Net-Zero America - georgia 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	8.063	8.867	0	0	0	0
Sale of space heating units by type - Electric Heat Pump	0.254	0.45	0.813	0.894	0.898	0.897	0.897
Sale of space heating units by type - Electric Resistance	0.184	0.197	0.083	0.057	0.055	0.056	0.056
Sale of space heating units by type - Fossil	0.044	0.056	0.021	0.014	0.013	0.013	0.013
Sale of space heating units by type - Gas	0.518	0.297	0.083	0.035	0.034	0.034	0.034
Sales of cooking units - Electric Resistance	0.669	0.74	0.955	0.998	1	1	1
Sales of cooking units - Gas	0.331	0.26	0.045	0.002	0	0	0
Sales of water heating units by type - Electric Heat Pump	0	0.116	0.614	0.725	0.73	0.729	0.729
Sales of water heating units by type - Electric Resistance	0.472	0.572	0.31	0.252	0.249	0.249	0.249
Sales of water heating units by type - Gas Furnace	0.5	0.291	0.055	0.002	0	0	0
Sales of water heating units by type - Other	0.028	0.021	0.021	0.021	0.021	0.021	0.021

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	0.015	0.017	0.012	0.004	0.001	0	0
End-use technology sales by technology - LDV - EV	0.042	0.161	0.477	0.823	0.964	0.993	1
End-use technology sales by technology - LDV - gasoline	0.894	0.77	0.475	0.16	0.032	0.006	0
End-use technology sales by technology - LDV - hybrid	0.047	0.047	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	1608534907	4203817182	6680911774	10172358495	11014573281	10532487047
Number of public EV charging plugs - DC Fast Charging	376	0	3151.9	0	12822.6	0	20550.5
Number of public EV charging plugs - L2 Charging	2429	0	75749	0	308163.4	0	493887.2

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	0.034	0	0	0.013
Power generation capital investment - biomass w/ccu power plant	0	0	0	0.007	6.925	0.666	0.001
Power generation capital investment - Solar PV - Base	0	0	6.499	23.255	14.651	31.243	25.28
Power generation capital investment - Solar PV - Constrained	0	1.411	10.848	26.465	20.993	26.369	28.084

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	33.727	33.727	33.727	46.971
Power generation by technology - biomass w/ccu power plant	0	0	0	8.056	7780.7	8528.3	8529

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	234.13	727.638	3104.4	5338.1	11215.6	16921.3
HV transmission for wind and solar - base other intra-state	0	125.979	346.97	1203.9	2176.5	4346.7	6491.6
HV transmission for wind and solar - base spur intra-state	0	64.836	288.471	1464.2	2320.3	4602.7	7018.6
HV transmission for wind and solar - constrained all	0	227.798	818.281	2422.1	5723.4	11998.1	17070.1
HV transmission for wind and solar - constrained other intra-state	0	122.979	155.29	699.385	2111.9	4476.7	6349.9
HV transmission for wind and solar - constrained spur intra-state	0	62.594	360.565	1087.6	2592.5	4710.9	6839.5

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

variable_name	2020	2025	2030	2035	2040	2045	2050
Biomass purchases	0	0	0	0.018	0.592	0.956	1.068
Capital investment	0	0	0	0	12.69	0	9.641
Number of facilities - allam power w ccu	0	0	0	1	1	1	2
Number of facilities - beccs hydrogen	0	0	0	1	6	14	16
Number of facilities - diesel	0	0	0	0	0	0	0
Number of facilities - diesel ccu	0	0	0	1	1	1	1
Number of facilities - power	0	0	0	0	0	0	0
Number of facilities - power ccu	0	0	0	1	6	7	8
Number of facilities - pyrolysis	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 - 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	0.55	18.44	25.85	31.88
Annual - BECCS	0	0	0.47	16.51	25.8	28.83
Annual - Cement	0	0	0	0	0	0
Annual - NGCC	0	0	0.08	1.93	0.05	3.05
Cumulative - All	0	0	0.55	18.99	44.84	76.72
Cumulative - BECCS	0	0	0.47	16.98	42.78	71.61
Cumulative - Cement	0	0	0	0	0	0
Cumulative - NGCC	0	0	0.08	2.01	2.06	5.11

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

variable_name	2025	2030	2035	2040	2045	2050
Annual	0	0	5.28	7.23	12.05	16.77
Injection wells	0	4	18	30	52	66
Resource characterization, appraisal and permitting costs cumulative	100.9	276.87	379.22	379.22	379.22	379.22
Wells and facilities construction costs cumulative	0	135.47	527.96	940.86	1573.2	1953.2

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

variable_name	2025	2030	2035	2040	2045	2050
CO2 pipelines - All	0	2891911.074	5026436.9	5798956.4	6727838.1	7049088.5
CO2 pipelines - Spur	0	0	206357.577	978876.6	1907758.4	2229008.8
CO2 pipelines - Trunk	0	2891911.074	4820079.669	4820079.669	4820079.669	4820079.669

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

variable_name	2020	2025	2030	2035	2040	2045	2050
Jobs by economic sector - agriculture	476.527	518.083	841.052	480.876	1472.5	1714.4	1546.5
Jobs by economic sector - construction	9812.5	8017.2	13648.8	25968	24743	36486.3	43167.3
Jobs by economic sector - manufacturing	8304.2	13876.5	25461.2	25847	21005.4	24521.5	20768.4
Jobs by economic sector - mining	4533.4	3111.7	2251.2	1493.9	912.13	601.642	360.341
Jobs by economic sector - other	809.72	578.585	1615.9	4569.9	4626.5	8156.1	10211.6
Jobs by economic sector - pipeline	750.022	733.222	929.072	757.373	444.111	411.981	395.77
Jobs by economic sector - professional	5717.3	4604.9	6026.3	10432	11690.9	17726	21766.9
Jobs by economic sector - trade	4710.4	3314.7	4063.5	7121.9	7273.9	11466.2	14462.2
Jobs by economic sector - utilities	14306.9	12276.7	14691.9	19694.9	20934	26101.9	31429
Jobs by resource sector - Biomass	1620.7	1824.1	2220.3	1246.3	4360.4	6262.1	6637.5
Jobs by resource sector - CO2	0	54.702	2697	2528	1044.1	1978.2	2462.9
Jobs by resource sector - Coal	4142.9	1328.1	0	0	0	0	0
Jobs by resource sector - Grid	15327.7	13097.8	16979.3	28948.2	32372.9	45104.9	57917.4
Jobs by resource sector - Natural Gas	7946.8	7359.6	6976.2	5694.4	6745.2	4316.6	3552.8
Jobs by resource sector - Nuclear	3202	3150.4	3100.1	2705.5	2174.8	1689.8	604.719
Jobs by resource sector - Oil	8485.8	7190.1	5570.5	3788.2	2361.6	1357.6	666.153
Jobs by resource sector - Solar	8688.1	12993.1	31052.1	50735	41815	60786.7	64463.9
Jobs by resource sector - Wind	6.734	33.774	933.49	720.312	2228.6	5690.1	7802.5
Median wages - All	56580.6	56677.2	55663.5	55966.3	57160	57723	58897
Required Level of Education - Associates degree or some college	15284.4	14596	21930	30902.4	29699.6	40706.4	46413
Required Level of Education - Bachelors degree	10624.5	10049.4	14014.8	18743	18146.2	24629.6	27889.4
Required Level of Education - Doctoral degree	341.945	295.441	384.66	581.83	601.772	869.25	1026.5
Required Level of Education - High school diploma or less	20636.8	19781.7	30087.5	41797.6	40316.2	54973.6	61812.1
Required Level of Education - Masters or professional degree	2533.2	2309.1	3112	4341.1	4338.8	6007.3	6967
Wage income - All	2796415779	2665739171	3870482913	5393910169	5322439748	7342789568	8489088175

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

variable_name	2050
Carbon sink enhancement potential - Accelerate regeneration	1367.011
Carbon sink enhancement potential - All (not counting overlap)	103329.3
Carbon sink enhancement potential - Avoid deforestation	4376.7
Carbon sink enhancement potential - corn-ethanol to energy grasses	-131.994
Carbon sink enhancement potential - cropland measures	-5780.987
Carbon sink enhancement potential - Extend rotation length	20307
Carbon sink enhancement potential - Improve plantations	11257.4
Carbon sink enhancement potential - Increase retention of HWP	42448.8
Carbon sink enhancement potential - Increase trees outside forests	1675.496
Carbon sink enhancement potential - permanent conservation cover	-101.565
Carbon sink enhancement potential - Reforest cropland	3302.6
Carbon sink enhancement potential - Reforest pasture	8713
Carbon sink enhancement potential - Restore productivity	9881.4
Carbon sink enhancement potential - total	-6014.544

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

variable_name	2050
Land impacted for carbon sink enhancement - Accelerate regeneration	550.957
Land impacted for carbon sink enhancement - All (not counting overlap)	20951.7
Land impacted for carbon sink enhancement - Avoid deforestation	1174.862
Land impacted for carbon sink enhancement - corn-ethanol to energy grasses	77.218
Land impacted for carbon sink enhancement - cropland measures	2444.265
Land impacted for carbon sink enhancement - Extend rotation length	11186.7
Land impacted for carbon sink enhancement - Improve plantations	6256.7
Land impacted for carbon sink enhancement - Increase retention of HWP	8489.8
Land impacted for carbon sink enhancement - Increase trees outside forests	472.638
Land impacted for carbon sink enhancement - permanent conservation cover	184.727
Land impacted for carbon sink enhancement - Reforest cropland	1099.546
Land impacted for carbon sink enhancement - Reforest pasture	658.841
Land impacted for carbon sink enhancement - Restore productivity	5576.3
Land impacted for carbon sink enhancement - total	2706.15
Land impacted for carbon sink enhancement - Total impacted (over 30 years)	14514.4

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

variable_name	2050
Business-as-usual carbon sink - Accelerate regeneration	127.758
Business-as-usual carbon sink - Avoid deforestation	374.256
Business-as-usual carbon sink - Extend rotation length	6119.9
Business-as-usual carbon sink - Improve plantations	2375.9
Business-as-usual carbon sink - Increase retention of HWP	0
Business-as-usual carbon sink - Increase trees outside forests	95.028
Business-as-usual carbon sink - Reforest cropland	124.771
Business-as-usual carbon sink - Reforest pasture	160.954
Business-as-usual carbon sink - Restore productivity	1963
Business-as-usual carbon sink - Total impacted (over 30 years)	124.771

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

variable_name	2020	2025	2030	2035	2040	2045	2050
Natural gas consumption	563721.6	572093.6	482242.6	386778.5	291161	183188.8	127054.9
Oil consumption	174083	161730.8	136548.5	100580.4	67513.4	41547	21701.3

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

variable_name	2020	2025	2030	2035	2040	2045	2050
Final energy demand by sector - commercial	0.252	0.253	0.245	0.233	0.224	0.221	0.224
Final energy demand by sector - industry	0.42	0.427	0.428	0.425	0.426	0.427	0.431
Final energy demand by sector - residential	0.362	0.344	0.319	0.286	0.259	0.244	0.24
Final energy demand by sector - transportation	1.057	0.99	0.878	0.74	0.614	0.535	0.499

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	34948961382	38934553673	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	0.073	0.274	0.706	0.84	0.853	0.854	0.854
Sales of space heating units - Electric Resistance	0.067	0.082	0.102	0.123	0.127	0.127	0.127
Sales of space heating units - Fossil	0	0.039	0.007	0	0	0	0
Sales of space heating units - Gas Furnace	0.86	0.605	0.184	0.037	0.02	0.019	0.019
Sales of water heating units - Electric Heat Pump	0.002	0.105	0.546	0.644	0.648	0.648	0.648
Sales of water heating units - Electric Resistance	0.055	0.109	0.284	0.323	0.325	0.325	0.325
Sales of water heating units - Gas Furnace	0.921	0.746	0.141	0.006	0	0	0
Sales of water heating units - Other	0.021	0.039	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	7.034	7.309	10.933	11.608	9.14	9.44

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	7.849	7.656	0	0	0	0

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

variable_name	2020	2025	2030	2035	2040	2045	2050
Sale of space heating units by type - Electric Heat Pump	0.231	0.532	0.543	0.56	0.571	0.583	0.601
Sale of space heating units by type - Electric Resistance	0.19	0.174	0.172	0.165	0.159	0.148	0.129
Sale of space heating units by type - Fossil	0.045	0.037	0.037	0.037	0.037	0.037	0.037
Sale of space heating units by type - Gas	0.534	0.256	0.248	0.238	0.233	0.232	0.233
Sales of cooking units - Electric Resistance	0.665	0.665	0.665	0.665	0.665	0.665	0.665
Sales of cooking units - Gas	0.335	0.335	0.335	0.335	0.335	0.335	0.335
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	0.472	0.633	0.633	0.632	0.631	0.63	0.63
Sales of water heating units by type - Gas Furnace	0.5	0.346	0.346	0.347	0.348	0.348	0.349
Sales of water heating units by type - Other	0.028	0.021	0.021	0.021	0.021	0.021	0.022

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	0.015	0.019	0.022	0.02	0.018	0.017	0.016
End-use technology sales by technology - LDV - EV	0.038	0.06	0.068	0.083	0.101	0.116	0.128
End-use technology sales by technology - LDV - gasoline	0.898	0.861	0.839	0.819	0.798	0.779	0.763
End-use technology sales by technology - LDV - hybrid	0.047	0.055	0.068	0.073	0.079	0.084	0.088
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	1367.011
Carbon sink enhancement potential - All (not counting overlap)	0	0	103329.3
Carbon sink enhancement potential - Avoid deforestation	0	0	4376.7
Carbon sink enhancement potential - Extend rotation length	0	0	20307
Carbon sink enhancement potential - Improve plantations	0	0	11257.4
Carbon sink enhancement potential - Increase retention of HWP	0	0	42448.8
Carbon sink enhancement potential - Increase trees outside forests	0	0	1675.496
Carbon sink enhancement potential - Reforest cropland	0	0	3302.6
Carbon sink enhancement potential - Reforest pasture	0	0	8713
Carbon sink enhancement potential - Restore productivity	0	0	9881.4
Land impacted for carbon sink enhancement - Accelerate regeneration	0	0	550.957
Land impacted for carbon sink enhancement - All (not counting overlap)	0	0	20951.7
Land impacted for carbon sink enhancement - Avoid deforestation	0	0	1174.862
Land impacted for carbon sink enhancement - Extend rotation length	0	0	11186.7
Land impacted for carbon sink enhancement - Improve plantations	0	0	6256.7
Land impacted for carbon sink enhancement - Increase retention of HWP	0	0	8489.8
Land impacted for carbon sink enhancement - Increase trees outside forests	0	0	472.638
Land impacted for carbon sink enhancement - Natural uptake	-11.05	-18.954	-15.36
Land impacted for carbon sink enhancement - Reforest cropland	0	0	1099.546
Land impacted for carbon sink enhancement - Reforest pasture	0	0	658.841
Land impacted for carbon sink enhancement - Restore productivity	0	0	5576.3
Land impacted for carbon sink enhancement - Retained in Hardwood Products	-6.93	-11.558	-12.167
Land impacted for carbon sink enhancement - Total	-17.98	-30.512	-27.527
Land impacted for carbon sink enhancement - Total impacted (over 30 years)	0	0	14514.4

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

variable_name	2050
Business-as-usual carbon sink - Accelerate regeneration	127.758
Business-as-usual carbon sink - Avoid deforestation	374.256
Business-as-usual carbon sink - Extend rotation length	6119.9
Business-as-usual carbon sink - Improve plantations	2375.9
Business-as-usual carbon sink - Increase retention of HWP	0

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

variable_name	2050
Business-as-usual carbon sink - Increase trees outside forests	95.028
Business-as-usual carbon sink - Reforest cropland	124.771
Business-as-usual carbon sink - Reforest pasture	160.954
Business-as-usual carbon sink - Restore productivity	1963
Business-as-usual carbon sink - Total impacted (over 30 years)	124.771

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

variable_name	2020	2025	2030	2035	2040	2045	2050
Final energy demand by sector - commercial	0.252	0.257	0.26	0.262	0.266	0.276	0.29
Final energy demand by sector - industry	0.42	0.441	0.459	0.477	0.5	0.522	0.549
Final energy demand by sector - residential	0.362	0.345	0.342	0.342	0.347	0.357	0.368
Final energy demand by sector - transportation	1.058	1.005	0.938	0.9	0.906	0.935	0.973

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	34430132509	35752850394	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	0.073	0.291	0.635	0.718	0.724	0.724	0.724
Sales of space heating units - Electric Resistance	0.067	0.094	0.146	0.202	0.248	0.256	0.256
Sales of space heating units - Fossil	0	0.041	0.025	0.012	0.002	0	0
Sales of space heating units - Gas Furnace	0.86	0.574	0.193	0.068	0.026	0.02	0.019
Sales of water heating units - Electric Heat Pump	0.002	0.003	0.003	0.003	0.003	0.003	0.003
Sales of water heating units - Electric Resistance	0.055	0.068	0.067	0.068	0.068	0.067	0.068
Sales of water heating units - Gas Furnace	0.921	0.887	0.887	0.887	0.887	0.887	0.887
Sales of water heating units - Other	0.021	0.042	0.043	0.042	0.043	0.043	0.043

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	7.501	7.832	10.508	11.119	9.452	9.792

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	7.979	8.747	0	0	0	0
Sale of space heating units by type - Electric Heat Pump	0.254	0.38	0.422	0.542	0.724	0.842	0.883
Sale of space heating units by type - Electric Resistance	0.184	0.219	0.205	0.166	0.108	0.072	0.06
Sale of space heating units by type - Fossil	0.044	0.062	0.059	0.048	0.03	0.019	0.015
Sale of space heating units by type - Gas	0.518	0.339	0.314	0.245	0.138	0.067	0.042
Sales of cooking units - Electric Resistance	0.668	0.677	0.707	0.787	0.899	0.967	0.991
Sales of cooking units - Gas	0.332	0.323	0.293	0.213	0.101	0.033	0.009
Sales of water heating units by type - Electric Heat Pump	0	0.02	0.077	0.24	0.49	0.653	0.709
Sales of water heating units by type - Electric Resistance	0.472	0.623	0.593	0.506	0.375	0.289	0.26
Sales of water heating units by type - Gas Furnace	0.5	0.336	0.309	0.233	0.114	0.036	0.01
Sales of water heating units by type - Other	0.028	0.021	0.021	0.021	0.021	0.021	0.021

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	0.015	0.019	0.02	0.016	0.01	0.005	0.002
End-use technology sales by technology - LDV - EV	0.02	0.049	0.123	0.266	0.491	0.725	0.878
End-use technology sales by technology - LDV - gasoline	0.915	0.871	0.789	0.658	0.454	0.243	0.108
End-use technology sales by technology - LDV - hybrid	0.049	0.057	0.063	0.057	0.042	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	274383098	545067843	1871016826	5792291106	8471683442
Number of public EV charging plugs - DC Fast Charging	376	0	1110.7	0	4861.5	0	13162.6
Number of public EV charging plugs - L2 Charging	2429	0	26693.6	0	116835.3	0	316334.5

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

variable_name	2050
Carbon sink enhancement potential - Accelerate regeneration	1367.011
Carbon sink enhancement potential - All (not counting overlap)	103329.3
Carbon sink enhancement potential - Avoid deforestation	4376.7
Carbon sink enhancement potential - corn-ethanol to energy grasses	-131.994
Carbon sink enhancement potential - cropland measures	-5780.987
Carbon sink enhancement potential - Extend rotation length	20307
Carbon sink enhancement potential - Improve plantations	11257.4
Carbon sink enhancement potential - Increase retention of HWP	42448.8
Carbon sink enhancement potential - Increase trees outside forests	1675.496
Carbon sink enhancement potential - permanent conservation cover	-101.565
Carbon sink enhancement potential - Reforest cropland	3302.6
Carbon sink enhancement potential - Reforest pasture	8713
Carbon sink enhancement potential - Restore productivity	9881.4
Carbon sink enhancement potential - total	-6014.544
Land impacted for carbon sink enhancement - Accelerate regeneration	550.957
Land impacted for carbon sink enhancement - All (not counting overlap)	20951.7
Land impacted for carbon sink enhancement - Avoid deforestation	1174.862
Land impacted for carbon sink enhancement - corn-ethanol to energy grasses	77.218
Land impacted for carbon sink enhancement - cropland measures	2444.265
Land impacted for carbon sink enhancement - Extend rotation length	11186.7
Land impacted for carbon sink enhancement - Improve plantations	6256.7
Land impacted for carbon sink enhancement - Increase retention of HWP	8489.8
Land impacted for carbon sink enhancement - Increase trees outside forests	472.638
Land impacted for carbon sink enhancement - permanent conservation cover	184.727
Land impacted for carbon sink enhancement - Reforest cropland	1099.546
Land impacted for carbon sink enhancement - Reforest pasture	658.841
Land impacted for carbon sink enhancement - Restore productivity	5576.3
Land impacted for carbon sink enhancement - total	2706.15
Land impacted for carbon sink enhancement - Total impacted (over 30 years)	14514.4

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

variable_name	2050
Business-as-usual carbon sink - Accelerate regeneration	127.758
Business-as-usual carbon sink - Avoid deforestation	374.256
Business-as-usual carbon sink - Extend rotation length	6119.9
Business-as-usual carbon sink - Improve plantations	2375.9
Business-as-usual carbon sink - Increase retention of HWP	0
Business-as-usual carbon sink - Increase trees outside forests	95.028
Business-as-usual carbon sink - Reforest cropland	124.771
Business-as-usual carbon sink - Reforest pasture	160.954
Business-as-usual carbon sink - Restore productivity	1963
Business-as-usual carbon sink - Total impacted (over 30 years)	124.771

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

variable_name	2020	2025	2030	2035	2040	2045	2050
Final energy demand by sector - commercial	0.252	0.254	0.251	0.248	0.242	0.237	0.235
Final energy demand by sector - industry	0.42	0.427	0.43	0.431	0.435	0.436	0.439
Final energy demand by sector - residential	0.362	0.345	0.337	0.326	0.309	0.288	0.268
Final energy demand by sector - transportation	1.059	0.999	0.916	0.848	0.794	0.73	0.654

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	34926751502	38922116999	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	0.073	0.192	0.241	0.385	0.61	0.769	0.83
Sales of space heating units - Electric Resistance	0.067	0.079	0.082	0.089	0.102	0.116	0.124
Sales of space heating units - Fossil	0	0.045	0.041	0.031	0.015	0.005	0.001
Sales of space heating units - Gas Furnace	0.86	0.684	0.636	0.496	0.272	0.11	0.044
Sales of water heating units - Electric Heat Pump	0.002	0.02	0.071	0.215	0.436	0.58	0.63
Sales of water heating units - Electric Resistance	0.055	0.075	0.094	0.152	0.24	0.298	0.318
Sales of water heating units - Gas Furnace	0.921	0.863	0.794	0.596	0.291	0.093	0.024
Sales of water heating units - Other	0.021	0.041	0.041	0.037	0.032	0.029	0.027

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	5.715	5.835	7.604	7.919	9.608	10.087

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	0	0.214	18.46
Power generation capital investment - Solar PV - Base	0.849	8.236	43.989	39.099	25.643	31.147

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	307.625	1241.4	7116.3	15024.2	20936.3	47877.2
HV transmission for wind and solar - base other intra-state	0	125.979	393.422	3065.8	6263.3	8193.8	10628.4
HV transmission for wind and solar - base spur intra-state	0	92.207	386.214	2847.4	5595.8	8101.9	20658

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

variable_name	2050
Carbon sink enhancement potential - Accelerate regeneration	1367.011
Carbon sink enhancement potential - All (not counting overlap)	103329.3
Carbon sink enhancement potential - Avoid deforestation	4376.7
Carbon sink enhancement potential - corn-ethanol to energy grasses	-131.994
Carbon sink enhancement potential - cropland measures	-5780.987
Carbon sink enhancement potential - Extend rotation length	20307
Carbon sink enhancement potential - Improve plantations	11257.4
Carbon sink enhancement potential - Increase retention of HWP	42448.8
Carbon sink enhancement potential - Increase trees outside forests	1675.496
Carbon sink enhancement potential - permanent conservation cover	-101.565
Carbon sink enhancement potential - Reforest cropland	3302.6
Carbon sink enhancement potential - Reforest pasture	8713
Carbon sink enhancement potential - Restore productivity	9881.4
Carbon sink enhancement potential - total	-6014.544
Land impacted for carbon sink enhancement - Accelerate regeneration	550.957
Land impacted for carbon sink enhancement - All (not counting overlap)	20951.7
Land impacted for carbon sink enhancement - Avoid deforestation	1174.862
Land impacted for carbon sink enhancement - corn-ethanol to energy grasses	77.218
Land impacted for carbon sink enhancement - cropland measures	2444.265
Land impacted for carbon sink enhancement - Extend rotation length	11186.7
Land impacted for carbon sink enhancement - Improve plantations	6256.7
Land impacted for carbon sink enhancement - Increase retention of HWP	8489.8
Land impacted for carbon sink enhancement - Increase trees outside forests	472.638
Land impacted for carbon sink enhancement - permanent conservation cover	184.727
Land impacted for carbon sink enhancement - Reforest cropland	1099.546
Land impacted for carbon sink enhancement - Reforest pasture	658.841
Land impacted for carbon sink enhancement - Restore productivity	5576.3
Land impacted for carbon sink enhancement - total	2706.15
Land impacted for carbon sink enhancement - Total impacted (over 30 years)	14514.4

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

variable_name	2050
Business-as-usual carbon sink - Accelerate regeneration	127.758
Business-as-usual carbon sink - Avoid deforestation	374.256
Business-as-usual carbon sink - Extend rotation length	6119.9
Business-as-usual carbon sink - Improve plantations	2375.9
Business-as-usual carbon sink - Increase retention of HWP	0
Business-as-usual carbon sink - Increase trees outside forests	95.028
Business-as-usual carbon sink - Reforest cropland	124.771
Business-as-usual carbon sink - Reforest pasture	160.954
Business-as-usual carbon sink - Restore productivity	1963
Business-as-usual carbon sink - Total impacted (over 30 years)	124.771

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	20.566	13.451	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	23082.6	38179.7	38179.7	38179.7

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

variable_name	2020	2025	2030	2035	2040	2045	2050
Biomass purchases	0	0	0	1.263	2.09	2.717	2.77
Capital investment	0	0	0	0	29.402	0	8.28
Number of facilities - allam power w ccu	0	0	0	0	0	0	0
Number of facilities - beccs hydrogen	0	0	0	0	0	9	10
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	18	30	30	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	22.9	37.83	48.25	48.1
Annual - BECCS	0	0	22.83	37.78	48.2	48.06
Annual - Cement	0	0	0	0	0	0
Annual - NGCC	0	0	0.07	0.05	0.05	0.04
Cumulative - All	0	0	22.9	60.73	108.98	157.08
Cumulative - BECCS	0	0	22.83	60.61	108.81	156.87
Cumulative - Cement	0	0	0	0	0	0
Cumulative - NGCC	0	0	0.07	0.12	0.17	0.21

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

variable_name	2025	2030	2035	2040	2045	2050
Annual	0	0	6.42	11.88	15.76	16.72
Injection wells	0	4	18	32	54	68
Resource characterization, appraisal and permitting costs cumulative	100.9	291.74	403.87	403.87	403.87	403.87
Wells and facilities construction costs cumulative	0	140.6	547.95	976.49	1632.8	2027.1

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

variable_name	2025	2030	2035	2040	2045	2050
CO2 pipelines - All	0	2891911.074	6154591.5	7286599.8	8159420.3	8576317.1
CO2 pipelines - Spur	0	0	1334511.8	2273543.1	3146363.6	3563260.4
CO2 pipelines - Trunk	0	2891911.074	4820079.669	5013056.669	5013056.669	5013056.669

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

variable_name	2050
Carbon sink enhancement potential - Accelerate regeneration	1367.011
Carbon sink enhancement potential - All (not counting overlap)	103329.3
Carbon sink enhancement potential - Avoid deforestation	4376.7
Carbon sink enhancement potential - corn-ethanol to energy grasses	-612.438
Carbon sink enhancement potential - cropland measures	-5229.177
Carbon sink enhancement potential - Cropland to woody energy crops	0
Carbon sink enhancement potential - Extend rotation length	20307
Carbon sink enhancement potential - Improve plantations	11257.4
Carbon sink enhancement potential - Increase retention of HWP	42448.8
Carbon sink enhancement potential - Increase trees outside forests	1675.496
Carbon sink enhancement potential - pasture to energy crops	0
Carbon sink enhancement potential - permanent conservation cover	-87.912
Carbon sink enhancement potential - Reforest cropland	3302.6
Carbon sink enhancement potential - Reforest pasture	8713
Carbon sink enhancement potential - Restore productivity	9881.4

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

variable_name	2050
Carbon sink enhancement potential - total	-5929.527
Land impacted for carbon sink enhancement - Accelerate regeneration	550.957
Land impacted for carbon sink enhancement - All (not counting overlap)	20951.7
Land impacted for carbon sink enhancement - Avoid deforestation	1174.862
Land impacted for carbon sink enhancement - corn-ethanol to energy grasses	381.77
Land impacted for carbon sink enhancement - cropland measures	4361.532
Land impacted for carbon sink enhancement - Cropland to woody energy crops	170.668
Land impacted for carbon sink enhancement - Extend rotation length	11186.7
Land impacted for carbon sink enhancement - Improve plantations	6256.7
Land impacted for carbon sink enhancement - Increase retention of HWP	8489.8
Land impacted for carbon sink enhancement - Increase trees outside forests	472.638
Land impacted for carbon sink enhancement - pasture to energy crops	294.636
Land impacted for carbon sink enhancement - permanent conservation cover	159.896
Land impacted for carbon sink enhancement - Reforest cropland	1099.546
Land impacted for carbon sink enhancement - Reforest pasture	658.841
Land impacted for carbon sink enhancement - Restore productivity	5576.3
Land impacted for carbon sink enhancement - total	5368.5
Land impacted for carbon sink enhancement - Total impacted (over 30 years)	14514.4

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

variable_name	2050
Business-as-usual carbon sink - Accelerate regeneration	127.758
Business-as-usual carbon sink - Avoid deforestation	374.256
Business-as-usual carbon sink - Extend rotation length	6119.9
Business-as-usual carbon sink - Improve plantations	2375.9
Business-as-usual carbon sink - Increase retention of HWP	0
Business-as-usual carbon sink - Increase trees outside forests	95.028
Business-as-usual carbon sink - Reforest cropland	124.771
Business-as-usual carbon sink - Reforest pasture	160.954
Business-as-usual carbon sink - Restore productivity	1963
Business-as-usual carbon sink - Total impacted (over 30 years)	124.771

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

variable_name	2050
Carbon sink enhancement potential - Accelerate regeneration	1367.011
Carbon sink enhancement potential - All (not counting overlap)	103329.3
Carbon sink enhancement potential - Avoid deforestation	4376.7
Carbon sink enhancement potential - corn-ethanol to energy grasses	-131.994
Carbon sink enhancement potential - cropland measures	-5780.987
Carbon sink enhancement potential - Extend rotation length	20307
Carbon sink enhancement potential - Improve plantations	11257.4
Carbon sink enhancement potential - Increase retention of HWP	42448.8
Carbon sink enhancement potential - Increase trees outside forests	1675.496
Carbon sink enhancement potential - permanent conservation cover	-101.565
Carbon sink enhancement potential - Reforest cropland	3302.6
Carbon sink enhancement potential - Reforest pasture	8713
Carbon sink enhancement potential - Restore productivity	9881.4
Carbon sink enhancement potential - total	-6014.544
Land impacted for carbon sink enhancement - Accelerate regeneration	550.957
Land impacted for carbon sink enhancement - All (not counting overlap)	20951.7
Land impacted for carbon sink enhancement - Avoid deforestation	1174.862
Land impacted for carbon sink enhancement - corn-ethanol to energy grasses	77.218
Land impacted for carbon sink enhancement - cropland measures	2444.265
Land impacted for carbon sink enhancement - Extend rotation length	11186.7
Land impacted for carbon sink enhancement - Improve plantations	6256.7
Land impacted for carbon sink enhancement - Increase retention of HWP	8489.8
Land impacted for carbon sink enhancement - Increase trees outside forests	472.638
Land impacted for carbon sink enhancement - permanent conservation cover	184.727

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

variable_name	2050
Land impacted for carbon sink enhancement - Reforest cropland	1099.546
Land impacted for carbon sink enhancement - Reforest pasture	658.841
Land impacted for carbon sink enhancement - Restore productivity	5576.3
Land impacted for carbon sink enhancement - total	2706.15
Land impacted for carbon sink enhancement - Total impacted (over 30 years)	14514.4

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

variable_name	2050
Business-as-usual carbon sink - Accelerate regeneration	127.758
Business-as-usual carbon sink - Avoid deforestation	374.256
Business-as-usual carbon sink - Extend rotation length	6119.9
Business-as-usual carbon sink - Improve plantations	2375.9
Business-as-usual carbon sink - Increase retention of HWP	0
Business-as-usual carbon sink - Increase trees outside forests	95.028
Business-as-usual carbon sink - Reforest cropland	124.771
Business-as-usual carbon sink - Reforest pasture	160.954
Business-as-usual carbon sink - Restore productivity	1963
Business-as-usual carbon sink - Total impacted (over 30 years)	124.771