Net-Zero America - arkansas state report v2

Larson et al. 2020

February 2021

Reading guide

IN DRAFT

List of Tables

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	2.31	2.824	0	0	0	0
Sale of space heating units by type - Electric Heat Pump	0.119	0.272	0.743	0.848	0.853	0.852	0.852
Sale of space heating units by type - Electric Resistance	0.349	0.338	0.142	0.098	0.096	0.098	0.099
Sale of space heating units by type - Fossil	0.081	0.119	0.056	0.042	0.041	0.04	0.04
Sale of space heating units by type - Gas	0.451	0.271	0.059	0.012	0.01	0.01	0.01
Sales of cooking units - Electric Resistance	0.527	0.628	0.936	0.997	1	1	1
Sales of cooking units - Gas	0.473	0.372	0.064	0.003	0	0	0
Sales of water heating units by type - Electric Heat Pump	0	0.113	0.597	0.706	0.711	0.711	0.711
Sales of water heating units by type - Electric Resistance	0.445	0.519	0.321	0.276	0.274	0.274	0.274
Sales of water heating units by type - Gas Furnace	0.537	0.353	0.067	0.003	0	0	0
Sales of water heating units by type - Other	0.019	0.015	0.015	0.015	0.015	0.015	0.015

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	0.018	0.02	0.014	0.004	0.001	0	0
End-use technology sales by technology - LDV - EV	0.03	0.125	0.423	0.801	0.961	0.993	1
End-use technology sales by technology - LDV - gasoline	0.913	0.81	0.531	0.182	0.035	0.006	0
End-use technology sales by technology - LDV - hybrid	0.036	0.039	0.029	0.011	0.003	0.001	0
End-use technology sales by technology - LDV - hydrogen FC	0.001	0.004	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	542388314	1384113231	2252763340	3408588868	3714047982	3538830484
Number of public EV charging plugs - DC Fast Charging	43	0	1119.7	0	5006.6	0	8112.6
Number of public EV charging plugs - L2 Charging	243	0	26924.1	0	120389.9	0	195079.1

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	0.022	0	0	0.032
Power generation capital investment - biomass w/ccu power plant	0	0	0	0	4.372	0	0.029
Power generation capital investment - Solar PV - Base	0	1.145	0.219	3.295	4.235	0.151	0
Power generation capital investment - Solar PV - Constrained	0	0.354	1.185	3.581	3.106	0.641	0
Power generation capital investment - Wind - Base	0	3.48	8.289	10.507	12.806	10.515	21.189
Power generation capital investment - Wind - Constrained	0	7.969	11.863	18.658	25.454	0.59	24.79

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	21.694	21.694	21.694	53.411
Power generation by technology - biomass w/ccu power plant	0	0	0	0	4906.7	4906.7	4939.7

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	367.808	1272.4	3379.2	6425.2	8277.8	14123.2
HV transmission for wind and solar - base other intra-state	0	114.741	292.17	1162.5	2600.3	3506.4	5817.8
HV transmission for wind and solar - base spur intra-state	0	177.926	511.752	1126.5	1936.8	2442.8	3633.2
HV transmission for wind and solar - constrained all	0	1134.2	3627	8383.5	14554.9	14696.9	14702.8
HV transmission for wind and solar - constrained other intra-state	0	330.461	1675.3	3888.2	4441.3	4490.3	4490.3
HV transmission for wind and solar - constrained spur intra-state	0	322.111	868.053	1960.2	4082.1	4138.4	4141.6

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

variable_name	2020	2025	2030	2035	2040	2045	2050
Biomass purchases	0	0	0	0.075	0.368	0.809	1.006
Capital investment	0	0	0	0	7.564	0	12.234
Number of facilities - allam power w ccu	0	0	0	1	1	1	2
Number of facilities - beccs hydrogen	0	0	0	1	4	14	17
Number of facilities - diesel	0	0	0	0	0	0	0
Number of facilities - diesel ccu	0	0	0	1	1	1	2

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

variable_name	2020	2025	2030	2035	2040	2045	2050
Number of facilities - power	0	0	0	0	0	0	0
Number of facilities - power ccu	0	0	0	0	4	4	5
Number of facilities - pyrolysis	0	0	0	0	0	0	0
Number of facilities - pyrolysis ccu	0	0	0	1	1	1	2
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	1.95	9.81	21.29	26.42
Annual - BECCS	0	0	1.95	9.81	21.29	26.42
Annual - Cement	0	0	0	0	0	0
Annual - NGCC	0	0	0	0	0	0
Cumulative - All	0	0	1.95	11.76	33.05	59.47
Cumulative - BECCS	0	0	1.95	11.76	33.05	59.47
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	2.19	8.81	16.26	25.82	35.41
Injection wells	0	2	10	18	30	38
Resource characterization, appraisal and permitting costs cumulative	14.18	255.24	404.41	404.41	404.41	404.41
Wells and facilities construction costs cumulative	0	78.25	304.95	543.45	908.69	1128.2

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

variable_name	2025	2030	2035	2040	2045	2050
CO2 pipelines - All	0	244437.604	539773.159	812248.078	1335971.33	2027350.6
CO2 pipelines - Spur	0	0	50897.852	323372.771	847096.523	1538475
CO2 pipelines - Trunk	0	244437.604	488875.308	488875.308	488875.308	488875.308

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

variable_name	2020	2025	2030	2035	2040	2045	2050
Jobs by economic sector - agriculture	105.64	121.789	247.274	258.845	771.623	1312.1	1335.8
Jobs by economic sector - construction	3854.2	4895.7	6363.1	11223.3	15190.7	14823.2	20176.4
Jobs by economic sector - manufacturing	3347	5351.2	6235.3	8016.2	8218.4	7278.7	9323.6
Jobs by economic sector - mining	5485	4369.7	3273.9	2307.8	1468.9	913.225	500.557
Jobs by economic sector - other	201.299	378.115	480.591	1264.5	1955.7	1707.4	2329.7
Jobs by economic sector - pipeline	463.592	461.573	421.998	347.53	245.182	210.154	294.378
Jobs by economic sector - professional	2918.5	3305.6	4324.4	7167.2	10565.5	12168.7	16525.8
Jobs by economic sector - trade	2461.3	2328.7	2667	4130.9	5742	6200	8554.3
Jobs by economic sector - utilities	6463.2	5433.1	5851.4	9005.8	12339.1	13050.7	18470.8
Jobs by resource sector - Biomass	437.905	522.702	681.798	737.226	2322.8	4785.5	5704.4
Jobs by resource sector - CO2	0	5.509	379.247	463.496	249.123	721.438	1890.8
Jobs by resource sector - Coal	2315.7	901.415	80.848	0	0	0	0
Jobs by resource sector - Grid	6565.6	5281.8	7779.5	14354.1	20576.2	22284	32951.8
Jobs by resource sector - Natural Gas	9699.9	9323.4	7513.6	5849.7	5167.1	3424.1	1725.9
Jobs by resource sector - Nuclear	946.485	548.831	0.005	0.01	0.011	0.023	0.035
Jobs by resource sector - Oil	4064.3	3608.9	2977.1	2297	1545.6	1027	570.782
Jobs by resource sector - Solar	901.223	2981.8	2521.1	6677	8730.1	4946.4	5815.9
Jobs by resource sector - Wind	368.644	3471	7931.7	13343.5	17906.2	20475.7	28851.9
Median wages - All	53841.4	53506.8	53546.5	53429.3	54134.5	55332.4	56195.7
Required Level of Education - Associates degree or some college	7727.3	8235.3	9337.6	13898.3	17963.5	18160.1	24604
Required Level of Education - Bachelors degree	5815.8	5967.4	6480.7	9159.6	11754.6	12196.8	16367
Required Level of Education - Doctoral degree	197.03	206.101	232.855	346.208	474.486	520.971	697.684
Required Level of Education - High school diploma or less	10139	10794.9	12232.1	18039.6	23296.7	23592.6	31540.4
Required Level of Education - Masters or professional degree	1420.6	1441.8	1581.6	2278.3	3007.8	3193.7	4302.3
Wage income - All	1362218971	1425783505	1599252971	2336247696	3058771348	3191004751	4356237782

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

variable_name	2050
Carbon sink enhancement potential - Accelerate regeneration	623.318
Carbon sink enhancement potential - All (not counting overlap)	75939.4
Carbon sink enhancement potential - Avoid deforestation	2112.651
Carbon sink enhancement potential - corn-ethanol to energy grasses	-485.112
Carbon sink enhancement potential - cropland measures	-15205.306
Carbon sink enhancement potential - Extend rotation length	15612.8
Carbon sink enhancement potential - Improve plantations	5313.6
Carbon sink enhancement potential - Increase retention of HWP	23042.2
Carbon sink enhancement potential - Increase trees outside forests	1876.33
Carbon sink enhancement potential - permanent conservation cover	-97.195
Carbon sink enhancement potential - Reforest cropland	1884.082
Carbon sink enhancement potential - Reforest pasture	17725.8

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

variable_name	2050
Carbon sink enhancement potential - Restore productivity	7748.5
Carbon sink enhancement potential - total	-15787.612
Land impacted for carbon sink enhancement - Accelerate regeneration	251.221
Land impacted for carbon sink enhancement - All (not counting overlap)	13471
Land impacted for carbon sink enhancement - Avoid deforestation	567.116
Land impacted for carbon sink enhancement - corn-ethanol to energy grasses	192.758
Land impacted for carbon sink enhancement - cropland measures	4462.4
Land impacted for carbon sink enhancement - Extend rotation length	8600.8
Land impacted for carbon sink enhancement - Improve plantations	2953.193
Land impacted for carbon sink enhancement - Increase retention of HWP	4608.4
Land impacted for carbon sink enhancement - Increase trees outside forests	529.291
Land impacted for carbon sink enhancement - permanent conservation cover	176.781
Land impacted for carbon sink enhancement - Reforest cropland	627.299
Land impacted for carbon sink enhancement - Reforest pasture	1340.348
Land impacted for carbon sink enhancement - Restore productivity	4372.584
Land impacted for carbon sink enhancement - total	4831.9
Land impacted for carbon sink enhancement - Total impacted (over 30 years)	10379.2

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

variable_name	2050
Business-as-usual carbon sink - Accelerate regeneration	58.254
Business-as-usual carbon sink - Avoid deforestation	180.657
Business-as-usual carbon sink - Extend rotation length	4705.2
Business-as-usual carbon sink - Improve plantations	1121.5
Business-as-usual carbon sink - Increase retention of HWP	0
Business-as-usual carbon sink - Increase trees outside forests	106.418
Business-as-usual carbon sink - Reforest cropland	71.183
Business-as-usual carbon sink - Reforest pasture	327.447
Business-as-usual carbon sink - Restore productivity	1539.3
Business-as-usual carbon sink - Total impacted (over 30 years)	71.183

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

variable_name	2020	2025	2030	2035	2040	2045	2050
Natural gas consumption	275194	279281	235418.1	188815	142137.1	89427.9	62024.9
Oil consumption	58313.5	54335.8	46299.5	34604.9	23481.4	14765	7609.1

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

variable_name	2020	2025	2030	2035	2040	2045	2050
Final energy demand by sector - commercial	0.09	0.09	0.087	0.082	0.077	0.076	0.078
Final energy demand by sector - industry	0.236	0.242	0.246	0.246	0.25	0.25	0.255
Final energy demand by sector - residential	0.123	0.117	0.108	0.096	0.085	0.079	0.076
Final energy demand by sector - transportation	0.324	0.303	0.265	0.22	0.179	0.155	0.146

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	10539152483	12307476207	0	0	0	0
Sales of cooking units - Electric Resistance	0.301	0.444	0.792	0.861	0.865	0.865	0.865
Sales of cooking units - Gas	0.699	0.556	0.208	0.139	0.135	0.136	0.135
Sales of space heating units - Electric Heat Pump	0.029	0.273	0.771	0.911	0.923	0.923	0.923
Sales of space heating units - Electric Resistance	0.027	0.044	0.047	0.061	0.063	0.064	0.064
Sales of space heating units - Fossil	0	0	0	0	0	0	0
Sales of space heating units - Gas Furnace	0.943	0.683	0.182	0.028	0.014	0.013	0.013
Sales of water heating units - Electric Heat Pump	0.001	0.107	0.563	0.665	0.669	0.669	0.669
Sales of water heating units - Electric Resistance	0.023	0.081	0.269	0.311	0.313	0.313	0.313
Sales of water heating units - Gas Furnace	0.965	0.794	0.15	0.006	0	0	0
Sales of water heating units - Other	0.011	0.018	0.018	0.018	0.018	0.018	0.018

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	2.42	2.483	3.87	4.09	4.014	4.2

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	2.281	2.673	0	0	0	0
Sale of space heating units by type - Electric Heat Pump	0.119	0.181	0.235	0.39	0.626	0.78	0.833
Sale of space heating units by type - Electric Resistance	0.349	0.376	0.352	0.287	0.19	0.127	0.105
Sale of space heating units by type - Fossil	0.081	0.131	0.125	0.103	0.071	0.05	0.043
Sale of space heating units by type - Gas	0.451	0.312	0.288	0.22	0.113	0.042	0.018
Sales of cooking units - Electric Resistance	0.525	0.538	0.581	0.696	0.855	0.953	0.987
Sales of cooking units - Gas	0.475	0.462	0.419	0.304	0.145	0.047	0.013
Sales of water heating units by type - Electric Heat Pump	0	0.019	0.075	0.233	0.477	0.636	0.691
Sales of water heating units by type - Electric Resistance	0.445	0.557	0.535	0.471	0.37	0.305	0.282
Sales of water heating units by type - Gas Furnace	0.537	0.409	0.375	0.281	0.138	0.044	0.011
Sales of water heating units by type - Other	0.019	0.015	0.015	0.015	0.015	0.015	0.015

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	0.974	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	0.018	0.022	0.021	0.017	0.011	0.006	0.002
End-use technology sales by technology - LDV - EV	0.016	0.04	0.105	0.236	0.459	0.704	0.869
End-use technology sales by technology - LDV - gasoline	0.927	0.887	0.818	0.695	0.49	0.266	0.117
End-use technology sales by technology - LDV - hybrid	0.037	0.046	0.052	0.048	0.038	0.023	0.011
End-use technology sales by technology - LDV - hydrogen FC	0.001	0.004	0.003	0.003	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	86670059	184495280	620744037	1960582304	2853861576
Number of public EV charging plugs - DC Fast Charging	43	0	333.729	0	1847	0	5196.1
Number of public EV charging plugs - L2 Charging	243	0	8025	0	44413.7	0	124948.1

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

variable_name	2050
Carbon sink enhancement potential - Accelerate regeneration	623.318
Carbon sink enhancement potential - All (not counting overlap)	75939.4
Carbon sink enhancement potential - Avoid deforestation	2112.651
Carbon sink enhancement potential - corn-ethanol to energy grasses	-485.112
Carbon sink enhancement potential - cropland measures	-15205.306
Carbon sink enhancement potential - Extend rotation length	15612.8
Carbon sink enhancement potential - Improve plantations	5313.6
Carbon sink enhancement potential - Increase retention of HWP	23042.2
Carbon sink enhancement potential - Increase trees outside forests	1876.33
Carbon sink enhancement potential - permanent conservation cover	-97.195
Carbon sink enhancement potential - Reforest cropland	1884.082
Carbon sink enhancement potential - Reforest pasture	17725.8
Carbon sink enhancement potential - Restore productivity	7748.5
Carbon sink enhancement potential - total	-15787.612
Land impacted for carbon sink enhancement - Accelerate regeneration	251.221
Land impacted for carbon sink enhancement - All (not counting overlap)	13471
Land impacted for carbon sink enhancement - Avoid deforestation	567.116
Land impacted for carbon sink enhancement - corn-ethanol to energy grasses	192.758
Land impacted for carbon sink enhancement - cropland measures	4462.4
Land impacted for carbon sink enhancement - Extend rotation length	8600.8
Land impacted for carbon sink enhancement - Improve plantations	2953.193
Land impacted for carbon sink enhancement - Increase retention of HWP	4608.4
Land impacted for carbon sink enhancement - Increase trees outside forests	529.291
Land impacted for carbon sink enhancement - permanent conservation cover	176.781
Land impacted for carbon sink enhancement - Reforest cropland	627.299
Land impacted for carbon sink enhancement - Reforest pasture	1340.348
Land impacted for carbon sink enhancement - Restore productivity	4372.584
Land impacted for carbon sink enhancement - total	4831.9
Land impacted for carbon sink enhancement - Total impacted (over 30 years)	10379.2

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

variable_name	2050
Business-as-usual carbon sink - Accelerate regeneration	58.254
Business-as-usual carbon sink - Avoid deforestation	180.657
Business-as-usual carbon sink - Extend rotation length	4705.2
Business-as-usual carbon sink - Improve plantations	1121.5
Business-as-usual carbon sink - Increase retention of HWP	0
Business-as-usual carbon sink - Increase trees outside forests	106.418
Business-as-usual carbon sink - Reforest cropland	71.183
Business-as-usual carbon sink - Reforest pasture	327.447
Business-as-usual carbon sink - Restore productivity	1539.3
Business-as-usual carbon sink - Total impacted (over 30 years)	71.183

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

variable_name	2020	2025	2030	2035	2040	2045	2050
Final energy demand by sector - commercial	0.09	0.091	0.09	0.09	0.088	0.085	0.084
Final energy demand by sector - industry	0.236	0.243	0.246	0.249	0.254	0.253	0.258
Final energy demand by sector - residential	0.123	0.118	0.114	0.11	0.103	0.094	0.087
Final energy demand by sector - transportation	0.324	0.305	0.276	0.255	0.238	0.219	0.197

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	10527468879	12222551925	0	0	0	0
Sales of cooking units - Electric Resistance	0.301	0.342	0.39	0.52	0.701	0.812	0.85
Sales of cooking units - Gas	0.699	0.658	0.61	0.48	0.299	0.188	0.15
Sales of space heating units - Electric Heat Pump	0.029	0.178	0.235	0.4	0.656	0.833	0.898
Sales of space heating units - Electric Resistance	0.027	0.044	0.045	0.046	0.051	0.057	0.062
Sales of space heating units - Fossil	0	0	0	0	0	0	0
Sales of space heating units - Gas Furnace	0.943	0.778	0.72	0.554	0.293	0.11	0.04
Sales of water heating units - Electric Heat Pump	0.001	0.02	0.071	0.221	0.45	0.599	0.651
Sales of water heating units - Electric Resistance	0.023	0.044	0.066	0.127	0.222	0.284	0.305
Sales of water heating units - Gas Furnace	0.965	0.918	0.845	0.634	0.31	0.099	0.026
Sales of water heating units - Other	0.011	0.018	0.018	0.018	0.018	0.018	0.018

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	2.102	2.127	2.569	2.644	3.754	3.952

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	2.247	2.324	0	0	0	0
Sale of space heating units by type - Electric Heat Pump	0.089	0.366	0.378	0.397	0.413	0.433	0.463
Sale of space heating units by type - Electric Resistance	0.362	0.302	0.296	0.289	0.279	0.261	0.23
Sale of space heating units by type - Fossil	0.083	0.086	0.087	0.087	0.085	0.085	0.085
Sale of space heating units by type - Gas	0.465	0.245	0.238	0.228	0.223	0.221	0.222
Sales of cooking units - Electric Resistance	0.521	0.521	0.521	0.521	0.521	0.521	0.521
Sales of cooking units - Gas	0.479	0.479	0.479	0.479	0.479	0.479	0.479
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	0.445	0.565	0.566	0.566	0.565	0.565	0.565
Sales of water heating units by type - Gas Furnace	0.537	0.42	0.419	0.418	0.42	0.42	0.42
Sales of water heating units by type - Other	0.019	0.015	0.015	0.015	0.015	0.015	0.015

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	0.981	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	0.018	0.022	0.022	0.021	0.019	0.018	0.017
End-use technology sales by technology - LDV - EV	0.027	0.045	0.052	0.063	0.077	0.091	0.102
End-use technology sales by technology - LDV - gasoline	0.917	0.883	0.866	0.851	0.833	0.813	0.796
End-use technology sales by technology - LDV - hybrid	0.036	0.045	0.055	0.061	0.067	0.074	0.08
End-use technology sales by technology - LDV - hydrogen FC	0.001	0.004	0.004	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 26: *REF scenario - PILLAR 6: Land carbon sinks - Agriculture*

variable_name	2020	2030	2050
Carbon sink enhancement potential - Accelerate regeneration	0	0	623.318
Carbon sink enhancement potential - All (not counting overlap)	0	0	75939.4
Carbon sink enhancement potential - Avoid deforestation	0	0	2112.651
Carbon sink enhancement potential - Extend rotation length	0	0	15612.8
Carbon sink enhancement potential - Improve plantations	0	0	5313.6
Carbon sink enhancement potential - Increase retention of HWP	0	0	23042.2
Carbon sink enhancement potential - Increase trees outside forests	0	0	1876.33
Carbon sink enhancement potential - Reforest cropland	0	0	1884.082
Carbon sink enhancement potential - Reforest pasture	0	0	17725.8
Carbon sink enhancement potential - Restore productivity	0	0	7748.5
Land impacted for carbon sink enhancement - Accelerate regeneration	0	0	251.221
Land impacted for carbon sink enhancement - All (not counting overlap)	0	0	13471
Land impacted for carbon sink enhancement - Avoid deforestation	0	0	567.116
Land impacted for carbon sink enhancement - Extend rotation length	0	0	8600.8
Land impacted for carbon sink enhancement - Improve plantations	0	0	2953.193
Land impacted for carbon sink enhancement - Increase retention of HWP	0	0	4608.4
Land impacted for carbon sink enhancement - Increase trees outside forests	0	0	529.291
Land impacted for carbon sink enhancement - Natural uptake	-22.22	-14.649	-11.872
Land impacted for carbon sink enhancement - Reforest cropland	0	0	627.299
Land impacted for carbon sink enhancement - Reforest pasture	0	0	1340.348
Land impacted for carbon sink enhancement - Restore productivity	0	0	4372.584
Land impacted for carbon sink enhancement - Retained in Hardwood Products	-3.762	-6.274	-6.604
Land impacted for carbon sink enhancement - Total	-25.982	-20.923	-18.476
Land impacted for carbon sink enhancement - Total impacted (over 30 years)	0	0	10379.2

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

variable_name	2050
Business-as-usual carbon sink - Accelerate regeneration	58.254
Business-as-usual carbon sink - Avoid deforestation	180.657
Business-as-usual carbon sink - Extend rotation length	4705.2
Business-as-usual carbon sink - Improve plantations	1121.5
Business-as-usual carbon sink - Increase retention of HWP	0
Business-as-usual carbon sink - Increase trees outside forests	106.418
Business-as-usual carbon sink - Reforest cropland	71.183
Business-as-usual carbon sink - Reforest pasture	327.447
Business-as-usual carbon sink - Restore productivity	1539.3
Business-as-usual carbon sink - Total impacted (over 30 years)	71.183

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

variable_name	2020	2025	2030	2035	2040	2045	2050
Final energy demand by sector - commercial	0.09	0.092	0.093	0.094	0.095	0.1	0.108
Final energy demand by sector - industry	0.236	0.248	0.257	0.261	0.27	0.278	0.287
Final energy demand by sector - residential	0.123	0.117	0.115	0.115	0.116	0.119	0.121
Final energy demand by sector - transportation	0.324	0.305	0.279	0.263	0.263	0.271	0.282

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	10304894328	10816376625	0	0	0	0
Sales of cooking units - Electric Resistance	0.301	0.323	0.323	0.323	0.323	0.323	0.323
Sales of cooking units - Gas	0.699	0.677	0.677	0.677	0.677	0.677	0.677
Sales of space heating units - Electric Heat Pump	0.029	0.284	0.67	0.783	0.794	0.795	0.795
Sales of space heating units - Electric Resistance	0.027	0.061	0.116	0.158	0.187	0.191	0.192
Sales of space heating units - Fossil	0	0	0	0	0	0	0
Sales of space heating units - Gas Furnace	0.943	0.655	0.214	0.059	0.019	0.014	0.013
Sales of water heating units - Electric Heat Pump	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Sales of water heating units - Electric Resistance	0.023	0.037	0.037	0.037	0.037	0.037	0.037
Sales of water heating units - Gas Furnace	0.965	0.944	0.944	0.944	0.944	0.944	0.944
Sales of water heating units - Other	0.011	0.018	0.018	0.018	0.018	0.018	0.018

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	2.282	2.329	3.463	3.639	3.574	3.722

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

variable_name	2025	2030	2035	2040	2045	2050
Power generation capital investment - Solar PV - Base	0.463	3.635	3.655	3.266	10.262	9.227
Power generation capital investment - Wind - Base	3.544	8.659	17.548	15.763	25.576	45.428

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	315.844	1623.9	5205.1	8509.7	17993.3	31056.4
HV transmission for wind and solar - base other intra-state	0	51.671	453.892	2059.5	3595.2	7958.6	11192
HV transmission for wind and solar - base spur intra-state	0	181.288	651.038	1594.8	2488.8	4639.4	8718.8

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

variable_name	2050
Carbon sink enhancement potential - Accelerate regeneration	623.318
Carbon sink enhancement potential - All (not counting overlap)	75939.4
Carbon sink enhancement potential - Avoid deforestation	2112.651
Carbon sink enhancement potential - corn-ethanol to energy grasses	-485.112
Carbon sink enhancement potential - cropland measures	-15205.306
Carbon sink enhancement potential - Extend rotation length	15612.8
Carbon sink enhancement potential - Improve plantations	5313.6
Carbon sink enhancement potential - Increase retention of HWP	23042.2
Carbon sink enhancement potential - Increase trees outside forests	1876.33
Carbon sink enhancement potential - permanent conservation cover	-97.195
Carbon sink enhancement potential - Reforest cropland	1884.082
Carbon sink enhancement potential - Reforest pasture	17725.8
Carbon sink enhancement potential - Restore productivity	7748.5
Carbon sink enhancement potential - total	-15787.612
Land impacted for carbon sink enhancement - Accelerate regeneration	251.221
Land impacted for carbon sink enhancement - All (not counting overlap)	13471
Land impacted for carbon sink enhancement - Avoid deforestation	567.116
Land impacted for carbon sink enhancement - corn-ethanol to energy grasses	192.758
Land impacted for carbon sink enhancement - cropland measures	4462.4
Land impacted for carbon sink enhancement - Extend rotation length	8600.8
Land impacted for carbon sink enhancement - Improve plantations	2953.193
Land impacted for carbon sink enhancement - Increase retention of HWP	4608.4
Land impacted for carbon sink enhancement - Increase trees outside forests	529.291
Land impacted for carbon sink enhancement - permanent conservation cover	176.781
Land impacted for carbon sink enhancement - Reforest cropland	627.299
Land impacted for carbon sink enhancement - Reforest pasture	1340.348
Land impacted for carbon sink enhancement - Restore productivity	4372.584
Land impacted for carbon sink enhancement - total	4831.9
Land impacted for carbon sink enhancement - Total impacted (over 30 years)	10379.2

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

variable_name	2050
Business-as-usual carbon sink - Accelerate regeneration	58.254
Business-as-usual carbon sink - Avoid deforestation	180.657
Business-as-usual carbon sink - Extend rotation length	4705.2
Business-as-usual carbon sink - Improve plantations	1121.5
Business-as-usual carbon sink - Increase retention of HWP	0
Business-as-usual carbon sink - Increase trees outside forests	106.418
Business-as-usual carbon sink - Reforest cropland	71.183
Business-as-usual carbon sink - Reforest pasture	327.447
Business-as-usual carbon sink - Restore productivity	1539.3
Business-as-usual carbon sink - Total impacted (over 30 years)	71.183

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	0.063
Power generation capital investment - biomass w/ccu power plant	0	0	0	13.134	6.329	8.695	5.049

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	62.874
Power generation by technology - biomass w/ccu power plant	0	0	0	14740.5	21843.7	31602.6	37269.6

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

variable_name	2020	2025	2030	2035	2040	2045	2050
Biomass purchases	0	0	0	0.835	1.8	2.353	2.676
Capital investment	0	0	0	0	23.433	0	11.953
Number of facilities - allam power w ccu	0	0	0	0	0	0	1
Number of facilities - beccs hydrogen	0	0	0	0	8	8	8
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	12	18	26	30
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 38: *RE+ scenario - PILLAR 4: CO2 capture, use, storage - CO2 capture*

variable_name	2025	2030	2035	2040	2045	2050
Annual - All	0	0	14.58	30.63	40.29	45.81
Annual - BECCS	0	0	14.58	30.63	40.29	45.81
Annual - Cement	0	0	0	0	0	0
Annual - NGCC	0	0	0	0	0	0
Cumulative - All	0	0	14.58	45.21	85.5	131.31
Cumulative - BECCS	0	0	14.58	45.21	85.5	131.31
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	3.69	14.98	30.89	41.36	45.14
Injection wells	0	4	14	26	42	54
Resource characterization, appraisal and permitting costs cumulative	14.18	350.03	561.53	561.53	561.53	561.53
Wells and facilities construction costs cumulative	0	110.94	432.36	770.5	1288.3	1599.5

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

variable_name	2025	2030	2035	2040	2045	2050
CO2 pipelines - All	0	284533.404	887368.427	1728684.382	2268057.5	2444019.1
CO2 pipelines - Spur	0	0	318301.719	875083.871	1414458.057	1590418.723
CO2 pipelines - Trunk	0	284533.404	569066.808	853600.111	853600.111	853600.111

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

variable_name	2050
Carbon sink enhancement potential - Accelerate regeneration	623.318
Carbon sink enhancement potential - All (not counting overlap)	75939.4
Carbon sink enhancement potential - Avoid deforestation	2112.651
Carbon sink enhancement potential - corn-ethanol to energy grasses	-1845.792
Carbon sink enhancement potential - cropland measures	-13897.514
Carbon sink enhancement potential - Cropland to woody energy crops	0
Carbon sink enhancement potential - Extend rotation length	15612.8
Carbon sink enhancement potential - Improve plantations	5313.6
Carbon sink enhancement potential - Increase retention of HWP	23042.2
Carbon sink enhancement potential - Increase trees outside forests	1876.33
Carbon sink enhancement potential - pasture to energy crops	0
Carbon sink enhancement potential - permanent conservation cover	-74.45
Carbon sink enhancement potential - Reforest cropland	1884.082
Carbon sink enhancement potential - Reforest pasture	17725.8
Carbon sink enhancement potential - Restore productivity	7748.5
Carbon sink enhancement potential - total	-15817.756
Land impacted for carbon sink enhancement - Accelerate regeneration	251.221
Land impacted for carbon sink enhancement - All (not counting overlap)	13471
Land impacted for carbon sink enhancement - Avoid deforestation	567.116
Land impacted for carbon sink enhancement - corn-ethanol to energy grasses	733.21
Land impacted for carbon sink enhancement - cropland measures	8060.2

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

variable_name	2050
Land impacted for carbon sink enhancement - Cropland to woody energy crops	286.756
Land impacted for carbon sink enhancement - Extend rotation length	8600.8
Land impacted for carbon sink enhancement - Improve plantations	2953.193
Land impacted for carbon sink enhancement - Increase retention of HWP	4608.4
Land impacted for carbon sink enhancement - Increase trees outside forests	529.291
Land impacted for carbon sink enhancement - pasture to energy crops	880.278
Land impacted for carbon sink enhancement - permanent conservation cover	135.411
Land impacted for carbon sink enhancement - Reforest cropland	627.299
Land impacted for carbon sink enhancement - Reforest pasture	1340.348
Land impacted for carbon sink enhancement - Restore productivity	4372.584
Land impacted for carbon sink enhancement - total	10095.9
Land impacted for carbon sink enhancement - Total impacted (over 30 years)	10379.2

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

variable_name	2050
Business-as-usual carbon sink - Accelerate regeneration	58.254
Business-as-usual carbon sink - Avoid deforestation	180.657
Business-as-usual carbon sink - Extend rotation length	4705.2
Business-as-usual carbon sink - Improve plantations	1121.5
Business-as-usual carbon sink - Increase retention of HWP	0
Business-as-usual carbon sink - Increase trees outside forests	106.418
Business-as-usual carbon sink - Reforest cropland	71.183
Business-as-usual carbon sink - Reforest pasture	327.447
Business-as-usual carbon sink - Restore productivity	1539.3
Business-as-usual carbon sink - Total impacted (over 30 years)	71.183

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

variable_name	2050
Carbon sink enhancement potential - Accelerate regeneration	623.318
Carbon sink enhancement potential - All (not counting overlap)	75939.4
Carbon sink enhancement potential - Avoid deforestation	2112.651
Carbon sink enhancement potential - corn-ethanol to energy grasses	-485.112
Carbon sink enhancement potential - cropland measures	-15205.306
Carbon sink enhancement potential - Extend rotation length	15612.8
Carbon sink enhancement potential - Improve plantations	5313.6
Carbon sink enhancement potential - Increase retention of HWP	23042.2
Carbon sink enhancement potential - Increase trees outside forests	1876.33
Carbon sink enhancement potential - permanent conservation cover	-97.195
Carbon sink enhancement potential - Reforest cropland	1884.082
Carbon sink enhancement potential - Reforest pasture	17725.8
Carbon sink enhancement potential - Restore productivity	7748.5
Carbon sink enhancement potential - total	-15787.612
Land impacted for carbon sink enhancement - Accelerate regeneration	251.221
Land impacted for carbon sink enhancement - All (not counting overlap)	13471
Land impacted for carbon sink enhancement - Avoid deforestation	567.116
Land impacted for carbon sink enhancement - corn-ethanol to energy grasses	192.758
Land impacted for carbon sink enhancement - cropland measures	4462.4
Land impacted for carbon sink enhancement - Extend rotation length	8600.8
Land impacted for carbon sink enhancement - Improve plantations	2953.193
Land impacted for carbon sink enhancement - Increase retention of HWP	4608.4
Land impacted for carbon sink enhancement - Increase trees outside forests	529.291
Land impacted for carbon sink enhancement - permanent conservation cover	176.781
Land impacted for carbon sink enhancement - Reforest cropland	627.299
Land impacted for carbon sink enhancement - Reforest pasture	1340.348
Land impacted for carbon sink enhancement - Restore productivity	4372.584
Land impacted for carbon sink enhancement - total	4831.9
Land impacted for carbon sink enhancement - Total impacted (over 30 years)	10379.2

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

variable_name	2050
Business-as-usual carbon sink - Accelerate regeneration	58.254
Business-as-usual carbon sink - Avoid deforestation	180.657
Business-as-usual carbon sink - Extend rotation length	4705.2
Business-as-usual carbon sink - Improve plantations	1121.5
Business-as-usual carbon sink - Increase retention of HWP	0
Business-as-usual carbon sink - Increase trees outside forests	106.418
Business-as-usual carbon sink - Reforest cropland	71.183
Business-as-usual carbon sink - Reforest pasture	327.447
Business-as-usual carbon sink - Restore productivity	1539.3
Business-as-usual carbon sink - Total impacted (over 30 years)	71.183