

Net-Zero America - pennsylvania state report

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

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Notes

- These data are all data from the study available at https://netzeroamerica.prince-ton.edu.
- The Net-Zero America study describes five pathways to reach net-zero emissions and one "no new policies" reference scenario. In this document, state-level results are grouped by scenario. For some scenarios, the study generated national, but not statelevel results.
- Within results for a given scenario, data tables are organized into corresponding sections of the full net-zero study (e.g., Pillar 1, Pillar 2, etc.)
- For Pillar 6 (Land sinks), values shown are maximum carbon storage potentials.

Data by category and subcategory

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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 - Cumulative 5-yr (million \$2018)	0	59,163	64,630	0	0	0	0
Sales of cooking units - Electric Resistance (%)	18.5	33.7	75.3	83.5	83.9	84	84
Sales of cooking units - Gas (%)	81.5	66.3	24.7	16.5	16.1	16	16
Sales of space heating units - Electric Heat Pump (%)	2.56	11.7	42	73.7	78.6	79.2	79.1
Sales of space heating units - Electric Resistance (%)	5.59	4.8	13.3	19	20.2	19.9	20
Sales of space heating units - Fossil (%)	19.4	14.8	2.91	0.126	0	0	0
Sales of space heating units - Gas Furnace (%)	72.4	68.7	41.8	7.14	1.21	0.873	0.87
Sales of water heating units - Electric Heat Pump (%)	0.624	4.78	29.6	52.2	55.8	56	56
Sales of water heating units - Electric Resistance (%)	3.49	4.26	19.8	40.2	43.6	43.8	43.8
Sales of water heating units - Gas Furnace (%)	94.2	89.8	50.2	7.42	0.426	0	0
Sales of water heating units - Other (%)	1.74	1.19	0.379	0.186	0.177	0.178	0.178

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

Item	2020	2025	2030	2035	2040	2045	2050
Electricity distribution capital invested -		6.13	6.27	11.6	12.4	12.4	13.1
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)	388	381	368	346	323	310	307
Final energy use - Industry (PJ)	791	783	767	757	724	706	669
Final energy use - Residential (PJ)	467	427	389	337	289	255	236
Final energy use - Transportation (PJ)	816	765	673	560	457	393	364

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

Item	2020	2025	2030	2035	2040	2045	2050
Residential HVAC investment in 2020s vs.	0	10.8	12.5	0	0	0	0
REF - Cumulative 5-yr (billion \$2018)							
Sales of cooking units - Electric	55.4	64.9	94	99.7	100	100	100
Resistance (%)							
Sales of cooking units - Gas (%)	44.6	35.1	6.01	0.303	0	0	0
Sales of space heating units - Electric	8.42	19.7	58.8	85.6	89.5	89.7	89.7
Heat Pump (%)							
Sales of space heating units - Electric	9.49	11.8	7.94	3.83	3.14	3.17	3.29
Resistance (%)							
Sales of space heating units - Fossil (%)	24.2	31.3	12.5	6.86	6.43	6.34	6.23
Sales of space heating units - Gas (%)	57.9	37.3	20.7	3.68	0.918	0.75	0.749
Sales of water heating units - Electric	0	3.85	24.2	40.2	42.6	42.8	42.8
Heat Pump (%)							
Sales of water heating units - Electric	35.5	52.4	52.4	56.3	57.1	57.1	57.1
Resistance (%)							
Sales of water heating units - Gas Furnace	58.8	40.5	22.7	3.36	0.193	0	0
(%)							
Sales of water heating units - Other (%)	5.73	3.25	0.692	0.122	0.097	0.097	0.098

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

Item	2020	2025	2030	2035	2040	2045	2050
Light-duty vehicle capital costs -	0	2,057	5,276	8,545	12,946	14,088	13,433
Cumulative 5-yr (million \$2018)							
Public EV charging plugs - DC Fast (1000	0.267	0	3.52	0	15.4	0	24.9
units)							
Public EV charging plugs - L2 (1000 units)	1.32	0	84.6	0	370	0	599
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 (%)	1.43	1.71	1.21	0.386	0.073	0.013	0
Vehicle sales - Light-duty - EV (%)	4.31	16.4	48.3	82.5	96.4	99.3	100
Vehicle sales - Light-duty - gasoline (%)	89.2	76.6	46.9	15.8	3.2	0.587	0
Vehicle sales - Light-duty - hybrid (%)	4.8	4.82	3.34	1.23	0.301	0.066	0
Vehicle sales - Light-duty - hydrogen FC	0.11	0.333	0.194	0.06	0.012	0.002	0
(%)							
Vehicle sales - Light-duty - other (%)	0.096	0.092	0.059	0.021	0.004	0.001	0
Vehicle sales - Medium-duty - diesel (%)	64.7	59.7	42.3	14.4	2.59	0.384	0
Vehicle sales - Medium-duty - EV (%)	0.784	5.07	25.3	60.8	76.5	79.5	80
Vehicle sales - Medium-duty - gasoline (%)	33.7	33.3	25.5	9.32	1.77	0.277	0
Vehicle sales - Medium-duty - hybrid (%)	0.363	0.402	0.341	0.14	0.03	0.005	0
Vehicle sales - Medium-duty - hydrogen	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 (billion \$2018)	0	0	0	0	0	0	0
Capital invested - Biomass w/ccu allam power plant (billion \$2018)	0	0	0	0	0	0	0.031
Capital invested - Biomass w/ccu power plant (billion \$2018)	0	0	0	0	0	0	0
Capital invested - Solar PV - Base (billion \$2018)	0	1.23	2.29	11.7	18.8	27.7	33.5
Capital invested - Solar PV - Constrained (billion \$2018)	0	0.076	2.55	12.2	15.2	34.6	27.8
Capital invested - Wind - Base (billion \$2018)	0	0	0	0	0	0	0
Capital invested - Wind - Constrained (billion \$2018)	0	0	0	15.8	85.7	0	0
Installed (cumulative) - OffshoreWind - Base land use assumptions (MW)	0	0	0	0	0	0	0
Installed (cumulative) - Rooftop PV (MW)	415	623	828	1,094	1,416	1,782	2,202
Installed (cumulative) - Solar - Base land use assumptions (MW)	86.8	1,009	2,921	13,557	31,631	59,894	96,038
Installed (cumulative) - Wind - Base land use assumptions (MW)	1,619	1,619	1,619	1,619	1,619	1,619	1,619

Table 7: E+ scenario - PILLAR 2: Clean Electricity - Generation

Item	2020	2025	2030	2035	2040	2045	2050
Biomass power plant (GWh)	0	0	0	0	0	0	0
Biomass w/ccu allam power plant (GWh)	0	0	0	0	0	0	30.7
Biomass w/ccu power plant (GWh)	0	0	0	0	0	0	0
Solar - Base land use assumptions (GWh)	169	1,660	3,407	18,503	31,007	48,179	61,738
Solar - Constrained land use assumptions (GWh)	72.1	5,681	7,705	19,865	27,989	70,404	48,941

Table 7: E+ scenario - PILLAR 2: Clean Electricity - Generation (continued)

Item	2020	2025	2030	2035	2040	2045	2050
Wind - Base land use assumptions (GWh)	6,912	0	0	0	0	0	0
Wind - Constrained land use assumptions	6,912	0	0	20,179	161,146	4,812	0
(GWh)							

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

Item	2020	2025	2030	2035	2040	2045	2050
Biomass purchases (million \$2018/year)	0	0	0	0	0	0	446
Conversion capital investment -	0	0	0	0	0	0	9,012
Cumulative 5-yr (million \$2018)							
Number of facilities - Allam power w ccu	0	0	0	0	0	0	1
(quantity)							
Number of facilities - Beccs hydrogen	0	0	0	0	0	0	9
(quantity)							
Number of facilities - Diesel (quantity)	0	0	0	0	0	0	0
Number of facilities - Diesel ccu (quantity)	0	0	0	0	0	0	0
Number of facilities - Power (quantity)	0	0	0	0	0	0	0
Number of facilities - Power ccu	0	0	0	0	0	0	0
(quantity)							
Number of facilities - Pyrolysis (quantity)	0	0	0	0	0	0	0
Number of facilities - Pyrolysis ccu	0	0	0	0	0	0	1
(quantity)							
Number of facilities - Sng (quantity)	0	0	0	0	0	0	0
Number of facilities - Sng ccu (quantity)	0	0	0	0	0	0	0

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

Item	2020	2025	2030	2035	2040	2045	2050
Annual - All (MMT)		0	0	3.35	3.32	6.84	18.6
Annual - BECCS (MMT)		0	0	0	0	0	11.5
Annual - Cement and lime (MMT)		0	0	3.35	3.32	6.84	7.07
Annual - NGCC (MMT)		0	0	0	0	0	0
Cumulative - All (MMT)		0	0	3.35	6.67	13.5	32.1
Cumulative - BECCS (MMT)		0	0	0	0	0	11.5
Cumulative - Cement and lime (MMT)		0	0	3.35	6.67	13.5	20.6
Cumulative - NGCC (MMT)		0	0	0	0	0	0

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

Item	2020	2025	2030	2035	2040	2045	2050
All (km)		0	622	1,001	826	909	2,002
Cumulative investment - All (million \$2018)		0	1,668	2,719	2,627	2,709	3,539
Cumulative investment - Spur (million \$2018)		0	54.5	190	97.7	180	1,010
Cumulative investment - Trunk (million \$2018)		0	1,614	2,529	2,529	2,529	2,529
Spur (km)		0	107	332	157	241	1,333
Trunk (km)		0	515	669	669	669	669

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

Item	2020	2025	2030	2035	2040	2045	2050
CO2 storage (MMT)		0	0	0	0	0	0
Injection wells (wells)		0	0	0	0	0	0
Resource characterization, appraisal, permitting costs (million \$2020)		0	0	0	0	0	0
Wells and facilities construction costs (million \$2020)		0	0	0	0	0	0

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

Item	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - Aggressive							-304
deployment - Corn-ethanol to energy							
grasses (1000 tC02e/y)							
Carbon sink potential - Aggressive							-2,059
deployment - Cropland measures (1000							
tCO2e/y)							
Carbon sink potential - Aggressive							-95.2
deployment - Permanent conservation							
cover (1000 tC02e/y)							
Carbon sink potential - Aggressive							-2,458
deployment - Total (1000 tC02e/y)							
Carbon sink potential - Moderate							-304
deployment - Corn-ethanol to energy							
grasses (1000 tCO2e/y)							
Carbon sink potential - Moderate							-1,086
deployment - Cropland measures (1000							
tCO2e/y)							
Carbon sink potential - Moderate							-47.6
deployment - Permanent conservation							
cover (1000 tCO2e/y)							
Carbon sink potential - Moderate							-1,437
deployment - Total (1000 tC02e/y)							
Land impacted for carbon sink -							139
Aggressive deployment - Corn-ethanol to							
energy grasses (1000 hectares)							
Land impacted for carbon sink -							1,571
Aggressive deployment - Cropland							
measures (1000 hectares)							
Land impacted for carbon sink -							173
Aggressive deployment - Permanent							
conservation cover (1000 hectares)							
Land impacted for carbon sink -							1,884
Aggressive deployment - Total (1000							,
hectares)							
Land impacted for carbon sink - Moderate							139
deployment - Corn-ethanol to energy							
grasses (1000 hectares)							
Land impacted for carbon sink - Moderate		+					829
deployment - Cropland measures (1000							-
hectares)							
Land impacted for carbon sink - Moderate							86.6
deployment - Permanent conservation							00.0
cover (1000 hectares)							
Land impacted for carbon sink - Moderate	+			+			1,055
deployment - Total (1000 hectares)							1,000
achickling it - intal (1000 liectal es)							

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

Item	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - High - Accelerate							-291
regeneration (1000 tCO2e/y)							
Carbon sink potential - High - All (not							-27,852
counting overlap) (1000 tCO2e/y)							
Carbon sink potential - High - Avoid							-3,104
deforestation (1000 tCO2e/y)							
Carbon sink potential - High - Extend							-8,777
rotation length (1000 tCO2e/y)							
Carbon sink potential - High - Improve							-440
plantations (1000 tCO2e/y)							
Carbon sink potential - High - Increase							-5,935
retention of HWP (1000 tCO2e/y)							

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

Item Idit 13: E+ scenario - PILLAR 6: Land sini	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - High - Increase		2020	2000		20.0	20.0	-1,121
trees outside forests (1000 tC02e/y)							
Carbon sink potential - High - Reforest							-186
cropland (1000 tCO2e/y)							
Carbon sink potential - High - Reforest							-4,122
pasture (1000 tCO2e/y)							
Carbon sink potential - High - Restore							-3,875
productivity (1000 tCO2e/y)							
Carbon sink potential - Low - Accelerate							-146
regeneration (1000 tCO2e/y)							
Carbon sink potential - Low - All (not							-8,341
counting overlap) (1000 tCO2e/y)							
Carbon sink potential - Low - Avoid							-517
deforestation (1000 tCO2e/y)							
Carbon sink potential - Low - Extend							-3,371
rotation length (1000 tCO2e/y)							
Carbon sink potential - Low - Improve							-224
plantations (1000 tCO2e/y)							
Carbon sink potential - Low - Increase							-1,978
retention of HWP (1000 tCO2e/y)							
Carbon sink potential - Low - Increase							-392
trees outside forests (1000 tC02e/y)							
Carbon sink potential - Low - Reforest							-93.2
cropland (1000 tCO2e/y)							010
Carbon sink potential - Low - Reforest							-312
pasture (1000 tC02e/y)							1.007
Carbon sink potential - Low - Restore							-1,306
productivity (1000 tC02e/y)							010
Carbon sink potential - Mid - Accelerate							-218
regeneration (1000 tC02e/y)							10.000
Carbon sink potential - Mid - All (not counting overlap) (1000 tC02e/y)							-18,092
Carbon sink potential - Mid - Avoid							-1,811
deforestation (1000 tC02e/y)							-1,011
Carbon sink potential - Mid - Extend							-6,074
rotation length (1000 tC02e/y)							-0,014
Carbon sink potential - Mid - Improve							-328
plantations (1000 tCO2e/y)							-520
Carbon sink potential - Mid - Increase							-3,957
retention of HWP (1000 tC02e/y)							-3,731
Carbon sink potential - Mid - Increase							-757
trees outside forests (1000 tCO2e/y)							101
Carbon sink potential - Mid - Reforest							-140
cropland (1000 tCO2e/y)							1-0
Carbon sink potential - Mid - Reforest							-2,217
pasture (1000 tC02e/y)							_,
Carbon sink potential - Mid - Restore							-2,591
productivity (1000 tCO2e/y)							2,071
Land impacted for carbon sink potential -							47.6
High - Accelerate regeneration (1000							
hectares)							
Land impacted for carbon sink potential -							420
High - Avoid deforestation (over 30 years)							_
(1000 hectares)							
Land impacted for carbon sink potential -							4,476
High - Extend rotation length (1000							,
hectares)							
Land impacted for carbon sink potential -							162
High - Improve plantations (1000	1		1	J.			

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

Item	2020	2025	2030	2035	2040	2045	2050
Land impacted for carbon sink potential -							0
High - Increase retention of HWP (1000 hectares)							
Land impacted for carbon sink potential -							107
High - Increase trees outside forests							101
(1000 hectares)							
Land impacted for carbon sink potential -							12.3
High - Reforest cropland (1000 hectares)							
Land impacted for carbon sink potential -							117
High - Reforest pasture (1000 hectares)							1.005
Land impacted for carbon sink potential - High - Restore productivity (1000							1,285
hectares)							
Land impacted for carbon sink potential -							6,626
High - Total impacted (over 30 years)							•
(1000 hectares)							
Land impacted for carbon sink potential -							23.8
Low - Accelerate regeneration (1000							
hectares)							
Land impacted for carbon sink potential -							395
Low - Avoid deforestation (over 30 years) (1000 hectares)							
Land impacted for carbon sink potential -							1,715
Low - Extend rotation length (1000							1,1 10
hectares)							
Land impacted for carbon sink potential -							81
Low - Improve plantations (1000							
hectares)							
Land impacted for carbon sink potential -							0
Low - Increase retention of HWP (1000							
hectares)							F/1
Land impacted for carbon sink potential - Low - Increase trees outside forests							56.1
(1000 hectares)							
Land impacted for carbon sink potential -							6.16
Low - Reforest cropland (1000 hectares)							0.10
Land impacted for carbon sink potential -							20.3
Low - Reforest pasture (1000 hectares)							
Land impacted for carbon sink potential -							777
Low - Restore productivity (1000							
hectares)							0.07/
Land impacted for carbon sink potential -							3,074
Low - Total impacted (over 30 years) (1000 hectares)							
Land impacted for carbon sink potential -							35.7
Mid - Accelerate regeneration (1000							00.1
hectares)							
Land impacted for carbon sink potential -							407
Mid - Avoid deforestation (over 30 years)							
(1000 hectares)							
Land impacted for carbon sink potential -							3,095
Mid - Extend rotation length (1000							
hectares)							122
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)							IZZ
Land impacted for carbon sink potential -							0
Mid - Increase retention of HWP (1000							U
hectares)							
Land impacted for carbon sink potential -							81.3
Mid - Increase trees outside forests (1000							
hectares)							

Table 13: E+	cconario -	DTII AD 6.	Land cinke	Enrocte	(continued)
Table 15. E+	scenurio -	PILLAR D.	LUIIU SIIIKS ·	- Furests i	COMUNICEUR

Item	2020	2025	2030	2035	2040	2045	2050
Land impacted for carbon sink potential -							9.24
Mid - Reforest cropland (1000 hectares)							
Land impacted for carbon sink potential -							147
Mid - Reforest pasture (1000 hectares)							
Land impacted for carbon sink potential -							1,565
Mid - Restore productivity (1000							
hectares)							
Land impacted for carbon sink potential -							5,463
Mid - Total impacted (over 30 years) (1000							
hectares)							

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

Item	2020	2025	2030	2035	2040	2045	2050
Natural gas consumption - Annual (tcf)		1,128	951	763	574	361	251
Natural gas consumption - Cumulative (tcf)		0	0	0	0	0	22,977
Natural gas production - Annual (tcf)		7,475	7,066	6,154	5,204	4,126	3,205
Oil consumption - Annual (million bbls)		181	162	132	104	81	62
Oil consumption - Cumulative (million bbls)		0	0	0	0	0	4,048
Oil production - Annual (million bbls)		8.39	8.42	8.41	6.66	5.42	3.6

Table 15: E+ scenario - IMPACTS - Health

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution -		2,374	1.62	1.6	1.47	1	0.081
Coal (million 2019\$)							
Monetary damages from air pollution -		615	453	294	268	170	68
Natural Gas (million 2019\$)							
Monetary damages from air pollution -		4,170	3,868	2,927	1,689	768	300
Transportation (million 2019\$)							
Premature deaths from air pollution -		268	0.183	0.181	0.166	0.113	0.009
Coal (deaths)							
Premature deaths from air pollution -		69.4	51.1	33.2	30.3	19.2	7.67
Natural Gas (deaths)							
Premature deaths from air pollution -		469	435	329	190	86.4	33.7
Transportation (deaths)							

Table 16: E+ scenario - IMPACTS - Jobs

Item	2020	2025	2030	2035	2040	2045	2050
By economic sector - Agriculture (jobs)		375	568	326	211	97.7	632
By economic sector - Construction (jobs)		16,338	16,396	22,401	28,171	34,355	45,295
By economic sector - Manufacturing		19,602	22,640	28,984	28,119	23,357	29,915
(jobs)							
By economic sector - Mining (jobs)		13,345	9,256	6,636	4,454	2,850	1,740
By economic sector - Other (jobs)		840	1,025	2,668	4,597	6,936	10,799
By economic sector - Pipeline (jobs)		2,600	2,426	1,920	1,378	931	741
By economic sector - Professional (jobs)		7,981	7,156	9,193	11,823	14,796	20,938
By economic sector - Trade (jobs)		6,468	5,545	6,817	8,520	10,749	15,134
By economic sector - Utilities (jobs)		22,849	21,083	22,795	24,713	26,600	31,661
By education level - All sectors -		28,277	27,133	32,433	36,054	39,103	50,749
Associates degree or some college (jobs)							
By education level - All sectors -		19,136	17,876	20,440	22,007	23,331	30,187
Bachelors degree (jobs)							
By education level - All sectors - Doctoral		573	512	590	672	768	1,034
degree (jobs)							
By education level - All sectors - High		37,948	36,483	43,620	48,135	51,879	67,564
school diploma or less (jobs)							

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

Table 10. L+ Scellul 10 - IMPACIS - Jubs (cu	•						
Item	2020	2025	2030	2035	2040	2045	2050
By education level - All sectors - Masters		4,461	4,091	4,658	5,117	5,591	7,319
or professional degree (jobs)							
By resource sector - Biomass (jobs)		1,243	1,475	817	568	365	2,730
By resource sector - CO2 (jobs)		0	1,596	1,020	136	246	1,446
By resource sector - Coal (jobs)		5,457	2,203	1,748	1,519	1,367	1,211
By resource sector - Grid (jobs)		17,018	17,049	25,485	33,636	43,359	57,865
By resource sector - Natural Gas (jobs)		34,052	28,380	22,686	19,157	13,137	7,603
By resource sector - Nuclear (jobs)		4,428	3,817	3,179	1,814	636	0
By resource sector - Oil (jobs)		11,169	9,436	7,556	5,500	4,056	2,774
By resource sector - Solar (jobs)		9,472	12,101	26,280	37,790	48,918	72,736
By resource sector - Wind (jobs)		7,559	10,039	12,969	11,865	8,587	10,490
Median wages - Annual - All (\$2019 per		62,196	62,443	62,390	63,104	64,136	64,668
job)							
On-Site or In-Plant Training - Total jobs - 1		14,758	14,077	16,683	18,469	20,011	25,828
to 4 years (jobs)							
On-Site or In-Plant Training - Total jobs - 4		5,839	5,485	6,450	7,325	8,213	10,550
to 10 years (jobs)							
On-Site or In-Plant Training - Total jobs -		14,411	13,811	16,423	18,119	19,532	25,569
None (jobs)							
On-Site or In-Plant Training - Total jobs -		743	719	863	971	1,066	1,377
Over 10 years (jobs)							
On-Site or In-Plant Training - Total jobs -		54,645	52,002	61,322	67,102	71,851	93,531
Up to 1 year (jobs)							
On-the-Job Training - All sectors - 1 to 4		19,018	18,116	21,429	23,745	25,759	33,185
years (jobs)							
On-the-Job Training - All sectors - 4 to 10		5,582	5,257	6,258	7,204	8,176	10,545
years (jobs)							
On-the-Job Training - All sectors - None		4,761	4,505	5,356	5,945	6,494	8,561
(jobs)							
On-the-Job Training - All sectors - Over 10		894	880	1,065	1,157	1,211	1,566
years (jobs)							
On-the-Job Training - All sectors - Up to 1		60,141	57,337	67,632	73,934	79,031	102,997
year (jobs)							
Related work experience - All sectors - 1		32,879	31,090	36,443	40,009	43,099	55,874
to 4 years (jobs)							
Related work experience - All sectors - 4		21,167	20,095	23,574	25,901	27,874	35,975
to 10 years (jobs)							
Related work experience - All sectors -		12,873	12,326	14,603	16,190	17,586	22,930
None (jobs)							
Related work experience - All sectors -		5,876	5,616	6,574	7,083	7,435	9,555
Over 10 years (jobs)							
Related work experience - All sectors - Up		17,602	16,968	20,547	22,802	24,678	32,520
to 1 year (jobs)							
Wage income - All (million \$2019)		5,622	5,376	6,348	7,067	7,741	10,145
				L	I		

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

Item	2020	2025	2030	2035	2040	2045	2050
Commercial HVAC investment in 2020s -	0	59,150	64,632	0	0	0	0
Cumulative 5-yr (million \$2018)							
Sales of cooking units - Electric	18.5	21.6	27.5	43	64.5	77.7	82.3
Resistance (%)							
Sales of cooking units - Gas (%)	81.5	78.4	72.5	57	35.5	22.3	17.7
Sales of space heating units - Electric	2.56	7.82	11.2	21.8	42.1	62.6	73.2
Heat Pump (%)							
Sales of space heating units - Electric	5.59	3.46	4.4	7.36	12.7	16.8	19
Resistance (%)							
Sales of space heating units - Fossil (%)	19.4	17.2	16.4	12.8	6.63	2.21	0.78
Sales of space heating units - Gas Furnace	72.4	71.6	67.9	58.1	38.6	18.3	7.04
(%)							

Table 17: E- scenario -	DILLAR 1. Efficience	//Electrification -	Commercial	continued
Table II. E- Scellul IO -	PILLAK I. EIIILIEIIL	// EIECH 111CUHUH -	CUITITIETCIULT	Continueur

Item	2020	2025	2030	2035	2040	2045	2050
Sales of water heating units - Electric	0.624	1.34	4.16	12.7	28.8	44.1	51.9
Heat Pump (%)							
Sales of water heating units - Electric	3.49	2.59	4.34	9.88	21.2	33.5	40.1
Resistance (%)							
Sales of water heating units - Gas Furnace	94.2	94.7	90.2	76.4	49.4	22.1	7.82
(%)							
Sales of water heating units - Other (%)	1.74	1.35	1.32	1.03	0.608	0.33	0.23

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

Item	2020	2025	2030	2035	2040	2045	2050
Electricity distribution capital invested -		5.07	5.09	7.06	7.31	10.1	10.6
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)	388	381	378	375	368	359	349
Final energy use - Industry (PJ)	791	783	769	764	735	716	676
Final energy use - Residential (PJ)	467	428	403	379	349	315	281
Final energy use - Transportation (PJ)	817	772	705	650	607	555	495

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

Item	2020	2025	2030	2035	2040	2045	2050
Residential HVAC investment in 2020s vs. REF - Cumulative 5-yr (billion \$2018)	0	10.8	13	0	0	0	0
Sales of cooking units - Electric Resistance (%)	55.2	56.3	60.5	71.3	86.3	95.6	98.8
Sales of cooking units - Gas (%)	44.8	43.7	39.5	28.7	13.7	4.42	1.19
Sales of space heating units - Electric Heat Pump (%)	8.42	13.6	18	31.2	54.5	74.9	84.5
Sales of space heating units - Electric Resistance (%)	9.49	12.2	11.8	10.4	7.78	5.17	3.89
Sales of space heating units - Fossil (%)	24.2	34.8	32.7	26.6	17	10.3	7.7
Sales of space heating units - Gas (%)	57.9	39.4	37.5	31.8	20.7	9.65	3.89
Sales of water heating units - Electric Heat Pump (%)	0	0.823	3.14	10.1	22.7	34.2	39.8
Sales of water heating units - Electric Resistance (%)	35.5	52.7	52.6	52.6	53.5	55.2	56.4
Sales of water heating units - Gas Furnace (%)	58.8	42.8	40.8	34.6	22.4	10	3.56
Sales of water heating units - Other (%)	5.73	3.74	3.46	2.63	1.37	0.535	0.247

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

Item	2020	2025	2030	2035	2040	2045	2050
Light-duty vehicle capital costs -	0	0	333	699	2,363	7,431	10,827
Cumulative 5-yr (million \$2018)							
Public EV charging plugs - DC Fast (1000	0.267	0	1.09	0	5.72	0	16
units)							
Public EV charging plugs - L2 (1000 units)	1.32	0	26.2	0	137	0	383
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 (%)	1.45	1.88	2.04	1.61	1.02	0.523	0.225

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

Item	2020	2025	2030	2035	2040	2045	2050
Vehicle sales - Light-duty - EV (%)	2.03	4.99	12.5	26.8	49.4	72.7	87.8
Vehicle sales - Light-duty - gasoline (%)	91.3	86.9	78.6	65.4	45	24.1	10.7
Vehicle sales - Light-duty - hybrid (%)	4.99	5.77	6.44	5.8	4.29	2.5	1.2
Vehicle sales - Light-duty - hydrogen FC	0.112	0.377	0.319	0.241	0.17	0.094	0.044
(%)							
Vehicle sales - Light-duty - other (%)	0.098	0.101	0.091	0.079	0.057	0.031	0.014
Vehicle sales - Medium-duty - diesel (%)	64.8	62.2	57.7	49.4	35.6	19.6	8.37
Vehicle sales - Medium-duty - EV (%)	0.664	1.94	5.49	14.3	31.4	52.6	68
Vehicle sales - Medium-duty - gasoline (%)	33.8	34.7	34.7	31.9	24.4	14.2	6.33
Vehicle sales - Medium-duty - hybrid (%)	0.363	0.418	0.464	0.478	0.414	0.275	0.141
Vehicle sales - Medium-duty - hydrogen	0.166	0.485	1.37	3.58	7.86	13.2	17
FC (%)							
Vehicle sales - Medium-duty - other (%)	0.253	0.266	0.279	0.286	0.258	0.184	0.102

Table 22: E- scenario - PILLAR 6: Land sink			0000	0005	00/0	00/5	0050
Item	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - Aggressive							-304
deployment - Corn-ethanol to energy							
grasses (1000 tC02e/y)							0.050
Carbon sink potential - Aggressive							-2,059
deployment - Cropland measures (1000 tCO2e/y)							
Carbon sink potential - Aggressive							-95.2
deployment - Permanent conservation							
cover (1000 tC02e/y)							
Carbon sink potential - Aggressive							-2,458
deployment - Total (1000 tCO2e/y)							
Carbon sink potential - Moderate							-304
deployment - Corn-ethanol to energy							
grasses (1000 tCO2e/y)							
Carbon sink potential - Moderate							-1,086
deployment - Cropland measures (1000							
tCO2e/y)							
Carbon sink potential - Moderate							-47.6
deployment - Permanent conservation							
cover (1000 tCO2e/y)							
Carbon sink potential - Moderate							-1,437
deployment - Total (1000 tCO2e/y)							
Land impacted for carbon sink -							139
Aggressive deployment - Corn-ethanol to							
energy grasses (1000 hectares)							
Land impacted for carbon sink -							1,571
Aggressive deployment - Cropland							
measures (1000 hectares)							
Land impacted for carbon sink -							173
Aggressive deployment - Permanent							
conservation cover (1000 hectares)							
Land impacted for carbon sink -							1,884
Aggressive deployment - Total (1000							
hectares)							
Land impacted for carbon sink - Moderate							139
deployment - Corn-ethanol to energy							
grasses (1000 hectares)							
Land impacted for carbon sink - Moderate							829
deployment - Cropland measures (1000							
hectares)							
Land impacted for carbon sink - Moderate							86.6
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 - Moderate							1,055
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							-291
regeneration (1000 tCO2e/y)							
Carbon sink potential - High - All (not							-27,852
counting overlap) (1000 tCO2e/y)							
Carbon sink potential - High - Avoid							-3,104
deforestation (1000 tCO2e/y)							
Carbon sink potential - High - Extend							-8,777
rotation length (1000 tCO2e/y)							
Carbon sink potential - High - Improve							-440
plantations (1000 tCO2e/y)							
Carbon sink potential - High - Increase							-5,935
retention of HWP (1000 tCO2e/y)							
Carbon sink potential - High - Increase							-1,121
trees outside forests (1000 tCO2e/y)							
Carbon sink potential - High - Reforest							-186
cropland (1000 tCO2e/y)							
Carbon sink potential - High - Reforest							-4,122
pasture (1000 tC02e/y)							•
Carbon sink potential - High - Restore							-3,875
productivity (1000 tCO2e/y)							2,2:2
Carbon sink potential - Low - Accelerate							-146
regeneration (1000 tCO2e/y)							
Carbon sink potential - Low - All (not							-8,341
counting overlap) (1000 tCO2e/y)							3,5
Carbon sink potential - Low - Avoid							-517
deforestation (1000 tCO2e/y)							0
Carbon sink potential - Low - Extend							-3,371
rotation length (1000 tC02e/y)							0,011
Carbon sink potential - Low - Improve							-224
plantations (1000 tC02e/y)							224
Carbon sink potential - Low - Increase							-1,978
retention of HWP (1000 tCO2e/y)							1,710
Carbon sink potential - Low - Increase							-392
trees outside forests (1000 tC02e/y)							-372
Carbon sink potential - Low - Reforest							-93.2
cropland (1000 tCO2e/y)							-73.2
Carbon sink potential - Low - Reforest							-312
pasture (1000 tC02e/y)							-312
Carbon sink potential - Low - Restore							-1,306
productivity (1000 tC02e/y)							-1,306
Carbon sink potential - Mid - Accelerate							-218
							-218
regeneration (1000 tC02e/y) Carbon sink potential - Mid - All (not							10.000
							-18,092
counting overlap) (1000 tC02e/y)							1 011
Carbon sink potential - Mid - Avoid							-1,811
deforestation (1000 tC02e/y)							
Carbon sink potential - Mid - Extend							-6,074
rotation length (1000 tC02e/y)							
Carbon sink potential - Mid - Improve							-328
plantations (1000 tC02e/y)							
Carbon sink potential - Mid - Increase							-3,957
retention of HWP (1000 tCO2e/y)							
Carbon sink potential - Mid - Increase							-757
trees outside forests (1000 tCO2e/y)							

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

2020	2025	2030	2035	2040	2045	2050
						-140
						0.017
						-2,217
						-2,591
						47.6
						420
						4,476
						162
						0
						· ·
						107
						101
						12.3
						12.3
						117
						117
						1.005
						1,285
						/ /0/
						6,626
						23.8
						395
						1,715
						81
						C
						56.1
						6.16
						0.10
						20.3
						20.3
						777
1	1	1		1	1	(((

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

Item	2020	2025	2030	2035	2040	2045	2050
Land impacted for carbon sink potential -							3,074
Low - Total impacted (over 30 years)							
(1000 hectares)							
Land impacted for carbon sink potential -							35.7
Mid - Accelerate regeneration (1000							
hectares)							
Land impacted for carbon sink potential -							407
Mid - Avoid deforestation (over 30 years)							
(1000 hectares)							
Land impacted for carbon sink potential -							3,095
Mid - Extend rotation length (1000							
hectares)							
Land impacted for carbon sink potential -							122
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 -							81.3
Mid - Increase trees outside forests (1000							
hectares)							
Land impacted for carbon sink potential -							9.24
Mid - Reforest cropland (1000 hectares)							
Land impacted for carbon sink potential -							147
Mid - Reforest pasture (1000 hectares)							
Land impacted for carbon sink potential -							1,565
Mid - Restore productivity (1000							
hectares)							
Land impacted for carbon sink potential -							5,463
Mid - Total impacted (over 30 years) (1000							
hectares)							

Table 24: E- scenario - IMPACTS - Health

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal (million 2019\$)		2,374	1.62	1.6	1.47	1	0.081
Monetary damages from air pollution - Natural Gas (million 2019\$)		589	376	166	77.4	25.1	16.2
Monetary damages from air pollution - Transportation (million 2019\$)		4,245	4,272	4,139	3,715	2,952	2,023
Premature deaths from air pollution - Coal (deaths)		268	0.183	0.181	0.166	0.113	0.009
Premature deaths from air pollution - Natural Gas (deaths)		66.5	42.4	18.8	8.74	2.84	1.83
Premature deaths from air pollution - Transportation (deaths)		477	480	466	418	332	228

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

Item	2020	2025	2030	2035	2040	2045	2050
Commercial HVAC investment in 2020s -	0	59,163	64,630	0	0	0	0
Cumulative 5-yr (million \$2018)							
Sales of cooking units - Electric	18.5	33.7	75.3	83.5	83.9	84	84
Resistance (%)							
Sales of cooking units - Gas (%)	81.5	66.3	24.7	16.5	16.1	16	16
Sales of space heating units - Electric	2.56	11.7	42	73.7	78.6	79.2	79.1
Heat Pump (%)							
Sales of space heating units - Electric	5.59	4.8	13.3	19	20.2	19.9	20
Resistance (%)							
Sales of space heating units - Fossil (%)	19.4	14.8	2.91	0.126	0	0	0

Table 25: F+RF+	scenario - DIII AR 1	Efficiency/Electrification -	Commercial (continued)
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Item	2020	2025	2030	2035	2040	2045	2050
Sales of space heating units - Gas Furnace (%)	72.4	68.7	41.8	7.14	1.21	0.873	0.87
Sales of water heating units - Electric Heat Pump (%)	0.624	4.78	29.6	52.2	55.8	56	56
Sales of water heating units - Electric Resistance (%)	3.49	4.26	19.8	40.2	43.6	43.8	43.8
Sales of water heating units - Gas Furnace (%)	94.2	89.8	50.2	7.42	0.426	0	0
Sales of water heating units - Other (%)	1.74	1.19	0.379	0.186	0.177	0.178	0.178

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

Item	2020	2025	2030	2035	2040	2045	2050
Electricity distribution capital invested -		6.13	6.27	11.6	12.4	12.4	13.1
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)	388	381	368	346	323	310	307
Final energy use - Industry (PJ)	791	783	767	757	724	706	669
Final energy use - Residential (PJ)	467	427	389	337	289	255	236
Final energy use - Transportation (PJ)	816	765	673	560	457	393	364

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

Item	2020	2025	2030	2035	2040	2045	2050
Residential HVAC investment in 2020s vs.	0	10.8	12.5	0	0	0	0
REF - Cumulative 5-yr (billion \$2018)							
Sales of cooking units - Electric	55.4	64.9	94	99.7	100	100	100
Resistance (%)							
Sales of cooking units - Gas (%)	44.6	35.1	6.01	0.303	0	0	0
Sales of space heating units - Electric	8.42	19.7	58.8	85.6	89.5	89.7	89.7
Heat Pump (%)							
Sales of space heating units - Electric	9.49	11.8	7.94	3.83	3.14	3.17	3.29
Resistance (%)							
Sales of space heating units - Fossil (%)	24.2	31.3	12.5	6.86	6.43	6.34	6.23
Sales of space heating units - Gas (%)	57.9	37.3	20.7	3.68	0.918	0.75	0.749
Sales of water heating units - Electric	0	3.85	24.2	40.2	42.6	42.8	42.8
Heat Pump (%)							
Sales of water heating units - Electric	35.5	52.4	52.4	56.3	57.1	57.1	57.1
Resistance (%)							
Sales of water heating units - Gas Furnace	58.8	40.5	22.7	3.36	0.193	0	0
(%)							
Sales of water heating units - Other (%)	5.73	3.25	0.692	0.122	0.097	0.097	0.098

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

Item	2020	2025	2030	2035	2040	2045	2050
Light-duty vehicle capital costs -	0	2,057	5,276	8,545	12,946	14,088	13,433
Cumulative 5-yr (million \$2018)							
Public EV charging plugs - DC Fast (1000	0.267	0	3.52	0	15.4	0	24.9
units)							
Public EV charging plugs - L2 (1000 units)	1.32	0	84.6	0	370	0	599
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
(%)							

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

Item	2020	2025	2030	2035	2040	2045	2050
Vehicle sales - Heavy-duty - other (%)	1.5	1.23	1.07	0.568	0.163	0.038	0
Vehicle sales - Light-duty - diesel (%)	1.43	1.71	1.21	0.386	0.073	0.013	0
Vehicle sales - Light-duty - EV (%)	4.31	16.4	48.3	82.5	96.4	99.3	100
Vehicle sales - Light-duty - gasoline (%)	89.2	76.6	46.9	15.8	3.2	0.587	0
Vehicle sales - Light-duty - hybrid (%)	4.8	4.82	3.34	1.23	0.301	0.066	0
Vehicle sales - Light-duty - hydrogen FC	0.11	0.333	0.194	0.06	0.012	0.002	0
(%)							
Vehicle sales - Light-duty - other (%)	0.096	0.092	0.059	0.021	0.004	0.001	0
Vehicle sales - Medium-duty - diesel (%)	64.7	59.7	42.3	14.4	2.59	0.384	0
Vehicle sales - Medium-duty - EV (%)	0.784	5.07	25.3	60.8	76.5	79.5	80
Vehicle sales - Medium-duty - gasoline (%)	33.7	33.3	25.5	9.32	1.77	0.277	0
Vehicle sales - Medium-duty - hybrid (%)	0.363	0.402	0.341	0.14	0.03	0.005	0
Vehicle sales - Medium-duty - hydrogen	0.196	1.27	6.33	15.2	19.1	19.9	20
FC (%)							
Vehicle sales - Medium-duty - other (%)	0.253	0.255	0.205	0.083	0.019	0.004	0

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

Item	2020	2025	2030	2035	2040	2045	2050
Capital invested - Solar PV - Base (billion \$2018)	0	3.22	5.38	30.1	47.8	37.4	20.4
Capital invested - Wind - Base (billion \$2018)	0	0	0	0	0	53	92.8
Installed (cumulative) - OffshoreWind - Base land use assumptions (MW)	0	0	0	0	0	0	0
Installed (cumulative) - Solar - Base land use assumptions (MW)	86.8	2,489	6,985	34,263	80,226	118,350	140,419
Installed (cumulative) - Wind - Base land use assumptions (MW)	1,619	1,619	1,619	1,619	1,619	27,886	76,561

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

Item	2020	2025	2030	2035	2040	2045	2050
Solar - Base land use assumptions (GWh)	169	4,271	7,915	46,819	78,275	63,857	39,202
Solar - Constrained land use assumptions (GWh)	169	5,843	13,364	70,137	70,469	30,013	55,423
Wind - Base land use assumptions (GWh)	6,912	0	0	0	0	92,150	140,459
Wind - Constrained land use assumptions (GWh)	6,912	0	0	127,912	58,224	0	0

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

Item	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - Aggressive							-304
deployment - Corn-ethanol to energy							
grasses (1000 tCO2e/y)							
Carbon sink potential - Aggressive							-2,059
deployment - Cropland measures (1000							
tCO2e/y)							
Carbon sink potential - Aggressive							-95.2
deployment - Permanent conservation							
cover (1000 tC02e/y)							
Carbon sink potential - Aggressive							-2,458
deployment - Total (1000 tCO2e/y)							
Carbon sink potential - Moderate							-304
deployment - Corn-ethanol to energy							
grasses (1000 tC02e/y)							
Carbon sink potential - Moderate							-1,086
deployment - Cropland measures (1000							
tCO2e/y)							

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

Item	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - Moderate							-47.6
deployment - Permanent conservation							
cover (1000 tCO2e/y)							
Carbon sink potential - Moderate							-1,437
deployment - Total (1000 tCO2e/y)							
Land impacted for carbon sink -							139
Aggressive deployment - Corn-ethanol to							
energy grasses (1000 hectares)							
Land impacted for carbon sink -							1,571
Aggressive deployment - Cropland							
measures (1000 hectares)							
Land impacted for carbon sink -							173
Aggressive deployment - Permanent							
conservation cover (1000 hectares)							
Land impacted for carbon sink -							1,884
Aggressive deployment - Total (1000							
hectares)							
Land impacted for carbon sink - Moderate							139
deployment - Corn-ethanol to energy							
grasses (1000 hectares)							
Land impacted for carbon sink - Moderate							829
deployment - Cropland measures (1000							
hectares)							
Land impacted for carbon sink - Moderate							86.6
deployment - Permanent conservation							
cover (1000 hectares)							
Land impacted for carbon sink - Moderate							1,055
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)							-291
Carbon sink potential - High - All (not counting overlap) (1000 tC02e/y)							-27,852
Carbon sink potential - High - Avoid deforestation (1000 tCO2e/y)							-3,104
Carbon sink potential - High - Extend rotation length (1000 tC02e/y)							-8,777
Carbon sink potential - High - Improve plantations (1000 tCO2e/y)							-440
Carbon sink potential - High - Increase retention of HWP (1000 tC02e/y)							-5,935
Carbon sink potential - High - Increase trees outside forests (1000 tC02e/y)							-1,121
Carbon sink potential - High - Reforest cropland (1000 tC02e/y)							-186
Carbon sink potential - High - Reforest pasture (1000 tCO2e/y)							-4,122
Carbon sink potential - High - Restore productivity (1000 tC02e/y)							-3,875
Carbon sink potential - Low - Accelerate regeneration (1000 tCO2e/y)							-146
Carbon sink potential - Low - All (not counting overlap) (1000 tC02e/y)							-8,341
Carbon sink potential - Low - Avoid deforestation (1000 tC02e/y)							-517
Carbon sink potential - Low - Extend rotation length (1000 tC02e/y)							-3,371

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

Item	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - Low - Improve plantations (1000 tCO2e/y)							-224
· · · · · · · · · · · · · · · · · · ·							1.070
Carbon sink potential - Low - Increase							-1,978
retention of HWP (1000 tCO2e/y)							000
Carbon sink potential - Low - Increase							-392
trees outside forests (1000 tC02e/y)							00.0
Carbon sink potential - Low - Reforest							-93.2
cropland (1000 tCO2e/y)							
Carbon sink potential - Low - Reforest							-312
pasture (1000 tCO2e/y)							
Carbon sink potential - Low - Restore							-1,306
productivity (1000 tCO2e/y)							
Carbon sink potential - Mid - Accelerate							-218
regeneration (1000 tCO2e/y)							
Carbon sink potential - Mid - All (not							-18,092
counting overlap) (1000 tCO2e/y)							•
Carbon sink potential - Mid - Avoid							-1,811
deforestation (1000 tCO2e/y)							.,
Carbon sink potential - Mid - Extend							-6,074
rotation length (1000 tC02e/y)							0,014
Carbon sink potential - Mid - Improve							-328
· · · · · · · · · · · · · · · · · · ·							-320
plantations (1000 tC02e/y)							0.057
Carbon sink potential - Mid - Increase							-3,957
retention of HWP (1000 tCO2e/y)							
Carbon sink potential - Mid - Increase							-757
trees outside forests (1000 tCO2e/y)							
Carbon sink potential - Mid - Reforest							-140
cropland (1000 tCO2e/y)							
Carbon sink potential - Mid - Reforest							-2,217
pasture (1000 tCO2e/y)							
Carbon sink potential - Mid - Restore							-2,591
productivity (1000 tCO2e/y)							,-
Land impacted for carbon sink potential -							47.6
High - Accelerate regeneration (1000							11.0
hectares)							
Land impacted for carbon sink potential -							420
High - Avoid deforestation (over 30 years)							420
(1000 hectares)							
Land impacted for carbon sink potential -							4,476
High - Extend rotation length (1000							
hectares)							
Land impacted for carbon sink potential -							162
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 -							107
High - Increase trees outside forests							
(1000 hectares)							
Land impacted for carbon sink potential -			+				12.3
High - Reforest cropland (1000 hectares)							12.3
							117
Land impacted for carbon sink potential -							117
High - Reforest pasture (1000 hectares)							
Land impacted for carbon sink potential -							1,285
High - Restore productivity (1000							
hectares)							
Land impacted for carbon sink potential -							6,626
High - Total impacted (over 30 years)							
(1000 hectares)							

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 -	2020	2025	2030	2035	2040	2045	23.8
Low - Accelerate regeneration (1000							23.0
= -							
hectares)							205
Land impacted for carbon sink potential -							395
Low - Avoid deforestation (over 30 years)							
(1000 hectares)							
Land impacted for carbon sink potential -							1,715
Low - Extend rotation length (1000							
hectares)							
Land impacted for carbon sink potential -							81
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 -							56.1
Low - Increase trees outside forests							
(1000 hectares)							
Land impacted for carbon sink potential -							6.16
Low - Reforest cropland (1000 hectares)							
Land impacted for carbon sink potential -							20.3
Low - Reforest pasture (1000 hectares)							
Land impacted for carbon sink potential -							777
Low - Restore productivity (1000							
hectares)							
Land impacted for carbon sink potential -							3,074
Low - Total impacted (over 30 years)							
(1000 hectares)							
Land impacted for carbon sink potential -							35.7
Mid - Accelerate regeneration (1000							
hectares)							
Land impacted for carbon sink potential -							407
Mid - Avoid deforestation (over 30 years)							
(1000 hectares)							
Land impacted for carbon sink potential -							3,095
Mid - Extend rotation length (1000							•
hectares)							
Land impacted for carbon sink potential -							122
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 -							81.3
Mid - Increase trees outside forests (1000							01.0
hectares)							
Land impacted for carbon sink potential -							9.24
Mid - Reforest cropland (1000 hectares)							7.2-7
Land impacted for carbon sink potential -			+	+		+	147
Mid - Reforest pasture (1000 hectares)							141
Land impacted for carbon sink potential -						+	1,565
Mid - Restore productivity (1000							1,000
hectares)						+	E / / 0
Land impacted for carbon sink potential -							5,463
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 - Coal (million 2019\$)		2,374	1.62	1.6	1.47	1	0.081

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Table 34: <i>E</i> -	+RE+ scenario -	IMPACIS - F	teaith i	continueai

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution -		548	388	233	167	59.1	11.4
Natural Gas (million 2019\$)							
Monetary damages from air pollution -		4,170	3,868	2,927	1,689	768	300
Transportation (million 2019\$)							
Premature deaths from air pollution -		268	0.183	0.181	0.166	0.113	0.009
Coal (deaths)							
Premature deaths from air pollution -		61.8	43.8	26.3	18.8	6.67	1.29
Natural Gas (deaths)							
Premature deaths from air pollution -		469	435	329	190	86.4	33.7
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 -	0	59,163	64,630	0	0	0	0
Cumulative 5-yr (million \$2018)							
Sales of cooking units - Electric	18.5	33.7	75.3	83.5	83.9	84	84
Resistance (%)							
Sales of cooking units - Gas (%)	81.5	66.3	24.7	16.5	16.1	16	16
Sales of space heating units - Electric	2.56	11.7	42	73.7	78.6	79.2	79.1
Heat Pump (%)							
Sales of space heating units - Electric	5.59	4.8	13.3	19	20.2	19.9	20
Resistance (%)							
Sales of space heating units - Fossil (%)	19.4	14.8	2.91	0.126	0	0	0
Sales of space heating units - Gas Furnace	72.4	68.7	41.8	7.14	1.21	0.873	0.87
(%)							
Sales of water heating units - Electric	0.624	4.78	29.6	52.2	55.8	56	56
Heat Pump (%)							
Sales of water heating units - Electric	3.49	4.26	19.8	40.2	43.6	43.8	43.8
Resistance (%)							
Sales of water heating units - Gas Furnace	94.2	89.8	50.2	7.42	0.426	0	0
(%)							
Sales of water heating units - Other (%)	1.74	1.19	0.379	0.186	0.177	0.178	0.178

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

Item	2020	2025	2030	2035	2040	2045	2050
Electricity distribution capital invested -		6.13	6.27	11.6	12.4	12.4	13.1
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)	388	381	368	346	323	310	307
Final energy use - Industry (PJ)	791	783	767	757	724	706	669
Final energy use - Residential (PJ)	467	427	389	337	289	255	236
Final energy use - Transportation (PJ)	816	765	673	560	457	393	364

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

Item	2020	2025	2030	2035	2040	2045	2050
Residential HVAC investment in 2020s vs.	0	10.8	12.5	0	0	0	0
REF - Cumulative 5-yr (billion \$2018)							
Sales of cooking units - Electric	55.4	64.9	94	99.7	100	100	100
Resistance (%)							
Sales of cooking units - Gas (%)	44.6	35.1	6.01	0.303	0	0	0
Sales of space heating units - Electric	8.42	19.7	58.8	85.6	89.5	89.7	89.7
Heat Pump (%)							
Sales of space heating units - Electric	9.49	11.8	7.94	3.83	3.14	3.17	3.29
Resistance (%)							

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

Item	2020	2025	2030	2035	2040	2045	2050
Sales of space heating units - Fossil (%)	24.2	31.3	12.5	6.86	6.43	6.34	6.23
Sales of space heating units - Gas (%)	57.9	37.3	20.7	3.68	0.918	0.75	0.749
Sales of water heating units - Electric Heat Pump (%)	0	3.85	24.2	40.2	42.6	42.8	42.8
Sales of water heating units - Electric Resistance (%)	35.5	52.4	52.4	56.3	57.1	57.1	57.1
Sales of water heating units - Gas Furnace (%)	58.8	40.5	22.7	3.36	0.193	0	0
Sales of water heating units - Other (%)	5.73	3.25	0.692	0.122	0.097	0.097	0.098

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

Tem
Cumulative 5-yr (million \$2018) Dublic EV charging plugs - DC Fast (1000 units) 0.267 0 3.52 0 15.4 0 24 units) Public EV charging plugs - L2 (1000 units) 1.32 0 84.6 0 370 0 59 Vehicle sales - Heavy-duty - diesel (%) 97.2 92.1 67 23.3 4.22 0.628 Vehicle sales - Heavy-duty - EV (%) 0.588 3.81 19 45.6 57.4 59.6 6 Vehicle sales - Heavy-duty - gasoline (%) 0.227 0.227 0.176 0.066 0.013 0.002 Vehicle sales - Heavy-duty - hydrogen FC (%) 0.392 2.54 12.7 30.4 38.2 39.7 4 (%) Vehicle sales - Heavy-duty - other (%) 1.5 1.23 1.07 0.568 0.163 0.038 Vehicle sales - Light-duty - diesel (%) 1.43 1.71 1.21 0.386 0.073 0.013 Vehicle sales - Light-duty - EV (%) 4.31 16.4 48.3 82.5 96.4 99.3 10 </td
Public EV charging plugs - DC Fast (1000 units) 0.267 0 3.52 0 15.4 0 24 units) Public EV charging plugs - L2 (1000 units) 1.32 0 84.6 0 370 0 59 Vehicle sales - Heavy-duty - diesel (%) 97.2 92.1 67 23.3 4.22 0.628 Vehicle sales - Heavy-duty - EV (%) 0.588 3.81 19 45.6 57.4 59.6 6 Vehicle sales - Heavy-duty - gasoline (%) 0.227 0.227 0.176 0.066 0.013 0.002 Vehicle sales - Heavy-duty - hybrid (%) 0.082 0.09 0.077 0.031 0.007 0.001 Vehicle sales - Heavy-duty - hydrogen FC (%) 1.5 1.23 1.07 0.568 0.163 0.038 Vehicle sales - Light-duty - diesel (%) 1.43 1.71 1.21 0.386 0.073 0.013 Vehicle sales - Light-duty - EV (%) 4.31 16.4 48.3 82.5 96.4 99.3 10 Vehicle sales - Light-duty - hybrid (%) 4.
units) Public EV charging plugs - L2 (1000 units) 1.32 0 84.6 0 370 0 59 Vehicle sales - Heavy-duty - diesel (%) 97.2 92.1 67 23.3 4.22 0.628 Vehicle sales - Heavy-duty - EV (%) 0.588 3.81 19 45.6 57.4 59.6 6 Vehicle sales - Heavy-duty - gasoline (%) 0.227 0.227 0.176 0.066 0.013 0.002 Vehicle sales - Heavy-duty - hybrid (%) 0.082 0.09 0.077 0.031 0.007 0.001 Vehicle sales - Heavy-duty - hydrogen FC (%) 0.392 2.54 12.7 30.4 38.2 39.7 4 (%) Vehicle sales - Heavy-duty - other (%) 1.5 1.23 1.07 0.568 0.163 0.038 Vehicle sales - Light-duty - diesel (%) 1.43 1.71 1.21 0.386 0.073 0.013 Vehicle sales - Light-duty - gasoline (%) 89.2 76.6 46.9 15.8 3.2 0.587 Vehicle sales - Light-duty - hybrid
Public EV charging plugs - L2 (1000 units) 1.32 0 84.6 0 370 0 59 Vehicle sales - Heavy-duty - diesel (%) 97.2 92.1 67 23.3 4.22 0.628 Vehicle sales - Heavy-duty - EV (%) 0.588 3.81 19 45.6 57.4 59.6 6 Vehicle sales - Heavy-duty - gasoline (%) 0.227 0.227 0.176 0.066 0.013 0.002 Vehicle sales - Heavy-duty - hybrid (%) 0.082 0.09 0.077 0.031 0.007 0.001 Vehicle sales - Heavy-duty - hydrogen FC (%) 0.392 2.54 12.7 30.4 38.2 39.7 4 Vehicle sales - Heavy-duty - other (%) 1.5 1.23 1.07 0.568 0.163 0.038 Vehicle sales - Light-duty - diesel (%) 1.43 1.71 1.21 0.386 0.073 0.013 Vehicle sales - Light-duty - gasoline (%) 4.31 16.4 48.3 82.5 96.4 99.3 10 Vehicle sales - Light-duty - hydrogen FC 0.1
Vehicle sales - Heavy-duty - diesel (%) 97.2 92.1 67 23.3 4.22 0.628 Vehicle sales - Heavy-duty - EV (%) 0.588 3.81 19 45.6 57.4 59.6 6 Vehicle sales - Heavy-duty - gasoline (%) 0.227 0.227 0.176 0.066 0.013 0.002 Vehicle sales - Heavy-duty - hybrid (%) 0.082 0.09 0.077 0.031 0.007 0.001 Vehicle sales - Heavy-duty - hydrogen FC (%) 0.392 2.54 12.7 30.4 38.2 39.7 4 Vehicle sales - Heavy-duty - other (%) 1.5 1.23 1.07 0.568 0.163 0.038 Vehicle sales - Light-duty - diesel (%) 1.43 1.71 1.21 0.386 0.073 0.013 Vehicle sales - Light-duty - EV (%) 4.31 16.4 48.3 82.5 96.4 99.3 10 Vehicle sales - Light-duty - hybrid (%) 4.8 4.82 3.34 1.23 0.301 0.066 Vehicle sales - Light-duty - hybrid (%) 4.8 4
Vehicle sales - Heavy-duty - EV (%) 0.588 3.81 19 45.6 57.4 59.6 6 Vehicle sales - Heavy-duty - gasoline (%) 0.227 0.227 0.176 0.066 0.013 0.002 Vehicle sales - Heavy-duty - hydrogen FC (%) 0.082 0.09 0.077 0.031 0.007 0.001 Vehicle sales - Heavy-duty - hydrogen FC (%) 1.5 1.23 1.07 0.568 0.163 0.038 Vehicle sales - Light-duty - diesel (%) 1.43 1.71 1.21 0.386 0.073 0.013 Vehicle sales - Light-duty - EV (%) 4.31 16.4 48.3 82.5 96.4 99.3 10 Vehicle sales - Light-duty - gasoline (%) 89.2 76.6 46.9 15.8 3.2 0.587 Vehicle sales - Light-duty - hybrid (%) 4.8 4.82 3.34 1.23 0.301 0.066 Vehicle sales - Light-duty - hydrogen FC (%) 0.11 0.333 0.194 0.06 0.012 0.002
Vehicle sales - Heavy-duty - gasoline (%) 0.227 0.227 0.176 0.066 0.013 0.002 Vehicle sales - Heavy-duty - hybrid (%) 0.082 0.09 0.077 0.031 0.007 0.001 Vehicle sales - Heavy-duty - hydrogen FC (%) 0.392 2.54 12.7 30.4 38.2 39.7 4 Vehicle sales - Heavy-duty - other (%) 1.5 1.23 1.07 0.568 0.163 0.038 Vehicle sales - Light-duty - diesel (%) 1.43 1.71 1.21 0.386 0.073 0.013 Vehicle sales - Light-duty - EV (%) 4.31 16.4 48.3 82.5 96.4 99.3 10 Vehicle sales - Light-duty - gasoline (%) 89.2 76.6 46.9 15.8 3.2 0.587 Vehicle sales - Light-duty - hybrid (%) 4.8 4.82 3.34 1.23 0.301 0.066 Vehicle sales - Light-duty - hydrogen FC (%) 0.11 0.333 0.194 0.06 0.012 0.002
Vehicle sales - Heavy-duty - hybrid (%) 0.082 0.09 0.077 0.031 0.007 0.001 Vehicle sales - Heavy-duty - hydrogen FC (%) 0.392 2.54 12.7 30.4 38.2 39.7 4 Vehicle sales - Heavy-duty - other (%) 1.5 1.23 1.07 0.568 0.163 0.038 Vehicle sales - Light-duty - diesel (%) 1.43 1.71 1.21 0.386 0.073 0.013 Vehicle sales - Light-duty - EV (%) 4.31 16.4 48.3 82.5 96.4 99.3 10 Vehicle sales - Light-duty - gasoline (%) 89.2 76.6 46.9 15.8 3.2 0.587 Vehicle sales - Light-duty - hybrid (%) 4.8 4.82 3.34 1.23 0.301 0.066 Vehicle sales - Light-duty - hydrogen FC 0.11 0.333 0.194 0.06 0.012 0.002 (%)
Vehicle sales - Heavy-duty - hydrogen FC (%) 0.392 2.54 12.7 30.4 38.2 39.7 4 (%) Vehicle sales - Heavy-duty - other (%) 1.5 1.23 1.07 0.568 0.163 0.038 Vehicle sales - Light-duty - diesel (%) 1.43 1.71 1.21 0.386 0.073 0.013 Vehicle sales - Light-duty - EV (%) 4.31 16.4 48.3 82.5 96.4 99.3 10 Vehicle sales - Light-duty - gasoline (%) 89.2 76.6 46.9 15.8 3.2 0.587 Vehicle sales - Light-duty - hybrid (%) 4.8 4.82 3.34 1.23 0.301 0.066 Vehicle sales - Light-duty - hydrogen FC 0.11 0.333 0.194 0.06 0.012 0.002 (%)
(%) Vehicle sales - Heavy-duty - other (%) 1.5 1.23 1.07 0.568 0.163 0.038 Vehicle sales - Light-duty - diesel (%) 1.43 1.71 1.21 0.386 0.073 0.013 Vehicle sales - Light-duty - EV (%) 4.31 16.4 48.3 82.5 96.4 99.3 10 Vehicle sales - Light-duty - gasoline (%) 89.2 76.6 46.9 15.8 3.2 0.587 Vehicle sales - Light-duty - hybrid (%) 4.8 4.82 3.34 1.23 0.301 0.066 Vehicle sales - Light-duty - hydrogen FC 0.11 0.333 0.194 0.06 0.012 0.002 (%)
Vehicle sales - Heavy-duty - other (%) 1.5 1.23 1.07 0.568 0.163 0.038 Vehicle sales - Light-duty - diesel (%) 1.43 1.71 1.21 0.386 0.073 0.013 Vehicle sales - Light-duty - EV (%) 4.31 16.4 48.3 82.5 96.4 99.3 10 Vehicle sales - Light-duty - gasoline (%) 89.2 76.6 46.9 15.8 3.2 0.587 Vehicle sales - Light-duty - hybrid (%) 4.8 4.82 3.34 1.23 0.301 0.066 Vehicle sales - Light-duty - hydrogen FC 0.11 0.333 0.194 0.06 0.012 0.002 (%)
Vehicle sales - Light-duty - diesel (%) 1.43 1.71 1.21 0.386 0.073 0.013 Vehicle sales - Light-duty - EV (%) 4.31 16.4 48.3 82.5 96.4 99.3 10 Vehicle sales - Light-duty - gasoline (%) 89.2 76.6 46.9 15.8 3.2 0.587 Vehicle sales - Light-duty - hybrid (%) 4.8 4.82 3.34 1.23 0.301 0.066 Vehicle sales - Light-duty - hydrogen FC 0.11 0.333 0.194 0.06 0.012 0.002 (%)
Vehicle sales - Light-duty - EV (%) 4.31 16.4 48.3 82.5 96.4 99.3 10 Vehicle sales - Light-duty - gasoline (%) 89.2 76.6 46.9 15.8 3.2 0.587 Vehicle sales - Light-duty - hybrid (%) 4.8 4.82 3.34 1.23 0.301 0.066 Vehicle sales - Light-duty - hydrogen FC (%) 0.11 0.333 0.194 0.06 0.012 0.002 (%) 0.002 0.002 0.002 0.002 0.002 0.002
Vehicle sales - Light-duty - gasoline (%) 89.2 76.6 46.9 15.8 3.2 0.587 Vehicle sales - Light-duty - hybrid (%) 4.8 4.82 3.34 1.23 0.301 0.066 Vehicle sales - Light-duty - hydrogen FC (%) 0.11 0.333 0.194 0.06 0.012 0.002 (%)
Vehicle sales - Light-duty - hybrid (%) 4.8 4.82 3.34 1.23 0.301 0.066 Vehicle sales - Light-duty - hydrogen FC 0.11 0.333 0.194 0.06 0.012 0.002 (%) 0.002 0.002 0.002 0.002 0.002 0.002
Vehicle sales - Light-duty - hydrogen FC 0.11 0.333 0.194 0.06 0.012 0.002 (%)
(%)
Vehicle sales - Light-duty - other (%) 0.096 0.092 0.059 0.021 0.004 0.001
13 2 2 ()
Vehicle sales - Medium-duty - diesel (%) 64.7 59.7 42.3 14.4 2.59 0.384
Vehicle sales - Medium-duty - EV (%) 0.784 5.07 25.3 60.8 76.5 79.5 8
Vehicle sales - Medium-duty - gasoline (%) 33.7 33.3 25.5 9.32 1.77 0.277
Vehicle sales - Medium-duty - hybrid (%) 0.363 0.402 0.341 0.14 0.03 0.005
Vehicle sales - Medium-duty - hydrogen 0.196 1.27 6.33 15.2 19.1 19.9 2
FC (%)
Vehicle sales - Medium-duty - other (%) 0.253 0.255 0.205 0.083 0.019 0.004

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

		<u>. </u>		<u>, </u>			
Item	2020	2025	2030	2035	2040	2045	2050
Capital invested - Solar PV - Base (billion		0	0.794	0.689	1.23	1.11	0
\$2018)							
Capital invested - Solar PV - Constrained (billion \$2018)		0.746	2.35	1.42	1.73	4.6	0.659
Capital invested - Wind - Base (billion \$2018)		0	0	0	0	0	0
Capital invested - Wind - Constrained (billion \$2018)		0	0	0	0	0	0

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

Item	2020	2025	2030	2035	2040	2045	2050
Solar - Base land use assumptions (GWh)	169	0	1,190	1,106	2,111	1,988	0
Solar - Constrained land use assumptions	169	997	3,506	2,291	2,931	8,269	1,241
(GWh)							
Wind - Base land use assumptions (GWh)	6,912	0	0	0	0	0	0
Wind - Constrained land use assumptions	6,912	0	0	0	0	0	0
(GWh)							

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

lable 42: E+RE- scenario - PILLAR 6: Land			2225	2225			
Item	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - Aggressive							-304
deployment - Corn-ethanol to energy							
grasses (1000 tCO2e/y)							
Carbon sink potential - Aggressive							-2,059
deployment - Cropland measures (1000							
tCO2e/y)							
Carbon sink potential - Aggressive							-95.2
deployment - Permanent conservation							
cover (1000 tCO2e/y)							
Carbon sink potential - Aggressive							-2,458
deployment - Total (1000 tCO2e/y)							
Carbon sink potential - Moderate							-304
deployment - Corn-ethanol to energy							
grasses (1000 tCO2e/y)							
Carbon sink potential - Moderate							-1,086
deployment - Cropland measures (1000							
tCO2e/y)							
Carbon sink potential - Moderate							-47.6
deployment - Permanent conservation							
cover (1000 tCO2e/y)							
Carbon sink potential - Moderate							-1,437
deployment - Total (1000 tCO2e/y)							
Land impacted for carbon sink -							139
Aggressive deployment - Corn-ethanol to							
energy grasses (1000 hectares)							
Land impacted for carbon sink -							1,571
Aggressive deployment - Cropland							•
measures (1000 hectares)							
Land impacted for carbon sink -							173
Aggressive deployment - Permanent							
conservation cover (1000 hectares)							
Land impacted for carbon sink -							1,884
Aggressive deployment - Total (1000							.,00 .
hectares)							
Land impacted for carbon sink - Moderate							139
deployment - Corn-ethanol to energy							
grasses (1000 hectares)							
Land impacted for carbon sink - Moderate							829
deployment - Cropland measures (1000							027
hectares)							
Land impacted for carbon sink - Moderate							86.6
deployment - Permanent conservation							00.0
cover (1000 hectares)							
Land impacted for carbon sink - Moderate				-			1,055
deployment - Total (1000 hectares)							1,000
acployment - Total (1000 lieutal 65)							

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

Item	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - High - Accelerate							-291
regeneration (1000 tCO2e/y)							
Carbon sink potential - High - All (not							-27,852
counting overlap) (1000 tCO2e/y)							
Carbon sink potential - High - Avoid							-3,104
deforestation (1000 tCO2e/y)							
Carbon sink potential - High - Extend							-8,777
rotation length (1000 tCO2e/y)							
Carbon sink potential - High - Improve							-440
plantations (1000 tCO2e/y)							
Carbon sink potential - High - Increase							-5,935
retention of HWP (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 - High - Increase							-1,12
trees outside forests (1000 tC02e/y)							10/
Carbon sink potential - High - Reforest cropland (1000 tCO2e/y)							-186
Carbon sink potential - High - Reforest pasture (1000 tC02e/y)							-4,122
Carbon sink potential - High - Restore productivity (1000 tCO2e/y)							-3,875
Carbon sink potential - Low - Accelerate regeneration (1000 tCO2e/y)							-146
Carbon sink potential - Low - All (not counting overlap) (1000 tCO2e/y)							-8,34
Carbon sink potential - Low - Avoid deforestation (1000 tC02e/y)							-51
Carbon sink potential - Low - Extend rotation length (1000 tCO2e/y)							-3,37
Carbon sink potential - Low - Improve plantations (1000 tCO2e/y)							-22
Carbon sink potential - Low - Increase retention of HWP (1000 tCO2e/y)							-1,97
Carbon sink potential - Low - Increase trees outside forests (1000 tC02e/y)							-39
Carbon sink potential - Low - Reforest cropland (1000 tCO2e/y)							-93.
Carbon sink potential - Low - Reforest pasture (1000 tC02e/y)							-31
Carbon sink potential - Low - Restore productivity (1000 tCO2e/y)							-1,30
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO2e/y)							-21
Carbon sink potential - Mid - All (not counting overlap) (1000 tC02e/y)							-18,09
Carbon sink potential - Mid - Avoid deforestation (1000 tCO2e/y)							-1,81
Carbon sink potential - Mid - Extend rotation length (1000 tCO2e/y)							-6,07
Carbon sink potential - Mid - Improve plantations (1000 tCO2e/y)							-32
Carbon sink potential - Mid - Increase retention of HWP (1000 tCO2e/y)							-3,95
Carbon sink potential - Mid - Increase trees outside forests (1000 tCO2e/y)							-75
Carbon sink potential - Mid - Reforest cropland (1000 tCO2e/y)							-14
Carbon sink potential - Mid - Reforest pasture (1000 tCO2e/y)							-2,21
Carbon sink potential - Mid - Restore productivity (1000 tCO2e/y)							-2,59
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)							47.
Land impacted for carbon sink potential - High - Avoid deforestation (over 30 years)							42
(1000 hectares) Land impacted for carbon sink potential - High - Extend rotation length (1000							4,4 <u>7</u>
hectares) Land impacted for carbon sink potential - High - Improve plantations (1000 hectares)							16

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

Land impacted for carbon sink potential -	2020	2025	2030	2035	2040	2045	2050
High - Increase retention of HWP (1000							(
hectares)							
Land impacted for carbon sink potential -							10
High - Increase trees outside forests							
(1000 hectares)							
Land impacted for carbon sink potential -							12.3
High - Reforest cropland (1000 hectares)							
Land impacted for carbon sink potential -							117
High - Reforest pasture (1000 hectares)							
Land impacted for carbon sink potential -							1,285
High - Restore productivity (1000							
hectares)							
Land impacted for carbon sink potential -							6,626
High - Total impacted (over 30 years)							
(1000 hectares)							
Land impacted for carbon sink potential -							23.8
Low - Accelerate regeneration (1000							
hectares)							
Land impacted for carbon sink potential -							395
Low - Avoid deforestation (over 30 years)							
(1000 hectares)							
Land impacted for carbon sink potential -							1,715
Low - Extend rotation length (1000							
hectares)							
Land impacted for carbon sink potential -							8
Low - Improve plantations (1000							
hectares)							
Land impacted for carbon sink potential -							(
Low - Increase retention of HWP (1000							
hectares)							
Land impacted for carbon sink potential -							56.
Low - Increase trees outside forests							
(1000 hectares)							
Land impacted for carbon sink potential -							6.16
Low - Reforest cropland (1000 hectares)							
Land impacted for carbon sink potential -							20.3
Low - Reforest pasture (1000 hectares)							
Land impacted for carbon sink potential -							77
Low - Restore productivity (1000							
hectares)							
Land impacted for carbon sink potential -							3,074
Low - Total impacted (over 30 years)							
(1000 hectares)							
Land impacted for carbon sink potential -							35.
Mid - Accelerate regeneration (1000							
hectares)							
Land impacted for carbon sink potential -							40
Mid - Avoid deforestation (over 30 years)							
(1000 hectares)							
Land impacted for carbon sink potential -							3,09
Mid - Extend rotation length (1000							-,-
hectares)							
Land impacted for carbon sink potential -		 					12:
Mid - Improve plantations (1000 hectares)		[12.
Land impacted for carbon sink potential -		-					
Mid - Increase retention of HWP (1000		[,
hectares)							
Land impacted for carbon sink potential -		-					81.3
Mid - Increase trees outside forests (1000							01.0
hectares)							

Table 43: E+RE-	cconario	DTIIAD	6. Land sinks	Enrocte	(continued)
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Item	2020	2025	2030	2035	2040	2045	2050
Land impacted for carbon sink potential -							9.24
Mid - Reforest cropland (1000 hectares)							
Land impacted for carbon sink potential -							147
Mid - Reforest pasture (1000 hectares)							
Land impacted for carbon sink potential -							1,565
Mid - Restore productivity (1000							
hectares)							
Land impacted for carbon sink potential -							5,463
Mid - Total impacted (over 30 years) (1000							
hectares)							

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

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution -		2,374	1.62	1.6	1.47	1	0.081
Coal (million 2019\$)							
Monetary damages from air pollution -		621	483	573	436	166	51.7
Natural Gas (million 2019\$)							
Monetary damages from air pollution -		4,170	3,868	2,927	1,689	768	300
Transportation (million 2019\$)							
Premature deaths from air pollution -		268	0.183	0.181	0.166	0.113	0.009
Coal (deaths)							
Premature deaths from air pollution -		70.1	54.5	64.6	49.2	18.8	5.84
Natural Gas (deaths)							
Premature deaths from air pollution -		469	435	329	190	86.4	33.7
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 - Cumulative 5-yr (million \$2018)	0	59,150	64,632	0	0	0	0
Sales of cooking units - Electric Resistance (%)	18.5	21.6	27.5	43	64.5	77.7	82.3
Sales of cooking units - Gas (%)	81.5	78.4	72.5	57	35.5	22.3	17.7
Sales of space heating units - Electric Heat Pump (%)	2.56	7.82	11.2	21.8	42.1	62.6	73.2
Sales of space heating units - Electric Resistance (%)	5.59	3.46	4.4	7.36	12.7	16.8	19
Sales of space heating units - Fossil (%)	19.4	17.2	16.4	12.8	6.63	2.21	0.78
Sales of space heating units - Gas Furnace (%)	72.4	71.6	67.9	58.1	38.6	18.3	7.04
Sales of water heating units - Electric Heat Pump (%)	0.624	1.34	4.16	12.7	28.8	44.1	51.9
Sales of water heating units - Electric Resistance (%)	3.49	2.59	4.34	9.88	21.2	33.5	40.1
Sales of water heating units - Gas Furnace (%)	94.2	94.7	90.2	76.4	49.4	22.1	7.82
Sales of water heating units - Other (%)	1.74	1.35	1.32	1.03	0.608	0.33	0.23

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

Item	2020	2025	2030	2035	2040	2045	2050
Electricity distribution capital invested -		5.07	5.09	7.06	7.31	10.1	10.6
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)	388	381	378	375	368	359	349

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

	-	-	•	-			
Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Industry (PJ)	791	783	769	764	735	716	676
Final energy use - Residential (PJ)	467	428	403	379	349	315	281
Final energy use - Transportation (PJ)	817	772	705	650	607	555	495

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

Item	2020	2025	2030	2035	2040	2045	2050
Residential HVAC investment in 2020s vs.	0	10.8	13	0	0	0	0
REF - Cumulative 5-yr (billion \$2018)							
Sales of cooking units - Electric	55.2	56.3	60.5	71.3	86.3	95.6	98.8
Resistance (%)							
Sales of cooking units - Gas (%)	44.8	43.7	39.5	28.7	13.7	4.42	1.19
Sales of space heating units - Electric	8.42	13.6	18	31.2	54.5	74.9	84.5
Heat Pump (%)							
Sales of space heating units - Electric	9.49	12.2	11.8	10.4	7.78	5.17	3.89
Resistance (%)							
Sales of space heating units - Fossil (%)	24.2	34.8	32.7	26.6	17	10.3	7.7
Sales of space heating units - Gas (%)	57.9	39.4	37.5	31.8	20.7	9.65	3.89
Sales of water heating units - Electric	0	0.823	3.14	10.1	22.7	34.2	39.8
Heat Pump (%)							
Sales of water heating units - Electric	35.5	52.7	52.6	52.6	53.5	55.2	56.4
Resistance (%)							
Sales of water heating units - Gas Furnace	58.8	42.8	40.8	34.6	22.4	10	3.56
(%)							
Sales of water heating units - Other (%)	5.73	3.74	3.46	2.63	1.37	0.535	0.247

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

Item	2020	2025	2030	2035	2040	2045	2050
Light-duty vehicle capital costs -	0	0	333	699	2,363	7,431	10,827
Cumulative 5-yr (million \$2018)							
Public EV charging plugs - DC Fast (1000	0.267	0	1.09	0	5.72	0	16
_units)							
Public EV charging plugs - L2 (1000 units)	1.32	0	26.2	0	137	0	383
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 (%)	1.45	1.88	2.04	1.61	1.02	0.523	0.225
Vehicle sales - Light-duty - EV (%)	2.03	4.99	12.5	26.8	49.4	72.7	87.8
Vehicle sales - Light-duty - gasoline (%)	91.3	86.9	78.6	65.4	45	24.1	10.7
Vehicle sales - Light-duty - hybrid (%)	4.99	5.77	6.44	5.8	4.29	2.5	1.2
Vehicle sales - Light-duty - hydrogen FC	0.112	0.377	0.319	0.241	0.17	0.094	0.044
(%)							
Vehicle sales - Light-duty - other (%)	0.098	0.101	0.091	0.079	0.057	0.031	0.014
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	0	0	0	0	0
Capital invested - Biomass w/ccu allam power plant (billion \$2018)	0	0	0	0	0	0	0
Capital invested - Biomass w/ccu power plant (billion \$2018)	0	0	0	0	0	0	0

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

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

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

Item	2020	2025	2030	2035	2040	2045	2050
Biomass purchases (million \$2018/year)	0	0	0	0	0	0	1,316
Conversion capital investment -	0	0	0	0	0	0	14,912
Cumulative 5-yr (million \$2018)							
Number of facilities - Allam power w ccu	0	0	0	0	0	0	0
(quantity)							
Number of facilities - Beccs hydrogen	0	0	0	0	0	0	0
(quantity)							
Number of facilities - Diesel (quantity)	0	0	0	0	0	0	0
Number of facilities - Diesel ccu (quantity)	0	0	0	0	0	0	0
Number of facilities - Power (quantity)	0	0	0	0	0	0	0
Number of facilities - Power ccu	0	0	0	0	0	0	0
(quantity)							
Number of facilities - Pyrolysis (quantity)	0	0	0	0	0	0	15
Number of facilities - Pyrolysis ccu	0	0	0	0	0	0	0
(quantity)							
Number of facilities - Sng (quantity)	0	0	0	0	0	0	0
Number of facilities - Sng ccu (quantity)	0	0	0	0	0	0	0

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

Item	2020	2025	2030	2035	2040	2045	2050
Annual - All (MMT)		0	0	3.35	3.32	6.84	7.07
Annual - BECCS (MMT)		0	0	0	0	0	0
Annual - Cement and lime (MMT)		0	0	3.35	3.32	6.84	7.07
Annual - NGCC (MMT)		0	0	0	0	0	0
Cumulative - All (MMT)		0	0	3.35	6.67	13.5	20.6
Cumulative - BECCS (MMT)		0	0	0	0	0	0
Cumulative - Cement and lime (MMT)		0	0	3.35	6.67	13.5	20.6
Cumulative - NGCC (MMT)		0	0	0	0	0	0

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

Item	2020	2025	2030	2035	2040	2045	2050
All (km)		0	622	826	826	1,084	909
Cumulative investment - All (million \$2018)		0	1,668	2,627	2,627	3,210	3,121
Cumulative investment - Spur (million \$2018)		0	54.5	97.9	97.7	272	183
Cumulative investment - Trunk (million \$2018)		0	1,614	2,529	2,529	2,938	2,938
Spur (km)		0	107	157	157	416	241
Trunk (km)		0	515	669	669	669	669

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

		•					
Item	2020	2025	2030	2035	2040	2045	2050
CO2 storage (MMT)		0	0	0	0	0	0
Injection wells (wells)		0	0	0	0	0	0
Resource characterization, appraisal, permitting costs (million \$2020)		0	0	0	0	0	0
Wells and facilities construction costs (million \$2020)		0	0	0	0	0	0

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

Item	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - Aggressive							-627
deployment - Corn-ethanol to energy							
grasses (1000 tCO2e/y)							
Carbon sink potential - Aggressive							-1,91
deployment - Cropland measures (1000							
tCO2e/y)							
Carbon sink potential - Aggressive							C
deployment - Cropland to woody energy							
crops (1000 tCO2e/y)							
Carbon sink potential - Aggressive							C
deployment - Pasture to energy crops							
(1000 tC02e/y)							
Carbon sink potential - Aggressive							-88.
deployment - Permanent conservation							
cover (1000 tC02e/y)							
Carbon sink potential - Aggressive							-2,62
deployment - Total (1000 tCO2e/y)							
Carbon sink potential - Moderate							-627
deployment - Corn-ethanol to energy							
grasses (1000 tCO2e/y)							1.000
Carbon sink potential - Moderate							-1,009
deployment - Cropland measures (1000							
tC02e/y)							
Carbon sink potential - Moderate							(
deployment - Cropland to woody energy							
crops (1000 tC02e/y)							
Carbon sink potential - Moderate							(
deployment - Pasture to energy crops							
(1000 tCO2e/y) Carbon sink potential - Moderate							1.1.
deployment - Permanent conservation							-44.
cover (1000 tCO2e/y)							
Carbon sink potential - Moderate							-1,680
deployment - Total (1000 tC02e/y)							-1,000
Land impacted for carbon sink -	-						253
Aggressive deployment - Corn-ethanol to							250
energy grasses (1000 hectares)							
Land impacted for carbon sink -							3,594
Aggressive deployment - Cropland							3,375
measures (1000 hectares)							
Land impacted for carbon sink -		+				+	14.8
Aggressive deployment - Cropland to							14.0
woody energy crops (1000 hectares)							
Land impacted for carbon sink -		+				+	58.
Aggressive deployment - Pasture to							00.
energy crops (1000 hectares)							
Land impacted for carbon sink -		+					160
Aggressive deployment - Permanent							100
conservation cover (1000 hectares)							
Land impacted for carbon sink -		+					4,080
Aggressive deployment - Total (1000							4,000
Aggi coolve achinyment - Intal (1000							

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							253
deployment - Corn-ethanol to energy							
grasses (1000 hectares)							
Land impacted for carbon sink - Moderate							768
deployment - Cropland measures (1000							
hectares)							
Land impacted for carbon sink - Moderate							14.8
deployment - Cropland to woody energy							
crops (1000 hectares)							
Land impacted for carbon sink - Moderate							58.1
deployment - Pasture to energy crops							
(1000 hectares)							
Land impacted for carbon sink - Moderate							80.2
deployment - Permanent conservation							
cover (1000 hectares)							
Land impacted for carbon sink - Moderate							1,174
deployment - Total (1000 hectares)							

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

Item	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - High - Accelerate							-29 ⁻
regeneration (1000 tCO2e/y)							
Carbon sink potential - High - All (not							-27,852
counting overlap) (1000 tCO2e/y)							
Carbon sink potential - High - Avoid							-3,104
deforestation (1000 tCO2e/y)							
Carbon sink potential - High - Extend							-8,777
rotation length (1000 tCO2e/y)							
Carbon sink potential - High - Improve							-440
plantations (1000 tCO2e/y)							
Carbon sink potential - High - Increase							-5,935
retention of HWP (1000 tCO2e/y)							
Carbon sink potential - High - Increase							-1,121
trees outside forests (1000 tCO2e/y)							
Carbon sink potential - High - Reforest							-186
cropland (1000 tCO2e/y)							
Carbon sink potential - High - Reforest							-4,122
pasture (1000 tCO2e/y)							
Carbon sink potential - High - Restore							-3,875
productivity (1000 tCO2e/y)							
Carbon sink potential - Low - Accelerate							-146
regeneration (1000 tCO2e/y)							
Carbon sink potential - Low - All (not							-8,341
counting overlap) (1000 tCO2e/y)							
Carbon sink potential - Low - Avoid							-517
deforestation (1000 tC02e/y)							
Carbon sink potential - Low - Extend							-3,37
rotation length (1000 tCO2e/y)							
Carbon sink potential - Low - Improve							-224
plantations (1000 tCO2e/y)							
Carbon sink potential - Low - Increase							-1,978
retention of HWP (1000 tCO2e/y)							•
Carbon sink potential - Low - Increase							-392
trees outside forests (1000 tCO2e/y)							
Carbon sink potential - Low - Reforest							-93.2
cropland (1000 tCO2e/y)							
Carbon sink potential - Low - Reforest							-312
pasture (1000 tC02e/y)							012
Carbon sink potential - Low - Restore							-1,306
productivity (1000 tC02e/y)							.,500

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

Item	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - Mid - Accelerate							-218
regeneration (1000 tC02e/y)							10.000
Carbon sink potential - Mid - All (not							-18,092
counting overlap) (1000 tC02e/y)							
Carbon sink potential - Mid - Avoid							-1,811
deforestation (1000 tCO2e/y)							
Carbon sink potential - Mid - Extend							-6,074
rotation length (1000 tCO2e/y)							
Carbon sink potential - Mid - Improve							-328
plantations (1000 tCO2e/y)							
Carbon sink potential - Mid - Increase							-3,957
retention of HWP (1000 tCO2e/y)							
Carbon sink potential - Mid - Increase							-757
trees outside forests (1000 tCO2e/y)							
Carbon sink potential - Mid - Reforest							-140
cropland (1000 tCO2e/y)							
Carbon sink potential - Mid - Reforest							-2,217
pasture (1000 tC02e/y)							
Carbon sink potential - Mid - Restore							-2,591
productivity (1000 tCO2e/y)							,-
Land impacted for carbon sink potential -							47.6
High - Accelerate regeneration (1000							
hectares)							
Land impacted for carbon sink potential -							420
High - Avoid deforestation (over 30 years)							720
(1000 hectares)							
Land impacted for carbon sink potential -							4,476
High - Extend rotation length (1000							4,410
hectares)							
-							162
Land impacted for carbon sink potential -							162
High - Improve plantations (1000							
hectares)							0
Land impacted for carbon sink potential -							0
High - Increase retention of HWP (1000							
hectares)							407
Land impacted for carbon sink potential -							107
High - Increase trees outside forests							
(1000 hectares)							
Land impacted for carbon sink potential -							12.3
High - Reforest cropland (1000 hectares)							
Land impacted for carbon sink potential -							117
High - Reforest pasture (1000 hectares)							
Land impacted for carbon sink potential -							1,285
High - Restore productivity (1000							
hectares)							
Land impacted for carbon sink potential -							6,626
High - Total impacted (over 30 years)							
(1000 hectares)							
Land impacted for carbon sink potential -							23.8
Low - Accelerate regeneration (1000							
hectares)							
Land impacted for carbon sink potential -							395
Low - Avoid deforestation (over 30 years)							
(1000 hectares)							
Land impacted for carbon sink potential -							1,715
Low - Extend rotation length (1000							,
hectares)							
Land impacted for carbon sink potential -		+					81
Low - Improve plantations (1000							
hectares)							
пестагеяј							

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 -							0
Low - Increase retention of HWP (1000							
hectares)							
Land impacted for carbon sink potential -							56.1
Low - Increase trees outside forests							
(1000 hectares)							
Land impacted for carbon sink potential -							6.16
Low - Reforest cropland (1000 hectares)							
Land impacted for carbon sink potential -							20.3
Low - Reforest pasture (1000 hectares)							
Land impacted for carbon sink potential -							777
Low - Restore productivity (1000							
hectares)							
Land impacted for carbon sink potential -							3,074
Low - Total impacted (over 30 years)							
(1000 hectares)							
Land impacted for carbon sink potential -							35.7
Mid - Accelerate regeneration (1000							
hectares)							
Land impacted for carbon sink potential -							407
Mid - Avoid deforestation (over 30 years)							
(1000 hectares)							
Land impacted for carbon sink potential -							3,095
Mid - Extend rotation length (1000							
hectares)							
Land impacted for carbon sink potential -							122
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 -							81.3
Mid - Increase trees outside forests (1000							
hectares)							
Land impacted for carbon sink potential -							9.24
Mid - Reforest cropland (1000 hectares)							
Land impacted for carbon sink potential -							147
Mid - Reforest pasture (1000 hectares)							
Land impacted for carbon sink potential -							1,565
Mid - Restore productivity (1000							
hectares)							
Land impacted for carbon sink potential -							5,463
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 -		2,374	1.62	1.6	1.47	1	0.081
Coal (million 2019\$)							
Monetary damages from air pollution -		599	357	206	160	92.3	25.3
Natural Gas (million 2019\$)							
Monetary damages from air pollution -		4,245	4,272	4,139	3,715	2,952	2,023
Transportation (million 2019\$)							
Premature deaths from air pollution -		268	0.183	0.181	0.166	0.113	0.009
Coal (deaths)							
Premature deaths from air pollution -		67.6	40.3	23.3	18.1	10.4	2.85
Natural Gas (deaths)							
Premature deaths from air pollution -		477	480	466	418	332	228
Transportation (deaths)							

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

Item	2020	2025	2030	2035	2040	2045	2050
Commercial HVAC investment in 2020s - Cumulative 5-yr (million \$2018)	0	58,459	60,226	0	0	0	0
Sales of cooking units - Electric Resistance (%)	18.5	19.4	19.4	19.6	19.7	19.8	19.9
Sales of cooking units - Gas (%)	81.5	80.6	80.6	80.4	80.3	80.2	80.1
Sales of space heating units - Electric Heat Pump (%)	2.56	12.8	39.8	61.7	65	65.6	65.5
Sales of space heating units - Electric Resistance (%)	5.59	4.04	8.87	21.3	31.9	33.3	33.6
Sales of space heating units - Fossil (%)	19.4	16.7	13	5.8	0.885	0.071	0
Sales of space heating units - Gas Furnace (%)	72.4	66.4	38.4	11.1	2.19	0.955	0.868
Sales of water heating units - Electric Heat Pump (%)	0.624	0.33	0.331	0.332	0.331	0.334	0.334
Sales of water heating units - Electric Resistance (%)	3.49	1.96	1.94	1.95	1.94	1.94	1.94
Sales of water heating units - Gas Furnace (%)	94.2	96.3	96.3	96.3	96.3	96.2	96.2
Sales of water heating units - Other (%)	1.74	1.38	1.45	1.44	1.45	1.49	1.49

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

Item	2020	2025	2030	2035	2040	2045	2050
Electricity distribution capital invested -		5.28	5.32	8.01	8.36	9.84	10.3
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)	388	385	387	386	389	402	426
Final energy use - Industry (PJ)	792	798	821	830	852	875	887
Final energy use - Residential (PJ)	467	430	411	398	391	386	383
Final energy use - Transportation (PJ)	816	774	716	682	684	705	733

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

Item	2020	2025	2030	2035	2040	2045	2050
Residential HVAC investment in 2020s vs.	0	10.4	10.9	0	0	0	0
REF - Cumulative 5-yr (billion \$2018)							
Sales of cooking units - Electric	54.8	54.8	54.8	54.8	54.8	54.8	54.8
Resistance (%)							
Sales of cooking units - Gas (%)	45.2	45.2	45.2	45.2	45.2	45.2	45.2
Sales of space heating units - Electric	6.94	20.6	21.2	22	22.5	23	23.7
Heat Pump (%)							
Sales of space heating units - Electric	9.71	11.3	11.1	10.9	10.7	10.1	9.42
Resistance (%)							
Sales of space heating units - Fossil (%)	24.6	29.7	17.7	10.2	9.79	9.79	9.79
Sales of space heating units - Gas (%)	58.8	38.5	50	56.9	57	57	57.1
Sales of water heating units - Electric	0	0	0	0	0	0	0
Heat Pump (%)							
Sales of water heating units - Electric	35.5	52.7	52.6	52.5	52.4	52.4	52.3
Resistance (%)							
Sales of water heating units - Gas Furnace	58.8	43.5	43.6	43.7	43.7	43.8	43.9
(%)							
Sales of water heating units - Other (%)	5.73	3.84	3.85	3.85	3.86	3.86	3.87

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 (%)	1.44	1.87	2.16	2.02	1.81	1.69	1.6
Vehicle sales - Light-duty - EV (%)	3.95	6.1	6.91	8.53	10.3	11.9	13.1
Vehicle sales - Light-duty - gasoline (%)	89.6	85.9	83.6	81.6	79.5	77.5	76
Vehicle sales - Light-duty - hybrid (%)	4.82	5.65	6.89	7.44	7.98	8.5	8.88
Vehicle sales - Light-duty - hydrogen FC	0.11	0.373	0.339	0.3	0.296	0.295	0.306
(%)							
Vehicle sales - Light-duty - other (%)	0.097	0.101	0.097	0.097	0.097	0.095	0.098
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							-29
regeneration (1000 tCO2e/y)							
Carbon sink potential - High - All (not							-27,852
counting overlap) (1000 tCO2e/y)							
Carbon sink potential - High - Avoid							-3,104
deforestation (1000 tCO2e/y)							
Carbon sink potential - High - Extend							-8,77
rotation length (1000 tCO2e/y)							
Carbon sink potential - High - Improve							-44(
plantations (1000 tCO2e/y)							
Carbon sink potential - High - Increase							-5,935
retention of HWP (1000 tCO2e/y)							
Carbon sink potential - High - Increase							-1,12
trees outside forests (1000 tCO2e/y)							
Carbon sink potential - High - Reforest							-18
cropland (1000 tCO2e/y)							
Carbon sink potential - High - Reforest							-4,12
pasture (1000 tCO2e/y)							
Carbon sink potential - High - Restore							-3,87
productivity (1000 tCO2e/y)							
Carbon sink potential - Low - Accelerate							-14
regeneration (1000 tCO2e/y)							
Carbon sink potential - Low - All (not							-8,34
counting overlap) (1000 tCO2e/y)							
Carbon sink potential - Low - Avoid							-51
deforestation (1000 tCO2e/y)							
Carbon sink potential - Low - Extend							-3,37
rotation length (1000 tCO2e/y)							
Carbon sink potential - Low - Improve							-22
plantations (1000 tCO2e/y)							
Carbon sink potential - Low - Increase							-1,97
retention of HWP (1000 tCO2e/y)							
Carbon sink potential - Low - Increase							-39
trees outside forests (1000 tC02e/y)							
Carbon sink potential - Low - Reforest							-93.
cropland (1000 tCO2e/y)							

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

Item Corbon sink notantial Law Referent	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - Low - Reforest							-312
pasture (1000 tC02e/y)							
Carbon sink potential - Low - Restore							-1,306
productivity (1000 tC02e/y)							04.0
Carbon sink potential - Mid - Accelerate							-218
regeneration (1000 tC02e/y)							10.000
Carbon sink potential - Mid - All (not							-18,092
counting overlap) (1000 tC02e/y)							1 011
Carbon sink potential - Mid - Avoid							-1,811
deforestation (1000 tC02e/y)							
Carbon sink potential - Mid - Extend							-6,074
rotation length (1000 tC02e/y)							000
Carbon sink potential - Mid - Improve							-328
plantations (1000 tC02e/y)							0.055
Carbon sink potential - Mid - Increase							-3,957
retention of HWP (1000 tC02e/y)							75-
Carbon sink potential - Mid - Increase							-757
trees outside forests (1000 tC02e/y)							
Carbon sink potential - Mid - Reforest							-140
cropland (1000 tCO2e/y)							
Carbon sink potential - Mid - Reforest							-2,217
pasture (1000 tCO2e/y)							
Carbon sink potential - Mid - Restore							-2,591
productivity (1000 tCO2e/y)							
Land impacted for carbon sink potential -							47.6
High - Accelerate regeneration (1000							
hectares)							
Land impacted for carbon sink potential -							420
High - Avoid deforestation (over 30 years)							
(1000 hectares)							
Land impacted for carbon sink potential -							4,476
High - Extend rotation length (1000							
hectares)							
Land impacted for carbon sink potential -							162
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 -							107
High - Increase trees outside forests							
(1000 hectares)							
Land impacted for carbon sink potential -							12.3
High - Reforest cropland (1000 hectares)							
Land impacted for carbon sink potential -							117
High - Reforest pasture (1000 hectares)							
Land impacted for carbon sink potential -							1,285
High - Restore productivity (1000							
hectares)							
Land impacted for carbon sink potential -							6,626
High - Total impacted (over 30 years)							
(1000 hectares)							
Land impacted for carbon sink potential -							23.8
Low - Accelerate regeneration (1000							
hectares)							
Land impacted for carbon sink potential -							395
Low - Avoid deforestation (over 30 years)							
(1000 hectares)							
Land impacted for carbon sink potential -							1,715
Low - Extend rotation length (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 -							81
Low - Improve plantations (1000							
hectares)							
Land impacted for carbon sink potential -							0
Low - Increase retention of HWP (1000							
hectares)							F/1
Land impacted for carbon sink potential -							56.1
Low - Increase trees outside forests							
(1000 hectares) Land impacted for carbon sink potential -							6.16
Low - Reforest cropland (1000 hectares)							0.10
Land impacted for carbon sink potential -							20.3
Low - Reforest pasture (1000 hectares)							20.3
Land impacted for carbon sink potential -							777
Low - Restore productivity (1000							111
hectares)							
Land impacted for carbon sink potential -							3,074
Low - Total impacted (over 30 years)							0,014
(1000 hectares)							
Land impacted for carbon sink potential -							35.7
Mid - Accelerate regeneration (1000							
hectares)							
Land impacted for carbon sink potential -							407
Mid - Avoid deforestation (over 30 years)							
(1000 hectares)							
Land impacted for carbon sink potential -							3,095
Mid - Extend rotation length (1000							
hectares)							
Land impacted for carbon sink potential -							122
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 -							81.3
Mid - Increase trees outside forests (1000							
hectares)							
Land impacted for carbon sink potential -							9.24
Mid - Reforest cropland (1000 hectares)							417
Land impacted for carbon sink potential -							147
Mid - Reforest pasture (1000 hectares)							15/5
Land impacted for carbon sink potential -							1,565
Mid - Restore productivity (1000							
hectares) Land impacted for carbon sink potential -							5,463
Mid - Total impacted (over 30 years) (1000							5,463
hectares)							
1100(a) 60)							

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

Item	2020	2025	2030	2035	2040	2045	2050
Business-as-usual carbon sink - Natural uptake (Mt CO2e/y)	-32.9		-14.7				-13.1
Business-as-usual carbon sink - Retained in Hardwood Products (Mt CO2e/y)	-1.61		-2.91				-3.02
Business-as-usual carbon sink - Total (Mt CO2e/y)	-34.5		-17.6				-16.2

Table 66: REF scenario - IMPACTS - Health

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution -		6,216	3,922	3,657	3,539	3,467	3,151
Coal (million 2019\$)							
Monetary damages from air pollution -		453	501	643	656	647	588
Natural Gas (million 2019\$)							
Monetary damages from air pollution -		4,236	4,322	4,405	4,511	4,620	4,736
Transportation (million 2019\$)							
Premature deaths from air pollution -		702	443	413	400	392	356
Coal (deaths)							
Premature deaths from air pollution -		51.1	56.6	72.5	74	73	66.4
Natural Gas (deaths)							
Premature deaths from air pollution -		476	486	495	507	520	533
Transportation (deaths)							