

Net-Zero America - missouri state report

2021-03-18

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

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Notes

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

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

Item	2020	2025	2030	2035	2040	2045	2050
Commercial HVAC investment in 2020s - Cumulative 5-yr (million \$2018)		16,269	17,611				
Sales of cooking units - Electric Resistance (%)	44.8	57.1	84	89.3	89.6	89.6	89.6
Sales of cooking units - Gas (%)	55.2	42.9	16	10.7	10.4	10.4	10.4
Sales of space heating units - Electric Heat Pump (%)	4.52	24.4	70.6	87.7	89.7	89.7	89.7
Sales of space heating units - Electric Resistance (%)	8.06	5.73	7.1	9.32	9.79	9.8	9.8
Sales of space heating units - Fossil (%)	0	1.75	0.337	0.014	0	0	0
Sales of space heating units - Gas Furnace (%)	87.4	68.1	22	2.94	0.553	0.458	0.459
Sales of water heating units - Electric Heat Pump (%)	1.19	10.6	53.1	64.2	65	65	65
Sales of water heating units - Electric Resistance (%)	10.1	11	28.4	33.8	34.3	34.3	34.3
Sales of water heating units - Gas Furnace (%)	87.7	77.5	17.8	1.26	0.041	0	0
Sales of water heating units - Other (%)	0.996	0.947	0.735	0.688	0.685	0.688	0.687

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

Item	2020	2025	2030	2035	2040	2045	2050
Electricity distribution capital invested -		3.82	3.92	6.23	6.6	6.19	6.47
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)	182	178	169	158	147	141	138
Final energy use - Industry (PJ)	241	249	271	274	290	326	330
Final energy use - Residential (PJ)	241	227	206	178	155	141	134
Final energy use - Transportation (PJ)	669	623	550	461	380	331	311

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

Item	2020	2025	2030	2035	2040	2045	2050
Residential HVAC investment in 2020s vs.		5.85	7.79				
REF - Cumulative 5-yr (billion \$2018)							
Sales of cooking units - Electric	76.5	81.5	96.8	99.8	100	100	100
Resistance (%)							
Sales of cooking units - Gas (%)	23.5	18.5	3.16	0.159	0	0	0
Sales of space heating units - Electric	7.5	22.5	72.3	86.1	87.5	87.8	87.4
Heat Pump (%)							
Sales of space heating units - Electric	19.7	22.4	10	6.61	6.36	6.55	6.72
Resistance (%)							
Sales of space heating units - Fossil (%)	9.34	13.6	7.39	5.58	5.03	4.63	4.86
Sales of space heating units - Gas (%)	63.5	41.4	10.2	1.69	1.08	1.04	1.02
Sales of water heating units - Electric	0	8.7	46.5	56.1	56.7	56.7	56.7
Heat Pump (%)							
Sales of water heating units - Electric	42.5	55.5	45.3	43.3	43.3	43.3	43.3
Resistance (%)							
Sales of water heating units - Gas Furnace	57.4	35.7	8.23	0.581	0.019	0	0
(%)							
Sales of water heating units - Other (%)	0.034	0.035	0.036	0.035	0.035	0.036	0.036

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

Item	2020	2025	2030	2035	2040	2045	2050
Light-duty vehicle capital costs -		1,055	2,704	4,381	6,637	7,223	6,887
Cumulative 5-yr (million \$2018)							
Public EV charging plugs - DC Fast (1000	0.178		1.98		8.67		14
units)							
Public EV charging plugs - L2 (1000 units)	1.67		47.5		208		337
Vehicle sales - Heavy-duty - diesel (%)	97.2	92.1	67	23.3	4.22	0.628	0
Vehicle sales - Heavy-duty - EV (%)	0.588	3.81	19	45.6	57.4	59.6	60
Vehicle sales - Heavy-duty - gasoline (%)	0.227	0.227	0.176	0.066	0.013	0.002	0
Vehicle sales - Heavy-duty - hybrid (%)	0.082	0.09	0.077	0.031	0.007	0.001	0
Vehicle sales - Heavy-duty - hydrogen FC	0.392	2.54	12.7	30.4	38.2	39.7	40
(%)							
Vehicle sales - Heavy-duty - other (%)	1.5	1.23	1.07	0.568	0.163	0.038	0
Vehicle sales - Light-duty - diesel (%)	1.59	1.85	1.27	0.408	0.075	0.013	0
Vehicle sales - Light-duty - EV (%)	3.79	14.8	45.9	81.6	96.3	99.3	100
Vehicle sales - Light-duty - gasoline (%)	90.1	78.5	49.4	16.8	3.32	0.591	0
Vehicle sales - Light-duty - hybrid (%)	4.3	4.45	3.17	1.18	0.287	0.063	0
Vehicle sales - Light-duty - hydrogen FC	0.111	0.342	0.206	0.064	0.013	0.002	0
(%)							
Vehicle sales - Light-duty - other (%)	0.103	0.099	0.065	0.023	0.004	0.001	0
Vehicle sales - Medium-duty - diesel (%)	64.7	59.7	42.3	14.4	2.59	0.384	0
Vehicle sales - Medium-duty - EV (%)	0.784	5.07	25.3	60.8	76.5	79.5	80
Vehicle sales - Medium-duty - gasoline (%)	33.7	33.3	25.5	9.32	1.77	0.277	0
Vehicle sales - Medium-duty - hybrid (%)	0.363	0.402	0.341	0.14	0.03	0.005	0
Vehicle sales - Medium-duty - hydrogen	0.196	1.27	6.33	15.2	19.1	19.9	20
FC (%)							
Vehicle sales - Medium-duty - other (%)	0.253	0.255	0.205	0.083	0.019	0.004	0

Table 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	0.003	0.021	0	0.003	0	0
Capital invested - Biomass w/ccu allam power plant (billion \$2018)	0	0	0	0	0	0.009	0
Capital invested - Biomass w/ccu power plant (billion \$2018)	0	0	0	0	1.19	0.005	0
Capital invested - Solar PV - Base (billion \$2018)		13.2	10.6	18.6	21	5.54	2.17
Capital invested - Solar PV - Constrained (billion \$2018)		9.58	11.6	13.9	23.7	1.24	0.374
Capital invested - Wind - Base (billion \$2018)		28.5	22.8	22	35.2	34.7	36.6
Capital invested - Wind - Constrained (billion \$2018)		31.6	32.5	34.5	16.2	1.98	80.4
Installed renewables - OffshoreWind - Base land use assumptions (MW)	0	0	0	0	0	0	0
Installed renewables - OffshoreWind - Constrained land use assumptions (MW)	0	0	0	0	0	0	0
Installed renewables - Rooftop PV (MW)	153	269	400	605	898	1,277	1,767
Installed renewables - Solar - Base land use assumptions (MW)	38	11,548	21,891	41,607	65,259	71,874	74,620
Installed renewables - Solar - Constrained land use assumptions (MW)	0	8,505	20,726	37,736	56,926	61,122	62,326
Installed renewables - Wind - Base land use assumptions (MW)	5,547	24,947	42,054	59,780	89,561	120,496	155,043
Installed renewables - Wind - Constrained land use assumptions (MW)	4,965	26,409	50,116	78,502	93,070	95,265	168,542

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

Item	2020	2025	2030	2035	2040	2045	2050
Biomass power plant (GWh)	0	5.97	46.4	46.4	52.4	52.4	52.4
Biomass w/ccu allam power plant (GWh)	0	0	0	0	0	9.08	9.08
Biomass w/ccu power plant (GWh)	0	0	0	0	1,335	1,341	1,341
OffshoreWind - Base land use	0	0	0	0	0	0	0
assumptions (GWh)							
OffshoreWind - Constrained land use	0	0	0	0	0	0	0
assumptions (GWh)							
Solar - Base land use assumptions (GWh)	72.4	18,541	35,193	66,831	104,688	115,313	119,768
Solar - Constrained land use assumptions	0	13,674	33,346	60,726	91,519	98,271	100,217
(GWh)							
Wind - Base land use assumptions (GWh)	19,737	83,563	139,217	196,305	291,874	389,204	494,930
Wind - Constrained land use assumptions	17,665	86,986	161,857	250,834	294,590	301,857	539,018
(GWh)							

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

Item	2020	2025	2030	2035	2040	2045	2050
Biomass purchases (million \$2018/year)		38.3	97	98	192	298	656
Conversion capital investment -		3.44	23	19.7	1,705	1,881	6,256
Cumulative 5-yr (million \$2018)							
Number of facilities - Allam power w ccu	0	0	0	0	0	1	1
(quantity)							
Number of facilities - Beccs hydrogen	0	0	0	0	1	4	11
(quantity)							
Number of facilities - Diesel (quantity)	0	0	0	1	1	1	1
Number of facilities - Diesel ccu (quantity)	0	0	0	0	0	1	1
Number of facilities - Power (quantity)	0	1	1	1	1	1	1
Number of facilities - Power ccu	0	0	0	0	1	2	2
(quantity)							
Number of facilities - Pyrolysis (quantity)	0	0	0	1	1	1	1
Number of facilities - Pyrolysis ccu	0	0	0	0	1	2	2
(quantity)							
Number of facilities - Sng (quantity)	0	1	1	1	1	1	1
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	3.24	3.35	5.37	14.7	23.1
Annual - BECCS (MMT)		0	0	0	2.05	4.46	12.5
Annual - Cement and lime (MMT)		0	3.24	3.35	3.32	10.3	10.6
Annual - NGCC (MMT)		0	0	0	0	0	0
Cumulative - All (MMT)		0	3.24	6.59	12	26.7	49.8
Cumulative - BECCS (MMT)		0	0	0	2.05	6.51	19
Cumulative - Cement and lime (MMT)		0	3.24	6.59	9.91	20.2	30.8
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	420	589	687	959	1,557
Cumulative investment - All (million \$2018)		0	1,962	2,109	2,192	2,337	2,845
Cumulative investment - Spur (million \$2018)		0	11.9	160	242	387	895
Cumulative investment - Trunk (million \$2018)		0	1,950	1,950	1,950	1,950	1,950
Spur (km)		0	10.4	180	278	550	1,148
Trunk (km)		0	409	409	409	409	409

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

	•						
Item	2020	2025	2030	2035	2040	2045	2050
CO2 storage (MMT)		0	0	0.88	1.81	3.44	3.73
Injection wells (wells)		0	1	2	4	7	9
Resource characterization, appraisal, permitting costs (million \$2020)		27.9	78.2	101	101	101	101
Wells and facilities construction costs (million \$2020)		0	18.6	72.5	129	216	268

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

Item	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - Aggressive							0
deployment - Corn-ethanol to energy							
grasses (1000 tCO2e/y)							
Carbon sink potential - Aggressive							-13,495
deployment - Cropland measures (1000							
tCO2e/y)							
Carbon sink potential - Aggressive							-313
deployment - Permanent conservation							
cover (1000 tCO2e/y)							
Carbon sink potential - Aggressive							-13,808
deployment - Total (1000 tC02e/y)							•
Carbon sink potential - Moderate							0
deployment - Corn-ethanol to energy							
grasses (1000 tC02e/y)							
Carbon sink potential - Moderate							-7,068
deployment - Cropland measures (1000							.,000
tCO2e/y)							
Carbon sink potential - Moderate							-157
deployment - Permanent conservation							101
cover (1000 tC02e/y)							
Carbon sink potential - Moderate							-7,225
deployment - Total (1000 tC02e/y)							-1,220
Land impacted for carbon sink -							0
Aggressive deployment - Corn-ethanol to							U
energy grasses (1000 hectares)							
Land impacted for carbon sink -							5,748
Aggressive deployment - Cropland							3,140
measures (1000 hectares)							
Land impacted for carbon sink -							570
Aggressive deployment - Permanent							570
conservation cover (1000 hectares)							/ 010
Land impacted for carbon sink -							6,318
Aggressive deployment - Total (1000							
hectares)							
Land impacted for carbon sink - Moderate							0
deployment - Corn-ethanol to energy							
grasses (1000 hectares)							
Land impacted for carbon sink - Moderate							3,016
deployment - Cropland measures (1000							
hectares)							
Land impacted for carbon sink - Moderate							285
deployment - Permanent conservation							
cover (1000 hectares)							
Land impacted for carbon sink - Moderate							3,301
deployment - Total (1000 hectares)							

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

Item	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - High - Accelerate							-164
regeneration (1000 tCO2e/y)							
Carbon sink potential - High - All (not							-51,213
counting overlap) (1000 tCO2e/y)							
Carbon sink potential - High - Avoid							-2,274
deforestation (1000 tC02e/y)							77/4
Carbon sink potential - High - Extend							-7,741
rotation length (1000 tCO2e/y)							151
Carbon sink potential - High - Improve							-151
plantations (1000 tC02e/y) Carbon sink potential - High - Increase							-3,212
retention of HWP (1000 tCO2e/y)							-3,212
Carbon sink potential - High - Increase							-2,247
trees outside forests (1000 tCO2e/y)							-2,241
Carbon sink potential - High - Reforest							-10,656
cropland (1000 tCO2e/y)							10,000
Carbon sink potential - High - Reforest							-21,079
pasture (1000 tCO2e/y)							2.,0.,
Carbon sink potential - High - Restore							-3,690
productivity (1000 tCO2e/y)							.,.
Carbon sink potential - Low - Accelerate							-82
regeneration (1000 tCO2e/y)							
Carbon sink potential - Low - All (not							-13,537
counting overlap) (1000 tCO2e/y)							
Carbon sink potential - Low - Avoid							-379
deforestation (1000 tCO2e/y)							
Carbon sink potential - Low - Extend							-2,973
rotation length (1000 tCO2e/y)							
Carbon sink potential - Low - Improve							-77
plantations (1000 tCO2e/y)							
Carbon sink potential - Low - Increase							-1,071
retention of HWP (1000 tC02e/y)							707
Carbon sink potential - Low - Increase							-787
trees outside forests (1000 tC02e/y)							F 000
Carbon sink potential - Low - Reforest							-5,328
cropland (1000 tCO2e/y) Carbon sink potential - Low - Reforest							-1,597
pasture (1000 tC02e/y)							-1,597
Carbon sink potential - Low - Restore							-1,244
productivity (1000 tC02e/y)							-1,244
Carbon sink potential - Mid - Accelerate							-123
regeneration (1000 tCO2e/y)							120
Carbon sink potential - Mid - All (not							-32,374
counting overlap) (1000 tC02e/y)							02,014
Carbon sink potential - Mid - Avoid							-1,326
deforestation (1000 tCO2e/y)							, -
Carbon sink potential - Mid - Extend							-5,357
rotation length (1000 tCO2e/y)							•
Carbon sink potential - Mid - Improve							-113
plantations (1000 tCO2e/y)							
Carbon sink potential - Mid - Increase							-2,141
retention of HWP (1000 tCO2e/y)							
Carbon sink potential - Mid - Increase							-1,517
trees outside forests (1000 tCO2e/y)							
Carbon sink potential - Mid - Reforest							-7,992
cropland (1000 tCO2e/y)							
Carbon sink potential - Mid - Reforest							-11,338
pasture (1000 tCO2e/y)							
Carbon sink potential - Mid - Restore							-2,467
productivity (1000 tCO2e/y)							

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

Table 13: E+ scenario - PILLAR 6: Land sini		·					
Item	2020	2025	2030	2035	2040	2045	2050
Land impacted for carbon sink potential -							26.8
High - Accelerate regeneration (1000							
hectares)							
Land impacted for carbon sink potential -							308
High - Avoid deforestation (over 30 years)							
(1000 hectares)							
Land impacted for carbon sink potential -							3,947
High - Extend rotation length (1000							
hectares)							
Land impacted for carbon sink potential -							55.7
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 -							214
High - Increase trees outside forests							
(1000 hectares)							
Land impacted for carbon sink potential -							705
High - Reforest cropland (1000 hectares)							103
Land impacted for carbon sink potential -							599
							599
High - Reforest pasture (1000 hectares)							4.000
Land impacted for carbon sink potential -							1,223
High - Restore productivity (1000							
hectares)							
Land impacted for carbon sink potential -							7,077
High - Total impacted (over 30 years)							
(1000 hectares)							
Land impacted for carbon sink potential -							13.4
Low - Accelerate regeneration (1000							
hectares)							
Land impacted for carbon sink potential -							289
Low - Avoid deforestation (over 30 years)							
(1000 hectares)							
Land impacted for carbon sink potential -							1,512
Low - Extend rotation length (1000							·
hectares)							
Land impacted for carbon sink potential -							27.9
Low - Improve plantations (1000							
hectares)							
Land impacted for carbon sink potential -	+						0
Low - Increase retention of HWP (1000							J
hectares)							
Land impacted for carbon sink potential -							112
Low - Increase trees outside forests							112
(1000 hectares)							
,							250
Land impacted for carbon sink potential -							352
Low - Reforest cropland (1000 hectares)							10/
Land impacted for carbon sink potential -							104
Low - Reforest pasture (1000 hectares)							
Land impacted for carbon sink potential -							740
Low - Restore productivity (1000							
hectares)							
Land impacted for carbon sink potential -							3,151
Low - Total impacted (over 30 years)							
(1000 hectares)							
Land impacted for carbon sink potential -							20.1
Mid - Accelerate regeneration (1000							

				_	
Table 13. Ex	ccanario -	DIII $\Lambda D A \cdot$	Land sinks -	Enracte	lcontinuedl
Table 15. LT	occiiui iu -	FILLAN U.	Luiiu siiiks -	ו טו בטנט	lcontinucui

Item	2020	2025	2030	2035	2040	2045	2050
Land impacted for carbon sink potential -							298
Mid - Avoid deforestation (over 30 years)							
(1000 hectares)							
Land impacted for carbon sink potential -							2,730
Mid - Extend rotation length (1000							
hectares)							
Land impacted for carbon sink potential -							41.9
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 -							163
Mid - Increase trees outside forests (1000							
hectares)							
Land impacted for carbon sink potential -							528
Mid - Reforest cropland (1000 hectares)							
Land impacted for carbon sink potential -							751
Mid - Reforest pasture (1000 hectares)							
Land impacted for carbon sink potential -							1,490
Mid - Restore productivity (1000							
hectares)							
Land impacted for carbon sink potential -							6,022
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)		249	210	169	127	79.8	55.4
Natural gas consumption - Cumulative							5,077
(tcf)							
Natural gas production - Annual (tcf)		0	0	0	0	0	0
Oil consumption - Annual (million bbls)		121	106	83.7	62.4	45.6	32.5
Oil consumption - Cumulative (million							2,577
bbls)							
Oil production - Annual (million bbls)		0.117	0.117	0.117	0.093	0.075	0.05

Table 15: E+ scenario - IMPACTS - Health

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal (million 2019\$)		556	0.464	0.445	0.372	0.247	0.01
Monetary damages from air pollution - Natural Gas (million 2019\$)		207	110	54.9	43.2	22.9	11.1
Monetary damages from air pollution - Transportation (million 2019\$)		1,300	1,208	916	529	246	103
Premature deaths from air pollution - Coal (deaths)		62.8	0.052	0.05	0.042	0.028	0.001
Premature deaths from air pollution - Natural Gas (deaths)		23.4	12.4	6.2	4.87	2.59	1.25
Premature deaths from air pollution - Transportation (deaths)		146	136	103	59.5	27.6	11.6

Table 16: E+ scenario - IMPACTS - Jobs

Item	2020	2025	2030	2035	2040	2045	2050
By economic sector - Agriculture (jobs)		441	515	610	545	438	734
By economic sector - Construction (jobs)		24,232	29,825	40,936	53,855	53,148	58,830
By economic sector - Manufacturing		8,268	10,342	13,920	14,930	13,555	17,080
(jobs)							
By economic sector - Mining (jobs)		2,224	1,584	1,073	699	468	322

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

Table 16: E+ scenario - IMPACTS - Jobs (co	ntinueaj						
Item	2020	2025	2030	2035	2040	2045	2050
By economic sector - Other (jobs)		3,011	3,744	6,020	8,467	7,691	8,637
By economic sector - Pipeline (jobs)		404	504	279	221	179	217
By economic sector - Professional (jobs)		12,914	16,867	23,916	32,989	36,250	42,699
By economic sector - Trade (jobs)		7,818	9,644	13,648	18,886	20,379	24,221
By economic sector - Utilities (jobs)		14,201	19,173	26,240	37,258	42,241	49,482
By education level - All sectors -		23,298	29,432	40,627	54,161	56,338	65,293
Associates degree or some college (jobs)							
By education level - All sectors -		14,948	18,745	25,637	34,102	36,078	42,175
Bachelors degree (jobs)							
By education level - All sectors - Doctoral		605	766	1,062	1,435	1,542	1,803
degree (jobs)							
By education level - All sectors - High		30,893	38,476	52,721	69,260	70,862	81,788
school diploma or less (jobs)							
By education level - All sectors - Masters		3,770	4,780	6,594	8,891	9,529	11,164
or professional degree (jobs)							
By resource sector - Biomass (jobs)		1,042	1,210	1,474	1,486	1,618	3,207
By resource sector - CO2 (jobs)		14.7	1,318	91.3	194	438	1,118
By resource sector - Coal (jobs)		1,495	345	151	132	119	105
By resource sector - Grid (jobs)		21,309	31,638	47,437	69,141	80,149	94,229
By resource sector - Natural Gas (jobs)		3,513	2,388	2,008	2,340	1,045	796
By resource sector - Nuclear (jobs)		624	614	356	0	0	0
By resource sector - Oil (jobs)		5,419	4,356	3,168	2,195	1,500	1,003
By resource sector - Solar (jobs)		18,264	19,292	31,168	39,241	26,325	26,730
By resource sector - Wind (jobs)		21,834	31,036	40,787	53,120	63,156	75,034
Median wages - Annual - All (\$2019 per		58,825	59,744	60,424	61,583	63,065	64,083
iob)		,	- '	,	, , , , , ,		, , , , , ,
On-Site or In-Plant Training - Total jobs - 1		12,061	15,181	20,867	27,762	28,841	33,341
to 4 years (jobs)		,	,		,	.	•
On-Site or In-Plant Training - Total jobs - 4		5,261	6,631	9,101	12,233	12,763	14,660
to 10 years (jobs)		, -	-,	, -	,	,	,
On-Site or In-Plant Training - Total jobs -		12,107	15,167	20,861	27,598	28,597	33,179
None (jobs)		, -	-, -	-,	,	.,-	•
On-Site or In-Plant Training - Total jobs -		646	822	1,133	1,519	1,590	1,842
Over 10 years (jobs)				,	,-	, , ,	,-
On-Site or In-Plant Training - Total jobs -		43,440	54,398	74,680	98,737	102,558	119,201
Up to 1 year (jobs)		-,	- ,	,	-, -	,,,,,,	, -
On-the-Job Training - All sectors - 1 to 4		15,610	19,683	27,057	36,063	37,539	43,389
years (jobs)		-,	,	,	,	, , , , ,	-,
On-the-Job Training - All sectors - 4 to 10		5,223	6,602	9,093	12,257	12,772	14,647
years (jobs)		-, -	-,	,	, -	,	•
On-the-Job Training - All sectors - None		4,076	5,060	6,956	9,192	9,466	10,954
(jobs)		,,,,,	5,555	7, 55	.,	,,,,,,	,
On-the-Job Training - All sectors - Over 10		739	911	1,239	1,598	1,605	1,840
years (jobs)				,,,	,,,,,	,,,,,	.,
On-the-Job Training - All sectors - Up to 1		47,866	59,943	82,296	108,739	112,967	131,392
year (jobs)		,000	07,7 .0	02,270	.00,.07	,,	.0.,07=
Related work experience - All sectors - 1		26,270	32,976	45,303	60,227	62,836	72,957
to 4 years (jobs)		20,2:0	0_,,.0	.5,555	00,22.	02,000	/ / 0 .
Related work experience - All sectors - 4		17,219	21,667	29,726	39,556	41,364	47,987
to 10 years (jobs)		11,217	21,001	27,120	07,000	41,004	41,701
Related work experience - All sectors -		10,540	13,227	18,195	24,170	25,038	29,025
None (jobs)		10,040	10,221	15,176	2-7,110	20,000	27,020
Related work experience - All sectors -		4,465	5,615	7,688	10,150	10,599	12,334
Over 10 years (jobs)		4,403	3,013	1,000	10,100	10,077	12,004
Related work experience - All sectors - Up		15,020	18,713	25,730	33,746	34,512	39,920
to 1 year (jobs)		10,020	10,110	20,100	55,140	04,012	37,720
Wage income - All (million \$2019)		4,325	5,509	7,653	10,338	10,997	12,961
vvage income - An (million \$2017)		4,320	3,309	1,000	10,330	10,771	12,701

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

Item	2020	2025	2030	2035	2040	2045	2050
Commercial HVAC investment in 2020s -		16,266	17,675				
Cumulative 5-yr (million \$2018)							
Sales of cooking units - Electric	44.8	49.3	53.1	63	76.9	85.5	88.5
Resistance (%)							
Sales of cooking units - Gas (%)	55.2	50.7	46.9	37	23.1	14.5	11.5
Sales of space heating units - Electric	4.52	15.9	21.2	36.6	61.3	79.5	86.8
Heat Pump (%)							
Sales of space heating units - Electric	8.06	5.57	5.72	6.25	7.38	8.69	9.45
Resistance (%)							
Sales of space heating units - Fossil (%)	0	2.02	1.9	1.42	0.689	0.224	0.059
Sales of space heating units - Gas Furnace	87.4	76.5	71.1	55.7	30.6	11.6	3.64
(%)							
Sales of water heating units - Electric	1.19	2.53	7.36	21.3	43.1	57.7	63
Heat Pump (%)							
Sales of water heating units - Electric	10.1	7.76	9.75	15.5	24.6	31	33.4
Resistance (%)							
Sales of water heating units - Gas Furnace	87.7	88.7	81.9	62.3	31.6	10.6	2.88
(%)							
Sales of water heating units - Other (%)	0.996	0.987	0.962	0.892	0.786	0.72	0.695

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

Item	2020	2025	2030	2035	2040	2045	2050
Electricity distribution capital invested -		3.2	3.23	3.9	4.01	5.79	6.1
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)	182	179	174	169	162	155	149
Final energy use - Industry (PJ)	241	250	272	277	295	331	335
Final energy use - Residential (PJ)	241	228	218	206	189	170	154
Final energy use - Transportation (PJ)	670	628	574	531	498	459	413

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

Item	2020	2025	2030	2035	2040	2045	2050
Residential HVAC investment in 2020s vs.		5.81	7.68				
REF - Cumulative 5-yr (billion \$2018)							
Sales of cooking units - Electric	76.4	77	79.2	84.9	92.8	97.7	99.4
Resistance (%)							
Sales of cooking units - Gas (%)	23.6	23	20.8	15.1	7.21	2.33	0.626
Sales of space heating units - Electric	7.5	13	18.7	35.2	61.1	79	85.2
Heat Pump (%)							
Sales of space heating units - Electric	19.7	24.8	23.3	19.2	12.8	8.51	7.04
Resistance (%)							
Sales of space heating units - Fossil (%)	9.34	14.9	14.4	12.2	8.46	5.78	5.24
Sales of space heating units - Gas (%)	63.5	47.3	43.7	33.5	17.6	6.67	2.55
Sales of water heating units - Electric	0	1.51	5.81	18.2	37.5	50.4	55
Heat Pump (%)							
Sales of water heating units - Electric	42.5	57.5	56.3	52.9	47.8	44.7	43.6
Resistance (%)							
Sales of water heating units - Gas Furnace	57.4	40.9	37.8	28.9	14.7	4.93	1.34
(%)							
Sales of water heating units - Other (%)	0.034	0.035	0.036	0.036	0.036	0.036	0.036

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

Item	2020	2025	2030	2035	2040	2045	2050
Light-duty vehicle capital costs -		0	171	359	1,211	3,810	5,551
Cumulative 5-yr (million \$2018)							
Public EV charging plugs - DC Fast (1000	0.178		0.611		3.21		8.98
units)							
Public EV charging plugs - L2 (1000 units)	1.67		14.7		77.3		216
Vehicle sales - Heavy-duty - diesel (%)	97.4	96	91.3	79.8	58.2	32.1	13.7
Vehicle sales - Heavy-duty - EV (%)	0.498	1.45	4.11	10.8	23.6	39.5	51
Vehicle sales - Heavy-duty - gasoline (%)	0.228	0.236	0.239	0.225	0.179	0.109	0.051
Vehicle sales - Heavy-duty - hybrid (%)	0.083	0.094	0.104	0.107	0.092	0.06	0.03
Vehicle sales - Heavy-duty - hydrogen FC	0.332	0.969	2.74	7.17	15.7	26.3	34
(%)							
Vehicle sales - Heavy-duty - other (%)	1.5	1.28	1.46	1.95	2.25	1.96	1.14
Vehicle sales - Light-duty - diesel (%)	1.6	2.01	2.06	1.64	1.05	0.542	0.232
Vehicle sales - Light-duty - EV (%)	1.84	4.58	11.7	25.5	48	71.8	87.5
Vehicle sales - Light-duty - gasoline (%)	91.9	87.7	79.9	67.1	46.6	25.1	11.1
Vehicle sales - Light-duty - hybrid (%)	4.45	5.27	5.93	5.41	4.08	2.42	1.18
Vehicle sales - Light-duty - hydrogen FC	0.113	0.381	0.328	0.251	0.179	0.1	0.046
(%)							
Vehicle sales - Light-duty - other (%)	0.105	0.108	0.098	0.086	0.062	0.034	0.016
Vehicle sales - Medium-duty - diesel (%)	64.8	62.2	57.7	49.4	35.6	19.6	8.37
Vehicle sales - Medium-duty - EV (%)	0.664	1.94	5.49	14.3	31.4	52.6	68
Vehicle sales - Medium-duty - gasoline (%)	33.8	34.7	34.7	31.9	24.4	14.2	6.33
Vehicle sales - Medium-duty - hybrid (%)	0.363	0.418	0.464	0.478	0.414	0.275	0.141
Vehicle sales - Medium-duty - hydrogen	0.166	0.485	1.37	3.58	7.86	13.2	17
FC (%)							
Vehicle sales - Medium-duty - other (%)	0.253	0.266	0.279	0.286	0.258	0.184	0.102

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

Item	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - Aggressive							0
deployment - Corn-ethanol to energy							
grasses (1000 tCO2e/y)							
Carbon sink potential - Aggressive							-13,495
deployment - Cropland measures (1000							
tCO2e/y)							
Carbon sink potential - Aggressive							-313
deployment - Permanent conservation							
cover (1000 tCO2e/y)							
Carbon sink potential - Aggressive							-13,808
deployment - Total (1000 tCO2e/y)							
Carbon sink potential - Moderate							0
deployment - Corn-ethanol to energy							
grasses (1000 tCO2e/y)							
Carbon sink potential - Moderate							-7,068
deployment - Cropland measures (1000							
tCO2e/y)							
Carbon sink potential - Moderate							-157
deployment - Permanent conservation							
cover (1000 tCO2e/y)							
Carbon sink potential - Moderate							-7,225
deployment - Total (1000 tCO2e/y)							
Land impacted for carbon sink -							0
Aggressive deployment - Corn-ethanol to							
energy grasses (1000 hectares)							
Land impacted for carbon sink -							5,748
Aggressive deployment - Cropland							
measures (1000 hectares)							
Land impacted for carbon sink -		\neg					570
Aggressive deployment - Permanent							
conservation cover (1000 hectares)							

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

Item	2020	2025	2030	2035	2040	2045	2050
Land impacted for carbon sink -							6,318
Aggressive deployment - Total (1000							
hectares)							
Land impacted for carbon sink - Moderate							0
deployment - Corn-ethanol to energy							
grasses (1000 hectares)							
Land impacted for carbon sink - Moderate							3,016
deployment - Cropland measures (1000							
hectares)							
Land impacted for carbon sink - Moderate							285
deployment - Permanent conservation							
cover (1000 hectares)							
Land impacted for carbon sink - Moderate							3,301
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							-164
regeneration (1000 tCO2e/y)							
Carbon sink potential - High - All (not							-51,213
counting overlap) (1000 tCO2e/y)							
Carbon sink potential - High - Avoid							-2,274
deforestation (1000 tCO2e/y)							
Carbon sink potential - High - Extend							-7,741
rotation length (1000 tCO2e/y)							
Carbon sink potential - High - Improve							-151
plantations (1000 tCO2e/y)							
Carbon sink potential - High - Increase							-3,212
retention of HWP (1000 tCO2e/y)							
Carbon sink potential - High - Increase							-2,247
trees outside forests (1000 tCO2e/y)							
Carbon sink potential - High - Reforest							-10,656
cropland (1000 tCO2e/y)							
Carbon sink potential - High - Reforest							-21,079
pasture (1000 tCO2e/y)							
Carbon sink potential - High - Restore							-3,690
productivity (1000 tCO2e/y)							
Carbon sink potential - Low - Accelerate							-82
regeneration (1000 tCO2e/y)							
Carbon sink potential - Low - All (not							-13,537
counting overlap) (1000 tCO2e/y)							
Carbon sink potential - Low - Avoid							-379
deforestation (1000 tCO2e/y)							
Carbon sink potential - Low - Extend							-2,973
rotation length (1000 tCO2e/y)							
Carbon sink potential - Low - Improve							-77
plantations (1000 tCO2e/y)							
Carbon sink potential - Low - Increase							-1,071
retention of HWP (1000 tCO2e/y)							
Carbon sink potential - Low - Increase							-787
trees outside forests (1000 tCO2e/y)							
Carbon sink potential - Low - Reforest							-5,328
cropland (1000 tCO2e/y)							
Carbon sink potential - Low - Reforest							-1,597
pasture (1000 tCO2e/y)							
Carbon sink potential - Low - Restore							-1,244
productivity (1000 tCO2e/y)							
Carbon sink potential - Mid - Accelerate							-123
regeneration (1000 tC02e/y)							

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

Item Carbon sink potential - Mid - All (not	2020	2025	2030	2035	2040	2045	2050 -32,374
counting overlap) (1000 tC02e/y)							-32,314
Carbon sink potential - Mid - Avoid							1 20/
·							-1,326
deforestation (1000 tC02e/y)							F 0F
Carbon sink potential - Mid - Extend							-5,35
rotation length (1000 tCO2e/y)							
Carbon sink potential - Mid - Improve							-113
plantations (1000 tCO2e/y)							
Carbon sink potential - Mid - Increase							-2,14
retention of HWP (1000 tCO2e/y)							
Carbon sink potential - Mid - Increase							-1,51
trees outside forests (1000 tCO2e/y)							
Carbon sink potential - Mid - Reforest							-7,992
cropland (1000 tC02e/y)							
Carbon sink potential - Mid - Reforest							-11,338
pasture (1000 tC02e/y)							•
Carbon sink potential - Mid - Restore							-2,46
productivity (1000 tCO2e/y)							_,
Land impacted for carbon sink potential -							26.8
High - Accelerate regeneration (1000							20.0
hectares)							
Land impacted for carbon sink potential -							308
							300
High - Avoid deforestation (over 30 years)							
(1000 hectares)							0.04
Land impacted for carbon sink potential -							3,94
High - Extend rotation length (1000							
hectares)							
Land impacted for carbon sink potential -							55.
High - Improve plantations (1000							
hectares)							
Land impacted for carbon sink potential -							(
High - Increase retention of HWP (1000							
hectares)							
Land impacted for carbon sink potential -							214
High - Increase trees outside forests							
(1000 hectares)							
Land impacted for carbon sink potential -							705
High - Reforest cropland (1000 hectares)							
Land impacted for carbon sink potential -							599
High - Reforest pasture (1000 hectares)							37
Land impacted for carbon sink potential -						+	1,22
							1,22
High - Restore productivity (1000							
hectares)							7.07
Land impacted for carbon sink potential -							7,07
High - Total impacted (over 30 years)							
(1000 hectares)							
Land impacted for carbon sink potential -							13.4
Low - Accelerate regeneration (1000							
hectares)							
Land impacted for carbon sink potential -							28
Low - Avoid deforestation (over 30 years)							
(1000 hectares)							
Land impacted for carbon sink potential -							1,51
Low - Extend rotation length (1000							.,51
hectares)							
Land impacted for carbon sink potential -							27.
Low - Improve plantations (1000							۷۱.
hectares)							
Land impacted for carbon sink potential - Low - Increase retention of HWP (1000							(
			II.				

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

Item	2020	2025	2030	2035	2040	2045	2050
Land impacted for carbon sink potential -							112
Low - Increase trees outside forests							
(1000 hectares)							
Land impacted for carbon sink potential -							352
Low - Reforest cropland (1000 hectares)							
Land impacted for carbon sink potential -							104
Low - Reforest pasture (1000 hectares)							
Land impacted for carbon sink potential -							740
Low - Restore productivity (1000							
hectares)							
Land impacted for carbon sink potential -							3,151
Low - Total impacted (over 30 years)							
(1000 hectares)							
Land impacted for carbon sink potential -							20.1
Mid - Accelerate regeneration (1000							
hectares)							
Land impacted for carbon sink potential -							298
Mid - Avoid deforestation (over 30 years)							
(1000 hectares)							
Land impacted for carbon sink potential -							2,730
Mid - Extend rotation length (1000							
hectares)							
Land impacted for carbon sink potential -							41.9
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 -							163
Mid - Increase trees outside forests (1000							
hectares)							
Land impacted for carbon sink potential -							528
Mid - Reforest cropland (1000 hectares)							
Land impacted for carbon sink potential -							751
Mid - Reforest pasture (1000 hectares)							
Land impacted for carbon sink potential -							1,490
Mid - Restore productivity (1000							
hectares)							
Land impacted for carbon sink potential -							6,022
Mid - Total impacted (over 30 years) (1000							
hectares)							

Table 24: E- scenario - IMPACTS - Health

Table 24. L Scenario Ini Aoro ricalti							
Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution -		556	0.464	0.445	0.372	0.247	0.01
Coal (million 2019\$)							
Monetary damages from air pollution -		201	92.7	41.3	19.8	7.64	5.99
Natural Gas (million 2019\$)							
Monetary damages from air pollution -		1,321	1,328	1,290	1,161	924	634
Transportation (million 2019\$)							
Premature deaths from air pollution -		62.8	0.052	0.05	0.042	0.028	0.001
Coal (deaths)							
Premature deaths from air pollution -		22.7	10.5	4.66	2.24	0.862	0.676
Natural Gas (deaths)							
Premature deaths from air pollution -		149	149	145	131	104	71.3
Transportation (deaths)							

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

	,,						
Item	2020	2025	2030	2035	2040	2045	2050
Commercial HVAC investment in 2020s -		16,269	17,611				
Cumulative 5-yr (million \$2018)							
Sales of cooking units - Electric	44.8	57.1	84	89.3	89.6	89.6	89.6
Resistance (%)							
Sales of cooking units - Gas (%)	55.2	42.9	16	10.7	10.4	10.4	10.4
Sales of space heating units - Electric	4.52	24.4	70.6	87.7	89.7	89.7	89.7
Heat Pump (%)							
Sales of space heating units - Electric	8.06	5.73	7.1	9.32	9.79	9.8	9.8
Resistance (%)							
Sales of space heating units - Fossil (%)	0	1.75	0.337	0.014	0	0	0
Sales of space heating units - Gas Furnace	87.4	68.1	22	2.94	0.553	0.458	0.459
(%)							
Sales of water heating units - Electric	1.19	10.6	53.1	64.2	65	65	65
Heat Pump (%)							
Sales of water heating units - Electric	10.1	11	28.4	33.8	34.3	34.3	34.3
Resistance (%)							
Sales of water heating units - Gas Furnace	87.7	77.5	17.8	1.26	0.041	0	0
(%)							
Sales of water heating units - Other (%)	0.996	0.947	0.735	0.688	0.685	0.688	0.687
Sales of water heating units - Gas Furnace (%)							

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

Item	2020	2025	2030	2035	2040	2045	2050
Electricity distribution capital invested -		3.82	3.92	6.23	6.6	6.19	6.47
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)	182	178	169	158	147	141	138
Final energy use - Industry (PJ)	241	249	271	274	290	326	330
Final energy use - Residential (PJ)	241	227	206	178	155	141	134
Final energy use - Transportation (PJ)	669	623	550	461	380	331	311

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

Item	2020	2025	2030	2035	2040	2045	2050
Residential HVAC investment in 2020s vs.		5.85	7.79				
REF - Cumulative 5-yr (billion \$2018)							
Sales of cooking units - Electric	76.5	81.5	96.8	99.8	100	100	100
Resistance (%)							
Sales of cooking units - Gas (%)	23.5	18.5	3.16	0.159	0	0	0
Sales of space heating units - Electric	7.5	22.5	72.3	86.1	87.5	87.8	87.4
Heat Pump (%)							
Sales of space heating units - Electric	19.7	22.4	10	6.61	6.36	6.55	6.72
Resistance (%)							
Sales of space heating units - Fossil (%)	9.34	13.6	7.39	5.58	5.03	4.63	4.86
Sales of space heating units - Gas (%)	63.5	41.4	10.2	1.69	1.08	1.04	1.02
Sales of water heating units - Electric	0	8.7	46.5	56.1	56.7	56.7	56.7
Heat Pump (%)							
Sales of water heating units - Electric	42.5	55.5	45.3	43.3	43.3	43.3	43.3
Resistance (%)							
Sales of water heating units - Gas Furnace	57.4	35.7	8.23	0.581	0.019	0	0
(%)							
Sales of water heating units - Other (%)	0.034	0.035	0.036	0.035	0.035	0.036	0.036

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

Item	2020	2025	2030	2035	2040	2045	2050
Light-duty vehicle capital costs -		1,055	2,704	4,381	6,637	7,223	6,887
Cumulative 5-yr (million \$2018)							
Public EV charging plugs - DC Fast (1000	0.178		1.98		8.67		14
units)							
Public EV charging plugs - L2 (1000 units)	1.67		47.5		208		337
Vehicle sales - Heavy-duty - diesel (%)	97.2	92.1	67	23.3	4.22	0.628	0
Vehicle sales - Heavy-duty - EV (%)	0.588	3.81	19	45.6	57.4	59.6	60
Vehicle sales - Heavy-duty - gasoline (%)	0.227	0.227	0.176	0.066	0.013	0.002	0
Vehicle sales - Heavy-duty - hybrid (%)	0.082	0.09	0.077	0.031	0.007	0.001	0
Vehicle sales - Heavy-duty - hydrogen FC	0.392	2.54	12.7	30.4	38.2	39.7	40
(%)							
Vehicle sales - Heavy-duty - other (%)	1.5	1.23	1.07	0.568	0.163	0.038	0
Vehicle sales - Light-duty - diesel (%)	1.59	1.85	1.27	0.408	0.075	0.013	0
Vehicle sales - Light-duty - EV (%)	3.79	14.8	45.9	81.6	96.3	99.3	100
Vehicle sales - Light-duty - gasoline (%)	90.1	78.5	49.4	16.8	3.32	0.591	0
Vehicle sales - Light-duty - hybrid (%)	4.3	4.45	3.17	1.18	0.287	0.063	0
Vehicle sales - Light-duty - hydrogen FC	0.111	0.342	0.206	0.064	0.013	0.002	0
(%)							
Vehicle sales - Light-duty - other (%)	0.103	0.099	0.065	0.023	0.004	0.001	0
Vehicle sales - Medium-duty - diesel (%)	64.7	59.7	42.3	14.4	2.59	0.384	0
Vehicle sales - Medium-duty - EV (%)	0.784	5.07	25.3	60.8	76.5	79.5	80
Vehicle sales - Medium-duty - gasoline (%)	33.7	33.3	25.5	9.32	1.77	0.277	0
Vehicle sales - Medium-duty - hybrid (%)	0.363	0.402	0.341	0.14	0.03	0.005	0
Vehicle sales - Medium-duty - hydrogen	0.196	1.27	6.33	15.2	19.1	19.9	20
FC (%)							
Vehicle sales - Medium-duty - other (%)	0.253	0.255	0.205	0.083	0.019	0.004	0

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

Item	2020	2025	2030	2035	2040	2045	2050
Capital invested - Solar PV - Base (billion		11.8	14.4	21.1	17.8	44.8	27.5
\$2018)							
Capital invested - Wind - Base (billion		29	22.7	41.1	51.8	57.2	30.3
\$2018)							
Installed renewables - OffshoreWind -	0	0	0	0	0	0	0
Base land use assumptions (MW)							
Installed renewables - OffshoreWind -	0	0	0	0	0	0	0
Constrained land use assumptions (MW)							
Installed renewables - Solar - Base land	128	10,423	24,534	46,913	66,934	120,413	155,109
use assumptions (MW)							
Installed renewables - Solar -	76	20,609	52,954	86,841	134,515	230,818	272,610
Constrained land use assumptions (MW)							
Installed renewables - Wind - Base land	5,547	25,250	42,336	75,470	119,284	170,306	198,927
use assumptions (MW)							
Installed renewables - Wind - Constrained	9,929	53,886	102,192	185,789	193,779	199,349	462,063
land use assumptions (MW)							

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

Item	2020	2025	2030	2035	2040	2045	2050
OffshoreWind - Base land use	0	0	0	0	0	0	0
assumptions (GWh)							
OffshoreWind - Constrained land use	0	0	0	0	0	0	0
assumptions (GWh)							
Solar - Base land use assumptions (GWh)	216	16,765	39,441	75,390	107,459	193,354	249,128
Solar - Constrained land use assumptions	145	33,147	85,095	139,507	215,976	370,604	437,809
(GWh)							
Wind - Base land use assumptions (GWh)	19,737	84,539	140,172	247,311	386,254	545,010	631,310
Wind - Constrained land use assumptions	35,330	177,376	330,559	588,274	614,269	631,531	1,466,853
(GWh)							

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

Item	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - Aggressive							0
deployment - Corn-ethanol to energy							
grasses (1000 tCO2e/y)							
Carbon sink potential - Aggressive							-13,495
deployment - Cropland measures (1000							
tCO2e/y)							
Carbon sink potential - Aggressive							-313
deployment - Permanent conservation							
cover (1000 tCO2e/y)							
Carbon sink potential - Aggressive							-13,808
deployment - Total (1000 tCO2e/y)							
Carbon sink potential - Moderate							0
deployment - Corn-ethanol to energy							
grasses (1000 tC02e/y)							
Carbon sink potential - Moderate							-7,068
deployment - Cropland measures (1000							.,
tCO2e/v)							
Carbon sink potential - Moderate							-157
deployment - Permanent conservation							
cover (1000 tC02e/y)							
Carbon sink potential - Moderate							-7,225
deployment - Total (1000 tCO2e/y)							1,220
Land impacted for carbon sink -							0
Aggressive deployment - Corn-ethanol to							U
energy grasses (1000 hectares)							
Land impacted for carbon sink -							5,748
·							5,146
Aggressive deployment - Cropland							
measures (1000 hectares)							570
Land impacted for carbon sink -							570
Aggressive deployment - Permanent							
conservation cover (1000 hectares)							
Land impacted for carbon sink -							6,318
Aggressive deployment - Total (1000							
hectares)							
Land impacted for carbon sink - Moderate							0
deployment - Corn-ethanol to energy							
grasses (1000 hectares)							
Land impacted for carbon sink - Moderate							3,016
deployment - Cropland measures (1000							
hectares)							
Land impacted for carbon sink - Moderate							285
deployment - Permanent conservation							
cover (1000 hectares)							
Land impacted for carbon sink - Moderate							3,301
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							-164
regeneration (1000 tCO2e/y)							
Carbon sink potential - High - All (not							-51,213
counting overlap) (1000 tCO2e/y)							
Carbon sink potential - High - Avoid							-2,274
deforestation (1000 tCO2e/y)							
Carbon sink potential - High - Extend							-7,741
rotation length (1000 tCO2e/y)							
Carbon sink potential - High - Improve							-151
plantations (1000 tCO2e/y)							
Carbon sink potential - High - Increase							-3,212
retention of HWP (1000 tCO2e/y)							

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

Item	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - High - Increase							-2,24
trees outside forests (1000 tC02e/y)							10 / 5
Carbon sink potential - High - Reforest cropland (1000 tC02e/y)							-10,65
Carbon sink potential - High - Reforest							-21,07
pasture (1000 tC02e/y)							21,01
Carbon sink potential - High - Restore							-3,690
productivity (1000 tCO2e/y)							•
Carbon sink potential - Low - Accelerate							-8:
regeneration (1000 tCO2e/y)							
Carbon sink potential - Low - All (not							-13,53
counting overlap) (1000 tCO2e/y)							
Carbon sink potential - Low - Avoid							-37
deforestation (1000 tC02e/y)	+						0.07
Carbon sink potential - Low - Extend rotation length (1000 tCO2e/y)							-2,97
Carbon sink potential - Low - Improve							-7
plantations (1000 tCO2e/y)							-1
Carbon sink potential - Low - Increase							-1,07
retention of HWP (1000 tCO2e/y)							1,01
Carbon sink potential - Low - Increase							-78
trees outside forests (1000 tCO2e/y)							
Carbon sink potential - Low - Reforest							-5,32
cropland (1000 tCO2e/y)							-
Carbon sink potential - Low - Reforest							-1,59
pasture (1000 tCO2e/y)							
Carbon sink potential - Low - Restore							-1,24
productivity (1000 tCO2e/y)							
Carbon sink potential - Mid - Accelerate							-12
regeneration (1000 tCO2e/y)							00.07
Carbon sink potential - Mid - All (not							-32,37
counting overlap) (1000 tC02e/y) Carbon sink potential - Mid - Avoid							-1,32
deforestation (1000 tCO2e/y)							-1,32
Carbon sink potential - Mid - Extend							-5,35
rotation length (1000 tC02e/y)							0,00
Carbon sink potential - Mid - Improve							-11
plantations (1000 tCO2e/y)							
Carbon sink potential - Mid - Increase							-2,14
retention of HWP (1000 tCO2e/y)							-
Carbon sink potential - Mid - Increase							-1,51
trees outside forests (1000 tCO2e/y)							
Carbon sink potential - Mid - Reforest							-7,99
cropland (1000 tCO2e/y)							
Carbon sink potential - Mid - Reforest							-11,33
pasture (1000 tCO2e/y)							
Carbon sink potential - Mid - Restore							-2,46
productivity (1000 tCO2e/y)							0.4
Land impacted for carbon sink potential -							26.
High - Accelerate regeneration (1000 hectares)							
Land impacted for carbon sink potential -						+	30
High - Avoid deforestation (over 30 years)							30
(1000 hectares)							
Land impacted for carbon sink potential -							3,94
High - Extend rotation length (1000							3,7-
hectares)							
Land impacted for carbon sink potential -							55
High - Improve plantations (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 - High - Increase retention of HWP (1000							0
hectares)							
Land impacted for carbon sink potential -							214
High - Increase trees outside forests							
(1000 hectares)							705
Land impacted for carbon sink potential -							705
High - Reforest cropland (1000 hectares) Land impacted for carbon sink potential -							599
High - Reforest pasture (1000 hectares)							399
Land impacted for carbon sink potential -							1,223
High - Restore productivity (1000							1,220
hectares)							
Land impacted for carbon sink potential -							7,077
High - Total impacted (over 30 years)							•
(1000 hectares)							
Land impacted for carbon sink potential -							13.4
Low - Accelerate regeneration (1000							
hectares)							
Land impacted for carbon sink potential -							289
Low - Avoid deforestation (over 30 years)							
(1000 hectares)							
Land impacted for carbon sink potential -							1,512
Low - Extend rotation length (1000							
hectares)							070
Land impacted for carbon sink potential -							27.9
Low - Improve plantations (1000							
hectares) Land impacted for carbon sink potential -							0
Low - Increase retention of HWP (1000							U
hectares)							
Land impacted for carbon sink potential -							112
Low - Increase trees outside forests							112
(1000 hectares)							
Land impacted for carbon sink potential -							352
Low - Reforest cropland (1000 hectares)							
Land impacted for carbon sink potential -							104
Low - Reforest pasture (1000 hectares)							
Land impacted for carbon sink potential -							740
Low - Restore productivity (1000							
hectares)							
Land impacted for carbon sink potential -							3,151
Low - Total impacted (over 30 years)							
(1000 hectares)							
Land impacted for carbon sink potential -							20.1
Mid - Accelerate regeneration (1000							
hectares) Land impacted for carbon sink potential -							298
Mid - Avoid deforestation (over 30 years)							298
(1000 hectares)							
Land impacted for carbon sink potential -							2,730
Mid - Extend rotation length (1000							2,100
hectares)							
Land impacted for carbon sink potential -							41.9
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 -							163
Mid - Increase trees outside forests (1000							
hectares)							

Table 33: <i>E+RE+</i>	scenario -	DTII AR 6.	I and sinks -	Forests	(continued)
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Item	2020	2025	2030	2035	2040	2045	2050
Land impacted for carbon sink potential -							528
Mid - Reforest cropland (1000 hectares)							
Land impacted for carbon sink potential -							751
Mid - Reforest pasture (1000 hectares)							
Land impacted for carbon sink potential -							1,490
Mid - Restore productivity (1000							
hectares)							
Land impacted for carbon sink potential -							6,022
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 -		556	0.464	0.445	0.372	0.247	0.01
Coal (million 2019\$)							
Monetary damages from air pollution -		192	100	36.9	24.9	9.27	5.4
Natural Gas (million 2019\$)							
Monetary damages from air pollution -		1,300	1,208	916	529	246	103
Transportation (million 2019\$)							
Premature deaths from air pollution -		62.8	0.052	0.05	0.042	0.028	0.001
Coal (deaths)							
Premature deaths from air pollution -		21.6	11.3	4.17	2.81	1.05	0.61
Natural Gas (deaths)							
Premature deaths from air pollution -		146	136	103	59.5	27.6	11.6
Transportation (deaths)							

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

Item	2020	2025	2030	2035	2040	2045	2050
Commercial HVAC investment in 2020s - Cumulative 5-yr (million \$2018)		16,269	17,611				
Sales of cooking units - Electric Resistance (%)	44.8	57.1	84	89.3	89.6	89.6	89.6
Sales of cooking units - Gas (%)	55.2	42.9	16	10.7	10.4	10.4	10.4
Sales of space heating units - Electric Heat Pump (%)	4.52	24.4	70.6	87.7	89.7	89.7	89.7
Sales of space heating units - Electric Resistance (%)	8.06	5.73	7.1	9.32	9.79	9.8	9.8
Sales of space heating units - Fossil (%)	0	1.75	0.337	0.014	0	0	0
Sales of space heating units - Gas Furnace (%)	87.4	68.1	22	2.94	0.553	0.458	0.459
Sales of water heating units - Electric Heat Pump (%)	1.19	10.6	53.1	64.2	65	65	65
Sales of water heating units - Electric Resistance (%)	10.1	11	28.4	33.8	34.3	34.3	34.3
Sales of water heating units - Gas Furnace (%)	87.7	77.5	17.8	1.26	0.041	0	0
Sales of water heating units - Other (%)	0.996	0.947	0.735	0.688	0.685	0.688	0.687

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

Item	2020	2025	2030	2035	2040	2045	2050
Electricity distribution capital invested -		3.82	3.92	6.23	6.6	6.19	6.47
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)	182	178	169	158	147	141	138

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

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Industry (PJ)	241	249	271	274	290	326	330
Final energy use - Residential (PJ)	241	227	206	178	155	141	134
Final energy use - Transportation (PJ)	669	623	550	461	380	331	311

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

Item	2020	2025	2030	2035	2040	2045	2050
Residential HVAC investment in 2020s vs.		5.85	7.79				
REF - Cumulative 5-yr (billion \$2018)							
Sales of cooking units - Electric	76.5	81.5	96.8	99.8	100	100	100
Resistance (%)							
Sales of cooking units - Gas (%)	23.5	18.5	3.16	0.159	0	0	0
Sales of space heating units - Electric	7.5	22.5	72.3	86.1	87.5	87.8	87.4
Heat Pump (%)							
Sales of space heating units - Electric	19.7	22.4	10	6.61	6.36	6.55	6.72
Resistance (%)							
Sales of space heating units - Fossil (%)	9.34	13.6	7.39	5.58	5.03	4.63	4.86
Sales of space heating units - Gas (%)	63.5	41.4	10.2	1.69	1.08	1.04	1.02
Sales of water heating units - Electric	0	8.7	46.5	56.1	56.7	56.7	56.7
Heat Pump (%)							
Sales of water heating units - Electric	42.5	55.5	45.3	43.3	43.3	43.3	43.3
Resistance (%)							
Sales of water heating units - Gas Furnace	57.4	35.7	8.23	0.581	0.019	0	0
(%)							
Sales of water heating units - Other (%)	0.034	0.035	0.036	0.035	0.035	0.036	0.036

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

Item	2020	2025	2030	2035	2040	2045	2050
Light-duty vehicle capital costs -		1,055	2,704	4,381	6,637	7,223	6,887
Cumulative 5-yr (million \$2018)							
Public EV charging plugs - DC Fast (1000	0.178		1.98		8.67		14
units)							
Public EV charging plugs - L2 (1000 units)	1.67		47.5		208		337
Vehicle sales - Heavy-duty - diesel (%)	97.2	92.1	67	23.3	4.22	0.628	0
Vehicle sales - Heavy-duty - EV (%)	0.588	3.81	19	45.6	57.4	59.6	60
Vehicle sales - Heavy-duty - gasoline (%)	0.227	0.227	0.176	0.066	0.013	0.002	0
Vehicle sales - Heavy-duty - hybrid (%)	0.082	0.09	0.077	0.031	0.007	0.001	0
Vehicle sales - Heavy-duty - hydrogen FC	0.392	2.54	12.7	30.4	38.2	39.7	40
(%)							
Vehicle sales - Heavy-duty - other (%)	1.5	1.23	1.07	0.568	0.163	0.038	0
Vehicle sales - Light-duty - diesel (%)	1.59	1.85	1.27	0.408	0.075	0.013	0
Vehicle sales - Light-duty - EV (%)	3.79	14.8	45.9	81.6	96.3	99.3	100
Vehicle sales - Light-duty - gasoline (%)	90.1	78.5	49.4	16.8	3.32	0.591	0
Vehicle sales - Light-duty - hybrid (%)	4.3	4.45	3.17	1.18	0.287	0.063	0
Vehicle sales - Light-duty - hydrogen FC	0.111	0.342	0.206	0.064	0.013	0.002	0
(%)							
Vehicle sales - Light-duty - other (%)	0.103	0.099	0.065	0.023	0.004	0.001	0
Vehicle sales - Medium-duty - diesel (%)	64.7	59.7	42.3	14.4	2.59	0.384	0
Vehicle sales - Medium-duty - EV (%)	0.784	5.07	25.3	60.8	76.5	79.5	80
Vehicle sales - Medium-duty - gasoline (%)	33.7	33.3	25.5	9.32	1.77	0.277	0
Vehicle sales - Medium-duty - hybrid (%)	0.363	0.402	0.341	0.14	0.03	0.005	0
Vehicle sales - Medium-duty - hydrogen	0.196	1.27	6.33	15.2	19.1	19.9	20
FC (%)							
Vehicle sales - Medium-duty - other (%)	0.253	0.255	0.205	0.083	0.019	0.004	0

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

Item	2020	2025	2030	2035	2040	2045	2050
Capital invested - Solar PV - Base (billion \$2018)		13.4	11.2	11.2	14.8	7.82	0
Capital invested - Solar PV - Constrained (billion \$2018)		12.7	12	9.51	12.8	6.74	0
Capital invested - Wind - Base (billion \$2018)		25.1	7.19	0	11.4	14.3	21.8
Capital invested - Wind - Constrained (billion \$2018)		27.8	8.28	0.338	16.4	24.2	26.7
Installed renewables - OffshoreWind - Base land use assumptions (MW)	0	0	0	0	0	0	0
Installed renewables - OffshoreWind - Constrained land use assumptions (MW)	0	0	0	0	0	0	0
Installed renewables - Solar - Base land use assumptions (MW)	38	11,791	22,769	34,703	51,385	60,722	60,722
Installed renewables - Solar - Constrained land use assumptions (MW)	128	11,265	22,961	33,063	47,438	55,482	55,482
Installed renewables - Wind - Base land use assumptions (MW)	4,629	21,719	27,121	27,121	36,752	49,540	70,118
Installed renewables - Wind - Constrained land use assumptions (MW)	4,138	23,048	29,268	29,541	43,453	65,037	90,259

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

Item	2020	2025	2030	2035	2040	2045	2050
OffshoreWind - Base land use	0	0	0	0	0	0	0
assumptions (GWh)							
OffshoreWind - Constrained land use	0	0	0	0	0	0	0
assumptions (GWh)							
Solar - Base land use assumptions (GWh)	72.4	18,933	36,537	55,667	82,436	97,369	97,369
Solar - Constrained land use assumptions	216	18,113	36,914	53,140	76,195	89,104	89,104
(GWh)							
Wind - Base land use assumptions (GWh)	16,617	73,100	90,582	90,582	122,043	163,615	228,918
Wind - Constrained land use assumptions	14,915	76,207	96,035	97,035	141,929	209,549	285,205
(GWh)							

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

Item	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - Aggressive							0
deployment - Corn-ethanol to energy							
grasses (1000 tCO2e/y)							
Carbon sink potential - Aggressive							-13,495
deployment - Cropland measures (1000							
tCO2e/y)							
Carbon sink potential - Aggressive							-313
deployment - Permanent conservation							
cover (1000 tCO2e/y)							
Carbon sink potential - Aggressive							-13,808
deployment - Total (1000 tCO2e/y)							
Carbon sink potential - Moderate							0
deployment - Corn-ethanol to energy							
grasses (1000 tCO2e/y)							
Carbon sink potential - Moderate							-7,068
deployment - Cropland measures (1000							
tCO2e/y)							
Carbon sink potential - Moderate							-157
deployment - Permanent conservation							
cover (1000 tCO2e/y)							
Carbon sink potential - Moderate							-7,225
deployment - Total (1000 tCO2e/y)							

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

Item	2020	2025	2030	2035	2040	2045	2050
Land impacted for carbon sink -							0
Aggressive deployment - Corn-ethanol to							
energy grasses (1000 hectares)							
Land impacted for carbon sink -							5,748
Aggressive deployment - Cropland							
measures (1000 hectares)							
Land impacted for carbon sink -							570
Aggressive deployment - Permanent							
conservation cover (1000 hectares)							
Land impacted for carbon sink -							6,318
Aggressive deployment - Total (1000							
hectares)							
Land impacted for carbon sink - Moderate							0
deployment - Corn-ethanol to energy							
grasses (1000 hectares)							
Land impacted for carbon sink - Moderate							3,016
deployment - Cropland measures (1000							
hectares)							
Land impacted for carbon sink - Moderate							285
deployment - Permanent conservation							
cover (1000 hectares)							
Land impacted for carbon sink - Moderate							3,301
deployment - Total (1000 hectares)							

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

Item	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - High - Accelerate							-164
regeneration (1000 tCO2e/y)							
Carbon sink potential - High - All (not							-51,213
counting overlap) (1000 tCO2e/y)							
Carbon sink potential - High - Avoid							-2,274
deforestation (1000 tCO2e/y)							
Carbon sink potential - High - Extend							-7,741
rotation length (1000 tCO2e/y)							
Carbon sink potential - High - Improve							-151
plantations (1000 tCO2e/y)							
Carbon sink potential - High - Increase							-3,212
retention of HWP (1000 tCO2e/y)							
Carbon sink potential - High - Increase							-2,247
trees outside forests (1000 tCO2e/y)							
Carbon sink potential - High - Reforest							-10,656
cropland (1000 tCO2e/y)							
Carbon sink potential - High - Reforest							-21,079
pasture (1000 tCO2e/y)							
Carbon sink potential - High - Restore							-3,690
productivity (1000 tCO2e/y)							
Carbon sink potential - Low - Accelerate							-82
regeneration (1000 tCO2e/y)							
Carbon sink potential - Low - All (not							-13,537
counting overlap) (1000 tCO2e/y)							
Carbon sink potential - Low - Avoid							-379
deforestation (1000 tCO2e/y)							
Carbon sink potential - Low - Extend							-2,973
rotation length (1000 tCO2e/y)							
Carbon sink potential - Low - Improve							-77
plantations (1000 tCO2e/y)							
Carbon sink potential - Low - Increase							-1,071
retention of HWP (1000 tC02e/y)							•
Carbon sink potential - Low - Increase							-787
trees outside forests (1000 tC02e/y)							

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

Item	2020	2025	2030	2035	2040	2045	205
Carbon sink potential - Low - Reforest							-5,32
cropland (1000 tCO2e/y)							4.50
Carbon sink potential - Low - Reforest							-1,59
pasture (1000 tC02e/y)							101
Carbon sink potential - Low - Restore							-1,24
productivity (1000 tC02e/y)							10
Carbon sink potential - Mid - Accelerate							-12
regeneration (1000 tCO2e/y)							
Carbon sink potential - Mid - All (not							-32,37
counting overlap) (1000 tCO2e/y)							
Carbon sink potential - Mid - Avoid							-1,32
deforestation (1000 tC02e/y)							
Carbon sink potential - Mid - Extend							-5,35
rotation length (1000 tCO2e/y)							
Carbon sink potential - Mid - Improve							-11
plantations (1000 tCO2e/y)							
Carbon sink potential - Mid - Increase							-2,14
retention of HWP (1000 tCO2e/y)							
Carbon sink potential - Mid - Increase							-1,51
trees outside forests (1000 tCO2e/y)							
Carbon sink potential - Mid - Reforest							-7,99
cropland (1000 tCO2e/y)							
Carbon sink potential - Mid - Reforest							-11,33
pasture (1000 tCO2e/y)							
Carbon sink potential - Mid - Restore							-2,46
productivity (1000 tCO2e/y)							
and impacted for carbon sink potential -							26
High - Accelerate regeneration (1000							
hectares)							
Land impacted for carbon sink potential -							30
High - Avoid deforestation (over 30 years)							
(1000 hectares)							
Land impacted for carbon sink potential -							3,94
High - Extend rotation length (1000							
hectares)							
Land impacted for carbon sink potential -							55
High - Improve plantations (1000							
hectares)							
Land impacted for carbon sink potential -							
High - Increase retention of HWP (1000							
nectares)							
Land impacted for carbon sink potential -							21
High - Increase trees outside forests							
(1000 hectares)							
Land impacted for carbon sink potential -							70
High - Reforest cropland (1000 hectares)							. •
Land impacted for carbon sink potential -							59
High - Reforest pasture (1000 hectares)							3,
Land impacted for carbon sink potential -							1,22
High - Restore productivity (1000							.,
nectares)							
and impacted for carbon sink potential -							7,07
High - Total impacted (over 30 years)							1,01
(1000 hectares)							
Land impacted for carbon sink potential -							13
Low - Accelerate regeneration (1000							13
hectares)							
-							28
Land impacted for carbon sink potential -							28
Low - Avoid deforestation (over 30 years)							

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

Item	2020	2025	2030	2035	2040	2045	2050
Land impacted for carbon sink potential -	T	Т	T	T		T	1,512
Low - Extend rotation length (1000							
hectares)							
Land impacted for carbon sink potential -							27.9
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 -							112
Low - Increase trees outside forests							
(1000 hectares)							
Land impacted for carbon sink potential -							352
Low - Reforest cropland (1000 hectares)							
Land impacted for carbon sink potential -		+					104
Low - Reforest pasture (1000 hectares)							104
Land impacted for carbon sink potential -		+					740
Low - Restore productivity (1000							140
hectares)							
•							3,151
Land impacted for carbon sink potential -							3,131
Low - Total impacted (over 30 years)							
(1000 hectares)							001
Land impacted for carbon sink potential -							20.1
Mid - Accelerate regeneration (1000							
hectares)							
Land impacted for carbon sink potential -							298
Mid - Avoid deforestation (over 30 years)							
(1000 hectares)							
Land impacted for carbon sink potential -							2,730
Mid - Extend rotation length (1000							
hectares)							
Land impacted for carbon sink potential -							41.9
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 -							163
Mid - Increase trees outside forests (1000							
hectares)							
Land impacted for carbon sink potential -							528
Mid - Reforest cropland (1000 hectares)							
Land impacted for carbon sink potential -							751
Mid - Reforest pasture (1000 hectares)							
Land impacted for carbon sink potential -		+					1,490
Mid - Restore productivity (1000							1,470
hectares)							
Land impacted for carbon sink potential -							6,022
							0,022
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 -		556	0.464	0.445	0.372	0.247	0.01
Coal (million 2019\$)							
Monetary damages from air pollution -		213	107	114	85.7	32.6	11.6
Natural Gas (million 2019\$)							
Monetary damages from air pollution -		1,300	1,208	916	529	246	103
Transportation (million 2019\$)							
Premature deaths from air pollution -		62.8	0.052	0.05	0.042	0.028	0.001
Coal (deaths)							

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

Item	2020	2025	2030	2035	2040	2045	2050
Premature deaths from air pollution -		24.1	12.1	12.8	9.67	3.68	1.31
Natural Gas (deaths)							
Premature deaths from air pollution -		146	136	103	59.5	27.6	11.6
Transportation (deaths)							

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

040 2045	2050
76.9 85.5	88.5
23.1 14.5	11.5
61.3 79.5	86.8
7.38 8.69	9.45
689 0.224	0.059
0.6 11.6	3.64
43.1 57.7	63
4.6 31	33.4
31.6 10.6	2.88
786 0.72	0.695
	76.9 85.5 23.1 14.5 61.3 79.5 7.38 8.69 689 0.224 30.6 11.6 43.1 57.7 24.6 31 31.6 10.6 786 0.72

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

Item	2020	2025	2030	2035	2040	2045	2050
Electricity distribution capital invested -		3.2	3.23	3.9	4.01	5.79	6.1
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)	182	179	174	169	162	155	149
Final energy use - Industry (PJ)	241	250	272	277	295	331	335
Final energy use - Residential (PJ)	241	228	218	206	189	170	154
Final energy use - Transportation (PJ)	670	628	574	531	498	459	413

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

Item	2020	2025	2030	2035	2040	2045	2050
Residential HVAC investment in 2020s vs.		5.81	7.68				
REF - Cumulative 5-yr (billion \$2018)							
Sales of cooking units - Electric	76.4	77	79.2	84.9	92.8	97.7	99.4
Resistance (%)							
Sales of cooking units - Gas (%)	23.6	23	20.8	15.1	7.21	2.33	0.626
Sales of space heating units - Electric	7.5	13	18.7	35.2	61.1	79	85.2
Heat Pump (%)							
Sales of space heating units - Electric	19.7	24.8	23.3	19.2	12.8	8.51	7.04
Resistance (%)							
Sales of space heating units - Fossil (%)	9.34	14.9	14.4	12.2	8.46	5.78	5.24
Sales of space heating units - Gas (%)	63.5	47.3	43.7	33.5	17.6	6.67	2.55
Sales of water heating units - Electric	0	1.51	5.81	18.2	37.5	50.4	55
Heat Pump (%)							
Sales of water heating units - Electric	42.5	57.5	56.3	52.9	47.8	44.7	43.6
Resistance (%)							

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

	•	-	•	-			
Item	2020	2025	2030	2035	2040	2045	2050
Sales of water heating units - Gas Furnace (%)	57.4	40.9	37.8	28.9	14.7	4.93	1.34
Sales of water heating units - Other (%)	0.034	0.035	0.036	0.036	0.036	0.036	0.036

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

Item	2020	2025	2030	2035	2040	2045	2050
Light-duty vehicle capital costs -		0	171	359	1,211	3,810	5,551
Cumulative 5-yr (million \$2018)							
Public EV charging plugs - DC Fast (1000	0.178		0.611		3.21		8.98
units)							
Public EV charging plugs - L2 (1000 units)	1.67		14.7		77.3		216
Vehicle sales - Heavy-duty - diesel (%)	97.4	96	91.3	79.8	58.2	32.1	13.7
Vehicle sales - Heavy-duty - EV (%)	0.498	1.45	4.11	10.8	23.6	39.5	51
Vehicle sales - Heavy-duty - gasoline (%)	0.228	0.236	0.239	0.225	0.179	0.109	0.051
Vehicle sales - Heavy-duty - hybrid (%)	0.083	0.094	0.104	0.107	0.092	0.06	0.03
Vehicle sales - Heavy-duty - hydrogen FC	0.332	0.969	2.74	7.17	15.7	26.3	34
(%)							
Vehicle sales - Heavy-duty - other (%)	1.5	1.28	1.46	1.95	2.25	1.96	1.14
Vehicle sales - Light-duty - diesel (%)	1.6	2.01	2.06	1.64	1.05	0.542	0.232
Vehicle sales - Light-duty - EV (%)	1.84	4.58	11.7	25.5	48	71.8	87.5
Vehicle sales - Light-duty - gasoline (%)	91.9	87.7	79.9	67.1	46.6	25.1	11.1
Vehicle sales - Light-duty - hybrid (%)	4.45	5.27	5.93	5.41	4.08	2.42	1.18
Vehicle sales - Light-duty - hydrogen FC	0.113	0.381	0.328	0.251	0.179	0.1	0.046
(%)							
Vehicle sales - Light-duty - other (%)	0.105	0.108	0.098	0.086	0.062	0.034	0.016
Vehicle sales - Medium-duty - diesel (%)	64.8	62.2	57.7	49.4	35.6	19.6	8.37
Vehicle sales - Medium-duty - EV (%)	0.664	1.94	5.49	14.3	31.4	52.6	68
Vehicle sales - Medium-duty - gasoline (%)	33.8	34.7	34.7	31.9	24.4	14.2	6.33
Vehicle sales - Medium-duty - hybrid (%)	0.363	0.418	0.464	0.478	0.414	0.275	0.141
Vehicle sales - Medium-duty - hydrogen	0.166	0.485	1.37	3.58	7.86	13.2	17
FC (%)							
Vehicle sales - Medium-duty - other (%)	0.253	0.266	0.279	0.286	0.258	0.184	0.102

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

Item	2020	2025	2030	2035	2040	2045	2050
Capital invested - Biomass power plant	0	0	0	0	0	0	0
(billion \$2018)							
Capital invested - Biomass w/ccu allam	0	0	0	0	0	0.01	0
power plant (billion \$2018)							
Capital invested - Biomass w/ccu power	0	0	0	0	3.67	21.9	3.22
plant (billion \$2018)							

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

Item	2020	2025	2030	2035	2040	2045	2050
Biomass power plant (GWh)	0	0	0	0	0	0	0
Biomass w/ccu allam power plant (GWh)	0	0	0	0	0	9.64	9.64
Biomass w/ccu power plant (GWh)	0	0	0	0	4,118	28,723	32,333

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	549	1,075	3,318	3,802
Conversion capital investment -		0	0	6,005	6,222	27,270	5,804
Cumulative 5-yr (million \$2018)							
Number of facilities - Allam power w ccu	0	0	0	0	0	1	1
(quantity)							

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Item	2020	2025	2030	2035	2040	2045	2050
Number of facilities - Beccs hydrogen	0	0	0	7	10	18	21
(quantity)							
Number of facilities - Diesel (quantity)	0	0	0	0	0	0	0
Number of facilities - Diesel ccu (quantity)	0	0	0	0	0	1	1
Number of facilities - Power (quantity)	0	0	0	0	0	0	0
Number of facilities - Power ccu	0	0	0	0	3	23	26
(quantity)							
Number of facilities - Pyrolysis (quantity)	0	0	0	0	0	0	0
Number of facilities - Pyrolysis ccu	0	0	0	0	1	1	2
(quantity)							
Number of facilities - Sng (quantity)	0	0	0	0	0	0	0
Number of facilities - Sng ccu (quantity)	0	0	0	0	0	0	0

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

Item	2020	2025	2030	2035	2040	2045	2050
Annual - All (MMT)		0	3.24	11.1	18.8	59.3	66.5
Annual - BECCS (MMT)		0	0	7.72	15.5	49	55.9
Annual - Cement and lime (MMT)		0	3.24	3.35	3.32	10.3	10.6
Annual - NGCC (MMT)		0	0	0	0	0	0
Cumulative - All (MMT)		0	3.24	14.3	33.1	92.3	159
Cumulative - BECCS (MMT)		0	0	7.72	23.2	72.2	128
Cumulative - Cement and lime (MMT)		0	3.24	6.59	9.91	20.2	30.8
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	420	582	802	2,436	2,996
Cumulative investment - All (million \$2018)		0	1,962	2,301	2,695	4,822	5,266
Cumulative investment - Spur (million \$2018)		0	11.9	351	550	2,677	3,120
Cumulative investment - Trunk (million \$2018)		0	1,950	1,950	2,145	2,145	2,145
Spur (km)		0	10.4	173	393	2,027	2,587
Trunk (km)		0	409	409	409	409	409

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

Item	2020	2025	2030	2035	2040	2045	2050
CO2 storage (MMT)		0	0.92	4.28	7.13	10.8	10.9
Injection wells (wells)		0	2	7	13	22	27
Resource characterization, appraisal, permitting costs (million \$2020)		27.9	123	190	190	190	190
Wells and facilities construction costs (million \$2020)		0	55.8	217	387	648	804

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

Item	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - Aggressive							-1,072
deployment - Corn-ethanol to energy							
grasses (1000 tCO2e/y)							
Carbon sink potential - Aggressive							-12,355
deployment - Cropland measures (1000							
tCO2e/y)							
Carbon sink potential - Aggressive							0
deployment - Cropland to woody energy							
crops (1000 tCO2e/y)							

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

Item	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - Aggressive							0
deployment - Pasture to energy crops							
(1000 tC02e/y)							
Carbon sink potential - Aggressive							-284
deployment - Permanent conservation							
cover (1000 tC02e/y)							
Carbon sink potential - Aggressive							-13,711
deployment - Total (1000 tC02e/y)							
Carbon sink potential - Moderate							-1,072
deployment - Corn-ethanol to energy							
grasses (1000 tCO2e/y)							
Carbon sink potential - Moderate							-6,467
deployment - Cropland measures (1000							
tCO2e/y)							
Carbon sink potential - Moderate							0
deployment - Cropland to woody energy							
crops (1000 tCO2e/y)							
Carbon sink potential - Moderate							0
deployment - Pasture to energy crops							
(1000 tC02e/y)							
Carbon sink potential - Moderate							-142
deployment - Permanent conservation							
cover (1000 tCO2e/y)							
Carbon sink potential - Moderate							-7,681
deployment - Total (1000 tCO2e/y)							
Land impacted for carbon sink -							497
Aggressive deployment - Corn-ethanol to							
energy grasses (1000 hectares)							
Land impacted for carbon sink -							13,018
Aggressive deployment - Cropland							
measures (1000 hectares)							
Land impacted for carbon sink -							292
Aggressive deployment - Cropland to							
woody energy crops (1000 hectares)							
Land impacted for carbon sink -							979
Aggressive deployment - Pasture to							
energy crops (1000 hectares)							
Land impacted for carbon sink -							517
Aggressive deployment - Permanent							
conservation cover (1000 hectares)							
Land impacted for carbon sink -							15,303
Aggressive deployment - Total (1000							,
hectares)							
Land impacted for carbon sink - Moderate							497
deployment - Corn-ethanol to energy							171
grasses (1000 hectares)							
Land impacted for carbon sink - Moderate							2,765
deployment - Cropland measures (1000							2,100
hectares)							
Land impacted for carbon sink - Moderate				+			292
deployment - Cropland to woody energy							272
crops (1000 hectares)							
Land impacted for carbon sink - Moderate							979
							717
deployment - Pasture to energy crops							
(1000 hectares)							050
Land impacted for carbon sink - Moderate							259
deployment - Permanent conservation							
cover (1000 hectares)							,
Land impacted for carbon sink - Moderate							4,793
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	2020	2020	2000	2000	2040	2040	-164
regeneration (1000 tCO2e/y)							10 1
Carbon sink potential - High - All (not							-51,213
counting overlap) (1000 tCO2e/y)							01,210
Carbon sink potential - High - Avoid							-2,274
deforestation (1000 tCO2e/y)							_,
Carbon sink potential - High - Extend							-7,741
rotation length (1000 tC02e/y)							.,
Carbon sink potential - High - Improve	+						-151
plantations (1000 tCO2e/y)							
Carbon sink potential - High - Increase							-3,212
retention of HWP (1000 tCO2e/y)							0,212
Carbon sink potential - High - Increase							-2,247
trees outside forests (1000 tCO2e/y)							_,
Carbon sink potential - High - Reforest							-10,656
cropland (1000 tCO2e/y)							10,000
Carbon sink potential - High - Reforest							-21,079
pasture (1000 tC02e/y)							21,017
Carbon sink potential - High - Restore							-3,690
productivity (1000 tC02e/y)							-5,070
Carbon sink potential - Low - Accelerate	+	+					-82
regeneration (1000 tCO2e/y)							-02
Carbon sink potential - Low - All (not							-13,537
counting overlap) (1000 tC02e/y)							-13,331
Carbon sink potential - Low - Avoid							-379
							-319
deforestation (1000 tC02e/y)							0.070
Carbon sink potential - Low - Extend							-2,973
rotation length (1000 tC02e/y)							77
Carbon sink potential - Low - Improve							-77
plantations (1000 tC02e/y)							4.074
Carbon sink potential - Low - Increase							-1,071
retention of HWP (1000 tC02e/y)							
Carbon sink potential - Low - Increase							-787
trees outside forests (1000 tCO2e/y)							
Carbon sink potential - Low - Reforest							-5,328
cropland (1000 tCO2e/y)							
Carbon sink potential - Low - Reforest							-1,597
pasture (1000 tCO2e/y)							
Carbon sink potential - Low - Restore							-1,244
productivity (1000 tCO2e/y)							
Carbon sink potential - Mid - Accelerate							-123
regeneration (1000 tCO2e/y)							
Carbon sink potential - Mid - All (not							-32,374
counting overlap) (1000 tCO2e/y)							
Carbon sink potential - Mid - Avoid							-1,326
deforestation (1000 tCO2e/y)							
Carbon sink potential - Mid - Extend							-5,357
rotation length (1000 tCO2e/y)							
Carbon sink potential - Mid - Improve							-113
plantations (1000 tCO2e/y)							
Carbon sink potential - Mid - Increase							-2,141
retention of HWP (1000 tCO2e/y)							,
Carbon sink potential - Mid - Increase							-1,517
trees outside forests (1000 tCO2e/y)							.,
Carbon sink potential - Mid - Reforest		+					-7,992
cropland (1000 tCO2e/y)							1,772
Carbon sink potential - Mid - Reforest	+						-11,338
pasture (1000 tC02e/y)							11,000
Carbon sink potential - Mid - Restore	+	+					-2,467
productivity (1000 tC02e/y)							2,401
pr duddtivity (1000 t0026/y)							

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

lable 57: E-B+ scenario - PILLAR 6: Land s		•	,				
Item	2020	2025	2030	2035	2040	2045	2050
Land impacted for carbon sink potential -							26.8
High - Accelerate regeneration (1000							
hectares)							000
Land impacted for carbon sink potential -							308
High - Avoid deforestation (over 30 years)							
(1000 hectares)							
Land impacted for carbon sink potential -							3,947
High - Extend rotation length (1000							
hectares)							
Land impacted for carbon sink potential -							55.7
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 -							214
High - Increase trees outside forests							
(1000 hectares)							
Land impacted for carbon sink potential -							705
High - Reforest cropland (1000 hectares)							
Land impacted for carbon sink potential -							599
High - Reforest pasture (1000 hectares)							
Land impacted for carbon sink potential -							1,223
High - Restore productivity (1000							
hectares)							
Land impacted for carbon sink potential -							7,077
High - Total impacted (over 30 years)							
(1000 hectares)							
Land impacted for carbon sink potential -							13.4
Low - Accelerate regeneration (1000							
hectares)							
Land impacted for carbon sink potential -							289
Low - Avoid deforestation (over 30 years)							
(1000 hectares)							
Land impacted for carbon sink potential -							1,512
Low - Extend rotation length (1000							
hectares)							
Land impacted for carbon sink potential -							27.9
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 -							112
Low - Increase trees outside forests							
(1000 hectares)							
Land impacted for carbon sink potential -							352
Low - Reforest cropland (1000 hectares)							
Land impacted for carbon sink potential -							104
Low - Reforest pasture (1000 hectares)							
Land impacted for carbon sink potential -							740
Low - Restore productivity (1000							
hectares)							
Land impacted for carbon sink potential -							3,151
Low - Total impacted (over 30 years)							•
(1000 hectares)							
Land impacted for carbon sink potential -					+		20.1
Mid - Accelerate regeneration (1000							
Mid - Accelerate regeneration riboo			,				

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

Item	2020	2025	2030	2035	2040	2045	2050
Land impacted for carbon sink potential -							298
Mid - Avoid deforestation (over 30 years)							
(1000 hectares)							
Land impacted for carbon sink potential -							2,730
Mid - Extend rotation length (1000							
hectares)							
Land impacted for carbon sink potential -							41.9
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 -							163
Mid - Increase trees outside forests (1000							
hectares)							
Land impacted for carbon sink potential -							528
Mid - Reforest cropland (1000 hectares)							
Land impacted for carbon sink potential -							751
Mid - Reforest pasture (1000 hectares)							
Land impacted for carbon sink potential -							1,490
Mid - Restore productivity (1000							
hectares)							
Land impacted for carbon sink potential -							6,022
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 -		556	0.464	0.445	0.372	0.247	0.01
Coal (million 2019\$)							
Monetary damages from air pollution -		201	87.5	51.2	33.1	14.6	7.52
Natural Gas (million 2019\$)							
Monetary damages from air pollution -		1,321	1,328	1,290	1,161	924	634
Transportation (million 2019\$)							
Premature deaths from air pollution -		62.8	0.052	0.05	0.042	0.028	0.001
Coal (deaths)							
Premature deaths from air pollution -		22.7	9.88	5.78	3.74	1.65	0.849
Natural Gas (deaths)							
Premature deaths from air pollution -		149	149	145	131	104	71.3
Transportation (deaths)							

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

Item	2020	2025	2030	2035	2040	2045	2050
Commercial HVAC investment in 2020s -		16,080	16,491				
Cumulative 5-yr (million \$2018)							
Sales of cooking units - Electric	44.8	47.8	47.9	47.8	47.9	47.9	48
Resistance (%)							
Sales of cooking units - Gas (%)	55.2	52.2	52.1	52.2	52.1	52.1	52
Sales of space heating units - Electric	4.52	20.5	48.3	71.1	74.8	75.2	75.2
Heat Pump (%)							
Sales of space heating units - Electric	8.06	6.43	10.8	18.4	23.5	24.2	24.3
Resistance (%)							
Sales of space heating units - Fossil (%)	0	1.98	1.55	0.695	0.102	0.009	0
Sales of space heating units - Gas Furnace	87.4	71.1	39.3	9.83	1.63	0.522	0.461
(%)							
Sales of water heating units - Electric	1.19	0.826	0.821	0.823	0.819	0.815	0.814
Heat Pump (%)							
Sales of water heating units - Electric	10.1	7.06	7.07	7.05	7.05	7.05	7.04
Resistance (%)							

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

Item	2020	2025	2030	2035	2040	2045	2050
Sales of water heating units - Gas Furnace (%)	87.7	91.1	91.1	91.1	91.1	91.1	91.1
Sales of water heating units - Other (%)	0.996	0.996	0.994	0.993	0.993	0.997	0.996

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

Item	2020	2025	2030	2035	2040	2045	2050
Electricity distribution capital invested -		3.46	3.52	3.75	3.83	4.56	4.72
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)	182	183	183	181	179	181	187
Final energy use - Industry (PJ)	241	258	268	276	288	303	318
Final energy use - Residential (PJ)	241	227	219	214	212	213	214
Final energy use - Transportation (PJ)	670	629	580	552	553	571	593

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

Item	2020	2025	2030	2035	2040	2045	2050
Residential HVAC investment in 2020s vs.		5.54	5.98				
REF - Cumulative 5-yr (billion \$2018)							
Sales of cooking units - Electric	76.2	76.2	76.2	76.2	76.2	76.2	76.2
Resistance (%)							
Sales of cooking units - Gas (%)	23.8	23.8	23.8	23.8	23.8	23.8	23.8
Sales of space heating units - Electric	4.86	29.6	30.8	32.6	34.1	35.7	37.6
Heat Pump (%)							
Sales of space heating units - Electric	20.4	20.8	20.3	19.8	19.4	18	15.9
Resistance (%)							
Sales of space heating units - Fossil (%)	9.54	10.9	11.1	11.1	10.6	10.2	10.6
Sales of space heating units - Gas (%)	65.2	38.7	37.8	36.4	35.8	36	36
Sales of water heating units - Electric	0	0	0	0	0	0	0
Heat Pump (%)							
Sales of water heating units - Electric	42.5	58	57.9	57.7	57.7	57.6	57.5
Resistance (%)							
Sales of water heating units - Gas Furnace	57.4	42	42.1	42.3	42.3	42.4	42.4
(%)							
Sales of water heating units - Other (%)	0.034	0.035	0.036	0.036	0.036	0.036	0.036

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

Item	2020	2025	2030	2035	2040	2045	2050
Vehicle sales - Heavy-duty - diesel (%)	98.1	98.2	97.9	97	95.6	93.5	91.6
Vehicle sales - Heavy-duty - EV (%)	0	0	0	0	0	0	0
Vehicle sales - Heavy-duty - gasoline (%)	0.229	0.242	0.257	0.274	0.294	0.317	0.343
Vehicle sales - Heavy-duty - hybrid (%)	0.083	0.096	0.112	0.13	0.15	0.174	0.202
Vehicle sales - Heavy-duty - hydrogen FC	0.119	0.138	0.16	0.186	0.216	0.25	0.29
(%)							
Vehicle sales - Heavy-duty - other (%)	1.51	1.31	1.57	2.37	3.69	5.71	7.57
Vehicle sales - Light-duty - diesel (%)	1.59	2	2.19	2.04	1.84	1.71	1.63
Vehicle sales - Light-duty - EV (%)	3.44	5.43	6.2	7.62	9.29	10.8	11.9
Vehicle sales - Light-duty - gasoline (%)	90.4	86.9	84.8	83	81	79	77.4
Vehicle sales - Light-duty - hybrid (%)	4.32	5.17	6.33	6.9	7.48	8.08	8.55
Vehicle sales - Light-duty - hydrogen FC	0.111	0.378	0.348	0.31	0.307	0.308	0.319
(%)							
Vehicle sales - Light-duty - other (%)	0.104	0.108	0.104	0.105	0.104	0.103	0.106
Vehicle sales - Medium-duty - diesel (%)	65.2	63.5	61.6	59.6	58	56.5	55.2
Vehicle sales - Medium-duty - EV (%)	0.027	0.105	0.329	0.671	0.895	0.973	0.993
Vehicle sales - Medium-duty - gasoline (%)	34	35.5	37	38.5	39.7	40.8	41.7

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

Item	2020	2025	2030	2035	2040	2045	2050
Vehicle sales - Medium-duty - hybrid (%)	0.365	0.427	0.496	0.577	0.674	0.793	0.929
Vehicle sales - Medium-duty - hydrogen FC (%)	0.175	0.208	0.242	0.285	0.339	0.409	0.487
Vehicle sales - Medium-duty - other (%)	0.255	0.271	0.298	0.345	0.42	0.528	0.671

Table 64: REF scenario - PILLAR 6: Land sinks - Forests

Item	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - High - Accelerate							-164
regeneration (1000 tCO2e/y)							
Carbon sink potential - High - All (not							-51,213
counting overlap) (1000 tCO2e/y)							
Carbon sink potential - High - Avoid							-2,274
deforestation (1000 tCO2e/y)							
Carbon sink potential - High - Extend							-7,74
rotation length (1000 tCO2e/y)							
Carbon sink potential - High - Improve							-15
plantations (1000 tCO2e/y)							
Carbon sink potential - High - Increase							-3,212
retention of HWP (1000 tCO2e/y)							
Carbon sink potential - High - Increase							-2,247
trees outside forests (1000 tC02e/y)							·
Carbon sink potential - High - Reforest							-10,656
cropland (1000 tCO2e/y)							•
Carbon sink potential - High - Reforest							-21,079
pasture (1000 tC02e/y)							,
Carbon sink potential - High - Restore							-3,690
productivity (1000 tCO2e/y)							-,
Carbon sink potential - Low - Accelerate							-82
regeneration (1000 tCO2e/y)							0.
Carbon sink potential - Low - All (not							-13,53
counting overlap) (1000 tC02e/y)							10,00
Carbon sink potential - Low - Avoid							-379
deforestation (1000 tC02e/y)							01.
Carbon sink potential - Low - Extend							-2,973
rotation length (1000 tCO2e/y)							2,710
Carbon sink potential - Low - Improve							-7
plantations (1000 tCO2e/y)							-1
Carbon sink potential - Low - Increase							-1,07
retention of HWP (1000 tCO2e/y)							-1,01
Carbon sink potential - Low - Increase							-78
trees outside forests (1000 tC02e/y)							-10
Carbon sink potential - Low - Reforest							-5,328
cropland (1000 tCO2e/y)							-0,320
Carbon sink potential - Low - Reforest							-1,59
pasture (1000 tCO2e/y)							-1,59
							-1,244
Carbon sink potential - Low - Restore							-1,244
productivity (1000 tC02e/y)							-123
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO2e/y)							-123
							00.07/
Carbon sink potential - Mid - All (not							-32,374
counting overlap) (1000 tC02e/y)							1.00
Carbon sink potential - Mid - Avoid							-1,326
deforestation (1000 tC02e/y)							
Carbon sink potential - Mid - Extend							-5,35
rotation length (1000 tCO2e/y)							
Carbon sink potential - Mid - Improve							-113
plantations (1000 tCO2e/y)							
Carbon sink potential - Mid - Increase						T	-2,14
retention of HWP (1000 tCO2e/y)							

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

Item Conhancial Mid Tanassa	2020	2025	2030	2035	2040	2045	2050
Carbon sink potential - Mid - Increase							-1,517
trees outside forests (1000 tC02e/y)							7000
Carbon sink potential - Mid - Reforest							-7,992
cropland (1000 tCO2e/y)							11 000
Carbon sink potential - Mid - Reforest							-11,338
pasture (1000 tC02e/y)							0.7.77
Carbon sink potential - Mid - Restore							-2,467
productivity (1000 tCO2e/y) Land impacted for carbon sink potential -							07.0
							26.8
High - Accelerate regeneration (1000							
hectares)							000
Land impacted for carbon sink potential -							308
High - Avoid deforestation (over 30 years)							
(1000 hectares)							0.047
Land impacted for carbon sink potential -							3,947
High - Extend rotation length (1000							
hectares)							
Land impacted for carbon sink potential -							55.7
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 -							214
High - Increase trees outside forests							
(1000 hectares)							
Land impacted for carbon sink potential -							705
High - Reforest cropland (1000 hectares)							
Land impacted for carbon sink potential -							599
High - Reforest pasture (1000 hectares)							
Land impacted for carbon sink potential -							1,223
High - Restore productivity (1000							
hectares)							
Land impacted for carbon sink potential -							7,077
High - Total impacted (over 30 years)							
(1000 hectares)							
Land impacted for carbon sink potential -							13.4
Low - Accelerate regeneration (1000							
hectares)							
Land impacted for carbon sink potential -							289
Low - Avoid deforestation (over 30 years)							
(1000 hectares)							
Land impacted for carbon sink potential -							1,512
Low - Extend rotation length (1000							
hectares)							
Land impacted for carbon sink potential -							27.9
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 -							112
Low - Increase trees outside forests							112
(1000 hectares)							
Land impacted for carbon sink potential -							352
Low - Reforest cropland (1000 hectares)							332
Land impacted for carbon sink potential -							104
Low - Reforest pasture (1000 hectares)							104
Land impacted for carbon sink potential -							740
Low - Restore productivity (1000							740
			I			I .	

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

Item	2020	2025	2030	2035	2040	2045	2050
Land impacted for carbon sink potential - Low - Total impacted (over 30 years) (1000 hectares)							3,151
Land impacted for carbon sink potential - Mid - Accelerate regeneration (1000 hectares)							20.1
Land impacted for carbon sink potential - Mid - Avoid deforestation (over 30 years) (1000 hectares)							298
Land impacted for carbon sink potential - Mid - Extend rotation length (1000 hectares)							2,730
Land impacted for carbon sink potential - Mid - Improve plantations (1000 hectares)							41.9
Land impacted for carbon sink potential - Mid - Increase retention of HWP (1000 hectares)							0
Land impacted for carbon sink potential - Mid - Increase trees outside forests (1000 hectares)							163
Land impacted for carbon sink potential - Mid - Reforest cropland (1000 hectares)							528
Land impacted for carbon sink potential - Mid - Reforest pasture (1000 hectares)							751
Land impacted for carbon sink potential - Mid - Restore productivity (1000 hectares)							1,490
Land impacted for carbon sink potential - Mid - Total impacted (over 30 years) (1000 hectares)							6,022

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)	-4.2		-13.4				-12
Business-as-usual carbon sink - Retained in Hardwood Products (Mt CO2e/y)	-0.874		-1.57				-1.63
Business-as-usual carbon sink - Total (Mt CO2e/y)	-5.07		-15				-13.6

Table 66: REF scenario - IMPACTS - Health

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution -		2,253	1,348	899	709	630	623
Coal (million 2019\$)							
Monetary damages from air pollution -		219	197	209	152	131	117
Natural Gas (million 2019\$)							
Monetary damages from air pollution -		1,320	1,347	1,376	1,412	1,448	1,483
Transportation (million 2019\$)							
Premature deaths from air pollution -		255	152	102	80	71.1	70.3
Coal (deaths)							
Premature deaths from air pollution -		24.7	22.2	23.6	17.2	14.8	13.2
Natural Gas (deaths)							
Premature deaths from air pollution -		149	152	155	159	163	167
Transportation (deaths)							