Net-Zero America - delaware state report v2

Larson et al. 2020

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Reading guide

IN DRAFT

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

variable_name	2020	2025	2030	2035	2040	2045	2050
Residential HVAC investment in 2020s vs. REF - Cumulative 5-yr	0	0.774	0.771	0	0	0	0
Sale of space heating units by type - Electric Heat Pump	0.143	0.321	0.799	0.906	0.91	0.91	0.91
Sale of space heating units by type - Electric Resistance	0.099	0.108	0.045	0.031	0.03	0.031	0.031
Sale of space heating units by type - Fossil	0.205	0.262	0.07	0.027	0.025	0.025	0.025
Sale of space heating units by type - Gas	0.553	0.309	0.086	0.036	0.034	0.034	0.034
Sales of cooking units - Electric Resistance	0.501	0.607	0.933	0.997	1	1	1
Sales of cooking units - Gas	0.499	0.393	0.067	0.003	0	0	0
Sales of water heating units by type - Electric Heat Pump	0	0.094	0.499	0.59	0.594	0.594	0.594
Sales of water heating units by type - Electric Resistance	0.302	0.459	0.403	0.39	0.389	0.389	0.389
Sales of water heating units by type - Gas Furnace	0.652	0.413	0.078	0.003	0	0	0
Sales of water heating units by type - Other	0.046	0.033	0.02	0.017	0.017	0.017	0.017

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

variable_name	2020	2025	2030	2035	2040	2045	2050
End-use technology sales by technology - HDV - diesel	0.972	0.921	0.67	0.233	0.042	0.006	0
End-use technology sales by technology - HDV - EV	0.006	0.038	0.19	0.456	0.574	0.596	0.6
End-use technology sales by technology - HDV - gasoline	0.002	0.002	0.002	0.001	0	0	0
End-use technology sales by technology - HDV - hybrid	0.001	0.001	0.001	0	0	0	0
End-use technology sales by technology - HDV - hydrogen FC	0.004	0.025	0.127	0.304	0.382	0.397	0.4
End-use technology sales by technology - HDV - other	0.015	0.012	0.011	0.006	0.002	0	0
End-use technology sales by technology - LDV - diesel	0.014	0.017	0.012	0.004	0.001	0	0
End-use technology sales by technology - LDV - EV	0.043	0.164	0.483	0.825	0.964	0.993	1
End-use technology sales by technology - LDV - gasoline	0.892	0.766	0.469	0.158	0.032	0.006	0
End-use technology sales by technology - LDV - hybrid	0.048	0.048	0.033	0.012	0.003	0.001	0
End-use technology sales by technology - LDV - hydrogen FC	0.001	0.003	0.002	0.001	0	0	0
End-use technology sales by technology - LDV - other	0.001	0.001	0.001	0	0	0	0
End-use technology sales by technology - MDV - diesel	0.647	0.597	0.423	0.144	0.026	0.004	0
End-use technology sales by technology - MDV - EV	0.008	0.051	0.253	0.608	0.765	0.795	0.8
End-use technology sales by technology - MDV - gasoline	0.337	0.333	0.255	0.093	0.018	0.003	0
End-use technology sales by technology - MDV - hybrid	0.004	0.004	0.003	0.001	0	0	0
End-use technology sales by technology - MDV - hydrogen FC	0.002	0.013	0.063	0.152	0.191	0.199	0.2
End-use technology sales by technology - MDV - other	0.003	0.003	0.002	0.001	0	0	0
Light-duty vehicle capital costs - Cumulative 5-yr	0	193436237	495989755	803420819	1217151141	1324570325	1262976977
Number of public EV charging plugs - DC Fast Charging	65	0	324.151	0	1420.8	0	2297.2
Number of public EV charging plugs - L2 Charging	118	0	7803.8	0	34205.3	0	55303

Table 3: *E- scenario - PILLAR 2: Clean Electricity - Generating capacity*

variable_name	2020	2025	2030	2035	2040	2045	2050
Power generation capital investment - biomass power plant	0	0	0	0	0	0	0
Power generation capital investment - biomass w/ccu allam power plant	0	0	0	0	0	0	0
Power generation capital investment - biomass w/ccu power plant	0	0	0	0	0	0	0
Power generation capital investment - Offshore Wind - Base	0	0	0	0	0	5.988	5.644
Power generation capital investment - Offshore Wind - Constrained	0	0	0	0	0	3.304	8.061
Power generation capital investment - Solar PV - Base	0	0.167	0.173	0.318	0	0	0
Power generation capital investment - Solar PV - Constrained	0	0.144	0.276	0.328	0	0	0

Table 4: *E- scenario - PILLAR 2: Clean Electricity - Generation*

variable_name	2020	2025	2030	2035	2040	2045	2050
Power generation by technology - biomass power plant	0	0	0	0	0	0	0
Power generation by technology - biomass w/ccu allam power plant	0	0	0	0	0	0	0
Power generation by technology - biomass w/ccu power plant	0	0	0	0	0	0	0

Table 5: *E- scenario - PILLAR 2: Clean Electricity - Transmission*

variable_name	2020	2025	2030	2035	2040	2045	2050
HV transmission for wind and solar - base all	0	46.077	183.518	644.575	819.813	7081.1	18537.9
HV transmission for wind and solar - base other intra-state	0	15.343	65.325	270.715	352.265	2441.1	3338.2
HV transmission for wind and solar - base spur intra-state	0	13.45	33.015	78.328	78.328	766.739	1289.1
HV transmission for wind and solar - constrained all	0	4.665	50.616	148.455	161.746	2301	17729.8
HV transmission for wind and solar - constrained other intra-state	0	1.674	21.42	67.717	74.596	1190	2984.2
HV transmission for wind and solar - constrained spur intra-state	0	0	8.333	35.332	35.332	378.31	1246.6

Table 6: *E- scenario - PILLAR 3: Bioenergy and Hydrogen - Bioconversion*

variable_name	2020	2025	2030	2035	2040	2045	2050
Biomass purchases	0	0	0	0	0	0	0
Capital investment	0	0	0	0	0	0	0
Number of facilities - allam power w ccu	0	0	0	0	0	0	0
Number of facilities - beccs hydrogen	0	0	0	0	0	0	0
Number of facilities - diesel	0	0	0	0	0	0	0

Table 6: *E- scenario - PILLAR 3: Bioenergy and Hydrogen - Bioconversion (continued)*

variable_name	2020	2025	2030	2035	2040	2045	2050
Number of facilities - diesel ccu	0	0	0	0	0	0	0
Number of facilities - power	0	0	0	0	0	0	0
Number of facilities - power ccu	0	0	0	0	0	0	0
Number of facilities - pyrolysis	0	0	0	0	0	0	0
Number of facilities - pyrolysis ccu	0	0	0	0	0	0	0
Number of facilities - sng	0	0	0	0	0	0	0
Number of facilities - sng ccu	0	0	0	0	0	0	0

Table 7: *E- scenario - PILLAR 4: CO2 capture, use, storage - CO2 capture*

variable_name	2025	2030	2035	2040	2045	2050
Annual - All	0	0	0	0	0	0
Annual - BECCS	0	0	0	0	0	0
Annual - Cement	0	0	0	0	0	0
Annual - NGCC	0	0	0	0	0	0
Cumulative - All	0	0	0	0	0	0
Cumulative - BECCS	0	0	0	0	0	0
Cumulative - Cement	0	0	0	0	0	0
Cumulative - NGCC	0	0	0	0	0	0

Table 8: *E- scenario - PILLAR 4: CO2 capture, use, storage - CO2 storage*

variable_name	2025	2030	2035	2040	2045	2050
Annual	0	0	0	0	0	0
Injection wells	0	0	0	0	0	0
Resource characterization, appraisal and permitting costs cumulative	0	0	0	0	0	0
Wells and facilities construction costs cumulative	0	0	0	0	0	0

Table 9: *E- scenario - PILLAR 4: CO2 capture, use, storage - CO2 transportation*

variable_name	2025	2030	2035	2040	2045	2050
CO2 pipelines - All	0	0	0	0	0	122541.706
CO2 pipelines - Spur	0	0	0	0	0	122541.706
CO2 pipelines - Trunk	0	0	0	0	0	0

Table 10: *E- scenario - IMPACTS - Jobs*

variable_name	2020	2025	2030	2035	2040	2045	2050
Jobs by economic sector - agriculture	3.295	3.798	7.712	2.948	2.286	1.681	1.249
Jobs by economic sector - construction	1159.4	1159.1	1095.4	1418.5	1413.6	4193.4	7337.3
Jobs by economic sector - manufacturing	778.798	1426.2	2601.5	2634.6	2093.5	2841.1	2825.9
Jobs by economic sector - mining	394.782	286.584	196.949	119.132	64.197	27.804	8.901
Jobs by economic sector - other	125.503	116.359	122.604	181.26	172.066	423.196	785.808
Jobs by economic sector - pipeline	83.732	81.814	67.896	51.967	36.671	21.431	39.273
Jobs by economic sector - professional	482.023	476.275	427.146	558.287	573.442	2180.7	4081.5
Jobs by economic sector - trade	413.809	359.475	317.282	376.183	364.327	1221.1	2325
Jobs by economic sector - utilities	1085.2	1300.2	1156.5	1570.7	1840.5	5242.3	8745.7
Jobs by resource sector - Biomass	13.657	16.301	21.263	8.395	6.883	6.129	5.334
Jobs by resource sector - CO2	0	0	0	0	0	0	224.019
Jobs by resource sector - Coal	188.013	60.274	0	0	0	0	0
Jobs by resource sector - Grid	981.199	1544.5	1578.2	2443.6	2814.6	10087.8	16956.2
Jobs by resource sector - Natural Gas	1272.6	1224.4	934.256	897.562	1048.2	700.74	712.506
Jobs by resource sector - Nuclear	0	0	0	0	0	0	0
Jobs by resource sector - Oil	705.912	582.541	435.431	274.791	147.439	58.845	0
Jobs by resource sector - Solar	1363.2	1776.9	2924.2	3212.3	2307.9	2259	2348.8
Jobs by resource sector - Wind	1.895	4.99	99.534	76.999	235.66	3040.2	5903.8
Median wages - All	63847.8	64184.6	63423	64500.9	66169	68740.4	70481.8
Required Level of Education - Associates degree or some college	1443	1677.5	1926.1	2243.7	2150.5	5289.7	8572.1
Required Level of Education - Bachelors degree	925.037	1048.8	1188.1	1347.9	1270.6	3178.2	5187.5
Required Level of Education - Doctoral degree	28.907	29.237	28.496	33.779	32.708	102.373	183.017
Required Level of Education - High school diploma or less	1913.4	2216.3	2596.8	2992.7	2820.5	6800.8	10887.3
Required Level of Education - Masters or professional degree	216.219	238.031	253.339	295.394	286.386	781.537	1320.8
Wage income - All	289029707	334411387	380108759	445964581	434139661	1110426502	1843313231

Table 11: *E- scenario - PILLAR 6: Land carbon sinks - Agriculture*

variable_name	2050
Carbon sink enhancement potential - Accelerate regeneration	12.144
Carbon sink enhancement potential - All (not counting overlap)	1482.128
Carbon sink enhancement potential - Avoid deforestation	325.625
Carbon sink enhancement potential - corn-ethanol to energy grasses	0
Carbon sink enhancement potential - cropland measures	-369.743
Carbon sink enhancement potential - Extend rotation length	340.449
Carbon sink enhancement potential - Improve plantations	47.701
Carbon sink enhancement potential - Increase retention of HWP	346.949
Carbon sink enhancement potential - Increase trees outside forests	139.849
Carbon sink enhancement potential - permanent conservation cover	-9.651
Carbon sink enhancement potential - Reforest cropland	9.456

Table 11: *E- scenario - PILLAR 6: Land carbon sinks - Agriculture (continued)*

variable_name	2050
Carbon sink enhancement potential - Reforest pasture	132.157
Carbon sink enhancement potential - Restore productivity	127.797
Carbon sink enhancement potential - total	-379.395
Land impacted for carbon sink enhancement - Accelerate regeneration	4.894
Land impacted for carbon sink enhancement - All (not counting overlap)	262.581
Land impacted for carbon sink enhancement - Avoid deforestation	87.41
Land impacted for carbon sink enhancement - corn-ethanol to energy grasses	0
Land impacted for carbon sink enhancement - cropland measures	260.09
Land impacted for carbon sink enhancement - Extend rotation length	187.547
Land impacted for carbon sink enhancement - Improve plantations	26.512
Land impacted for carbon sink enhancement - Increase retention of HWP	69.39
Land impacted for carbon sink enhancement - Increase trees outside forests	39.45
Land impacted for carbon sink enhancement - permanent conservation cover	17.554
Land impacted for carbon sink enhancement - Reforest cropland	3.149
Land impacted for carbon sink enhancement - Reforest pasture	9.993
Land impacted for carbon sink enhancement - Restore productivity	72.118
Land impacted for carbon sink enhancement - total	277.643
Land impacted for carbon sink enhancement - Total impacted (over 30 years)	237.88

Table 12: *E- scenario - PILLAR 6: Land carbon sinks - Forests*

variable_name	2050
Business-as-usual carbon sink - Accelerate regeneration	1.135
Business-as-usual carbon sink - Avoid deforestation	27.845
Business-as-usual carbon sink - Extend rotation length	102.601
Business-as-usual carbon sink - Improve plantations	10.068
Business-as-usual carbon sink - Increase retention of HWP	0
Business-as-usual carbon sink - Increase trees outside forests	7.932
Business-as-usual carbon sink - Reforest cropland	0.357
Business-as-usual carbon sink - Reforest pasture	2.441
Business-as-usual carbon sink - Restore productivity	25.387
Business-as-usual carbon sink - Total impacted (over 30 years)	0.357

Table 13: *E- scenario - IMPACTS - Fossil fuel industries*

variable_name	2020	2025	2030	2035	2040	2045	2050
Natural gas consumption	72850.4	73932.3	62320.7	49983.8	37627.1	23673.7	16419.4
Oil consumption	14481.4	13103.5	10673.6	7296	4214.9	1800.8	0.002

Table 14: *E- scenario - PILLAR 1: Efficiency/Electrification - Overview*

variable_name	2020	2025	2030	2035	2040	2045	2050
Final energy demand by sector - commercial	0.03	0.03	0.028	0.026	0.025	0.024	0.025
Final energy demand by sector - industry	0.016	0.016	0.017	0.017	0.017	0.017	0.018
Final energy demand by sector - residential	0.042	0.039	0.036	0.031	0.028	0.025	0.024
Final energy demand by sector - transportation	0.081	0.076	0.067	0.056	0.046	0.04	0.037

Table 15: *E- scenario - PILLAR 1: Efficiency/Electrification - Commercial*

variable_name	2020	2025	2030	2035	2040	2045	2050
Commercial HVAC investment in 2020s - Cumulative 5-yr	0	3471963328	3882916912	0	0	0	0
Sales of cooking units - Electric Resistance	0.32	0.46	0.799	0.865	0.869	0.869	0.869
Sales of cooking units - Gas	0.68	0.54	0.201	0.135	0.131	0.131	0.131
Sales of space heating units - Electric Heat Pump	0.015	0.282	0.706	0.837	0.85	0.851	0.851
Sales of space heating units - Electric Resistance	0.019	0.084	0.106	0.127	0.131	0.131	0.131
Sales of space heating units - Fossil	0.122	0.042	0.008	0	0	0	0
Sales of space heating units - Gas Furnace	0.843	0.592	0.18	0.035	0.019	0.019	0.018
Sales of water heating units - Electric Heat Pump	0.001	0.105	0.546	0.644	0.649	0.649	0.649
Sales of water heating units - Electric Resistance	0.02	0.108	0.283	0.322	0.324	0.324	0.324
Sales of water heating units - Gas Furnace	0.933	0.745	0.141	0.006	0	0	0
Sales of water heating units - Other	0.047	0.043	0.03	0.027	0.027	0.027	0.027

Table 16: *E- scenario - PILLAR 1: Efficiency/Electrification - Electricity demand*

variable_name	2025	2030	2035	2040	2045	2050
Electricity distribution peak load (capital invested) - Cumulative 5-yr	0.526	0.536	0.919	0.973	0.907	0.947

Table 17: *RE- scenario - PILLAR 1: Efficiency/Electrification - Residential*

variable_name	2020	2025	2030	2035	2040	2045	2050
Residential HVAC investment in 2020s vs. REF - Cumulative 5-yr	0	0.756	0.716	0	0	0	0
Sale of space heating units by type - Electric Heat Pump	0.111	0.379	0.391	0.403	0.412	0.419	0.429
Sale of space heating units by type - Electric Resistance	0.104	0.099	0.097	0.094	0.09	0.084	0.073
Sale of space heating units by type - Fossil	0.212	0.213	0.118	0.075	0.072	0.072	0.072
Sale of space heating units by type - Gas	0.573	0.309	0.394	0.427	0.426	0.426	0.426
Sales of cooking units - Electric Resistance	0.494	0.494	0.494	0.494	0.494	0.494	0.494
Sales of cooking units - Gas	0.506	0.506	0.506	0.506	0.506	0.506	0.506
Sales of water heating units by type - Electric Heat Pump	0	0	0	0	0	0	0
Sales of water heating units by type - Electric Resistance	0.302	0.472	0.472	0.471	0.47	0.47	0.469
Sales of water heating units by type - Gas Furnace	0.652	0.491	0.492	0.492	0.493	0.494	0.494
Sales of water heating units by type - Other	0.046	0.036	0.036	0.037	0.037	0.037	0.037

Table 18: *RE- scenario - PILLAR 1: Efficiency/Electrification - Transportation*

variable_name	2020	2025	2030	2035	2040	2045	2050
End-use technology sales by technology - HDV - diesel	0.981	0.982	0.979	0.97	0.956	0.935	0.916
End-use technology sales by technology - HDV - EV	0	0	0	0	0	0	0
End-use technology sales by technology - HDV - gasoline	0.002	0.002	0.003	0.003	0.003	0.003	0.003
End-use technology sales by technology - HDV - hybrid	0.001	0.001	0.001	0.001	0.002	0.002	0.002
End-use technology sales by technology - HDV - hydrogen FC	0.001	0.001	0.002	0.002	0.002	0.002	0.003
End-use technology sales by technology - HDV - other	0.015	0.013	0.016	0.024	0.037	0.057	0.076
End-use technology sales by technology - LDV - diesel	0.014	0.019	0.022	0.02	0.018	0.017	0.016
End-use technology sales by technology - LDV - EV	0.04	0.061	0.069	0.085	0.103	0.119	0.131
End-use technology sales by technology - LDV - gasoline	0.896	0.859	0.836	0.816	0.795	0.775	0.76
End-use technology sales by technology - LDV - hybrid	0.048	0.057	0.069	0.074	0.08	0.085	0.089
End-use technology sales by technology - LDV - hydrogen FC	0.001	0.004	0.003	0.003	0.003	0.003	0.003
End-use technology sales by technology - LDV - other	0.001	0.001	0.001	0.001	0.001	0.001	0.001
End-use technology sales by technology - MDV - diesel	0.652	0.635	0.616	0.596	0.58	0.565	0.552
End-use technology sales by technology - MDV - EV	0	0.001	0.003	0.007	0.009	0.01	0.01
End-use technology sales by technology - MDV - gasoline	0.34	0.355	0.37	0.385	0.397	0.408	0.417
End-use technology sales by technology - MDV - hybrid	0.004	0.004	0.005	0.006	0.007	0.008	0.009
End-use technology sales by technology - MDV - hydrogen FC	0.002	0.002	0.002	0.003	0.003	0.004	0.005
End-use technology sales by technology - MDV - other	0.003	0.003	0.003	0.003	0.004	0.005	0.007

Table 19: *RE- scenario - PILLAR 6: Land carbon sinks - Agriculture*

variable_name	2020	2030	2050
Carbon sink enhancement potential - Accelerate regeneration	0	0	12.144
Carbon sink enhancement potential - All (not counting overlap)	0	0	1482.128
Carbon sink enhancement potential - Avoid deforestation	0	0	325.625
Carbon sink enhancement potential - Extend rotation length	0	0	340.449
Carbon sink enhancement potential - Improve plantations	0	0	47.701
Carbon sink enhancement potential - Increase retention of HWP	0	0	346.949
Carbon sink enhancement potential - Increase trees outside forests	0	0	139.849
Carbon sink enhancement potential - Reforest cropland	0	0	9.456
Carbon sink enhancement potential - Reforest pasture	0	0	132.157
Carbon sink enhancement potential - Restore productivity	0	0	127.797
Land impacted for carbon sink enhancement - Accelerate regeneration	0	0	4.894
Land impacted for carbon sink enhancement - All (not counting overlap)	0	0	262.581
Land impacted for carbon sink enhancement - Avoid deforestation	0	0	87.41
Land impacted for carbon sink enhancement - Extend rotation length	0	0	187.547
Land impacted for carbon sink enhancement - Improve plantations	0	0	26.512
Land impacted for carbon sink enhancement - Increase retention of HWP	0	0	69.39
Land impacted for carbon sink enhancement - Increase trees outside forests	0	0	39.45
Land impacted for carbon sink enhancement - Natural uptake	-0.69	-0.314	-0.281
Land impacted for carbon sink enhancement - Reforest cropland	0	0	3.149
Land impacted for carbon sink enhancement - Reforest pasture	0	0	9.993
Land impacted for carbon sink enhancement - Restore productivity	0	0	72.118
Land impacted for carbon sink enhancement - Retained in Hardwood Products	-0.057	-0.102	-0.106
Land impacted for carbon sink enhancement - Total	-0.747	-0.416	-0.387
Land impacted for carbon sink enhancement - Total impacted (over 30 years)	0	0	237.88

Table 20: *RE- scenario - PILLAR 6: Land carbon sinks - Forests*

variable_name	2050
Business-as-usual carbon sink - Accelerate regeneration	1.135
Business-as-usual carbon sink - Avoid deforestation	27.845
Business-as-usual carbon sink - Extend rotation length	102.601
Business-as-usual carbon sink - Improve plantations	10.068

Table 20: *RE- scenario - PILLAR 6: Land carbon sinks - Forests (continued)*

variable_name	2050
Business-as-usual carbon sink - Increase retention of HWP	0
Business-as-usual carbon sink - Increase trees outside forests	7.932
Business-as-usual carbon sink - Reforest cropland	0.357
Business-as-usual carbon sink - Reforest pasture	2.441
Business-as-usual carbon sink - Restore productivity	25.387
Business-as-usual carbon sink - Total impacted (over 30 years)	0.357

Table 21: *RE- scenario - PILLAR 1: Efficiency/Electrification - Overview*

variable_name	2020	2025	2030	2035	2040	2045	2050
Final energy demand by sector - commercial	0.03	0.03	0.031	0.031	0.031	0.032	0.033
Final energy demand by sector - industry	0.016	0.017	0.018	0.019	0.02	0.021	0.023
Final energy demand by sector - residential	0.042	0.039	0.039	0.039	0.039	0.04	0.041
Final energy demand by sector - transportation	0.081	0.076	0.07	0.067	0.067	0.068	0.071

Table 22: *RE- scenario - PILLAR 1: Efficiency/Electrification - Commercial*

variable_name	2020	2025	2030	2035	2040	2045	2050
Commercial HVAC investment in 2020s - Cumulative 5-yr	0	3420869957	3557606777	0	0	0	0
Sales of cooking units - Electric Resistance	0.32	0.343	0.343	0.343	0.344	0.343	0.343
Sales of cooking units - Gas	0.68	0.657	0.657	0.657	0.656	0.657	0.657
Sales of space heating units - Electric Heat Pump	0.015	0.241	0.485	0.684	0.717	0.721	0.721
Sales of space heating units - Electric Resistance	0.019	0.088	0.128	0.201	0.252	0.259	0.26
Sales of space heating units - Fossil	0.122	0.048	0.035	0.015	0.002	0	0
Sales of space heating units - Gas Furnace	0.843	0.624	0.352	0.099	0.028	0.019	0.018
Sales of water heating units - Electric Heat Pump	0.001	0.003	0.003	0.003	0.003	0.003	0.003
Sales of water heating units - Electric Resistance	0.02	0.067	0.066	0.066	0.067	0.066	0.067
Sales of water heating units - Gas Furnace	0.933	0.885	0.885	0.886	0.885	0.885	0.885
Sales of water heating units - Other	0.047	0.045	0.046	0.045	0.046	0.046	0.045

Table 23: *RE- scenario - PILLAR 1: Efficiency/Electrification - Electricity demand*

variable_name	2025	2030	2035	2040	2045	2050
Electricity distribution peak load (capital invested) - Cumulative 5-yr	0.488	0.492	0.647	0.67	0.83	0.869

Table 24: *REF scenario - PILLAR 1: Efficiency/Electrification - Residential*

variable_name	2020	2025	2030	2035	2040	2045	2050
Residential HVAC investment in 2020s vs. REF - Cumulative 5-yr	0	0.769	0.798	0	0	0	0
Sale of space heating units by type - Electric Heat Pump	0.143	0.229	0.283	0.44	0.68	0.837	0.891
Sale of space heating units by type - Electric Resistance	0.099	0.12	0.112	0.091	0.059	0.039	0.033
Sale of space heating units by type - Fossil	0.205	0.299	0.278	0.215	0.118	0.055	0.033
Sale of space heating units by type - Gas	0.553	0.352	0.326	0.254	0.142	0.069	0.043
Sales of cooking units - Electric Resistance	0.499	0.512	0.558	0.679	0.847	0.951	0.987
Sales of cooking units - Gas	0.501	0.488	0.442	0.321	0.153	0.049	0.013
Sales of water heating units by type - Electric Heat Pump	0	0.016	0.062	0.195	0.399	0.532	0.578
Sales of water heating units by type - Electric Resistance	0.302	0.47	0.463	0.444	0.416	0.398	0.391
Sales of water heating units by type - Gas Furnace	0.652	0.478	0.44	0.33	0.162	0.052	0.013
Sales of water heating units by type - Other	0.046	0.036	0.034	0.03	0.023	0.019	0.018

Table 25: *REF scenario - PILLAR 1: Efficiency/Electrification - Transportation*

variable_name	2020	2025	2030	2035	2040	2045	2050
End-use technology sales by technology - HDV - diesel	0.974	0.96	0.913	0.798	0.582	0.321	0.137
End-use technology sales by technology - HDV - EV	0.005	0.015	0.041	0.108	0.236	0.394	0.51
End-use technology sales by technology - HDV - gasoline	0.002	0.002	0.002	0.002	0.002	0.001	0.001
End-use technology sales by technology - HDV - hybrid	0.001	0.001	0.001	0.001	0.001	0.001	0
End-use technology sales by technology - HDV - hydrogen FC	0.003	0.01	0.027	0.072	0.157	0.263	0.34
End-use technology sales by technology - HDV - other	0.015	0.013	0.015	0.019	0.022	0.02	0.011
End-use technology sales by technology - LDV - diesel	0.014	0.019	0.02	0.016	0.01	0.005	0.002
End-use technology sales by technology - LDV - EV	0.02	0.05	0.125	0.268	0.494	0.727	0.878
End-use technology sales by technology - LDV - gasoline	0.913	0.869	0.786	0.654	0.45	0.241	0.107
End-use technology sales by technology - LDV - hybrid	0.05	0.058	0.064	0.058	0.043	0.025	0.012
End-use technology sales by technology - LDV - hydrogen FC	0.001	0.004	0.003	0.002	0.002	0.001	0
End-use technology sales by technology - LDV - other	0.001	0.001	0.001	0.001	0.001	0	0
End-use technology sales by technology - MDV - diesel	0.648	0.622	0.577	0.494	0.356	0.196	0.084
End-use technology sales by technology - MDV - EV	0.007	0.019	0.055	0.143	0.314	0.526	0.68
End-use technology sales by technology - MDV - gasoline	0.338	0.347	0.347	0.319	0.244	0.142	0.063
End-use technology sales by technology - MDV - hybrid	0.004	0.004	0.005	0.005	0.004	0.003	0.001
End-use technology sales by technology - MDV - hydrogen FC	0.002	0.005	0.014	0.036	0.079	0.132	0.17
End-use technology sales by technology - MDV - other	0.003	0.003	0.003	0.003	0.003	0.002	0.001
Light-duty vehicle capital costs - Cumulative 5-yr	0	0	31323780	65748363	222099161	698690379	1017989060
Number of public EV charging plugs - DC Fast Charging	65	0	100.472	0	527.11	0	1471.3
Number of public EV charging plugs - L2 Charging	118	0	2418.8	0	12689.9	0	35421.6

Table 26: *REF scenario - PILLAR 6: Land carbon sinks - Agriculture*

variable_name	2050
Carbon sink enhancement potential - Accelerate regeneration	12.144
Carbon sink enhancement potential - All (not counting overlap)	1482.128
Carbon sink enhancement potential - Avoid deforestation	325.625
Carbon sink enhancement potential - corn-ethanol to energy grasses	0
Carbon sink enhancement potential - cropland measures	-369.743
Carbon sink enhancement potential - Extend rotation length	340.449
Carbon sink enhancement potential - Improve plantations	47.701
Carbon sink enhancement potential - Increase retention of HWP	346.949
Carbon sink enhancement potential - Increase trees outside forests	139.849
Carbon sink enhancement potential - permanent conservation cover	-9.651
Carbon sink enhancement potential - Reforest cropland	9.456
Carbon sink enhancement potential - Reforest pasture	132.157
Carbon sink enhancement potential - Restore productivity	127.797
Carbon sink enhancement potential - total	-379.395
Land impacted for carbon sink enhancement - Accelerate regeneration	4.894
Land impacted for carbon sink enhancement - All (not counting overlap)	262.581
Land impacted for carbon sink enhancement - Avoid deforestation	87.41
Land impacted for carbon sink enhancement - corn-ethanol to energy grasses	0
Land impacted for carbon sink enhancement - cropland measures	260.09
Land impacted for carbon sink enhancement - Extend rotation length	187.547
Land impacted for carbon sink enhancement - Improve plantations	26.512
Land impacted for carbon sink enhancement - Increase retention of HWP	69.39
Land impacted for carbon sink enhancement - Increase trees outside forests	39.45
Land impacted for carbon sink enhancement - permanent conservation cover	17.554
Land impacted for carbon sink enhancement - Reforest cropland	3.149
Land impacted for carbon sink enhancement - Reforest pasture	9.993
Land impacted for carbon sink enhancement - Restore productivity	72.118
Land impacted for carbon sink enhancement - total	277.643
Land impacted for carbon sink enhancement - Total impacted (over 30 years)	237.88

Table 27: *REF scenario - PILLAR 6: Land carbon sinks - Forests*

variable_name	2050
Business-as-usual carbon sink - Accelerate regeneration	1.135
Business-as-usual carbon sink - Avoid deforestation	27.845
Business-as-usual carbon sink - Extend rotation length	102.601
Business-as-usual carbon sink - Improve plantations	10.068
Business-as-usual carbon sink - Increase retention of HWP	0
Business-as-usual carbon sink - Increase trees outside forests	7.932
Business-as-usual carbon sink - Reforest cropland	0.357
Business-as-usual carbon sink - Reforest pasture	2.441
Business-as-usual carbon sink - Restore productivity	25.387
Business-as-usual carbon sink - Total impacted (over 30 years)	0.357

Table 28: *REF scenario - PILLAR 1: Efficiency/Electrification - Overview*

variable_name	2020	2025	2030	2035	2040	2045	2050
Final energy demand by sector - commercial	0.03	0.03	0.029	0.029	0.028	0.027	0.026
Final energy demand by sector - industry	0.016	0.016	0.017	0.017	0.018	0.018	0.018
Final energy demand by sector - residential	0.042	0.039	0.038	0.037	0.035	0.032	0.029
Final energy demand by sector - transportation	0.082	0.076	0.07	0.065	0.061	0.056	0.05

Table 29: *REF scenario - PILLAR 1: Efficiency/Electrification - Commercial*

variable_name	2020	2025	2030	2035	2040	2045	2050
Commercial HVAC investment in 2020s - Cumulative 5-yr	0	3468127347	3852494617	0	0	0	0
Sales of cooking units - Electric Resistance	0.32	0.362	0.409	0.534	0.71	0.817	0.855
Sales of cooking units - Gas	0.68	0.638	0.591	0.466	0.29	0.183	0.145
Sales of space heating units - Electric Heat Pump	0.015	0.201	0.249	0.389	0.611	0.768	0.828
Sales of space heating units - Electric Resistance	0.019	0.081	0.083	0.092	0.106	0.12	0.128
Sales of space heating units - Fossil	0.122	0.049	0.046	0.035	0.017	0.005	0.001
Sales of space heating units - Gas Furnace	0.843	0.669	0.622	0.484	0.266	0.107	0.043
Sales of water heating units - Electric Heat Pump	0.001	0.02	0.07	0.215	0.436	0.581	0.631
Sales of water heating units - Electric Resistance	0.02	0.074	0.093	0.151	0.24	0.297	0.317
Sales of water heating units - Gas Furnace	0.933	0.861	0.792	0.595	0.291	0.093	0.024
Sales of water heating units - Other	0.047	0.045	0.044	0.039	0.033	0.029	0.028

Table 30: *REF scenario - PILLAR 1: Efficiency/Electrification - Electricity demand*

variable_name	2025	2030	2035	2040	2045	2050
Electricity distribution peak load (capital invested) - Cumulative 5-yr	0.457	0.458	0.597	0.614	0.89	0.939

Table 31: *E+ scenario - PILLAR 2: Clean Electricity - Generating capacity*

variable_name	2025	2030	2035	2040	2045	2050
Power generation capital investment - Offshore Wind - Base	0	0	0	3.881	7.843	1.016
Power generation capital investment - Solar PV - Base	0	0.242	0	0	0	2.911
Power generation capital investment - Wind - Base	0	0	0	0	0	0.246

Table 32: *E+ scenario - PILLAR 2: Clean Electricity - Transmission*

variable_name	2020	2025	2030	2035	2040	2045	2050
HV transmission for wind and solar - base all	0	90.58	154.02	317.55	3913.8	19972.9	23685.9
HV transmission for wind and solar - base other intra-state	0	36.709	63.811	138.746	1301.9	3086.1	3640.1
HV transmission for wind and solar - base spur intra-state	0	0.059	23.348	23.348	365.826	1234.1	1621.6

Table 33: *E+ scenario - PILLAR 6: Land carbon sinks - Agriculture*

variable_name	2050
Carbon sink enhancement potential - Accelerate regeneration	12.144
Carbon sink enhancement potential - All (not counting overlap)	1482.128
Carbon sink enhancement potential - Avoid deforestation	325.625
Carbon sink enhancement potential - corn-ethanol to energy grasses	0
Carbon sink enhancement potential - cropland measures	-369.743
Carbon sink enhancement potential - Extend rotation length	340.449
Carbon sink enhancement potential - Improve plantations	47.701
Carbon sink enhancement potential - Increase retention of HWP	346.949
Carbon sink enhancement potential - Increase trees outside forests	139.849
Carbon sink enhancement potential - permanent conservation cover	-9.651
Carbon sink enhancement potential - Reforest cropland	9.456
Carbon sink enhancement potential - Reforest pasture	132.157
Carbon sink enhancement potential - Restore productivity	127.797
Carbon sink enhancement potential - total	-379.395
Land impacted for carbon sink enhancement - Accelerate regeneration	4.894
Land impacted for carbon sink enhancement - All (not counting overlap)	262.581
Land impacted for carbon sink enhancement - Avoid deforestation	87.41
Land impacted for carbon sink enhancement - corn-ethanol to energy grasses	0
Land impacted for carbon sink enhancement - cropland measures	260.09
Land impacted for carbon sink enhancement - Extend rotation length	187.547
Land impacted for carbon sink enhancement - Improve plantations	26.512
Land impacted for carbon sink enhancement - Increase retention of HWP	69.39
Land impacted for carbon sink enhancement - Increase trees outside forests	39.45
Land impacted for carbon sink enhancement - permanent conservation cover	17.554
Land impacted for carbon sink enhancement - Reforest cropland	3.149
Land impacted for carbon sink enhancement - Reforest pasture	9.993
Land impacted for carbon sink enhancement - Restore productivity	72.118
Land impacted for carbon sink enhancement - total	277.643
Land impacted for carbon sink enhancement - Total impacted (over 30 years)	237.88

Table 34: *E+ scenario - PILLAR 6: Land carbon sinks - Forests*

variable_name	2050
Business-as-usual carbon sink - Accelerate regeneration	1.135
Business-as-usual carbon sink - Avoid deforestation	27.845
Business-as-usual carbon sink - Extend rotation length	102.601
Business-as-usual carbon sink - Improve plantations	10.068
Business-as-usual carbon sink - Increase retention of HWP	0
Business-as-usual carbon sink - Increase trees outside forests	7.932
Business-as-usual carbon sink - Reforest cropland	0.357
Business-as-usual carbon sink - Reforest pasture	2.441
Business-as-usual carbon sink - Restore productivity	25.387
Business-as-usual carbon sink - Total impacted (over 30 years)	0.357

Table 35: *RE+ scenario - PILLAR 2: Clean Electricity - Generating capacity*

variable_name	2020	2025	2030	2035	2040	2045	2050
Power generation capital investment - biomass power plant	0	0	0	0	0	0	0
Power generation capital investment - biomass w/ccu allam power plant	0	0	0	0	0	0	0
Power generation capital investment - biomass w/ccu power plant	0	0	0	0	0	0	0

Table 36: *RE+ scenario - PILLAR 2: Clean Electricity - Generation*

variable_name	2020	2025	2030	2035	2040	2045	2050
Power generation by technology - biomass power plant	0	0	0	0	0	0	0
Power generation by technology - biomass w/ccu allam power plant	0	0	0	0	0	0	0
Power generation by technology - biomass w/ccu power plant	0	0	0	0	0	0	0

Table 37: *RE+ scenario - PILLAR 3: Bioenergy and Hydrogen - Bioconversion*

variable_name	2020	2025	2030	2035	2040	2045	2050
Biomass purchases	0	0	0	0	0	0	0.065
Capital investment	0	0	0	0	0	0	0.728
Number of facilities - allam power w ccu	0	0	0	0	0	0	0
Number of facilities - beccs hydrogen	0	0	0	0	0	0	0
Number of facilities - diesel	0	0	0	0	0	0	0
Number of facilities - diesel ccu	0	0	0	0	0	0	0
Number of facilities - power	0	0	0	0	0	0	0
Number of facilities - power ccu	0	0	0	0	0	0	0
Number of facilities - pyrolysis	0	0	0	0	0	0	1
Number of facilities - pyrolysis ccu	0	0	0	0	0	0	0
Number of facilities - sng	0	0	0	0	0	0	0
Number of facilities - sng ccu	0	0	0	0	0	0	0

Table 38: *RE+ scenario - PILLAR 4: CO2 capture, use, storage - CO2 capture*

variable_name	2025	2030	2035	2040	2045	2050
Annual - All	0	0	0	0	0	0
Annual - BECCS	0	0	0	0	0	0
Annual - Cement	0	0	0	0	0	0
Annual - NGCC	0	0	0	0	0	0
Cumulative - All	0	0	0	0	0	0
Cumulative - BECCS	0	0	0	0	0	0
Cumulative - Cement	0	0	0	0	0	0
Cumulative - NGCC	0	0	0	0	0	0

Table 39: *RE+ scenario - PILLAR 4: CO2 capture, use, storage - CO2 storage*

variable_name	2025	2030	2035	2040	2045	2050
Annual	0	0	0	0	0	0
Injection wells	0	0	0	0	0	0
Resource characterization, appraisal and permitting costs cumulative	0	0	0	0	0	0
Wells and facilities construction costs cumulative	0	0	0	0	0	0

Table 40: *RE+ scenario - PILLAR 4: CO2 capture, use, storage - CO2 transportation*

variable_name	2025	2030	2035	2040	2045	2050
CO2 pipelines - All	0	0	0	0	0	0
CO2 pipelines - Spur	0	0	0	0	0	0
CO2 pipelines - Trunk	0	0	0	0	0	0

Table 41: *RE+ scenario - PILLAR 6: Land carbon sinks - Agriculture*

variable_name	2050
Carbon sink enhancement potential - Accelerate regeneration	12.144
Carbon sink enhancement potential - All (not counting overlap)	1482.128
Carbon sink enhancement potential - Avoid deforestation	325.625
Carbon sink enhancement potential - corn-ethanol to energy grasses	-51.874
Carbon sink enhancement potential - cropland measures	-341.547
Carbon sink enhancement potential - Cropland to woody energy crops	0
Carbon sink enhancement potential - Extend rotation length	340.449
Carbon sink enhancement potential - Improve plantations	47.701
Carbon sink enhancement potential - Increase retention of HWP	346.949
Carbon sink enhancement potential - Increase trees outside forests	139.849
Carbon sink enhancement potential - pasture to energy crops	0
Carbon sink enhancement potential - permanent conservation cover	-8.41
Carbon sink enhancement potential - Reforest cropland	9.456
Carbon sink enhancement potential - Reforest pasture	132.157
Carbon sink enhancement potential - Restore productivity	127.797

Table 41: *RE+ scenario - PILLAR 6: Land carbon sinks - Agriculture (continued)*

variable_name	2050
Carbon sink enhancement potential - total	-401.832
Land impacted for carbon sink enhancement - Accelerate regeneration	4.894
Land impacted for carbon sink enhancement - All (not counting overlap)	262.581
Land impacted for carbon sink enhancement - Avoid deforestation	87.41
Land impacted for carbon sink enhancement - corn-ethanol to energy grasses	27.626
Land impacted for carbon sink enhancement - cropland measures	471.368
Land impacted for carbon sink enhancement - Cropland to woody energy crops	6.15
Land impacted for carbon sink enhancement - Extend rotation length	187.547
Land impacted for carbon sink enhancement - Improve plantations	26.512
Land impacted for carbon sink enhancement - Increase retention of HWP	69.39
Land impacted for carbon sink enhancement - Increase trees outside forests	39.45
Land impacted for carbon sink enhancement - pasture to energy crops	0.28
Land impacted for carbon sink enhancement - permanent conservation cover	15.297
Land impacted for carbon sink enhancement - Reforest cropland	3.149
Land impacted for carbon sink enhancement - Reforest pasture	9.993
Land impacted for carbon sink enhancement - Restore productivity	72.118
Land impacted for carbon sink enhancement - total	520.719
Land impacted for carbon sink enhancement - Total impacted (over 30 years)	237.88

Table 42: *RE+ scenario - PILLAR 6: Land carbon sinks - Forests*

variable_name	2050
Business-as-usual carbon sink - Accelerate regeneration	1.135
Business-as-usual carbon sink - Avoid deforestation	27.845
Business-as-usual carbon sink - Extend rotation length	102.601
Business-as-usual carbon sink - Improve plantations	10.068
Business-as-usual carbon sink - Increase retention of HWP	0
Business-as-usual carbon sink - Increase trees outside forests	7.932
Business-as-usual carbon sink - Reforest cropland	0.357
Business-as-usual carbon sink - Reforest pasture	2.441
Business-as-usual carbon sink - Restore productivity	25.387
Business-as-usual carbon sink - Total impacted (over 30 years)	0.357

Table 43: *B+ scenario - PILLAR 6: Land carbon sinks - Agriculture*

variable_name	2050
Carbon sink enhancement potential - Accelerate regeneration	12.144
Carbon sink enhancement potential - All (not counting overlap)	1482.128
Carbon sink enhancement potential - Avoid deforestation	325.625
Carbon sink enhancement potential - corn-ethanol to energy grasses	0
Carbon sink enhancement potential - cropland measures	-369.743
Carbon sink enhancement potential - Extend rotation length	340.449
Carbon sink enhancement potential - Improve plantations	47.701
Carbon sink enhancement potential - Increase retention of HWP	346.949
Carbon sink enhancement potential - Increase trees outside forests	139.849
Carbon sink enhancement potential - permanent conservation cover	-9.651
Carbon sink enhancement potential - Reforest cropland	9.456
Carbon sink enhancement potential - Reforest pasture	132.157
Carbon sink enhancement potential - Restore productivity	127.797
Carbon sink enhancement potential - total	-379.395
Land impacted for carbon sink enhancement - Accelerate regeneration	4.894
Land impacted for carbon sink enhancement - All (not counting overlap)	262.581
Land impacted for carbon sink enhancement - Avoid deforestation	87.41
Land impacted for carbon sink enhancement - corn-ethanol to energy grasses	0
Land impacted for carbon sink enhancement - cropland measures	260.09
Land impacted for carbon sink enhancement - Extend rotation length	187.547
Land impacted for carbon sink enhancement - Improve plantations	26.512
Land impacted for carbon sink enhancement - Increase retention of HWP	69.39
Land impacted for carbon sink enhancement - Increase trees outside forests	39.45
Land impacted for carbon sink enhancement - permanent conservation cover	17.554

Table 43: *B+ scenario - PILLAR 6: Land carbon sinks - Agriculture (continued)*

variable_name	2050
Land impacted for carbon sink enhancement - Reforest cropland	3.149
Land impacted for carbon sink enhancement - Reforest pasture	9.993
Land impacted for carbon sink enhancement - Restore productivity	72.118
Land impacted for carbon sink enhancement - total	277.643
Land impacted for carbon sink enhancement - Total impacted (over 30 years)	237.88

Table 44: *B+ scenario - PILLAR 6: Land carbon sinks - Forests*

variable_name	2050
Business-as-usual carbon sink - Accelerate regeneration	1.135
Business-as-usual carbon sink - Avoid deforestation	27.845
Business-as-usual carbon sink - Extend rotation length	102.601
Business-as-usual carbon sink - Improve plantations	10.068
Business-as-usual carbon sink - Increase retention of HWP	0
Business-as-usual carbon sink - Increase trees outside forests	7.932
Business-as-usual carbon sink - Reforest cropland	0.357
Business-as-usual carbon sink - Reforest pasture	2.441
Business-as-usual carbon sink - Restore productivity	25.387
Business-as-usual carbon sink - Total impacted (over 30 years)	0.357