	26.4
Resistance (%)							
Sales of water heating units - Gas Furnace	79.8	54.8	10.6	0.486	0.003	0	0
(%)							
Sales of water heating units - Other (%)	2.7	2.75	2.76	2.79	2.8	2.82	2.83

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

Item	2020	2025	2030	2035	2040	2045	2050
Light-duty vehicle capital costs -		5,550	15,540	23,053	35,766	38,007	36,736
Cumulative 5-yr (million \$2018)							
Public EV charging plugs - DC Fast (1000	4.35		11.9		38.9		60.4
units)							
Public EV charging plugs - L2 (1000 units)	21.5		285		934		1,452
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 (%)	1.18	1.49	1.11	0.353	0.069	0.013	0
Vehicle sales - Light-duty - EV (%)	5.15	19	52	84	96.6	99.3	100
Vehicle sales - Light-duty - gasoline (%)	87.8	73.7	43	14.3	3	0.581	0
Vehicle sales - Light-duty - hybrid (%)	5.63	5.42	3.61	1.3	0.323	0.072	0
Vehicle sales - Light-duty - hydrogen FC	0.108	0.318	0.174	0.052	0.011	0.002	0
(%)							
Vehicle sales - Light-duty - other (%)	0.085	0.08	0.049	0.017	0.003	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

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

Item	2020	2025	2030	2035	2040	2045	2050
Vehicle sales - Medium-duty - hydrogen FC (%)	0.196	1.27	6.33	15.2	19.1	19.9	20
Vehicle sales - Medium-duty - other (%)	0.253	0.255	0.205	0.083	0.019	0.004	0

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

Item	2020	2025	2030	2035	2040	2045	2050
Capital invested - Offshore Wind - Base (billion \$2018)		0.292	0	0	0	0.588	0.429
Capital invested - Offshore Wind - Constrained (billion \$2018)		0.153	0	0	0.097	0.622	0.374
Capital invested - Solar PV - Base (billion \$2018)		11.9	7.32	6.33	16.7	12.1	21.6
Capital invested - Solar PV - Constrained (billion \$2018)		11.2	9.7	10.7	14.1	12.5	21
Capital invested - Wind - Base (billion \$2018)		0	0	0	0	0	0.054
Capital invested - Wind - Constrained (billion \$2018)		0	0.062	0	0.347	0.265	1.01
Installed renewables - OffshoreWind - Base land use assumptions (MW)	0	76.3	76.3	76.3	76.3	435	760
Installed renewables - OffshoreWind - Constrained land use assumptions (MW)	0	39.9	39.9	39.9	87.6	468	750
Installed renewables - Solar - Base land use assumptions (MW)	32,006	42,401	49,556	56,280	75,133	89,612	116,934
Installed renewables - Solar - Constrained land use assumptions (MW)	33,114	42,924	52,406	63,769	79,643	94,519	121,035
Installed renewables - Wind - Base land use assumptions (MW)	7,005	7,005	7,005	7,005	7,005	7,005	7,044
Installed renewables - Wind - Constrained land use assumptions (MW)	7,089	7,089	7,124	7,124	7,350	7,531	8,263

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

Item	2020	2025	2030	2035	2040	2045	2050
OffshoreWind - Base land use	0	418	418	418	418	2,400	4,197
assumptions (GWh)							
OffshoreWind - Constrained land use	0	219	219	219	477	2,558	4,106
assumptions (GWh)							
Solar - Base land use assumptions (GWh)	76,176	98,009	113,175	127,060	164,853	192,978	245,329
Solar - Constrained land use assumptions	78,455	99,044	118,573	141,109	171,332	199,522	249,459
(GWh)							
Wind - Base land use assumptions (GWh)	27,863	27,863	27,863	27,863	27,863	27,863	27,998
Wind - Constrained land use assumptions	27,871	27,871	27,995	27,995	28,624	29,123	31,003
_(GWh)							

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

Item	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - Aggressive							0
deployment - Corn-ethanol to energy							
grasses (1000 tCO2e/y)							
Carbon sink potential - Aggressive							-4,034
deployment - Cropland measures (1000							
tCO2e/y)							
Carbon sink potential - Aggressive							-47.2
deployment - Permanent conservation							
cover (1000 tCO2e/y)							
Carbon sink potential - Aggressive							-4,082
deployment - Total (1000 tCO2e/y)							

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

2020	2025	2030	2035	2040	2045	2050
						0
						-2,030
						-23.6
						-2,054
						0
						3,813
						•
						73.8
						3,887
						0
						1,925
						.,
						36.9
						1,962
						1,702
	2020	2020 2025	2020 2025 2030	2020 2025 2030 2035	2020 2025 2030 2035 2040	2020 2025 2030 2035 2040 2045

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

Item	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - High - Accelerate							-3,748
regeneration (1000 tCO2e/y)							
Carbon sink potential - High - All (not							-43,341
counting overlap) (1000 tCO2e/y)							
Carbon sink potential - High - Avoid							-5,255
deforestation (1000 tCO2e/y)							
Carbon sink potential - High - Extend							-13,545
rotation length (1000 tCO2e/y)							
Carbon sink potential - High - Improve							-1,299
plantations (1000 tCO2e/y)							
Carbon sink potential - High - Increase							-6,568
retention of HWP (1000 tCO2e/y)							
Carbon sink potential - High - Increase							-2,022
trees outside forests (1000 tCO2e/y)							
Carbon sink potential - High - Reforest							-288
cropland (1000 tCO2e/y)							
Carbon sink potential - High - Reforest							-2,778
pasture (1000 tCO2e/y)							
Carbon sink potential - High - Restore							-7,838
productivity (1000 tCO2e/y)							
Carbon sink potential - Low - Accelerate							-1,878
regeneration (1000 tCO2e/y)							

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

Item	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - Low - All (not							-14,51
counting overlap) (1000 tCO2e/y)							07
Carbon sink potential - Low - Avoid							-87
deforestation (1000 tC02e/y)							
Carbon sink potential - Low - Extend							-5,20
rotation length (1000 tC02e/y)							
Carbon sink potential - Low - Improve							-66
plantations (1000 tCO2e/y)							
Carbon sink potential - Low - Increase							-2,18
retention of HWP (1000 tCO2e/y)							
Carbon sink potential - Low - Increase							-708
trees outside forests (1000 tC02e/y)							
Carbon sink potential - Low - Reforest							-14
cropland (1000 tCO2e/y)							
Carbon sink potential - Low - Reforest							-21
pasture (1000 tCO2e/y)							
Carbon sink potential - Low - Restore							-2,64
productivity (1000 tCO2e/y)							
Carbon sink potential - Mid - Accelerate							-2,81
regeneration (1000 tCO2e/y)							
Carbon sink potential - Mid - All (not							-28,91
counting overlap) (1000 tCO2e/y)							
Carbon sink potential - Mid - Avoid							-3,06
deforestation (1000 tCO2e/y)							
Carbon sink potential - Mid - Extend							-9,37
rotation length (1000 tCO2e/y)							
Carbon sink potential - Mid - Improve							-96
plantations (1000 tCO2e/y)							
Carbon sink potential - Mid - Increase							-4,37
retention of HWP (1000 tCO2e/y)							•
Carbon sink potential - Mid - Increase							-1,36
trees outside forests (1000 tCO2e/y)							,
Carbon sink potential - Mid - Reforest							-21
cropland (1000 tCO2e/y)							
Carbon sink potential - Mid - Reforest						+	-1,49
pasture (1000 tC02e/y)							1,-17
Carbon sink potential - Mid - Restore							-5,24
productivity (1000 tC02e/y)							0,24
Land impacted for carbon sink potential -							61
High - Accelerate regeneration (1000							O1
hectares)							
Land impacted for carbon sink potential -						+	7
High - Avoid deforestation (over 30 years)							ſ
(1000 hectares)							
Land impacted for carbon sink potential -							/ 00
·							6,90
High - Extend rotation length (1000							
hectares)							
Land impacted for carbon sink potential -							47
High - Improve plantations (1000							
hectares)							
Land impacted for carbon sink potential -							
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 -							1
High - Reforest cropland (1000 hectares)							
Land impacted for carbon sink potential -							78.
High - Reforest pasture (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 - High - Restore productivity (1000 hectares)							2,598
Land impacted for carbon sink potential - High - Total impacted (over 30 years)							11,598
(1000 hectares) Land impacted for carbon sink potential - Low - Accelerate regeneration (1000							307
hectares) Land impacted for carbon sink potential -							668
Low - Avoid deforestation (over 30 years) (1000 hectares)							
Land impacted for carbon sink potential - Low - Extend rotation length (1000 hectares)							2,646
Land impacted for carbon sink potential - Low - Improve plantations (1000							239
hectares) Land impacted for carbon sink potential - Low - Increase retention of HWP (1000							0
hectares) Land impacted for carbon sink potential - Low - Increase trees outside forests							101
(1000 hectares) Land impacted for carbon sink potential - Low - Reforest cropland (1000 hectares)							9.51
Land impacted for carbon sink potential - Low - Reforest pasture (1000 hectares)							13.7
Land impacted for carbon sink potential - Low - Restore productivity (1000 hectares)							1,572
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)							5,556
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)							460
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)							690
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)							4,777
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)							360
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)							147
Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares)							14.3
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)							98.9
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)							3,166
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)							9,712

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Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution -		251	0.33	0.328	0.172	0.099	0
Coal (million 2019\$)							
Monetary damages from air pollution -		2,098	678	1,028	1,343	674	172
Natural Gas (million 2019\$)							
Monetary damages from air pollution -		31,487	29,710	22,808	13,295	6,015	2,235
Transportation (million 2019\$)							
Premature deaths from air pollution -		28.3	0.037	0.037	0.019	0.011	0
Coal (deaths)							
Premature deaths from air pollution -		237	76.6	116	152	76.1	19.5
Natural Gas (deaths)							
Premature deaths from air pollution -		3,541	3,341	2,565	1,495	676	251
Transportation (deaths)							

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

Item	2020	2025	2030	2035	2040	2045	2050
Commercial HVAC investment in 2020s -		120,137	130,140				
Cumulative 5-yr (million \$2018)							
Sales of cooking units - Electric	27.5	31	36.1	49.7	68.6	80.2	84.3
Resistance (%)							
Sales of cooking units - Gas (%)	72.5	69	63.9	50.3	31.4	19.8	15.7
Sales of space heating units - Electric	1.74	13	17.8	31.6	53.4	68.7	74.5
Heat Pump (%)							
Sales of space heating units - Electric	11.4	13.3	14	15.8	18.8	21.2	22.2
Resistance (%)							
Sales of space heating units - Fossil (%)	0	0	0	0	0	0	0
Sales of space heating units - Gas Furnace	86.9	73.7	68.3	52.6	27.8	10.2	3.31
(%)							
Sales of water heating units - Electric	0.63	2.65	7.89	23	46.1	61.3	66.6
Heat Pump (%)							
Sales of water heating units - Electric	2.03	3.16	5.36	11.7	21.4	27.8	30.1
Resistance (%)							
Sales of water heating units - Gas Furnace	96.8	93.6	86.1	64.7	31.8	10.2	2.7
(%)							
Sales of water heating units - Other (%)	0.501	0.619	0.623	0.624	0.623	0.624	0.625

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

Item	2020	2025	2030	2035	2040	2045	2050
Electricity distribution capital invested -		9.31	9.32	16.2	17	25.6	27.3
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)	793	800	806	802	788	770	759
Final energy use - Industry (PJ)	1,021	1,058	1,081	1,146	1,217	1,253	1,293
Final energy use - Residential (PJ)	878	825	766	706	626	537	459
Final energy use - Transportation (PJ)	3,060	2,970	2,767	2,590	2,445	2,267	2,054

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

Item	2020	2025	2030	2035	2040	2045	2050
Residential HVAC investment in 2020s vs.		27.5	36.2				
REF - Cumulative 5-yr (billion \$2018)							
Sales of cooking units - Electric	39.8	41.4	46.9	61.4	81.6	94.1	98.4
Resistance (%)							
Sales of cooking units - Gas (%)	60.2	58.6	53.1	38.6	18.4	5.94	1.6
Sales of space heating units - Electric	5.99	14.3	19.7	35.3	59.2	74.8	80.3
Heat Pump (%)							

Table /.Q. E. R. scanario	PILLAR 1: Efficiency/Electrification	- Posidential (continued)
- Table 40. E-D+ Sceliul 10 -	PILLAR I. EIIICIEIICV/EIECUTIICUUUII	- Residential Icontinuear

Item	2020	2025	2030	2035	2040	2045	2050
Sales of space heating units - Electric	16.4	25.3	24.3	21.5	17.3	14.5	13.6
Resistance (%)							
Sales of space heating units - Fossil (%)	3.33	6.29	6.05	5.3	4.13	3.36	3.07
Sales of space heating units - Gas (%)	74.3	54.1	50	38	19.4	7.29	3.04
Sales of water heating units - Electric	0	1.93	7.42	23.2	47.5	63.3	68.9
Heat Pump (%)							
Sales of water heating units - Electric	17.5	32.1	31.6	30.2	28.2	26.9	26.5
Resistance (%)							
Sales of water heating units - Gas Furnace	79.8	63.2	58.2	43.8	21.5	6.93	1.83
(%)							
Sales of water heating units - Other (%)	2.7	2.75	2.76	2.78	2.8	2.81	2.83

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

Item	2020	2025	2030	2035	2040	2045	2050
Light-duty vehicle capital costs -		0	1,128	1,859	6,771	19,756	29,318
Cumulative 5-yr (million \$2018)							
Public EV charging plugs - DC Fast (1000	4.35		5.46		15.8		38.7
units)							
Public EV charging plugs - L2 (1000 units)	21.5		131		380		930
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 (%)	1.19	1.67	1.99	1.57	0.974	0.494	0.213
Vehicle sales - Light-duty - EV (%)	2.32	5.65	13.7	28.9	51.7	74.1	88.4
Vehicle sales - Light-duty - gasoline (%)	90.4	85.6	76.6	62.8	42.5	22.7	10.1
Vehicle sales - Light-duty - hybrid (%)	5.86	6.61	7.25	6.42	4.63	2.63	1.24
Vehicle sales - Light-duty - hydrogen FC	0.112	0.369	0.305	0.225	0.155	0.085	0.04
(%)							
Vehicle sales - Light-duty - other (%)	0.087	0.09	0.08	0.069	0.049	0.026	0.012
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 (billion \$2018)	0	0.012	0.833	0	0	0	0
Capital invested - Biomass w/ccu allam power plant (billion \$2018)	0	0	0	0.105	0.017	0.003	0.03
Capital invested - Biomass w/ccu power plant (billion \$2018)	0	0	1.31	0.033	0.129	0	0

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

Item	2020	2025	2030	2035	2040	2045	2050
Biomass power plant (GWh)	0	22.5	1,658	1,658	1,658	1,658	1,658
Biomass w/ccu allam power plant (GWh)	0	0	0	105	122	125	155
Biomass w/ccu power plant (GWh)	0	0	1,475	1,512	1,657	1,657	1,657

Table 52: E-B+	coonanio	DTIIAD 2.	Cloan	fuole	Dinononay
1aule 52. E-D+	scenurio -	PILLAR 5.	GIEUII	iueis -	BIUEIIEI UV

Item	2020	2025	2030	2035	2040	2045	2050
Biomass purchases (million \$2018/year)		9.04	119	484	687	752	768
Conversion capital investment -		12.9	2,135	12,011	6,685	2,104	577
Cumulative 5-yr (million \$2018)							
Number of facilities - Allam power w ccu	0	0	0	4	5	6	6
(quantity)							
Number of facilities - Beccs hydrogen	0	0	0	12	18	20	21
(quantity)							
Number of facilities - Diesel (quantity)	0	0	0	2	2	2	2
Number of facilities - Diesel ccu (quantity)	0	0	0	4	5	6	6
Number of facilities - Power (quantity)	0	2	2	2	2	2	2
Number of facilities - Power ccu	0	0	4	6	7	7	7
(quantity)							
Number of facilities - Pyrolysis (quantity)	0	0	0	2	2	2	2
Number of facilities - Pyrolysis ccu	0	0	0	4	5	6	6
(quantity)							
Number of facilities - Sng (quantity)	0	2	2	2	2	2	2
Number of facilities - Sng ccu (quantity)	0	0	4	4	4	4	4

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

Item	2020	2025	2030	2035	2040	2045	2050
Annual - All (MMT)		0	1.48	30.2	45	54.6	61
Annual - BECCS (MMT)		0	1.47	16.7	25.2	27.9	28.5
Annual - Cement and lime (MMT)		0	0	6.71	9.95	13.7	14.1
Annual - NGCC (MMT)		0	0.01	6.82	9.85	13	18.3
Cumulative - All (MMT)		0	1.48	31.7	76.7	131	192
Cumulative - BECCS (MMT)		0	1.47	18.1	43.4	71.3	99.8
Cumulative - Cement and lime (MMT)		0	0	6.71	16.7	30.4	44.5
Cumulative - NGCC (MMT)		0	0.01	6.83	16.7	29.6	47.9

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

Item	2020	2025	2030	2035	2040	2045	2050
All (km)		0	2,057	5,127	6,088	6,545	7,397
Cumulative investment - All (million \$2018)		0	5,343	7,995	8,768	9,111	9,664
Cumulative investment - Spur (million \$2018)		0	423	2,309	3,082	3,425	3,978
Cumulative investment - Trunk (million \$2018)		0	4,920	5,686	5,686	5,686	5,686
Spur (km)		0	772	3,598	4,559	5,016	5,868
Trunk (km)		0	1,285	1,529	1,529	1,529	1,529

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

		-					
Item	2020	2025	2030	2035	2040	2045	2050
CO2 storage (MMT)		0	0	34.2	57	61.1	75.2
Injection wells (wells)		0	0	66	96	128	182
Resource characterization, appraisal,		250	918	1,410	1,410	1,410	1,410
permitting costs (million \$2020)							
Wells and facilities construction costs		0	0	1,946	2,887	3,828	5,460
(million \$2020)							

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

Item	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - Aggressive							0
deployment - Corn-ethanol to energy							
grasses (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 deployment - Cropland measures (1000							-4,034
tCO2e/y)							
Carbon sink potential - Aggressive							0
deployment - Cropland to woody energy							U
crops (1000 tC02e/y)							
Carbon sink potential - Aggressive							0
deployment - Pasture to energy crops							
(1000 tCO2e/y)							
Carbon sink potential - Aggressive							-47.2
deployment - Permanent conservation							
cover (1000 tC02e/y)							
Carbon sink potential - Aggressive							-4,081
deployment - Total (1000 tC02e/y)							
Carbon sink potential - Moderate deployment - Corn-ethanol to energy							0
grasses (1000 tCO2e/y)							
Carbon sink potential - Moderate							-2,030
deployment - Cropland measures (1000							2,000
tCO2e/y)							
Carbon sink potential - Moderate							0
deployment - Cropland to woody energy							
crops (1000 tCO2e/y)							
Carbon sink potential - Moderate							0
deployment - Pasture to energy crops							
(1000 tC02e/y)							
Carbon sink potential - Moderate							-23.6
deployment - Permanent conservation cover (1000 tCO2e/y)							
Carbon sink potential - Moderate							-2,054
deployment - Total (1000 tCO2e/y)							-2,004
Land impacted for carbon sink -							0
Aggressive deployment - Corn-ethanol to							·
energy grasses (1000 hectares)							
Land impacted for carbon sink -							9,415
Aggressive deployment - Cropland							
measures (1000 hectares)							
Land impacted for carbon sink -							0.125
Aggressive deployment - Cropland to							
woody energy crops (1000 hectares)							10 (
Land impacted for carbon sink -							10.6
Aggressive deployment - Pasture to energy crops (1000 hectares)							
Land impacted for carbon sink -							73.8
Aggressive deployment - Permanent							10.0
conservation cover (1000 hectares)							
Land impacted for carbon sink -							9,499
Aggressive deployment - Total (1000							•
hectares)							
Land impacted for carbon sink - Moderate							0
deployment - Corn-ethanol to energy							
grasses (1000 hectares)							
Land impacted for carbon sink - Moderate							1,925
deployment - Cropland measures (1000							
hectares)							0.107
Land impacted for carbon sink - Moderate deployment - Cropland to woody energy							0.126
crops (1000 hectares)							
Land impacted for carbon sink - Moderate							10.6
deployment - Pasture to energy crops							10.0
(1000 hectares)							

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

Item	2020	2025	2030	2035	2040	2045	2050
Land impacted for carbon sink - Moderate deployment - Permanent conservation cover (1000 hectares)							36.9
Land impacted for carbon sink - Moderate deployment - Total (1000 hectares)							1,973

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

Table 57: E-B+ scenario - PILLAR 6: Land		sts					
Item	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - High - Accelerate							-3,748
regeneration (1000 tCO2e/y)							
Carbon sink potential - High - All (not							-43,341
counting overlap) (1000 tCO2e/y)							
Carbon sink potential - High - Avoid							-5,255
deforestation (1000 tCO2e/y)							
Carbon sink potential - High - Extend							-13,545
rotation length (1000 tCO2e/y)							
Carbon sink potential - High - Improve							-1,299
plantations (1000 tCO2e/y)							
Carbon sink potential - High - Increase							-6,568
retention of HWP (1000 tCO2e/y)							
Carbon sink potential - High - Increase							-2,022
trees outside forests (1000 tCO2e/y)							
Carbon sink potential - High - Reforest							-288
cropland (1000 tCO2e/y)							
Carbon sink potential - High - Reforest							-2,778
pasture (1000 tCO2e/y)							
Carbon sink potential - High - Restore							-7,838
productivity (1000 tCO2e/y)							
Carbon sink potential - Low - Accelerate							-1,878
regeneration (1000 tCO2e/y)							
Carbon sink potential - Low - All (not							-14,511
counting overlap) (1000 tCO2e/y)							
Carbon sink potential - Low - Avoid							-876
deforestation (1000 tC02e/y)							
Carbon sink potential - Low - Extend							-5,203
rotation length (1000 tCO2e/y)							
Carbon sink potential - Low - Improve							-661
plantations (1000 tCO2e/y)							
Carbon sink potential - Low - Increase							-2,189
retention of HWP (1000 tCO2e/y)							
Carbon sink potential - Low - Increase							-708
trees outside forests (1000 tC02e/y)							
Carbon sink potential - Low - Reforest							-144
cropland (1000 tCO2e/y)							
Carbon sink potential - Low - Reforest							-210
pasture (1000 tCO2e/y)							
Carbon sink potential - Low - Restore							-2,642
productivity (1000 tCO2e/y)							
Carbon sink potential - Mid - Accelerate							-2,813
regeneration (1000 tCO2e/y)							
Carbon sink potential - Mid - All (not							-28,914
counting overlap) (1000 tCO2e/y)							
Carbon sink potential - Mid - Avoid							-3,065
deforestation (1000 tCO2e/y)							
Carbon sink potential - Mid - Extend							-9,374
rotation length (1000 tCO2e/y)							
Carbon sink potential - Mid - Improve							-968
plantations (1000 tCO2e/y)							
Carbon sink potential - Mid - Increase							-4,379
retention of HWP (1000 tCO2e/y)							•
			l.				

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

Item Carbon sink potential - Mid - Increase	2020	2025	2030	2035	2040	2045	2050 -1,365
trees outside forests (1000 tC02e/y)							-1,365
•							-216
Carbon sink potential - Mid - Reforest							-210
cropland (1000 tCO2e/y) Carbon sink potential - Mid - Reforest							-1,494
pasture (1000 tC02e/y)							-1,494
Carbon sink potential - Mid - Restore							-5,240
productivity (1000 tC02e/y)							-3,240
Land impacted for carbon sink potential -							613
High - Accelerate regeneration (1000							010
hectares)							
Land impacted for carbon sink potential -							711
High - Avoid deforestation (over 30 years)							
(1000 hectares)							
Land impacted for carbon sink potential -							6,907
High - Extend rotation length (1000							0,70.
hectares)							
Land impacted for carbon sink potential -							479
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 -							192
High - Increase trees outside forests							
(1000 hectares)							
Land impacted for carbon sink potential -							19
High - Reforest cropland (1000 hectares)							
Land impacted for carbon sink potential -							78.9
High - Reforest pasture (1000 hectares)							
Land impacted for carbon sink potential -							2,598
High - Restore productivity (1000							
hectares)							
Land impacted for carbon sink potential -							11,598
High - Total impacted (over 30 years)							
(1000 hectares)							
Land impacted for carbon sink potential -							307
Low - Accelerate regeneration (1000							
hectares)							
Land impacted for carbon sink potential -							668
Low - Avoid deforestation (over 30 years)							
(1000 hectares)							
Land impacted for carbon sink potential -							2,646
Low - Extend rotation length (1000							
hectares)							
Land impacted for carbon sink potential -							239
Low - Improve plantations (1000							
hectares)							
Land impacted for carbon sink potential -							0
Low - Increase retention of HWP (1000							
hectares)							101
Land impacted for carbon sink potential -							101
Low - Increase trees outside forests							
(1000 hectares)							0.51
Land impacted for carbon sink potential -							9.51
Low - Reforest cropland (1000 hectares)							10 7
Land impacted for carbon sink potential -							13.7
Low - Reforest pasture (1000 hectares)							4 570
Land impacted for carbon sink potential -							1,572
Low - Restore productivity (1000							

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 -							5,556
Low - Total impacted (over 30 years)							
(1000 hectares)							
Land impacted for carbon sink potential -							460
Mid - Accelerate regeneration (1000							
hectares)							
Land impacted for carbon sink potential -							690
Mid - Avoid deforestation (over 30 years)							
(1000 hectares)							
Land impacted for carbon sink potential -							4,777
Mid - Extend rotation length (1000							
hectares)							
Land impacted for carbon sink potential -							360
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 -							147
Mid - Increase trees outside forests (1000							
hectares)							
Land impacted for carbon sink potential -							14.3
Mid - Reforest cropland (1000 hectares)							
Land impacted for carbon sink potential -							98.9
Mid - Reforest pasture (1000 hectares)							
Land impacted for carbon sink potential -							3,166
Mid - Restore productivity (1000							
hectares)							
Land impacted for carbon sink potential -							9,712
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 -		251	0.33	0.328	0.172	0.099	0
Coal (million 2019\$)							
Monetary damages from air pollution -		1,910	936	610	452	254	180
Natural Gas (million 2019\$)							
Monetary damages from air pollution -		32,107	32,984	32,552	29,690	23,875	16,465
Transportation (million 2019\$)							
Premature deaths from air pollution -		28.3	0.037	0.037	0.019	0.011	0
Coal (deaths)							
Premature deaths from air pollution -		216	106	68.8	51.1	28.6	20.3
Natural Gas (deaths)							
Premature deaths from air pollution -		3,611	3,710	3,661	3,339	2,685	1,852
Transportation (deaths)							

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

Item	2020	2025	2030	2035	2040	2045	2050
Commercial HVAC investment in 2020s -		119,229	123,203				
Cumulative 5-yr (million \$2018)							
Sales of cooking units - Electric	27.5	29	29	29	29	28.9	28.9
Resistance (%)							
Sales of cooking units - Gas (%)	72.5	71	71	71	71	71.1	71.1
Sales of space heating units - Electric	1.74	24.2	61.6	69.2	69.7	69.7	69.6
Heat Pump (%)							
Sales of space heating units - Electric	11.4	15.3	21.9	26.1	29.1	29.6	29.7
Resistance (%)							
Sales of space heating units - Fossil (%)	0	0	0	0	0	0	0

Table CO. DCC assessia	DILLAD 1. Efficiency /Floorwiff continue	0
Table 59: REE Scenorio	- PTLLAR 1 [,] Efficiency/Flectrification -	Commerciai I continuea i

Item	2020	2025	2030	2035	2040	2045	2050
Sales of space heating units - Gas Furnace	86.9	60.6	16.5	4.65	1.21	0.731	0.683
Sales of water heating units - Electric	0.63	0.808	0.81	0.813	0.819	0.823	0.824
Heat Pump (%)							
Sales of water heating units - Electric	2.03	2.38	2.39	2.4	2.4	2.4	2.41
Resistance (%)							
Sales of water heating units - Gas Furnace	96.8	96.2	96.2	96.2	96.2	96.1	96.1
(%)							
Sales of water heating units - Other (%)	0.501	0.619	0.623	0.624	0.623	0.624	0.625

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

Item	2020	2025	2030	2035	2040	2045	2050
Electricity distribution capital invested -		11.4	11.7	20.7	22	18.4	19.1
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)	793	809	826	837	860	902	960
Final energy use - Industry (PJ)	1,021	1,088	1,143	1,208	1,279	1,368	1,470
Final energy use - Residential (PJ)	878	827	784	756	740	729	719
Final energy use - Transportation (PJ)	3,057	2,998	2,847	2,765	2,800	2,893	3,001

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

Item	2020	2025	2030	2035	2040	2045	2050
Residential HVAC investment in 2020s vs.		26.2	28.8				
REF - Cumulative 5-yr (billion \$2018)							
Sales of cooking units - Electric	39.3	39.3	39.3	39.3	39.3	39.3	39.3
Resistance (%)							
Sales of cooking units - Gas (%)	60.7	60.7	60.7	60.7	60.7	60.7	60.7
Sales of space heating units - Electric	4.04	25.4	26.3	27.8	29.1	30.6	32.8
Heat Pump (%)							
Sales of space heating units - Electric	16.9	22.7	22.3	21.7	21	19.5	17.3
Resistance (%)							
Sales of space heating units - Fossil (%)	3.38	4.97	5	5	4.95	4.95	4.96
Sales of space heating units - Gas (%)	75.7	46.9	46.4	45.5	45	44.9	44.9
Sales of water heating units - Electric	0	0	0	0	0	0	0
Heat Pump (%)							
Sales of water heating units - Electric	17.5	32.2	32.2	32.2	32.2	32.1	32.1
Resistance (%)							
Sales of water heating units - Gas Furnace	79.8	65	65	65	65.1	65.1	65.1
(%)							
Sales of water heating units - Other (%)	2.7	2.75	2.76	2.78	2.79	2.81	2.82

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 (%)	1.18	1.65	2.12	1.98	1.77	1.65	1.57
Vehicle sales - Light-duty - EV (%)	4.79	7.2	8.03	9.95	12	13.5	14.8
Vehicle sales - Light-duty - gasoline (%)	88.2	84.3	81.7	79.4	77.1	75.3	73.9
Vehicle sales - Light-duty - hybrid (%)	5.65	6.45	7.76	8.29	8.76	9.15	9.38

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

Item	2020	2025	2030	2035	2040	2045	2050
Vehicle sales - Light-duty - hydrogen FC	0.109	0.363	0.325	0.284	0.278	0.277	0.286
(%)							
Vehicle sales - Light-duty - other (%)	0.085	0.089	0.085	0.086	0.085	0.084	0.085
Vehicle sales - Medium-duty - diesel (%)	65.2	63.5	61.6	59.6	58	56.5	55.2
Vehicle sales - Medium-duty - EV (%)	0.027	0.105	0.329	0.671	0.895	0.973	0.993
Vehicle sales - Medium-duty - gasoline (%)	34	35.5	37	38.5	39.7	40.8	41.7
Vehicle sales - Medium-duty - hybrid (%)	0.365	0.427	0.496	0.577	0.674	0.793	0.929
Vehicle sales - Medium-duty - hydrogen	0.175	0.208	0.242	0.285	0.339	0.409	0.487
FC (%)							
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 regeneration (1000 tCO2e/y)	2020	2020	2000	2000	2040	2040	-3,748
Carbon sink potential - High - All (not counting overlap) (1000 tC02e/y)							-43,341
Carbon sink potential - High - Avoid deforestation (1000 tC02e/y)							-5,255
Carbon sink potential - High - Extend rotation length (1000 tC02e/y)							-13,545
Carbon sink potential - High - Improve plantations (1000 tCO2e/y)							-1,299
Carbon sink potential - High - Increase retention of HWP (1000 tC02e/y)							-6,568
Carbon sink potential - High - Increase trees outside forests (1000 tCO2e/y)							-2,022
Carbon sink potential - High - Reforest cropland (1000 tCO2e/y)							-288
Carbon sink potential - High - Reforest pasture (1000 tC02e/y)							-2,778
Carbon sink potential - High - Restore productivity (1000 tCO2e/y)							-7,838
Carbon sink potential - Low - Accelerate regeneration (1000 tCO2e/y)							-1,878
Carbon sink potential - Low - All (not counting overlap) (1000 tC02e/y)							-14,511
Carbon sink potential - Low - Avoid deforestation (1000 tCO2e/y)							-876
Carbon sink potential - Low - Extend rotation length (1000 tC02e/y)							-5,203
Carbon sink potential - Low - Improve plantations (1000 tCO2e/y)							-661
Carbon sink potential - Low - Increase retention of HWP (1000 tCO2e/y)							-2,189
Carbon sink potential - Low - Increase trees outside forests (1000 tCO2e/y)							-708
Carbon sink potential - Low - Reforest cropland (1000 tCO2e/y)							-144
Carbon sink potential - Low - Reforest pasture (1000 tCO2e/y)							-210
Carbon sink potential - Low - Restore productivity (1000 tCO2e/y)							-2,642
Carbon sink potential - Mid - Accelerate regeneration (1000 tC02e/y)							-2,813
Carbon sink potential - Mid - All (not counting overlap) (1000 tC02e/y)							-28,914
Carbon sink potential - Mid - Avoid deforestation (1000 tCO2e/y)							-3,065

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

Item	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - Mid - Extend							-9,374
rotation length (1000 tCO2e/y)							
Carbon sink potential - Mid - Improve							-968
plantations (1000 tCO2e/y)							4 070
Carbon sink potential - Mid - Increase							-4,379
retention of HWP (1000 tCO2e/y)							
Carbon sink potential - Mid - Increase							-1,365
trees outside forests (1000 tC02e/y)							04.
Carbon sink potential - Mid - Reforest							-216
cropland (1000 tCO2e/y)							
Carbon sink potential - Mid - Reforest							-1,494
pasture (1000 tC02e/y)							F 0/ 0
Carbon sink potential - Mid - Restore							-5,240
productivity (1000 tCO2e/y)							/40
Land impacted for carbon sink potential -							613
High - Accelerate regeneration (1000							
hectares)							744
Land impacted for carbon sink potential -							711
High - Avoid deforestation (over 30 years)							
(1000 hectares)							(0.07
Land impacted for carbon sink potential -							6,907
High - Extend rotation length (1000							
hectares)							
Land impacted for carbon sink potential -							479
High - Improve plantations (1000							
hectares)							
Land impacted for carbon sink potential -							0
High - Increase retention of HWP (1000							
hectares)							100
Land impacted for carbon sink potential -							192
High - Increase trees outside forests							
(1000 hectares)							
Land impacted for carbon sink potential -							19
High - Reforest cropland (1000 hectares)							
Land impacted for carbon sink potential -							78.9
High - Reforest pasture (1000 hectares)							0.500
Land impacted for carbon sink potential -							2,598
High - Restore productivity (1000							
hectares)							44 = 00
Land impacted for carbon sink potential -							11,598
High - Total impacted (over 30 years)							
(1000 hectares)							
Land impacted for carbon sink potential -							307
Low - Accelerate regeneration (1000							
hectares)							
Land impacted for carbon sink potential -							668
Low - Avoid deforestation (over 30 years)							
(1000 hectares)							
Land impacted for carbon sink potential -							2,646
Low - Extend rotation length (1000							
hectares)							
Land impacted for carbon sink potential -							239
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 -	T	T		T			101
Low - Increase trees outside forests							
(1000 hectares)							

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

Item	2020	2025	2030	2035	2040	2045	2050
Land impacted for carbon sink potential -							9.51
Low - Reforest cropland (1000 hectares)							
Land impacted for carbon sink potential -							13.7
Low - Reforest pasture (1000 hectares)							
Land impacted for carbon sink potential -							1,572
Low - Restore productivity (1000							
hectares)							
Land impacted for carbon sink potential -							5,556
Low - Total impacted (over 30 years)							
(1000 hectares)							
Land impacted for carbon sink potential -							460
Mid - Accelerate regeneration (1000							
hectares)							
Land impacted for carbon sink potential -							690
Mid - Avoid deforestation (over 30 years)							
(1000 hectares)							
Land impacted for carbon sink potential -							4,777
Mid - Extend rotation length (1000							
hectares)							
Land impacted for carbon sink potential -							360
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 -							147
Mid - Increase trees outside forests (1000							
hectares)							
Land impacted for carbon sink potential -							14.3
Mid - Reforest cropland (1000 hectares)							
Land impacted for carbon sink potential -							98.9
Mid - Reforest pasture (1000 hectares)							
Land impacted for carbon sink potential -							3,166
Mid - Restore productivity (1000							
hectares)							
Land impacted for carbon sink potential -							9,712
Mid - Total impacted (over 30 years) (1000							
hectares)							

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	-13.7		-7.63				-6.35
uptake (Mt CO2e/y) Business-as-usual carbon sink - Retained	-1.79		2				-3.16
in Hardwood Products (Mt CO2e/y)	-1.79		-3				-3.10
Business-as-usual carbon sink - Total (Mt CO2e/y)	-15.5		-10.6				-9.51

Table 66: REF scenario - IMPACTS - Health

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal (million 2019\$)		436	229	117	86.4	79.4	75
Monetary damages from air pollution - Natural Gas (million 2019\$)		1,786	1,197	1,492	1,695	1,893	1,768
Monetary damages from air pollution - Transportation (million 2019\$)		32,012	33,340	34,643	36,132	37,595	39,009
Premature deaths from air pollution - Coal (deaths)		49.2	25.9	13.3	9.76	8.97	8.47
Premature deaths from air pollution - Natural Gas (deaths)		202	135	168	191	214	200

Table 66: REF scenario - IMPACTS - Health (continued)

	•	,					
Item	2020	2025	2030	2035	2040	2045	2050
Premature deaths from air pollution - Transportation (deaths)		3,600	3,750	3,896	4,064	4,228	4,387