Net-Zero America - utah state report

Larson et al. 2020

February 2021

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

Notes

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

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

Item	2020	2025	2030	2035	2040	2045	2050
Residential HVAC investment in 2020s vs. REF -	0	2.76	3.21	0	0	0	0
Cumulative 5-yr (billion \$2018)							
Sales of cooking units - Electric Resistance (%)	37.1	50.5	91.5	99.6	100	100	100
Sales of cooking units - Gas (%)	62.9	49.5	8.47	0.426	0	0	0
Sales of space heating units - Electric Heat Pump	3.03	9.9	34.8	79.5	87.6	88.4	88.2
(%)							
Sales of space heating units - Electric Resistance	3.81	7.35	5.69	2.51	1.97	1.95	1.97
(%)							
Sales of space heating units - Fossil (%)	3.57	9.24	8.91	8.06	7.57	7.25	7.38
Sales of space heating units - Gas (%)	89.6	73.5	50.6	9.98	2.86	2.43	2.43
Sales of water heating units - Electric Heat Pump	0	1.51	15.7	41.6	46.2	46.5	46.5
(%)							
Sales of water heating units - Electric Resistance	7.01	15.7	26.3	48.5	52.5	52.7	52.7
(%)							
Sales of water heating units - Gas Furnace (%)	92.3	82	57.3	9.09	0.535	0	0
Sales of water heating units - Other (%)	0.642	0.79	0.79	0.787	0.779	0.778	0.778

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

Item	2020	2025	2030	2035	2040	2045	2050
Light-duty vehicle capital costs - Cumulative 5-yr (million \$2018)	0	449	1,171	1,866	2,839	3,076	2,940
Public EV charging plugs - DC Fast (1000 units)	0.174	0	0.748	0	3.07	0	4.93
Public EV charging plugs - L2 (1000 units)	1.07	0	18	0	73.9	0	119
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 (%)	1.55	1.82	1.26	0.402	0.075	0.013	0
Vehicle sales - Light-duty - EV (%)	3.91	15.2	46.4	81.8	96.3	99.3	100
Vehicle sales - Light-duty - gasoline (%)	89.9	78	48.8	16.5	3.29	0.59	0
Vehicle sales - Light-duty - hybrid (%)	4.42	4.54	3.21	1.19	0.291	0.063	0
Vehicle sales - Light-duty - hydrogen FC (%)	0.11	0.34	0.203	0.063	0.013	0.002	0
Vehicle sales - Light-duty - other (%)	0.102	0.098	0.064	0.022	0.004	0.001	0
Vehicle sales - Medium-duty - diesel (%)	64.7	59.7	42.3	14.4	2.59	0.384	0
Vehicle sales - Medium-duty - EV (%)	0.784	5.07	25.3	60.8	76.5	79.5	80
Vehicle sales - Medium-duty - gasoline (%)	33.7	33.3	25.5	9.32	1.77	0.277	0
Vehicle sales - Medium-duty - hybrid (%)	0.363	0.402	0.341	0.14	0.03	0.005	0
Vehicle sales - Medium-duty - hydrogen FC (%)	0.196	1.27	6.33	15.2	19.1	19.9	20
Vehicle sales - Medium-duty - other (%)	0.253	0.255	0.205	0.083	0.019	0.004	0

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

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Commercial (PJ)	103	103	101	94.8	87.6	82.5	80.3
Final energy use - Industry (PJ)	86.5	89.3	90.2	96.9	111	116	122
Final energy use - Residential (PJ)	126	122	118	106	90.4	79.2	72.3
Final energy use - Transportation (PJ)	304	290	260	223	188	168	161

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

Item	2020	2025	2030	2035	2040	2045	2050
Commercial HVAC investment in 2020s -	0	7,533	8,381	0	0	0	0
Cumulative 5-yr (million \$2018)							
Sales of cooking units - Electric Resistance (%)	41.9	54.6	83	88.6	88.9	88.9	88.9
Sales of cooking units - Gas (%)	58.1	45.4	17	11.4	11.1	11.1	11.1
Sales of space heating units - Electric Heat Pump (%)	0.749	8.98	33.5	81.9	90.4	91	91
Sales of space heating units - Electric Resistance (%)	0.855	3.41	4.83	7.94	8.5	8.54	8.55
Sales of space heating units - Fossil (%)	0	0.208	0.04	0.002	0	0	0

Table 4: E+ scenario -	PTI I AR 1: Efficiency	//Flectrification -	Commercial	(continued)
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Item	2020	2025	2030	2035	2040	2045	2050
Sales of space heating units - Gas Furnace (%)	98.4	87.4	61.6	10.2	1.06	0.491	0.49
Sales of water heating units - Electric Heat Pump (%)	0.008	1.61	16.7	45	50	50.3	50.3
Sales of water heating units - Electric Resistance (%)	0.41	2.69	16.3	44.1	49	49.3	49.3
Sales of water heating units - Gas Furnace (%)	99.5	95.3	66.6	10.6	0.622	0	0
Sales of water heating units - Other (%)	0.1	0.381	0.381	0.382	0.381	0.381	0.381

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

Item	2020	2025	2030	2035	2040	2045	2050
Electricity distribution capital invested -	0	1.72	1.81	3.2	3.44	3.67	3.91
Cumulative 5-yr (billion \$2018)							

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

Item	2020	2025	2030	2035	2040	2045	2050
Capital invested - Biomass power plant (billion	0	0.003	0.029	0	0	0	0
\$2018)							
Capital invested - Biomass w/ccu allam power	0	0	0	0	0	0	0
plant (billion \$2018)							
Capital invested - Biomass w/ccu power plant	0	0	0	0	0	0	0.377
(billion \$2018)							
Capital invested - Solar PV - Base (billion \$2018)	0	0	0	0	0	0	0.525
Capital invested - Solar PV - Constrained (billion	0	1.09	0	0	2.18	2.6	1.2
\$2018)							
Capital invested - Wind - Base (billion \$2018)	0	0.251	7.55	5.67	2.22	1.04	3.24
Capital invested - Wind - Constrained (billion	0	0.199	7.9	6.7	0.918	0.419	2.7
\$2018)							

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

Item	2020	2025	2030	2035	2040	2045	2050
Biomass power plant (GWh)	0	4.9	61.8	61.8	61.8	61.8	61.8
Biomass w/ccu allam power plant (GWh)	0	0	0	0	0	0	0
Biomass w/ccu power plant (GWh)	0	0	0	0	0	0	423
Solar - Base land use assumptions (GWh)	2,042	0	0	0	0	0	1,245
Solar - Constrained land use assumptions (GWh)	2,037	0	0	0	15,608	2,359	2,413
Wind - Base land use assumptions (GWh)	1,617	508	16,025	12,502	4,938	2,416	8,258
Wind - Constrained land use assumptions (GWh)	3,563	2,082	15,525	9,625	2,054	823	5,491

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

Item	2020	2025	2030	2035	2040	2045	2050
Biomass purchases (million \$2018/year)	0	0.333	3.78	4.99	5.18	5.22	26.6
Conversion capital investment - Cumulative 5-yr	0	2.83	32.3	18.6	2.91	0.542	346
(million \$2018)							
Number of facilities - Allam power w ccu	0	0	0	0	0	0	0
(quantity)							
Number of facilities - Beccs hydrogen (quantity)	0	0	0	0	0	0	0
Number of facilities - Diesel (quantity)	0	0	0	1	1	1	1
Number of facilities - Diesel ccu (quantity)	0	0	0	0	0	0	0
Number of facilities - Power (quantity)	0	1	1	1	1	1	1
Number of facilities - Power ccu (quantity)	0	0	0	0	0	0	1
Number of facilities - Pyrolysis (quantity)	0	0	0	1	1	1	1
Number of facilities - Pyrolysis ccu (quantity)	0	0	0	0	0	0	0
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	0	0	0	0	0	0.4
Annual - BECCS (MMT)	0	0	0	0	0	0	0.4
Annual - Cement and lime (MMT)	0	0	0	0	0	0	0
Annual - NGCC (MMT)	0	0	0	0	0	0	0
Cumulative - All (MMT)	0	0	0	0	0	0	0.4
Cumulative - BECCS (MMT)	0	0	0	0	0	0	0.4
Cumulative - Cement and lime (MMT)	0	0	0	0	0	0	0
Cumulative - NGCC (MMT)	0	0	0	0	0	0	0

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

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

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

Item	2020	2025	2030	2035	2040	2045	2050
All (km)	0	0	0	0	0	0	22.6
Cumulative investment - All (million \$2018)	0	0	0	0	0	0	13.5
Cumulative investment - Spur (million \$2018)	0	0	0	0	0	0	13.5
Cumulative investment - Trunk (million \$2018)	0	0	0	0	0	0	0
Spur (km)	0	0	0	0	0	0	22.6
Trunk (km)	0	0	0	0	0	0	0

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

Carbon sink potential - Aggressive deployment - Corn-ethanol to energy grasses (1000 tCO2e/y) Carbon sink potential - Aggressive deployment - Cropland measures (1000 tCO2e/y) Carbon sink potential - Aggressive deployment - Permanent conservation cover (1000 tCO2e/y) Carbon sink potential - Aggressive deployment - Total (1000 tCO2e/y) Carbon sink potential - Moderate deployment - Corn-ethanol to energy grasses (1000 tCO2e/y) Carbon sink potential - Moderate deployment - Cropland measures (1000 tCO2e/y) Carbon sink potential - Moderate deployment - Cropland measures (1000 tCO2e/y) Carbon sink potential - Moderate deployment - Permanent conservation cover (1000 tCO2e/y) Carbon sink potential - Moderate deployment - Potal (1000 tCO2e/y) Land impacted for carbon sink - Aggressive (1000 hectares) Land impacted for carbon sink - Aggressive (1000 tcozer) Land impacted for carbon sink - Aggressive (1000 hectares)
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deployment - Cropland measures (1000
hectares)
Land impacted for carbon sink - Aggressive 0 0 24.1
deployment - Permanent conservation cover
(1000 hectares)
Land impacted for carbon sink - Aggressive 0 0 670
deployment - Total (1000 hectares)
Land impacted for carbon sink - Moderate 0 0 0
deployment - Corn-ethanol to energy grasses
(1000 hectares)

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

Item	2020	2025	2050
Land impacted for carbon sink - Moderate	0	0	329
deployment - Cropland measures (1000			
hectares)			
Land impacted for carbon sink - Moderate	0	0	12.1
deployment - Permanent conservation cover			
(1000 hectares)			
Land impacted for carbon sink - Moderate	0	0	341
deployment - Total (1000 hectares)			

Item	2020	2025	2050
Carbon sink potential - High - Accelerate	0	0	1,412
regeneration (1000 tCO2e/y)			
Carbon sink potential - High - All (not counting overlap) (1000 tCO2e/y)	0	0	18,580
Carbon sink potential - High - Avoid deforestation (1000 tCO2e/y)	0	0	838
Carbon sink potential - High - Extend rotation length (1000 tC02e/y)	0	0	7,600
Carbon sink potential - High - Improve plantations (1000 tC02e/y)	0	0	10.6
Carbon sink potential - High - Increase retention of HWP (1000 tCO2e/y)	0	0	29.8
Carbon sink potential - High - Increase trees outside forests (1000 tC02e/y)	0	0	332
Carbon sink potential - High - Reforest cropland (1000 tCO2e/y)	0	0	2,378
Carbon sink potential - High - Reforest pasture (1000 tCO2e/y)	0	0	1,329
Carbon sink potential - High - Restore productivity (1000 tC02e/y)	0	0	4,651
Carbon sink potential - Low - Accelerate regeneration (1000 tC02e/y)	0	0	707
Carbon sink potential - Low - All (not counting overlap) (1000 tC02e/y)	0	0	6,755
Carbon sink potential - Low - Avoid deforestation (1000 tC02e/y)	0	0	140
Carbon sink potential - Low - Extend rotation length (1000 tC02e/y)	0	0	2,919
Carbon sink potential - Low - Improve plantations (1000 tC02e/y)	0	0	5.38
Carbon sink potential - Low - Increase retention of HWP (1000 tC02e/y)	0	0	9.92
Carbon sink potential - Low - Increase trees outside forests (1000 tC02e/y)	0	0	116
Carbon sink potential - Low - Reforest cropland (1000 tCO2e/y)	0	0	1,189
Carbon sink potential - Low - Reforest pasture (1000 tCO2e/y)	0	0	101
Carbon sink potential - Low - Restore productivity (1000 tCO2e/y)	0	0	1,568
Carbon sink potential - Mid - Accelerate regeneration (1000 tCO2e/y)	0	0	1,060
Carbon sink potential - Mid - All (not counting overlap) (1000 tCO2e/y)	0	0	12,667
Carbon sink potential - Mid - Avoid deforestation (1000 tCO2e/y)	0	0	489
Carbon sink potential - Mid - Extend rotation length (1000 tCO2e/y)	0	0	5,260
Carbon sink potential - Mid - Improve plantations (1000 tC02e/y)	0	0	7.89
Carbon sink potential - Mid - Increase retention of HWP (1000 tC02e/y)	0	0	19.8

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

Table 13: E+ scenario - PILLAR 6: Land sinks - Fo	orests (contin	uedJ	
Item	2020	2025	2050
Carbon sink potential - Mid - Increase trees	0	0	224
outside forests (1000 tCO2e/y)			
Carbon sink potential - Mid - Reforest cropland	0	0	1,783
(1000 tC02e/y)			
Carbon sink potential - Mid - Reforest pasture	0	0	715
(1000 tC02e/y)			
Carbon sink potential - Mid - Restore	0	0	3,109
productivity (1000 tCO2e/y)			0,.07
Land impacted for carbon sink potential - High -	0	0	231
Accelerate regeneration (1000 hectares)		0	201
Land impacted for carbon sink potential - High -	0	0	113
	0	0	113
Avoid deforestation (over 30 years) (1000			
hectares)			0.07/
Land impacted for carbon sink potential - High -	0	0	3,876
Extend rotation length (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	3.9
Improve plantations (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	0
Increase retention of HWP (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	31.5
Increase trees outside forests (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	157
Reforest cropland (1000 hectares)		0	101
Land impacted for carbon sink potential - High -	0	0	37.8
	0	0	31.0
Reforest pasture (1000 hectares)			4.510
Land impacted for carbon sink potential - High -	0	0	1,542
Restore productivity (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	5,992
Total impacted (over 30 years) (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	116
Accelerate regeneration (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	106
Avoid deforestation (over 30 years) (1000			
hectares)			
Land impacted for carbon sink potential - Low -	0	0	1,485
Extend rotation length (1000 hectares)			1, 100
Land impacted for carbon sink potential - Low -	0	0	1.95
Improve plantations (1000 hectares)	0	0	1.90
	0	0	
Land impacted for carbon sink potential - Low -	0	0	0
Increase retention of HWP (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	16.6
Increase trees outside forests (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	78.6
Reforest cropland (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	6.55
Reforest pasture (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	933
Restore productivity (1000 hectares)		9	700
Land impacted for carbon sink potential - Low -	0	0	2,743
	0	0	2,143
Total impacted (over 30 years) (1000 hectares)			170
Land impacted for carbon sink potential - Mid -	0	0	173
Accelerate regeneration (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	110
Avoid deforestation (over 30 years) (1000			
hectares)			
Land impacted for carbon sink potential - Mid -	0	0	2,680
Extend rotation length (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	2.93
Improve plantations (1000 hectares)		-	2.73
Land impacted for carbon sink potential - Mid -	0	0	0
	"	0	U
Increase retention of HWP (1000 hectares)			0/1
Land impacted for carbon sink potential - Mid - Increase trees outside forests (1000 hectares)	0	0	24.1
	1	1	

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

Item	2020	2025	2050
Land impacted for carbon sink potential - Mid -	0	0	118
Reforest cropland (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	47.3
Reforest pasture (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	1,879
Restore productivity (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	5,034
Total impacted (over 30 years) (1000 hectares)			

Table 14: E+ scenario - IMPACTS - Health

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal	0	159	0.184	0.184	0.164	0.108	0
(million 2019\$)							
Monetary damages from air pollution - Natural	0	38.7	29.3	22	19.4	15.2	11.3
Gas (million 2019\$)							
Monetary damages from air pollution -	0	745	724	572	341	160	64.3
Transportation (million 2019\$)							
Premature deaths from air pollution - Coal	0	17.8	0.021	0.021	0.018	0.012	0
(deaths)							
Premature deaths from air pollution - Natural	0	4.37	3.31	2.48	2.19	1.72	1.28
Gas (deaths)							
Premature deaths from air pollution -	0	83.8	81.5	64.3	38.3	18	7.23
Transportation (deaths)							

Table 15: E+ scenario - IMPACTS - Jobs

Item	2020	2025	2030	2035	2040	2045	2050
By economic sector - Agriculture (jobs)	3.65	4.2	10.7	10.8	9.3	7.45	25
By economic sector - Construction (jobs)	5,728	4,630	7,652	8,842	8,198	7,716	9,218
By economic sector - Manufacturing (jobs)	4,316	4,247	5,979	6,951	6,077	5,186	5,480
By economic sector - Mining (jobs)	6,520	4,907	3,453	2,594	1,720	1,121	655
By economic sector - Other (jobs)	655	445	717	909	968	1,034	1,668
By economic sector - Pipeline (jobs)	397	401	356	302	229	161	108
By economic sector - Professional (jobs)	3,120	2,672	4,371	5,247	5,088	4,956	6,002
By economic sector - Trade (jobs)	3,364	2,730	3,174	3,505	3,276	3,138	3,829
By economic sector - Utilities (jobs)	3,792	3,947	7,062	7,742	6,905	6,562	6,858
By education level - All sectors - Associates	8,367	7,240	10,231	11,371	10,292	9,532	10,866
degree or some college (jobs)							
By education level - All sectors - Bachelors	5,989	5,270	6,970	7,584	6,784	6,213	6,963
degree (jobs)							
By education level - All sectors - Doctoral degree	202	174	239	267	247	232	272
(jobs)							
By education level - All sectors - High school	11,926	10,055	13,651	15,035	13,477	12,356	13,984
diploma or less (jobs)							
By education level - All sectors - Masters or	1,414	1,243	1,684	1,846	1,670	1,547	1,759
professional degree (jobs)							
By resource sector - Biomass (jobs)	15.1	18	29.5	30.7	28	27.2	107
By resource sector - CO2 (jobs)	0	0	0	0	0	0	29.4
By resource sector - Coal (jobs)	4,431	2,670	1,040	529	460	414	367
By resource sector - Grid (jobs)	4,054	4,799	11,712	13,605	12,053	11,417	12,440
By resource sector - Natural Gas (jobs)	5,205	4,855	4,123	3,305	2,617	2,125	1,300
By resource sector - Nuclear (jobs)	0	0	0	0	0	0	0
By resource sector - Oil (jobs)	7,307	6,802	5,928	5,041	3,591	2,603	1,588
By resource sector - Solar (jobs)	6,180	3,444	3,627	4,869	5,150	5,442	9,230
By resource sector - Wind (jobs)	705	1,395	6,316	8,723	8,572	7,853	8,782
Median wages - Annual - All (\$2019 per job)	56,613	58,060	58,319	58,637	59,219	59,958	60,200
On-Site or In-Plant Training - Total jobs - 1 to 4	4,439	3,831	5,342	5,897	5,310	4,898	5,541
years (jobs)							
On-Site or In-Plant Training - Total jobs - 4 to 10	1,744	1,511	2,176	2,407	2,184	2,036	2,316
years (jobs)							
On-Site or In-Plant Training - Total jobs - None	4,421	3,814	5,258	5,822	5,259	4,849	5,547
(jobs)							

Table 15:	E+ scenario -	IMPACTS	Johs	(continued)
Table 10.	L' SCCHUITO	11'11 7010		i Continuaca.

Item	2020	2025	2030	2035	2040	2045	2050
On-Site or In-Plant Training - Total jobs - Over 10	207	185	275	309	281	262	298
years (jobs)							
On-Site or In-Plant Training - Total jobs - Up to 1	17,085	14,643	19,724	21,668	19,436	17,836	20,143
year (jobs)							
On-the-Job Training - All sectors - 1 to 4 years	5,651	4,888	6,870	7,592	6,847	6,325	7,159
(jobs)							
On-the-Job Training - All sectors - 4 to 10 years	1,659	1,427	2,102	2,341	2,136	2,001	2,295
(jobs)							
On-the-Job Training - All sectors - None (jobs)	1,540	1,313	1,756	1,928	1,736	1,599	1,840
On-the-Job Training - All sectors - Over 10 years	267	229	316	351	315	287	327
(jobs)							
On-the-Job Training - All sectors - Up to 1 year	18,780	16,125	21,731	23,891	21,437	19,668	22,223
(jobs)							
Related work experience - All sectors - 1 to 4	10,259	8,827	11,924	13,081	11,745	10,800	12,185
years (jobs)							
Related work experience - All sectors - 4 to 10	6,391	5,564	7,686	8,466	7,621	7,022	7,925
years (jobs)							
Related work experience - All sectors - None	3,891	3,368	4,658	5,134	4,624	4,267	4,852
(jobs)							
Related work experience - All sectors - Over 10	1,743	1,527	2,084	2,288	2,047	1,870	2,092
years (jobs)							
Related work experience - All sectors - Up to 1	5,613	4,696	6,424	7,134	6,434	5,921	6,789
year (jobs)							
Wage income - All (million \$2019)	1,579	1,393	1,912	2,117	1,923	1,792	2,038

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

Item	2020	2025	2030	2035	2040	2045	2050
Natural gas consumption - Annual (tcf)	186	189	159	128	96	60.4	41.9
Natural gas consumption - Cumulative (tcf)	0	0	0	0	0	0	3,842
Natural gas production - Annual (tcf)	314	348	329	287	242	192	149
Oil consumption - Annual (million bbls)	57	53.1	45.7	34.9	24.7	16.6	10
Oil consumption - Cumulative (million bbls)	0	0	0	0	0	0	1,076
Oil production - Annual (million bbls)	44.4	48	48.2	48.1	38.1	31	20.6

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

Item	2020	2025	2030	2035	2040	2045	2050
Residential HVAC investment in 2020s vs. REF -	0	2.75	3.16	0	0	0	0
Cumulative 5-yr (billion \$2018)							
Sales of cooking units - Electric Resistance (%)	36.9	38.5	44.3	59.5	80.7	93.8	98.3
Sales of cooking units - Gas (%)	63.1	61.5	55.7	40.5	19.3	6.23	1.68
Sales of space heating units - Electric Heat Pump	3.03	8.14	10.8	19.7	39.7	63.6	77.1
(%)							
Sales of space heating units - Electric Resistance	3.81	7.45	7.24	6.69	5.41	3.74	2.75
(%)							
Sales of space heating units - Fossil (%)	3.57	9.27	9.34	9.11	8.39	7.66	7.61
Sales of space heating units - Gas (%)	89.6	75.1	72.6	64.6	46.5	25	12.6
Sales of water heating units - Electric Heat Pump	0	0.562	2.11	7.14	18.6	32.3	40.2
(%)							
Sales of water heating units - Electric Resistance	7.01	15.2	16.4	20.2	29.3	40.6	47.3
(%)							
Sales of water heating units - Gas Furnace (%)	92.3	83.4	80.7	71.9	51.3	26.3	11.8
Sales of water heating units - Other (%)	0.642	0.79	0.789	0.787	0.783	0.781	0.778

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

Item	2020	2025	2030	2035	2040	2045	2050
Light-duty vehicle capital costs - Cumulative 5-yr	0	0	76.1	152	522	1,618	2,366
(million \$2018)							
Public EV charging plugs - DC Fast (1000 units)	0.174	0	0.26	0	1.16	0	3.16
Public EV charging plugs - L2 (1000 units)	1.07	0	6.25	0	27.9	0	75.9
Vehicle sales - Heavy-duty - diesel (%)	97.4	96	91.3	79.8	58.2	32.1	13.7

Table 18: E- scenario -	PTI I AR 1: Efficienc	v/Flectrification - `	Transnortation	(continued)

Item	2020	2025	2030	2035	2040	2045	2050
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 (%)	1.56	1.97	2.06	1.64	1.05	0.537	0.23
Vehicle sales - Light-duty - EV (%)	1.89	4.68	11.8	25.9	48.4	72	87.6
Vehicle sales - Light-duty - gasoline (%)	91.8	87.5	79.6	66.7	46.2	24.9	11
Vehicle sales - Light-duty - hybrid (%)	4.58	5.39	6.05	5.51	4.13	2.44	1.18
Vehicle sales - Light-duty - hydrogen FC (%)	0.113	0.38	0.326	0.249	0.177	0.098	0.046
Vehicle sales - Light-duty - other (%)	0.103	0.106	0.097	0.084	0.061	0.033	0.015
Vehicle sales - Medium-duty - diesel (%)	64.8	62.2	57.7	49.4	35.6	19.6	8.37
Vehicle sales - Medium-duty - EV (%)	0.664	1.94	5.49	14.3	31.4	52.6	68
Vehicle sales - Medium-duty - gasoline (%)	33.8	34.7	34.7	31.9	24.4	14.2	6.33
Vehicle sales - Medium-duty - hybrid (%)	0.363	0.418	0.464	0.478	0.414	0.275	0.141
Vehicle sales - Medium-duty - hydrogen FC (%)	0.166	0.485	1.37	3.58	7.86	13.2	17
Vehicle sales - Medium-duty - other (%)	0.253	0.266	0.279	0.286	0.258	0.184	0.102

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

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Commercial (PJ)	103	103	103	102	99.5	96.4	92.8
Final energy use - Industry (PJ)	86.5	89.4	90.4	97.9	112	117	124
Final energy use - Residential (PJ)	126	122	121	118	114	105	94.6
Final energy use - Transportation (PJ)	304	292	270	253	241	225	207

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

Item	2020	2025	2030	2035	2040	2045	2050
Commercial HVAC investment in 2020s -	0	7,532	8,365	0	0	0	0
Cumulative 5-yr (million \$2018)							
Sales of cooking units - Electric Resistance (%)	41.9	46.2	50.2	60.8	75.4	84.6	87.8
Sales of cooking units - Gas (%)	58.1	53.8	49.8	39.2	24.6	15.4	12.2
Sales of space heating units - Electric Heat Pump	0.749	7.59	10.3	19	39.5	64.5	79
(%)							
Sales of space heating units - Electric Resistance	0.855	3.35	3.5	4.01	5.26	6.85	7.79
(%)							
Sales of space heating units - Fossil (%)	0	0.241	0.225	0.172	0.092	0.04	0.021
Sales of space heating units - Gas Furnace (%)	98.4	88.8	86	76.8	55.2	28.6	13.2
Sales of water heating units - Electric Heat Pump	0.008	0.63	2.29	7.68	20	34.8	43.4
(%)							
Sales of water heating units - Electric Resistance	0.41	2	3.48	8.38	19.9	34.2	42.5
(%)							
Sales of water heating units - Gas Furnace (%)	99.5	97	93.8	83.6	59.7	30.6	13.7
Sales of water heating units - Other (%)	0.1	0.381	0.381	0.382	0.381	0.381	0.381

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

Item	2020	2025	2030	2035	2040	2045	2050
Electricity distribution capital invested -	0	1.43	1.48	1.97	2.07	2.75	2.92
Cumulative 5-yr (billion \$2018)							

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

Item	2020	2025	2050
Carbon sink potential - Aggressive deployment -	0	0	0
Corn-ethanol to energy grasses (1000 tCO2e/y)			
Carbon sink potential - Aggressive deployment -	0	0	-360
Cropland measures (1000 tCO2e/y)			
Carbon sink potential - Aggressive deployment -	0	0	-15.7
Permanent conservation cover (1000 tCO2e/y)			
Carbon sink potential - Aggressive deployment -	0	0	-376
Total (1000 tC02e/y)			

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

Table 22. E Scenario I IEEAN O. Eana Sinks F	igi icaitai c (c	ontinacaj	
Item	2020	2025	2050
Carbon sink potential - Moderate deployment -	0	0	0
Corn-ethanol to energy grasses (1000 tCO2e/y)			
Carbon sink potential - Moderate deployment -	0	0	-184
Cropland measures (1000 tC02e/y)			
Carbon sink potential - Moderate deployment -	0	0	-7.84
Permanent conservation cover (1000 tCO2e/y)			
Carbon sink potential - Moderate deployment -	0	0	-192
Total (1000 tC02e/y)			
Land impacted for carbon sink - Aggressive	0	0	0
deployment - Corn-ethanol to energy grasses			
(1000 hectares)			
Land impacted for carbon sink - Aggressive	0	0	646
deployment - Cropland measures (1000			
hectares)			
Land impacted for carbon sink - Aggressive	0	0	24.1
deployment - Permanent conservation cover			
(1000 hectares)			
Land impacted for carbon sink - Aggressive	0	0	670
deployment - Total (1000 hectares)			
Land impacted for carbon sink - Moderate	0	0	0
deployment - Corn-ethanol to energy grasses			
(1000 hectares)			
Land impacted for carbon sink - Moderate	0	0	329
deployment - Cropland measures (1000			
hectares)			
Land impacted for carbon sink - Moderate	0	0	12.1
deployment - Permanent conservation cover			
(1000 hectares)			
Land impacted for carbon sink - Moderate	0	0	341
deployment - Total (1000 hectares)			

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

กษรเร		
2020	2025	2050
0	0	1,412
0	0	18,580
0	0	838
0	0	7,600
0	0	10.6
0	0	29.8
0	0	332
0	0	2,378
0	0	1,329
0	0	4,651
_	_	
0	0	707
	_	
0	0	6,755
0	0	140
_	_	
0	0	2,919
	_	
0	0	5.38
	0	2020 2025 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

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

Table 23: E- scenario - PILLAR 6: Land sinks - Fo	2020	2025	2050
Carbon sink potential - Low - Increase retention	2020	0	9.92
of HWP (1000 tCO2e/y)		0	7.72
Carbon sink potential - Low - Increase trees	0	0	116
outside forests (1000 tCO2e/y)			
Carbon sink potential - Low - Reforest cropland	0	0	1,189
(1000 tC02e/y)			
Carbon sink potential - Low - Reforest pasture	0	0	101
(1000 tCO2e/y)			
Carbon sink potential - Low - Restore	0	0	1,568
productivity (1000 tCO2e/y)			
Carbon sink potential - Mid - Accelerate	0	0	1,060
regeneration (1000 tCO2e/y)			10 (/ 7
Carbon sink potential - Mid - All (not counting	0	0	12,667
overlap) (1000 tC02e/y)	0	0	/ 00
Carbon sink potential - Mid - Avoid deforestation (1000 tCO2e/y)	0	0	489
Carbon sink potential - Mid - Extend rotation	0	0	5,260
length (1000 tCO2e/y)		0	5,260
Carbon sink potential - Mid - Improve plantations	0	0	7.89
(1000 tCO2e/y)		0	1.07
Carbon sink potential - Mid - Increase retention	0	0	19.8
of HWP (1000 tC02e/y)			17.0
Carbon sink potential - Mid - Increase trees	0	0	224
outside forests (1000 tCO2e/y)			
Carbon sink potential - Mid - Reforest cropland	0	0	1,783
(1000 tC02e/y)			
Carbon sink potential - Mid - Reforest pasture	0	0	715
(1000 tC02e/y)			
Carbon sink potential - Mid - Restore	0	0	3,109
productivity (1000 tCO2e/y)			
Land impacted for carbon sink potential - High -	0	0	231
Accelerate regeneration (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	113
Avoid deforestation (over 30 years) (1000			
hectares)	0	0	0.07/
Land impacted for carbon sink potential - High -	0	0	3,876
Extend rotation length (1000 hectares) Land impacted for carbon sink potential - High -	0	0	3.9
Improve plantations (1000 hectares)		0	3.7
Land impacted for carbon sink potential - High -	0	0	0
Increase retention of HWP (1000 hectares)		0	U
Land impacted for carbon sink potential - High -	0	0	31.5
Increase trees outside forests (1000 hectares)			01.0
Land impacted for carbon sink potential - High -	0	0	157
Reforest cropland (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	37.8
Reforest pasture (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	1,542
Restore productivity (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	5,992
Total impacted (over 30 years) (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	116
Accelerate regeneration (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	106
Avoid deforestation (over 30 years) (1000			
hectares)			4,
Land impacted for carbon sink potential - Low -	0	0	1,485
Extend rotation length (1000 hectares)			105
Land impacted for carbon sink potential - Low -	0	0	1.95
Improve plantations (1000 hectares)	0	0	0
Land impacted for carbon sink potential - Low - Increase retention of HWP (1000 hectares)	"	U	U
The case recention or river (1000 lieutal es)			

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

Item	2020	2025	2050
Land impacted for carbon sink potential - Low -	0	0	16.6
Increase trees outside forests (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	78.6
Reforest cropland (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	6.55
Reforest pasture (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	933
Restore productivity (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	2,743
Total impacted (over 30 years) (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	173
Accelerate regeneration (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	110
Avoid deforestation (over 30 years) (1000			
hectares)			
Land impacted for carbon sink potential - Mid -	0	0	2,680
Extend rotation length (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	2.93
Improve plantations (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	0
Increase retention of HWP (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	24.1
Increase trees outside forests (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	118
Reforest cropland (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	47.3
Reforest pasture (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	1,879
Restore productivity (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	5,034
Total impacted (over 30 years) (1000 hectares)			

Table 24: E- scenario - IMPACTS - Health

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal	0	159	0.184	0.184	0.164	0.108	0
(million 2019\$)							
Monetary damages from air pollution - Natural	0	42.4	21.4	14.8	8.7	4.13	4.98
Gas (million 2019\$)							
Monetary damages from air pollution -	0	757	796	806	751	617	436
Transportation (million 2019\$)							
Premature deaths from air pollution - Coal	0	17.8	0.021	0.021	0.018	0.012	0
(deaths)							
Premature deaths from air pollution - Natural	0	4.79	2.42	1.68	0.983	0.467	0.563
Gas (deaths)							
Premature deaths from air pollution -	0	85.1	89.6	90.6	84.5	69.4	49.1
Transportation (deaths)							

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

Item	2020	2025	2030	2035	2040	2045	2050
Residential HVAC investment in 2020s vs. REF -	0	2.76	3.21	0	0	0	0
Cumulative 5-yr (billion \$2018)							
Sales of cooking units - Electric Resistance (%)	37.1	50.5	91.5	99.6	100	100	100
Sales of cooking units - Gas (%)	62.9	49.5	8.47	0.426	0	0	0
Sales of space heating units - Electric Heat Pump	3.03	9.9	34.8	79.5	87.6	88.4	88.2
(%)							
Sales of space heating units - Electric Resistance	3.81	7.35	5.69	2.51	1.97	1.95	1.97
(%)							
Sales of space heating units - Fossil (%)	3.57	9.24	8.91	8.06	7.57	7.25	7.38
Sales of space heating units - Gas (%)	89.6	73.5	50.6	9.98	2.86	2.43	2.43
Sales of water heating units - Electric Heat Pump	0	1.51	15.7	41.6	46.2	46.5	46.5
(%)							

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

Item	2020	2025	2030	2035	2040	2045	2050
Sales of water heating units - Electric Resistance	7.01	15.7	26.3	48.5	52.5	52.7	52.7
(%)							
Sales of water heating units - Gas Furnace (%)	92.3	82	57.3	9.09	0.535	0	0
Sales of water heating units - Other (%)	0.642	0.79	0.79	0.787	0.779	0.778	0.778

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

Item	2020	2025	2030	2035	2040	2045	2050
Light-duty vehicle capital costs - Cumulative 5-yr	0	449	1,171	1,866	2,839	3,076	2,940
(million \$2018)							
Public EV charging plugs - DC Fast (1000 units)	0.174	0	0.748	0	3.07	0	4.93
Public EV charging plugs - L2 (1000 units)	1.07	0	18	0	73.9	0	119
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 (%)	1.55	1.82	1.26	0.402	0.075	0.013	0
Vehicle sales - Light-duty - EV (%)	3.91	15.2	46.4	81.8	96.3	99.3	100
Vehicle sales - Light-duty - gasoline (%)	89.9	78	48.8	16.5	3.29	0.59	0
Vehicle sales - Light-duty - hybrid (%)	4.42	4.54	3.21	1.19	0.291	0.063	0
Vehicle sales - Light-duty - hydrogen FC (%)	0.11	0.34	0.203	0.063	0.013	0.002	0
Vehicle sales - Light-duty - other (%)	0.102	0.098	0.064	0.022	0.004	0.001	0
Vehicle sales - Medium-duty - diesel (%)	64.7	59.7	42.3	14.4	2.59	0.384	0
Vehicle sales - Medium-duty - EV (%)	0.784	5.07	25.3	60.8	76.5	79.5	80
Vehicle sales - Medium-duty - gasoline (%)	33.7	33.3	25.5	9.32	1.77	0.277	0
Vehicle sales - Medium-duty - hybrid (%)	0.363	0.402	0.341	0.14	0.03	0.005	0
Vehicle sales - Medium-duty - hydrogen FC (%)	0.196	1.27	6.33	15.2	19.1	19.9	20
Vehicle sales - Medium-duty - other (%)	0.253	0.255	0.205	0.083	0.019	0.004	0

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

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Commercial (PJ)	103	103	101	94.8	87.6	82.5	80.3
Final energy use - Industry (PJ)	86.5	89.3	90.2	96.9	111	116	122
Final energy use - Residential (PJ)	126	122	118	106	90.4	79.2	72.3
Final energy use - Transportation (PJ)	304	290	260	223	188	168	161

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

2020	2025	2030	2035	2040	2045	2050
0	7,533	8,381	0	0	0	0
41.9	54.6	83	88.6	88.9	88.9	88.9
58.1	45.4	17	11.4	11.1	11.1	11.1
0.749	8.98	33.5	81.9	90.4	91	91
0.855	3.41	4.83	7.94	8.5	8.54	8.55
0	0.208	0.04	0.002	0	0	0
98.4	87.4	61.6	10.2	1.06	0.491	0.49
0.008	1.61	16.7	45	50	50.3	50.3
0.41	2.69	16.3	44.1	49	49.3	49.3
99.5	95.3	66.6	10.6	0.622	0	0
0.1	0.381	0.381	0.382	0.381	0.381	0.381
	0 41.9 58.1 0.749 0.855 0 98.4 0.008	0 7,533 41.9 54.6 58.1 45.4 0.749 8.98 0.855 3.41 0 0.208 98.4 87.4 0.008 1.61 0.41 2.69 99.5 95.3	0 7,533 8,381 41.9 54.6 83 58.1 45.4 17 0.749 8.98 33.5 0.855 3.41 4.83 0 0.208 0.04 98.4 87.4 61.6 0.008 1.61 16.7 0.41 2.69 16.3 99.5 95.3 66.6	0 7,533 8,381 0 41.9 54.6 83 88.6 58.1 45.4 17 11.4 0.749 8.98 33.5 81.9 0.855 3.41 4.83 7.94 0 0.208 0.04 0.002 98.4 87.4 61.6 10.2 0.008 1.61 16.7 45 0.41 2.69 16.3 44.1 99.5 95.3 66.6 10.6	0 7,533 8,381 0 0 41.9 54.6 83 88.6 88.9 58.1 45.4 17 11.4 11.1 0.749 8.98 33.5 81.9 90.4 0.855 3.41 4.83 7.94 8.5 0 0.208 0.04 0.002 0 98.4 87.4 61.6 10.2 1.06 0.008 1.61 16.7 45 50 0.41 2.69 16.3 44.1 49 99.5 95.3 66.6 10.6 0.622	0 7,533 8,381 0 0 0 41.9 54.6 83 88.6 88.9 88.9 58.1 45.4 17 11.4 11.1 11.1 0.749 8.98 33.5 81.9 90.4 91 0.855 3.41 4.83 7.94 8.5 8.54 0 0.208 0.04 0.002 0 0 98.4 87.4 61.6 10.2 1.06 0.491 0.008 1.61 16.7 45 50 50.3 0.41 2.69 16.3 44.1 49 49.3 99.5 95.3 66.6 10.6 0.622 0

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

Item	2020	2025	2030	2035	2040	2045	2050
Electricity distribution capital invested -	0	1.72	1.81	3.2	3.44	3.67	3.91
Cumulative 5-yr (billion \$2018)							

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

Item	2020	2025	2030	2035	2040	2045	2050
Capital invested - Solar PV - Base (billion \$2018)	0	0	0	0	0	0	7.15
Capital invested - Wind - Base (billion \$2018)	0	0.668	8.7	6.39	4.89	2.47	3.24

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

Item	2020	2025	2030	2035	2040	2045	2050
Solar - Base land use assumptions (GWh)	2,042	0	0	0	0	0	16,142
Solar - Constrained land use assumptions (GWh)	2,042	0	0	10,834	4,539	4,837	15,788
Wind - Base land use assumptions (GWh)	1,617	1,331	18,362	13,914	10,844	5,461	7,656
Wind - Constrained land use assumptions (GWh)	3,563	4,044	17,306	8,018	4,733	1,601	4,423

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

Table 32. L+NL+ 3Cellal to - FILLAN O. Lalla Silika	•		
Item	2020	2025	2050
Carbon sink potential - Aggressive deployment -	0	0	0
Corn-ethanol to energy grasses (1000 tCO2e/y)			
Carbon sink potential - Aggressive deployment -	0	0	-360
Cropland measures (1000 tCO2e/y)			
Carbon sink potential - Aggressive deployment -	0	0	-15.7
Permanent conservation cover (1000 tCO2e/y)			
Carbon sink potential - Aggressive deployment -	0	0	-376
Total (1000 tC02e/y)			
Carbon sink potential - Moderate deployment -	0	0	0
Corn-ethanol to energy grasses (1000 tCO2e/y)			
Carbon sink potential - Moderate deployment -	0	0	-184
Cropland measures (1000 tCO2e/y)			
Carbon sink potential - Moderate deployment -	0	0	-7.84
Permanent conservation cover (1000 tCO2e/y)			
Carbon sink potential - Moderate deployment -	0	0	-192
Total (1000 tC02e/y)			
Land impacted for carbon sink - Aggressive	0	0	0
deployment - Corn-ethanol to energy grasses			
(1000 hectares)			
Land impacted for carbon sink - Aggressive	0	0	646
deployment - Cropland measures (1000			
hectares)			
Land impacted for carbon sink - Aggressive	0	0	24.1
deployment - Permanent conservation cover			
(1000 hectares)			
Land impacted for carbon sink - Aggressive	0	0	670
deployment - Total (1000 hectares)			
Land impacted for carbon sink - Moderate	0	0	0
deployment - Corn-ethanol to energy grasses			
(1000 hectares)			
Land impacted for carbon sink - Moderate	0	0	329
deployment - Cropland measures (1000			
hectares)			
Land impacted for carbon sink - Moderate	0	0	12.1
deployment - Permanent conservation cover			
(1000 hectares)			
Land impacted for carbon sink - Moderate	0	0	341
deployment - Total (1000 hectares)			

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

Table 33: E+RE+ scenario - PILLAR 6: Land sinks	s - Forests		
Item	2020	2025	2050
Carbon sink potential - High - Accelerate	0	0	1,412
regeneration (1000 tCO2e/y)			
Carbon sink potential - High - All (not counting	0	0	18,580
overlap) (1000 tCO2e/y)			
Carbon sink potential - High - Avoid deforestation	0	0	838
(1000 tC02e/y)			
Carbon sink potential - High - Extend rotation	0	0	7,600
length (1000 tCO2e/y)			
Carbon sink potential - High - Improve	0	0	10.6
plantations (1000 tCO2e/y)			
Carbon sink potential - High - Increase retention	0	0	29.8
of HWP (1000 tCO2e/y)			
Carbon sink potential - High - Increase trees	0	0	332
outside forests (1000 tCO2e/y)			
Carbon sink potential - High - Reforest cropland	0	0	2,378
(1000 tC02e/y)			
Carbon sink potential - High - Reforest pasture	0	0	1,329
(1000 tC02e/y)			
Carbon sink potential - High - Restore	0	0	4,651
productivity (1000 tCO2e/y)			
Carbon sink potential - Low - Accelerate	0	0	707
regeneration (1000 tCO2e/y)			
Carbon sink potential - Low - All (not counting	0	0	6,755
overlap) (1000 tC02e/y)			
Carbon sink potential - Low - Avoid deforestation	0	0	140
(1000 tC02e/y)			
Carbon sink potential - Low - Extend rotation	0	0	2,919
length (1000 tC02e/y)			
Carbon sink potential - Low - Improve	0	0	5.38
plantations (1000 tCO2e/y)	0		0.00
Carbon sink potential - Low - Increase retention	0	0	9.92
of HWP (1000 tCO2e/y)	0		11./
Carbon sink potential - Low - Increase trees outside forests (1000 tCO2e/y)	0	0	116
Carbon sink potential - Low - Reforest cropland	0	0	1,189
(1000 tCO2e/y)	U	U	1,109
Carbon sink potential - Low - Reforest pasture	0	0	101
(1000 tCO2e/y)	o	0	101
	0	0	1,568
carbon sink potential - Low - Restore productivity (1000 tCO2e/y)	U	0	1,500
Carbon sink potential - Mid - Accelerate	0	0	1,060
regeneration (1000 tC02e/y)	0	0	1,000
Carbon sink potential - Mid - All (not counting	0	0	12,667
overlap) (1000 tC02e/y)	0	0	12,001
Carbon sink potential - Mid - Avoid deforestation	0	0	489
(1000 tC02e/y)	0	0	407
Carbon sink potential - Mid - Extend rotation	0	0	5,260
length (1000 tC02e/y)		0	0,200
Carbon sink potential - Mid - Improve plantations	0	0	7.89
(1000 tC02e/y)	0	0	1.07
Carbon sink potential - Mid - Increase retention	0	0	19.8
of HWP (1000 tCO2e/y)	0	0	17.0
Carbon sink potential - Mid - Increase trees	0	0	224
outside forests (1000 tC02e/y)		0	227
Carbon sink potential - Mid - Reforest cropland	0	0	1,783
(1000 tC02e/y)	0	0	1,100
Carbon sink potential - Mid - Reforest pasture	0	0	715
(1000 tC02e/y)	0	0	113
Carbon sink potential - Mid - Restore	0	0	3,109
productivity (1000 tCO2e/y)	9	١	5,107
Land impacted for carbon sink potential - High -	0	0	231
Accelerate regeneration (1000 hectares)	9	١	201
Account ato regeneration (1000 Hootal 60)			

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

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

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal	0	159	0.184	0.184	0.164	0.108	0
(million 2019\$)							
Monetary damages from air pollution - Natural	0	37.2	22.7	13	9.6	4.39	3.47
Gas (million 2019\$)							
Monetary damages from air pollution -	0	745	724	572	341	160	64.3
Transportation (million 2019\$)							
Premature deaths from air pollution - Coal	0	17.8	0.021	0.021	0.018	0.012	0
(deaths)							
Premature deaths from air pollution - Natural	0	4.2	2.57	1.46	1.08	0.496	0.392
Gas (deaths)							
Premature deaths from air pollution -	0	83.8	81.5	64.3	38.3	18	7.23
Transportation (deaths)							

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

Item	2020	2025	2030	2035	2040	2045	2050
Residential HVAC investment in 2020s vs. REF -	0	2.76	3.21	0	0	0	0
Cumulative 5-yr (billion \$2018)							
Sales of cooking units - Electric Resistance (%)	37.1	50.5	91.5	99.6	100	100	100
Sales of cooking units - Gas (%)	62.9	49.5	8.47	0.426	0	0	0
Sales of space heating units - Electric Heat Pump	3.03	9.9	34.8	79.5	87.6	88.4	88.2
(%)							
Sales of space heating units - Electric Resistance	3.81	7.35	5.69	2.51	1.97	1.95	1.97
(%)							
Sales of space heating units - Fossil (%)	3.57	9.24	8.91	8.06	7.57	7.25	7.38
Sales of space heating units - Gas (%)	89.6	73.5	50.6	9.98	2.86	2.43	2.43
Sales of water heating units - Electric Heat Pump	0	1.51	15.7	41.6	46.2	46.5	46.5
(%)							
Sales of water heating units - Electric Resistance	7.01	15.7	26.3	48.5	52.5	52.7	52.7
(%)							
Sales of water heating units - Gas Furnace (%)	92.3	82	57.3	9.09	0.535	0	0
Sales of water heating units - Other (%)	0.642	0.79	0.79	0.787	0.779	0.778	0.778

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

Item	2020	2025	2030	2035	2040	2045	2050
Light-duty vehicle capital costs - Cumulative 5-yr	0	449	1,171	1,866	2,839	3,076	2,940
(million \$2018)							
Public EV charging plugs - DC Fast (1000 units)	0.174	0	0.748	0	3.07	0	4.93
Public EV charging plugs - L2 (1000 units)	1.07	0	18	0	73.9	0	119
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 (%)	1.55	1.82	1.26	0.402	0.075	0.013	0
Vehicle sales - Light-duty - EV (%)	3.91	15.2	46.4	81.8	96.3	99.3	100
Vehicle sales - Light-duty - gasoline (%)	89.9	78	48.8	16.5	3.29	0.59	0
Vehicle sales - Light-duty - hybrid (%)	4.42	4.54	3.21	1.19	0.291	0.063	0
Vehicle sales - Light-duty - hydrogen FC (%)	0.11	0.34	0.203	0.063	0.013	0.002	0
Vehicle sales - Light-duty - other (%)	0.102	0.098	0.064	0.022	0.004	0.001	0
Vehicle sales - Medium-duty - diesel (%)	64.7	59.7	42.3	14.4	2.59	0.384	0
Vehicle sales - Medium-duty - EV (%)	0.784	5.07	25.3	60.8	76.5	79.5	80
Vehicle sales - Medium-duty - gasoline (%)	33.7	33.3	25.5	9.32	1.77	0.277	0
Vehicle sales - Medium-duty - hybrid (%)	0.363	0.402	0.341	0.14	0.03	0.005	0
Vehicle sales - Medium-duty - hydrogen FC (%)	0.196	1.27	6.33	15.2	19.1	19.9	20
Vehicle sales - Medium-duty - other (%)	0.253	0.255	0.205	0.083	0.019	0.004	0

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

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Commercial (PJ)	103	103	101	94.8	87.6	82.5	80.3
Final energy use - Industry (PJ)	86.5	89.3	90.2	96.9	111	116	122
Final energy use - Residential (PJ)	126	122	118	106	90.4	79.2	72.3
Final energy use - Transportation (PJ)	304	290	260	223	188	168	161

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

Item	2020	2025	2030	2035	2040	2045	2050
Commercial HVAC investment in 2020s -	0	7,533	8,381	0	0	0	0
Cumulative 5-yr (million \$2018)							
Sales of cooking units - Electric Resistance (%)	41.9	54.6	83	88.6	88.9	88.9	88.9
Sales of cooking units - Gas (%)	58.1	45.4	17	11.4	11.1	11.1	11.1
Sales of space heating units - Electric Heat Pump	0.749	8.98	33.5	81.9	90.4	91	91
(%)							
Sales of space heating units - Electric Resistance	0.855	3.41	4.83	7.94	8.5	8.54	8.55
(%)							
Sales of space heating units - Fossil (%)	0	0.208	0.04	0.002	0	0	0
Sales of space heating units - Gas Furnace (%)	98.4	87.4	61.6	10.2	1.06	0.491	0.49
Sales of water heating units - Electric Heat Pump	0.008	1.61	16.7	45	50	50.3	50.3
(%)							
Sales of water heating units - Electric Resistance	0.41	2.69	16.3	44.1	49	49.3	49.3
(%)							
Sales of water heating units - Gas Furnace (%)	99.5	95.3	66.6	10.6	0.622	0	0
Sales of water heating units - Other (%)	0.1	0.381	0.381	0.382	0.381	0.381	0.381

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

Item	2020	2025	2030	2035	2040	2045	2050
Electricity distribution capital invested -	0	1.72	1.81	3.2	3.44	3.67	3.91
Cumulative 5-yr (billion \$2018)							

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

Item	2020	2025	2030	2035	2040	2045	2050
Capital invested - Solar PV - Base (billion \$2018)	0	1.57	1.01	0.394	0.559	0.839	0
Capital invested - Solar PV - Constrained (billion \$2018)	0	0.463	0	0	2.75	2.17	0
Capital invested - Wind - Base (billion \$2018)	0	0.149	2.14	4.88	3.54	1.7	1.52
Capital invested - Wind - Constrained (billion \$2018)	0	0.838	1.8	5.5	3.35	1.73	0.966

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

Item	2020	2025	2030	2035	2040	2045	2050
Solar - Base land use assumptions (GWh)	5,120	2,460	1,785	705	1,131	1,794	0
Solar - Constrained land use assumptions (GWh)	2,203	711	0	0	5,780	4,885	0
Wind - Base land use assumptions (GWh)	1,617	299	4,612	11,071	8,101	4,054	3,958
Wind - Constrained land use assumptions (GWh)	3,189	1,614	3,784	11,406	6,636	3,524	2,049

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

Item	2020	2025	2050
Carbon sink potential - Aggressive deployment -	0	0	0
Corn-ethanol to energy grasses (1000 tCO2e/y)			
Carbon sink potential - Aggressive deployment -	0	0	-360
Cropland measures (1000 tCO2e/y)			
Carbon sink potential - Aggressive deployment -	0	0	-15.7
Permanent conservation cover (1000 tCO2e/y)			
Carbon sink potential - Aggressive deployment -	0	0	-376
Total (1000 tC02e/y)			
Carbon sink potential - Moderate deployment -	0	0	0
Corn-ethanol to energy grasses (1000 tCO2e/y)			

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

Table 42. LTNL Scenario Tillan O. Lana Silino	rigilicalta	i e (continue	uj
Item	2020	2025	2050
Carbon sink potential - Moderate deployment -	0	0	-184
Cropland measures (1000 tCO2e/y)			
Carbon sink potential - Moderate deployment -	0	0	-7.84
Permanent conservation cover (1000 tCO2e/y)			
Carbon sink potential - Moderate deployment -	0	0	-192
Total (1000 tC02e/y)			
Land impacted for carbon sink - Aggressive	0	0	0
deployment - Corn-ethanol to energy grasses			
(1000 hectares)			
Land impacted for carbon sink - Aggressive	0	0	646
deployment - Cropland measures (1000			
hectares)			
Land impacted for carbon sink - Aggressive	0	0	24.1
deployment - Permanent conservation cover			
(1000 hectares)			
Land impacted for carbon sink - Aggressive	0	0	670
deployment - Total (1000 hectares)			
Land impacted for carbon sink - Moderate	0	0	0
deployment - Corn-ethanol to energy grasses			
(1000 hectares)			
Land impacted for carbon sink - Moderate	0	0	329
deployment - Cropland measures (1000			
hectares)			
Land impacted for carbon sink - Moderate	0	0	12.1
deployment - Permanent conservation cover			
(1000 hectares)			
Land impacted for carbon sink - Moderate	0	0	341
deployment - Total (1000 hectares)			

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

Table 43. LTNL Scenario - FILLAN O. Lana Sinks			
Item	2020	2025	2050
Carbon sink potential - High - Accelerate	0	0	1,412
regeneration (1000 tCO2e/y)			
Carbon sink potential - High - All (not counting	0	0	18,580
overlap) (1000 tCO2e/y)			
Carbon sink potential - High - Avoid deforestation	0	0	838
(1000 tCO2e/y)			
Carbon sink potential - High - Extend rotation	0	0	7,600
length (1000 tCO2e/y)			
Carbon sink potential - High - Improve	0	0	10.6
plantations (1000 tCO2e/y)			
Carbon sink potential - High - Increase retention	0	0	29.8
of HWP (1000 tCO2e/y)			
Carbon sink potential - High - Increase trees	0	0	332
outside forests (1000 tCO2e/y)			
Carbon sink potential - High - Reforest cropland	0	0	2,378
(1000 tC02e/y)			
Carbon sink potential - High - Reforest pasture	0	0	1,329
(1000 tCO2e/y)			
Carbon sink potential - High - Restore	0	0	4,651
productivity (1000 tCO2e/y)			
Carbon sink potential - Low - Accelerate	0	0	707
regeneration (1000 tCO2e/y)			
Carbon sink potential - Low - All (not counting	0	0	6,755
overlap) (1000 tC02e/y)			-
Carbon sink potential - Low - Avoid deforestation	0	0	140
(1000 tC02e/y)			
Carbon sink potential - Low - Extend rotation	0	0	2,919
length (1000 tC02e/y)			,
Carbon sink potential - Low - Improve	0	0	5.38
plantations (1000 tCO2e/y)		-	
Carbon sink potential - Low - Increase retention	0	0	9.92
of HWP (1000 tC02e/y)		-	_

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

Table 43: E+RE- scenario - PILLAR 6: Land sinks	- Forests (C	ontinueaj	
Item	2020	2025	2050
Carbon sink potential - Low - Increase trees	0	0	116
outside forests (1000 tCO2e/y)			
Carbon sink potential - Low - Reforest cropland	0	0	1,189
(1000 tC02e/y)			•
Carbon sink potential - Low - Reforest pasture	0	0	101
(1000 tC02e/y)			
Carbon sink potential - Low - Restore	0	0	1,568
productivity (1000 tCO2e/y)		0	1,000
Carbon sink potential - Mid - Accelerate	0	0	1,060
regeneration (1000 tCO2e/y)		0	1,000
Carbon sink potential - Mid - All (not counting	0	0	10 / / 7
	0	U	12,667
overlap) (1000 tC02e/y)	0		/ 00
Carbon sink potential - Mid - Avoid deforestation	0	0	489
(1000 tC02e/y)			5.040
Carbon sink potential - Mid - Extend rotation	0	0	5,260
length (1000 tC02e/y)			
Carbon sink potential - Mid - Improve plantations	0	0	7.89
(1000 tC02e/y)			
Carbon sink potential - Mid - Increase retention	0	0	19.8
of HWP (1000 tCO2e/y)			
Carbon sink potential - Mid - Increase trees	0	0	224
outside forests (1000 tCO2e/y)			
Carbon sink potential - Mid - Reforest cropland	0	0	1,783
(1000 tC02e/y)			
Carbon sink potential - Mid - Reforest pasture	0	0	715
(1000 tC02e/y)			
Carbon sink potential - Mid - Restore	0	0	3,109
productivity (1000 tCO2e/y)		•	0,107
Land impacted for carbon sink potential - High -	0	0	231
Accelerate regeneration (1000 hectares)		0	201
Land impacted for carbon sink potential - High -	0	0	113
Avoid deforestation (over 30 years) (1000		0	113
hectares)			
Land impacted for carbon sink potential - High -	0	0	2.07/
	0	0	3,876
Extend rotation length (1000 hectares)	0		0.0
Land impacted for carbon sink potential - High -	0	0	3.9
Improve plantations (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	0
Increase retention of HWP (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	31.5
Increase trees outside forests (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	157
Reforest cropland (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	37.8
Reforest pasture (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	1,542
Restore productivity (1000 hectares)			, -
Land impacted for carbon sink potential - High -	0	0	5,992
Total impacted (over 30 years) (1000 hectares)		•	0,772
Land impacted for carbon sink potential - Low -	0	0	116
Accelerate regeneration (1000 hectares)		0	110
Land impacted for carbon sink potential - Low -	0	0	106
	0	0	100
Avoid deforestation (over 30 years) (1000			
hectares)			4 / 0 =
Land impacted for carbon sink potential - Low -	0	0	1,485
Extend rotation length (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	1.95
Improve plantations (1000 hectares)			
the state of the s	0	0	0
Land impacted for carbon sink potential - Low -			
Increase retention of HWP (1000 hectares)			
	0	0	16.6

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

Item	2020	2025	2050
Land impacted for carbon sink potential - Low -	0	0	78.6
Reforest cropland (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	6.55
Reforest pasture (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	933
Restore productivity (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	2,743
Total impacted (over 30 years) (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	173
Accelerate regeneration (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	110
Avoid deforestation (over 30 years) (1000			
hectares)			
Land impacted for carbon sink potential - Mid -	0	0	2,680
Extend rotation length (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	2.93
Improve plantations (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	0
Increase retention of HWP (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	24.1
Increase trees outside forests (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	118
Reforest cropland (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	47.3
Reforest pasture (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	1,879
Restore productivity (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	5,034
Total impacted (over 30 years) (1000 hectares)			

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

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal	0	159	0.184	0.184	0.164	0.108	0
(million 2019\$)							
Monetary damages from air pollution - Natural	0	41.6	28.2	24.9	28.7	21.3	6.71
Gas (million 2019\$)							
Monetary damages from air pollution -	0	745	724	572	341	160	64.3
Transportation (million 2019\$)							
Premature deaths from air pollution - Coal	0	17.8	0.021	0.021	0.018	0.012	0
(deaths)							
Premature deaths from air pollution - Natural	0	4.69	3.19	2.81	3.24	2.4	0.758
Gas (deaths)							
Premature deaths from air pollution -	0	83.8	81.5	64.3	38.3	18	7.23
Transportation (deaths)							

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

_					2045	2050
0	2.75	3.16	0	0	0	0
36.9	38.5	44.3	59.5	80.7	93.8	98.3
63.1	61.5	55.7	40.5	19.3	6.23	1.68
3.03	8.14	10.8	19.7	39.7	63.6	77.1
3.81	7.45	7.24	6.69	5.41	3.74	2.75
3.57	9.27	9.34	9.11	8.39	7.66	7.61
89.6	75.1	72.6	64.6	46.5	25	12.6
0	0.562	2.11	7.14	18.6	32.3	40.2
7.01	15.2	16.4	20.2	29.3	40.6	47.3
	3.81 3.57 89.6	63.1 61.5 3.03 8.14 3.81 7.45 3.57 9.27 89.6 75.1 0 0.562	63.1 61.5 55.7 3.03 8.14 10.8 3.81 7.45 7.24 3.57 9.27 9.34 89.6 75.1 72.6 0 0.562 2.11	63.1 61.5 55.7 40.5 3.03 8.14 10.8 19.7 3.81 7.45 7.24 6.69 3.57 9.27 9.34 9.11 89.6 75.1 72.6 64.6 0 0.562 2.11 7.14	63.1 61.5 55.7 40.5 19.3 3.03 8.14 10.8 19.7 39.7 3.81 7.45 7.24 6.69 5.41 3.57 9.27 9.34 9.11 8.39 89.6 75.1 72.6 64.6 46.5 0 0.562 2.11 7.14 18.6	63.1 61.5 55.7 40.5 19.3 6.23 3.03 8.14 10.8 19.7 39.7 63.6 3.81 7.45 7.24 6.69 5.41 3.74 3.57 9.27 9.34 9.11 8.39 7.66 89.6 75.1 72.6 64.6 46.5 25 0 0.562 2.11 7.14 18.6 32.3

Table 45: E-B+ scenario - PILLAR 1: Efficiency/Electrification - Residential (continued)

Item	2020	2025	2030	2035	2040	2045	2050
Sales of water heating units - Gas Furnace (%)	92.3	83.4	80.7	71.9	51.3	26.3	11.8
Sales of water heating units - Other (%)	0.642	0.79	0.789	0.787	0.783	0.781	0.778

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

Item	2020	2025	2030	2035	2040	2045	2050
Light-duty vehicle capital costs - Cumulative 5-yr	0	0	76.1	152	522	1,618	2,366
(million \$2018)							
Public EV charging plugs - DC Fast (1000 units)	0.174	0	0.26	0	1.16	0	3.16
Public EV charging plugs - L2 (1000 units)	1.07	0	6.25	0	27.9	0	75.9
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 (%)	1.56	1.97	2.06	1.64	1.05	0.537	0.23
Vehicle sales - Light-duty - EV (%)	1.89	4.68	11.8	25.9	48.4	72	87.6
Vehicle sales - Light-duty - gasoline (%)	91.8	87.5	79.6	66.7	46.2	24.9	11
Vehicle sales - Light-duty - hybrid (%)	4.58	5.39	6.05	5.51	4.13	2.44	1.18
Vehicle sales - Light-duty - hydrogen FC (%)	0.113	0.38	0.326	0.249	0.177	0.098	0.046
Vehicle sales - Light-duty - other (%)	0.103	0.106	0.097	0.084	0.061	0.033	0.015
Vehicle sales - Medium-duty - diesel (%)	64.8	62.2	57.7	49.4	35.6	19.6	8.37
Vehicle sales - Medium-duty - EV (%)	0.664	1.94	5.49	14.3	31.4	52.6	68
Vehicle sales - Medium-duty - gasoline (%)	33.8	34.7	34.7	31.9	24.4	14.2	6.33
Vehicle sales - Medium-duty - hybrid (%)	0.363	0.418	0.464	0.478	0.414	0.275	0.141
Vehicle sales - Medium-duty - hydrogen FC (%)	0.166	0.485	1.37	3.58	7.86	13.2	17
Vehicle sales - Medium-duty - other (%)	0.253	0.266	0.279	0.286	0.258	0.184	0.102

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

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Commercial (PJ)	103	103	103	102	99.5	96.4	92.8
Final energy use - Industry (PJ)	86.5	89.4	90.4	97.9	112	117	124
Final energy use - Residential (PJ)	126	122	121	118	114	105	94.6
Final energy use - Transportation (PJ)	304	292	270	253	241	225	207

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

2020	2025	2030	2035	2040	2045	2050
0	7,532	8,365	0	0	0	0
41.9	46.2	50.2	60.8	75.4	84.6	87.8
58.1	53.8	49.8	39.2	24.6	15.4	12.2
0.749	7.59	10.3	19	39.5	64.5	79
0.855	3.35	3.5	4.01	5.26	6.85	7.79
0	0.241	0.225	0.172	0.092	0.04	0.021
98.4	88.8	86	76.8	55.2	28.6	13.2
0.008	0.63	2.29	7.68	20	34.8	43.4
0.41	2	3.48	8.38	19.9	34.2	42.5
99.5	97	93.8	83.6	59.7	30.6	13.7
0.1	0.381	0.381	0.382	0.381	0.381	0.381
	41.9 58.1 0.749 0.855 0 98.4 0.008	0 7,532 41.9 46.2 58.1 53.8 0.749 7.59 0.855 3.35 0 0.241 98.4 88.8 0.008 0.63 0.41 2 99.5 97	0 7,532 8,365 41.9 46.2 50.2 58.1 53.8 49.8 0.749 7.59 10.3 0 0.241 0.225 98.4 88.8 86 0.008 0.63 2.29 0.41 2 3.48 99.5 97 93.8	0 7,532 8,365 0 41.9 46.2 50.2 60.8 58.1 53.8 49.8 39.2 0.749 7.59 10.3 19 0.855 3.35 3.5 4.01 0 0.241 0.225 0.172 98.4 88.8 86 76.8 0.008 0.63 2.29 7.68 0.41 2 3.48 8.38 99.5 97 93.8 83.6	0 7,532 8,365 0 0 41.9 46.2 50.2 60.8 75.4 58.1 53.8 49.8 39.2 24.6 0.749 7.59 10.3 19 39.5 0.855 3.35 3.5 4.01 5.26 0 0.241 0.225 0.172 0.092 98.4 88.8 86 76.8 55.2 0.008 0.63 2.29 7.68 20 0.41 2 3.48 8.38 19.9 99.5 97 93.8 83.6 59.7	0 7,532 8,365 0 0 0 41.9 46.2 50.2 60.8 75.4 84.6 58.1 53.8 49.8 39.2 24.6 15.4 0.749 7.59 10.3 19 39.5 64.5 0.855 3.35 3.5 4.01 5.26 6.85 0 0.241 0.225 0.172 0.092 0.04 98.4 88.8 86 76.8 55.2 28.6 0.008 0.63 2.29 7.68 20 34.8 0.41 2 3.48 8.38 19.9 34.2 99.5 97 93.8 83.6 59.7 30.6

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

	•		•				
Item	2020	2025	2030	2035	2040	2045	2050
Electricity distribution capital invested -	0	1.43	1.48	1.97	2.07	2.75	2.92
Cumulative 5-yr (billion \$2018)							

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

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

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

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

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

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

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

Item	2020	2025	2030	2035	2040	2045	2050
Annual - All (MMT)	0	0	0	0	0	0	0
Annual - BECCS (MMT)	0	0	0	0	0	0	0
Annual - Cement and lime (MMT)	0	0	0	0	0	0	0
Annual - NGCC (MMT)	0	0	0	0	0	0	0
Cumulative - All (MMT)	0	0	0	0	0	0	0
Cumulative - BECCS (MMT)	0	0	0	0	0	0	0
Cumulative - Cement and lime (MMT)	0	0	0	0	0	0	0
Cumulative - NGCC (MMT)	0	0	0	0	0	0	0

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

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

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

Item	2020	2025	2030	2035	2040	2045	2050
All (km)	0	0	0	0	0	0	0
Cumulative investment - All (million \$2018)	0	0	0	0	0	0	0
Cumulative investment - Spur (million \$2018)	0	0	0	0	0	0	0
Cumulative investment - Trunk (million \$2018)	0	0	0	0	0	0	0
Spur (km)	0	0	0	0	0	0	0
Trunk (km)	0	0	0	0	0	0	0

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

Table 56: E-B+ scenario - PILLAR 6: Land sinks	- Agriculture		
Item	2020	2025	2050
Carbon sink potential - Aggressive deployment -	0	0	0
Corn-ethanol to energy grasses (1000 tCO2e/y)			
Carbon sink potential - Aggressive deployment -	0	0	-360
Cropland measures (1000 tCO2e/y)			
Carbon sink potential - Aggressive deployment -	0	0	0
Cropland to woody energy crops (1000 tCO2e/y)			
Carbon sink potential - Aggressive deployment -	0	0	0
Pasture to energy crops (1000 tC02e/y)			
Carbon sink potential - Aggressive deployment -	0	0	-15.7
Permanent conservation cover (1000 tCO2e/y)			
Carbon sink potential - Aggressive deployment -	0	0	-376
Total (1000 tC02e/y)			
Carbon sink potential - Moderate deployment -	0	0	0
Corn-ethanol to energy grasses (1000 tC02e/y)			
Carbon sink potential - Moderate deployment -	0	0	-184
Cropland measures (1000 tCO2e/y)		-	
Carbon sink potential - Moderate deployment -	0	0	0
Cropland to woody energy crops (1000 tC02e/y)			
Carbon sink potential - Moderate deployment -	0	0	0
Pasture to energy crops (1000 tCO2e/y)			
Carbon sink potential - Moderate deployment -	0	0	-7.84
Permanent conservation cover (1000 tCO2e/y)		0	1.04
Carbon sink potential - Moderate deployment -	0	0	-192
Total (1000 tCO2e/y)		0	-172
Land impacted for carbon sink - Aggressive	0	0	0
deployment - Corn-ethanol to energy grasses		0	0
(1000 hectares)			
Land impacted for carbon sink - Aggressive	0	0	1,595
deployment - Cropland measures (1000	"	0	1,595
hectares)			
	0	0	0.002
Land impacted for carbon sink - Aggressive	0	0	0.002
deployment - Cropland to woody energy crops			
(1000 hectares)		0	1.05
Land impacted for carbon sink - Aggressive	0	0	1.05
deployment - Pasture to energy crops (1000			
hectares)			0/ 1
Land impacted for carbon sink - Aggressive	0	0	24.1
deployment - Permanent conservation cover			
(1000 hectares)			1 (00
Land impacted for carbon sink - Aggressive	0	0	1,620
deployment - Total (1000 hectares)			
Land impacted for carbon sink - Moderate	0	0	0
deployment - Corn-ethanol to energy grasses			
(1000 hectares)			
Land impacted for carbon sink - Moderate	0	0	329
deployment - Cropland measures (1000			
hectares)			
Land impacted for carbon sink - Moderate	0	0	0.002
deployment - Cropland to woody energy crops			
(1000 hectares)			
Land impacted for carbon sink - Moderate	0	0	1.05
deployment - Pasture to energy crops (1000			
hectares)			
Land impacted for carbon sink - Moderate	0	0	12.1
deployment - Permanent conservation cover			
(1000 hectares)			
Land impacted for carbon sink - Moderate	0	0	342
deployment - Total (1000 hectares)			

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

Table 57: E-B+ scenario - PILLAR 6: Land sinks	- Forests		
Item	2020	2025	2050
Carbon sink potential - High - Accelerate	0	0	1,412
regeneration (1000 tCO2e/y)			
Carbon sink potential - High - All (not counting	0	0	18,580
overlap) (1000 tCO2e/y)			
Carbon sink potential - High - Avoid deforestation	0	0	838
(1000 tCO2e/y)			
Carbon sink potential - High - Extend rotation	0	0	7,600
length (1000 tCO2e/y)			
Carbon sink potential - High - Improve	0	0	10.6
plantations (1000 tCO2e/y)			
Carbon sink potential - High - Increase retention	0	0	29.8
of HWP (1000 tCO2e/y)			
Carbon sink potential - High - Increase trees	0	0	332
outside forests (1000 tCO2e/y)			
Carbon sink potential - High - Reforest cropland	0	0	2,378
(1000 tC02e/y)			-
Carbon sink potential - High - Reforest pasture	0	0	1,329
(1000 tC02e/y)		_	,-
Carbon sink potential - High - Restore	0	0	4,651
productivity (1000 tCO2e/y)		•	.,
Carbon sink potential - Low - Accelerate	0	0	707
regeneration (1000 tCO2e/y)		Ü	
Carbon sink potential - Low - All (not counting	0	0	6,755
overlap) (1000 tC02e/y)		J	0,100
Carbon sink potential - Low - Avoid deforestation	0	0	140
(1000 tC02e/y)		O	140
Carbon sink potential - Low - Extend rotation	0	0	2,919
length (1000 tC02e/y)		O	2,717
Carbon sink potential - Low - Improve	0	0	5.38
plantations (1000 tCO2e/y)		U	0.36
Carbon sink potential - Low - Increase retention	0	0	9.92
of HWP (1000 tCO2e/y)		U	7.72
Carbon sink potential - Low - Increase trees	0	0	116
outside forests (1000 tCO2e/y)		U	110
Carbon sink potential - Low - Reforest cropland	0	0	1,189
(1000 tC02e/y)		U	1,107
Carbon sink potential - Low - Reforest pasture	0	0	101
(1000 tC02e/y)	"	U	101
	0	0	1 5 4 0
Carbon sink potential - Low - Restore productivity (1000 tCO2e/y)	0	Ü	1,568
Carbon sink potential - Mid - Accelerate	0	0	10/0
regeneration (1000 tCO2e/y)	0	U	1,060
Carbon sink potential - Mid - All (not counting	0		10 / / 7
	0	0	12,667
overlap) (1000 tCO2e/y)			/ 00
Carbon sink potential - Mid - Avoid deforestation	0	0	489
(1000 tC02e/y)			5.070
Carbon sink potential - Mid - Extend rotation	0	0	5,260
length (1000 tC02e/y)			
Carbon sink potential - Mid - Improve plantations	0	0	7.89
(1000 tC02e/y)			
Carbon sink potential - Mid - Increase retention	0	0	19.8
of HWP (1000 tC02e/y)			
Carbon sink potential - Mid - Increase trees	0	0	224
outside forests (1000 tCO2e/y)			
Carbon sink potential - Mid - Reforest cropland	0	0	1,783
(1000 tC02e/y)			
Carbon sink potential - Mid - Reforest pasture	0	0	715
(1000 tC02e/y)			
Carbon sink potential - Mid - Restore	0	0	3,109
productivity (1000 tCO2e/y)			
		0	231
Land impacted for carbon sink potential - High - Accelerate regeneration (1000 hectares)	0	U	231

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

Table 57: E-B+ scenario - PILLAR 6: Land sinks -	- Forests (con	tinueaj	
Item	2020	2025	2050
Land impacted for carbon sink potential - High -	0	0	113
Avoid deforestation (over 30 years) (1000			
hectares)			
Land impacted for carbon sink potential - High -	0	0	3,876
Extend rotation length (1000 hectares)		-	
Land impacted for carbon sink potential - High -	0	0	3.9
Improve plantations (1000 hectares)			0.7
Land impacted for carbon sink potential - High -	0	0	0
Increase retention of HWP (1000 hectares)		١	0
Land impacted for carbon sink potential - High -	0	0	31.5
Increase trees outside forests (1000 hectares)	"	U	51.5
	0	0	157
Land impacted for carbon sink potential - High -	0	0	157
Reforest cropland (1000 hectares)		-	07.0
Land impacted for carbon sink potential - High -	0	0	37.8
Reforest pasture (1000 hectares)			15/0
Land impacted for carbon sink potential - High -	0	0	1,542
Restore productivity (1000 hectares)			
Land impacted for carbon sink potential - High -	0	0	5,992
Total impacted (over 30 years) (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	116
Accelerate regeneration (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	106
Avoid deforestation (over 30 years) (1000			
hectares)			
Land impacted for carbon sink potential - Low -	0	0	1,485
Extend rotation length (1000 hectares)		-	
Land impacted for carbon sink potential - Low -	0	0	1.95
Improve plantations (1000 hectares)			,0
Land impacted for carbon sink potential - Low -	0	0	0
Increase retention of HWP (1000 hectares)		١	١ -
Land impacted for carbon sink potential - Low -	0	0	16.6
Increase trees outside forests (1000 hectares)	"	U	10.0
	_	0	70 /
Land impacted for carbon sink potential - Low -	0	0	78.6
Reforest cropland (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	6.55
Reforest pasture (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	933
Restore productivity (1000 hectares)			
Land impacted for carbon sink potential - Low -	0	0	2,743
Total impacted (over 30 years) (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	173
Accelerate regeneration (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	110
Avoid deforestation (over 30 years) (1000			
hectares)			
Land impacted for carbon sink potential - Mid -	0	0	2,680
Extend rotation length (1000 hectares)		١ -	2,000
Land impacted for carbon sink potential - Mid -	0	0	2.93
Improve plantations (1000 hectares)		U	2.70
		0	
Land impacted for carbon sink potential - Mid -	0	0	0
Increase retention of HWP (1000 hectares)			0/1
Land impacted for carbon sink potential - Mid -	0	0	24.1
Increase trees outside forests (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	118
Reforest cropland (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	47.3
Reforest pasture (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	1,879
Restore productivity (1000 hectares)			
Land impacted for carbon sink potential - Mid -	0	0	5,034
Total impacted (over 30 years) (1000 hectares)		-	

Table CO DCC assessia	DILLADA EEC-!	/F1 4 - 161 41	Desidential
Table 58: REF scenario -	PILLAR I: Efficiency	/Electrification -	Kesiaentiai

Item	2020	2025	2030	2035	2040	2045	2050
Residential HVAC investment in 2020s vs. REF -	0	2.68	2.8	0	0	0	0
Cumulative 5-yr (billion \$2018)							
Sales of cooking units - Electric Resistance (%)	36.3	36.3	36.3	36.3	36.3	36.3	36.3
Sales of cooking units - Gas (%)	63.7	63.7	63.7	63.7	63.7	63.7	63.7
Sales of space heating units - Electric Heat Pump	2.42	11.3	11.7	12.3	12.7	13	13.3
(%)							
Sales of space heating units - Electric Resistance	3.86	7.17	7.1	7.05	7.03	6.83	6.47
(%)							
Sales of space heating units - Fossil (%)	3.61	9.13	9.24	9.18	8.79	8.45	8.65
Sales of space heating units - Gas (%)	90.1	72.4	72	71.5	71.5	71.7	71.5
Sales of water heating units - Electric Heat Pump	0	0	0	0	0	0	0
(%)							
Sales of water heating units - Electric Resistance	7.01	14.8	14.8	14.8	14.9	14.9	14.9
(%)							
Sales of water heating units - Gas Furnace (%)	92.3	84.4	84.4	84.4	84.4	84.4	84.3
Sales of water heating units - Other (%)	0.642	0.79	0.789	0.787	0.784	0.782	0.78

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

Item	2020	2025	2030	2035	2040	2045	2050
Vehicle sales - Heavy-duty - diesel (%)	98.1	98.2	97.9	97	95.6	93.5	91.6
Vehicle sales - Heavy-duty - EV (%)	0	0	0	0	0	0	0
Vehicle sales - Heavy-duty - gasoline (%)	0.229	0.242	0.257	0.274	0.294	0.317	0.343
Vehicle sales - Heavy-duty - hybrid (%)	0.083	0.096	0.112	0.13	0.15	0.174	0.202
Vehicle sales - Heavy-duty - hydrogen FC (%)	0.119	0.138	0.16	0.186	0.216	0.25	0.29
Vehicle sales - Heavy-duty - other (%)	1.51	1.31	1.57	2.37	3.69	5.71	7.57
Vehicle sales - Light-duty - diesel (%)	1.56	1.97	2.18	2.03	1.83	1.71	1.62
Vehicle sales - Light-duty - EV (%)	3.56	5.59	6.37	7.84	9.55	11	12.2
Vehicle sales - Light-duty - gasoline (%)	90.2	86.7	84.5	82.7	80.6	78.7	77.1
Vehicle sales - Light-duty - hybrid (%)	4.44	5.28	6.46	7.03	7.6	8.18	8.63
Vehicle sales - Light-duty - hydrogen FC (%)	0.111	0.377	0.346	0.307	0.304	0.305	0.316
Vehicle sales - Light-duty - other (%)	0.102	0.106	0.102	0.103	0.102	0.101	0.104
Vehicle sales - Medium-duty - diesel (%)	65.2	63.5	61.6	59.6	58	56.5	55.2
Vehicle sales - Medium-duty - EV (%)	0.027	0.105	0.329	0.671	0.895	0.973	0.993
Vehicle sales - Medium-duty - gasoline (%)	34	35.5	37	38.5	39.7	40.8	41.7
Vehicle sales - Medium-duty - hybrid (%)	0.365	0.427	0.496	0.577	0.674	0.793	0.929
Vehicle sales - Medium-duty - hydrogen FC (%)	0.175	0.208	0.242	0.285	0.339	0.409	0.487
Vehicle sales - Medium-duty - other (%)	0.255	0.271	0.298	0.345	0.42	0.528	0.671

Table 60: REF scenario - PILLAR 1: Efficiency/Electrification - Overview

Item	2020	2025	2030	2035	2040	2045	2050
Final energy use - Commercial (PJ)	103	105	107	106	106	108	113
Final energy use - Industry (PJ)	86.4	92	95.3	99.3	105	112	121
Final energy use - Residential (PJ)	126	123	123	125	127	130	132
Final energy use - Transportation (PJ)	304	294	276	267	271	282	297

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

Item	2020	2025	2030	2035	2040	2045	2050
Commercial HVAC investment in 2020s -	0	7,440	7,806	0	0	0	0
Cumulative 5-yr (million \$2018)							
Sales of cooking units - Electric Resistance (%)	41.9	44.7	44.7	44.6	44.4	44.5	44.6
Sales of cooking units - Gas (%)	58.1	55.3	55.3	55.4	55.6	55.5	55.4
Sales of space heating units - Electric Heat Pump	0.749	14.6	48.1	74.1	78.4	78.8	78.8
(%)							
Sales of space heating units - Electric Resistance	0.855	4.29	8.82	15.6	19.9	20.6	20.7
(%)							
Sales of space heating units - Fossil (%)	0	0.225	0.13	0.037	0.005	0	0
Sales of space heating units - Gas Furnace (%)	98.4	80.9	43	10.2	1.68	0.552	0.49
Sales of water heating units - Electric Heat Pump	0.008	0.03	0.03	0.03	0.03	0.03	0.03
(%)							

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

Item	2020	2025	2030	2035	2040	2045	2050
Sales of water heating units - Electric Resistance	0.41	1.46	1.46	1.47	1.46	1.47	1.46
(%)							
Sales of water heating units - Gas Furnace (%)	99.5	98.1	98.1	98.1	98.1	98.1	98.1
Sales of water heating units - Other (%)	0.1	0.381	0.381	0.382	0.381	0.381	0.381

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

Item	2020	2025	2030	2035	2040	2045	2050
Electricity distribution capital invested -	0	1.54	1.6	1.88	1.97	2.43	2.57
Cumulative 5-yr (billion \$2018)							

Table 63: REF scenario - PILLAR 6: Land sinks - Forests

Table 63: REF scenario - PILLAR 6: Land sinks - F	orests			
Item	2020	2025	2030	2050
Business-as-usual carbon sink - Natural uptake (Mt CO2e/y)	-0.72	0	2.42	0.695
Business-as-usual carbon sink - Retained in Hardwood Products (Mt CO2e/y)	-0.008	0	-0.017	-0.018
Business-as-usual carbon sink - Total (Mt CO2e/y)	-0.728	0	2.41	0.677
Carbon sink potential - High - Accelerate	0	0	0	1,412
regeneration (1000 tCO2e/y)	0	0	0	
Carbon sink potential - High - All (not counting overlap) (1000 tCO2e/y)	0	0	0	18,580
Carbon sink potential - High - Avoid deforestation (1000 tCO2e/y)	0	0	0	838
Carbon sink potential - High - Extend rotation length (1000 tCO2e/y)	0	0	0	7,600
Carbon sink potential - High - Improve plantations (1000 tCO2e/y)	0	0	0	10.6
Carbon sink potential - High - Increase retention of HWP (1000 tC02e/y)	0	0	0	29.8
Carbon sink potential - High - Increase trees outside forests (1000 tCO2e/y)	0	0	0	332
Carbon sink potential - High - Reforest cropland (1000 tCO2e/y)	0	0	0	2,378
Carbon sink potential - High - Reforest pasture (1000 tC02e/y)	0	0	0	1,329
Carbon sink potential - High - Restore productivity (1000 tC02e/y)	0	0	0	4,651
Carbon sink potential - Low - Accelerate regeneration (1000 tCO2e/y)	0	0	0	707
Carbon sink potential - Low - All (not counting overlap) (1000 tCO2e/y)	0	0	0	6,755
Carbon sink potential - Low - Avoid deforestation (1000 tCO2e/y)	0	0	0	140
Carbon sink potential - Low - Extend rotation length (1000 tC02e/y)	0	0	0	2,919
Carbon sink potential - Low - Improve	0	0	0	5.38
plantations (1000 tC02e/y) Carbon sink potential - Low - Increase retention	0	0	0	9.92
of HWP (1000 tCO2e/y) Carbon sink potential - Low - Increase trees	0	0	0	116
outside forests (1000 tCO2e/y) Carbon sink potential - Low - Reforest cropland	0	0	0	1,189
(1000 tCO2e/γ) Carbon sink potential - Low - Reforest pasture	0	0	0	101
(1000 tCO2e/y) Carbon sink potential - Low - Restore	0	0	0	1,568
productivity (1000 tCO2e/y) Carbon sink potential - Mid - Accelerate	0	0	0	1,060
regeneration (1000 tCO2e/y) Carbon sink potential - Mid - All (not counting	0	0	0	12,667
overlap) (1000 tC02e/y)	U	U	U	12,007

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

Table 63: REF scenario - PILLAR 6: Land sinks - I				
Item	2020	2025	2030	2050
Carbon sink potential - Mid - Avoid deforestation	0	0	0	489
(1000 tC02e/y)	0	0		F 0 / 0
Carbon sink potential - Mid - Extend rotation	0	0	0	5,260
length (1000 tCO2e/y) Carbon sink potential - Mid - Improve plantations	0	0	0	7.00
	U	U	0	7.89
(1000 tC02e/y) Carbon sink potential - Mid - Increase retention	0	0	0	19.8
	U	U	U	19.8
of HWP (1000 tC02e/y) Carbon sink potential - Mid - Increase trees	0	0	0	224
outside forests (1000 tC02e/y)	U	U	0	224
Carbon sink potential - Mid - Reforest cropland	0	0	0	1,783
(1000 tCO2e/y)	U	0	0	1,103
Carbon sink potential - Mid - Reforest pasture	0	0	0	715
(1000 tCO2e/y)	0	0	0	110
Carbon sink potential - Mid - Restore	0	0	0	3,109
productivity (1000 tCO2e/y)	0	0	0	3,107
Land impacted for carbon sink potential - High -	0	0	0	231
Accelerate regeneration (1000 hectares)	0	0	0	201
Land impacted for carbon sink potential - High -	0	0	0	113
Avoid deforestation (over 30 years) (1000	0	0	0	110
hectares)				
Land impacted for carbon sink potential - High -	0	0	0	3,876
Extend rotation length (1000 hectares)				0,0.0
Land impacted for carbon sink potential - High -	0	0	0	3.9
Improve plantations (1000 hectares)				
Land impacted for carbon sink potential - High -	0	0	0	0
Increase retention of HWP (1000 hectares)				
Land impacted for carbon sink potential - High -	0	0	0	31.5
Increase trees outside forests (1000 hectares)				
Land impacted for carbon sink potential - High -	0	0	0	157
Reforest cropland (1000 hectares)				
Land impacted for carbon sink potential - High -	0	0	0	37.8
Reforest pasture (1000 hectares)				
Land impacted for carbon sink potential - High -	0	0	0	1,542
Restore productivity (1000 hectares)				
Land impacted for carbon sink potential - High -	0	0	0	5,992
Total impacted (over 30 years) (1000 hectares)				
Land impacted for carbon sink potential - Low -	0	0	0	116
Accelerate regeneration (1000 hectares)				
Land impacted for carbon sink potential - Low -	0	0	0	106
Avoid deforestation (over 30 years) (1000				
hectares)				
Land impacted for carbon sink potential - Low -	0	0	0	1,485
Extend rotation length (1000 hectares)				
Land impacted for carbon sink potential - Low -	0	0	0	1.95
Improve plantations (1000 hectares)				
Land impacted for carbon sink potential - Low -	0	0	0	0
Increase retention of HWP (1000 hectares)				
Land impacted for carbon sink potential - Low -	0	0	0	16.6
Increase trees outside forests (1000 hectares)				
Land impacted for carbon sink potential - Low -	0	0	0	78.6
Reforest cropland (1000 hectares)				
Land impacted for carbon sink potential - Low -	0	0	0	6.55
Reforest pasture (1000 hectares)				
Land impacted for carbon sink potential - Low -	0	0	0	933
Restore productivity (1000 hectares)				
Land impacted for carbon sink potential - Low -	0	0	0	2,743
Total impacted (over 30 years) (1000 hectares)				
Land impacted for carbon sink potential - Mid -	0	0	0	173
Accelerate regeneration (1000 hectares)				
Land impacted for carbon sink potential - Mid -	0	0	0	110
Avoid deforestation (over 30 years) (1000				
hectares)				

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

Item	2020	2025	2030	2050
Land impacted for carbon sink potential - Mid -	0	0	2030	2,680
·	0	U	U	2,000
Extend rotation length (1000 hectares)				
Land impacted for carbon sink potential - Mid -	0	0	0	2.93
Improve plantations (1000 hectares)				
Land impacted for carbon sink potential - Mid -	0	0	0	0
Increase retention of HWP (1000 hectares)				
Land impacted for carbon sink potential - Mid -	0	0	0	24.1
Increase trees outside forests (1000 hectares)				
Land impacted for carbon sink potential - Mid -	0	0	0	118
Reforest cropland (1000 hectares)				
Land impacted for carbon sink potential - Mid -	0	0	0	47.3
Reforest pasture (1000 hectares)				
Land impacted for carbon sink potential - Mid -	0	0	0	1,879
Restore productivity (1000 hectares)				
Land impacted for carbon sink potential - Mid -	0	0	0	5,034
Total impacted (over 30 years) (1000 hectares)				

Table 64: REF scenario - IMPACTS - Health

Item	2020	2025	2030	2035	2040	2045	2050
Monetary damages from air pollution - Coal (million 2019\$)	0	204	156	74.9	60.2	56.5	53.2
Monetary damages from air pollution - Natural Gas (million 2019\$)	0	36.9	33.8	56.3	38.8	54.1	51.1
Monetary damages from air pollution - Transportation (million 2019\$)	0	757	808	859	914	969	1,026
Premature deaths from air pollution - Coal (deaths)	0	22.9	17.5	8.4	6.75	6.34	5.97
Premature deaths from air pollution - Natural Gas (deaths)	0	4.17	3.81	6.36	4.38	6.11	5.78
Premature deaths from air pollution - Transportation (deaths)	0	85.1	90.8	96.6	103	109	115