

Net-Zero America - new york 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	13.506	14.147	0	0	0	0
Sale of space heating units by type - Electric Heat Pump	0.019	0.192	0.2	0.21	0.215	0.221	0.229
Sale of space heating units by type - Electric Resistance	0.087	0.099	0.097	0.095	0.094	0.089	0.081
Sale of space heating units by type - Fossil	0.246	0.3	0.16	0.076	0.068	0.068	0.068
Sale of space heating units by type - Gas	0.648	0.409	0.543	0.619	0.622	0.623	0.623
Sales of cooking units - Electric Resistance	0.338	0.338	0.338	0.338	0.338	0.338	0.338
Sales of cooking units - Gas	0.662	0.662	0.662	0.662	0.662	0.662	0.662
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	0.187	0.351	0.35	0.35	0.35	0.349	0.349
Sales of water heating units by type - Gas Furnace	0.711	0.58	0.581	0.581	0.581	0.582	0.582
Sales of water heating units by type - Other	0.103	0.069	0.069	0.069	0.069	0.069	0.069

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	0.981	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	0.039	0.061	0.069	0.085	0.103	0.118	0.13
End-use technology sales by technology - LDV - gasoline	0.896	0.86	0.837	0.817	0.795	0.776	0.761
End-use technology sales by technology - LDV - hybrid	0.048	0.056	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 3: *E- scenario - PILLAR 6: Land carbon sinks - Agriculture*

variable_name	2020	2030	2050
Carbon sink enhancement potential - Accelerate regeneration	0	0	670.208
Carbon sink enhancement potential - All (not counting overlap)	0	0	51871
Carbon sink enhancement potential - Avoid deforestation	0	0	4357.6
Carbon sink enhancement potential - Extend rotation length	0	0	20064.2
Carbon sink enhancement potential - Improve plantations	0	0	1054.658
Carbon sink enhancement potential - Increase retention of HWP	0	0	9106.2
Carbon sink enhancement potential - Increase trees outside forests	0	0	1795.735
Carbon sink enhancement potential - Reforest cropland	0	0	477.532
Carbon sink enhancement potential - Reforest pasture	0	0	8483.1
Carbon sink enhancement potential - Restore productivity	0	0	5861.6
Land impacted for carbon sink enhancement - Accelerate regeneration	0	0	270.118
Land impacted for carbon sink enhancement - All (not counting overlap)	0	0	9447.6
Land impacted for carbon sink enhancement - Avoid deforestation	0	0	1169.749
Land impacted for carbon sink enhancement - Extend rotation length	0	0	11053
Land impacted for carbon sink enhancement - Improve plantations	0	0	586.157
Land impacted for carbon sink enhancement - Increase retention of HWP	0	0	1821.2
Land impacted for carbon sink enhancement - Increase trees outside forests	0	0	506.545
Land impacted for carbon sink enhancement - Natural uptake	-10.19	-16.436	-14.697
Land impacted for carbon sink enhancement - Reforest cropland	0	0	158.99
Land impacted for carbon sink enhancement - Reforest pasture	0	0	641.46
Land impacted for carbon sink enhancement - Restore productivity	0	0	3307.78
Land impacted for carbon sink enhancement - Retained in Hardwood Products	-1.487	-2.674	-2.78
Land impacted for carbon sink enhancement - Total	-11.677	-19.111	-17.477
Land impacted for carbon sink enhancement - Total impacted (over 30 years)	0	0	10067.4

Table 4: *E- scenario - PILLAR 6: Land carbon sinks - Forests*

variable_name	2050
Business-as-usual carbon sink - Accelerate regeneration	62.636
Business-as-usual carbon sink - Avoid deforestation	372.627
Business-as-usual carbon sink - Extend rotation length	6046.7
Business-as-usual carbon sink - Improve plantations	222.591

Table 4: *E- 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	101.845
Business-as-usual carbon sink - Reforest cropland	18.041
Business-as-usual carbon sink - Reforest pasture	156.708
Business-as-usual carbon sink - Restore productivity	1164.4
Business-as-usual carbon sink - Total impacted (over 30 years)	18.041

Table 5: *E- scenario - PILLAR 1: Efficiency/Electrification - Overview*

variable_name	2020	2025	2030	2035	2040	2045	2050
Final energy demand by sector - commercial	0.69	0.686	0.69	0.689	0.696	0.725	0.772
Final energy demand by sector - industry	0.488	0.516	0.537	0.55	0.569	0.586	0.604
Final energy demand by sector - residential	0.88	0.816	0.779	0.749	0.73	0.718	0.709
Final energy demand by sector - transportation	1.162	1.127	1.072	1.042	1.053	1.087	1.129

Table 6: *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	88595201072	91263313974	0	0	0	0
Sales of cooking units - Electric Resistance	0.185	0.194	0.194	0.196	0.197	0.198	0.199
Sales of cooking units - Gas	0.815	0.806	0.806	0.804	0.803	0.802	0.801
Sales of space heating units - Electric Heat Pump	0.006	0.147	0.407	0.619	0.651	0.657	0.655
Sales of space heating units - Electric Resistance	0.021	0.04	0.089	0.213	0.318	0.333	0.336
Sales of space heating units - Fossil	0.191	0.163	0.128	0.057	0.009	0.001	0
Sales of space heating units - Gas Furnace	0.782	0.65	0.377	0.11	0.022	0.01	0.009
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	0.013	0.019	0.019	0.019	0.019	0.019	0.019
Sales of water heating units - Gas Furnace	0.97	0.964	0.963	0.963	0.963	0.963	0.963
Sales of water heating units - Other	0.015	0.014	0.015	0.014	0.015	0.015	0.015

Table 7: *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	6.354	6.406	12.094	12.818	14.638	15.492

Table 8: *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	14.264	15.154	0	0	0	0
Sale of space heating units by type - Electric Heat Pump	0.036	0.162	0.661	0.89	0.917	0.919	0.92
Sale of space heating units by type - Electric Resistance	0.085	0.105	0.06	0.033	0.029	0.03	0.031
Sale of space heating units by type - Fossil	0.242	0.321	0.103	0.047	0.044	0.042	0.041
Sale of space heating units by type - Gas	0.637	0.412	0.176	0.03	0.01	0.009	0.009
Sales of cooking units - Electric Resistance	0.346	0.486	0.912	0.996	1	1	1
Sales of cooking units - Gas	0.654	0.514	0.088	0.004	0	0	0
Sales of water heating units by type - Electric Heat Pump	0	0.065	0.372	0.517	0.535	0.536	0.536
Sales of water heating units by type - Electric Resistance	0.187	0.357	0.398	0.454	0.463	0.464	0.463
Sales of water heating units by type - Gas Furnace	0.711	0.52	0.219	0.029	0.002	0	0
Sales of water heating units by type - Other	0.103	0.058	0.011	0.001	0	0	0

Table 9: *RE- scenario - PILLAR 1: Efficiency/Electrification - Transportation*

variable_name	2020	2025	2030	2035	2040	2045	2050
End-use technology sales by technology - HDV - diesel	0.972	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	0.163	0.481	0.825	0.964	0.993	1
End-use technology sales by technology - LDV - gasoline	0.893	0.767	0.471	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	2187163210	5658022874	9084194799	13794298519	14976777526	14299277106
Number of public EV charging plugs - DC Fast Charging	560	0	3541.6	0	14980.2	0	24120.9
Number of public EV charging plugs - L2 Charging	4226	0	85075.9	0	359852.6	0	579428.5

Table 10: *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	0.005	0.001	0	0.013
Power generation capital investment - biomass w/ccu power plant	0	0	0.008	0	0.001	0	0
Power generation capital investment - Offshore Wind - Base	0	0.393	0.409	15.887	10.92	11.008	11.313
Power generation capital investment - Offshore Wind - Constrained	0	0.782	0.412	15.433	10.835	9.526	12.444
Power generation capital investment - Solar PV - Base	0	6.818	6.338	2.754	6.462	14.055	7.552
Power generation capital investment - Solar PV - Constrained	0	11.45	11.205	5.227	7.172	8.601	3.671
Power generation capital investment - Wind - Base	0	0	5.054	7.372	1.235	3.44	1.036
Power generation capital investment - Wind - Constrained	0	0	8.469	7.671	1.796	3.59	1.055

Table 11: *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	4.498	5.425	5.425	18.817
Power generation by technology - biomass w/ccu power plant	0	0	8.548	8.548	9.282	9.282	9.282

Table 12: *RE- scenario - PILLAR 2: Clean Electricity - Transmission*

variable_name	2020	2025	2030	2035	2040	2045	2050
HV transmission for wind and solar - base all	0	1940.2	4314	16754.7	27434.3	43978.7	63661.8
HV transmission for wind and solar - base other intra-state	0	975.484	2115.7	9082.3	15831.7	23232.6	30384.6
HV transmission for wind and solar - base spur intra-state	0	902.162	1893.3	6600.5	9899.1	17861.1	27426.9
HV transmission for wind and solar - constrained all	0	2139.2	4995	17672.7	28755.8	44148.1	62927.6
HV transmission for wind and solar - constrained other intra-state	0	1109.8	2104.5	10396.8	16150.4	22028.1	29375.1
HV transmission for wind and solar - constrained spur intra-state	0	833.907	2373.2	6076	10900.2	18621.6	26240.1

Table 13: *RE- scenario - PILLAR 3: Bioenergy and Hydrogen - Bioconversion*

variable_name	2020	2025	2030	2035	2040	2045	2050
Biomass purchases	0	0	0	0.001	0.001	0.001	0.222
Capital investment	0	0	0.007	0	0.022	0	4.641
Number of facilities - allam power w ccu	0	0	0	1	1	1	2
Number of facilities - beccs hydrogen	0	0	0	1	1	1	3
Number of facilities - diesel	0	0	0	0	0	0	0
Number of facilities - diesel ccu	0	0	0	1	1	1	2
Number of facilities - power	0	0	0	0	0	0	0
Number of facilities - power ccu	0	0	1	1	1	1	1
Number of facilities - pyrolysis	0	0	0	0	0	0	2
Number of facilities - pyrolysis ccu	0	0	0	1	1	1	1
Number of facilities - sng	0	0	0	0	0	0	0
Number of facilities - sng ccu	0	0	1	1	1	1	2

Table 14: *RE- scenario - PILLAR 4: CO2 capture, use, storage - CO2 capture*

variable_name	2025	2030	2035	2040	2045	2050
Annual - All	0	0.01	3.38	3.35	3.45	7.35
Annual - BECCS	0	0.01	0.02	0.02	0.02	3.8
Annual - Cement	0	0	3.35	3.32	3.42	3.53
Annual - NGCC	0	0	0.01	0.01	0.01	0.01
Cumulative - All	0	0.01	3.39	6.74	10.19	17.54
Cumulative - BECCS	0	0.01	0.03	0.05	0.07	3.87
Cumulative - Cement	0	0	3.35	6.67	10.09	13.62
Cumulative - NGCC	0	0	0.01	0.02	0.03	0.04

Table 15: *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 16: *RE- scenario - PILLAR 4: CO2 capture, use, storage - CO2 transportation*

variable_name	2025	2030	2035	2040	2045	2050
CO2 pipelines - All	0	225376.286	402277.505	493329.505	496772.805	905958.7
CO2 pipelines - Spur	0	111369.921	288271.14	379323.14	382766.44	791952.4
CO2 pipelines - Trunk	0	114006.365	114006.365	114006.365	114006.365	114006.365

Table 17: *RE- scenario - IMPACTS - Jobs*

variable_name	2020	2025	2030	2035	2040	2045	2050
Jobs by economic sector - agriculture	456.394	480.572	668.786	431.365	267.504	105.94	368.483
Jobs by economic sector - construction	20987.7	20386.9	20455.4	27156	32688.7	39642.5	48992.9
Jobs by economic sector - manufacturing	8057.8	11545.7	19113.5	19203.5	21504.9	29079.7	42589.7
Jobs by economic sector - mining	5962.8	4806.7	3438.6	2289.2	1447	864.157	515.561
Jobs by economic sector - other	2509.9	2536.3	2751	3294	4520.9	6473.1	8647.2
Jobs by economic sector - pipeline	1246.6	1234.7	1062.6	877.025	669.09	459.87	415.566
Jobs by economic sector - professional	8563.6	8723.9	8960.8	12804	16052.8	20585.9	29306.6
Jobs by economic sector - trade	6914.2	6685.1	6452	8127.1	9940.6	12837.6	17587.3
Jobs by economic sector - utilities	15247.9	16105.3	15702.2	26569.7	32113.9	37844	61267.8
Jobs by resource sector - Biomass	1375.2	1480.6	1700.3	1048.9	699.819	400.305	1622.4
Jobs by resource sector - CO2	0	0	119.943	358.802	356.984	355.536	1027.6
Jobs by resource sector - Coal	706.081	481.486	138.741	10.136	9.639	9.2	3.529
Jobs by resource sector - Grid	15494.9	16815.3	20756.2	44820.8	54716.3	64769.1	79741.6
Jobs by resource sector - Natural Gas	13328.9	14747.5	10459.7	8379.6	9432.3	7325.7	5429.3
Jobs by resource sector - Nuclear	2655.3	1883.3	1369.1	1224.3	1031.3	3073.9	24819.8
Jobs by resource sector - Oil	11855.7	10343	8327.4	6119.8	4319.6	3030.7	2063.4
Jobs by resource sector - Solar	21874.1	23547.5	26598.8	20144.3	27959.6	44430.3	54376.3
Jobs by resource sector - Wind	2656.9	3206.3	9134.5	18645.3	20680	24498	40607.1
Median wages - All	68926.8	69340.7	68899.1	71168.8	72306	73074.7	75181.6
Required Level of Education - Associates degree or some college	21816.2	22843.6	24849	32391.5	38633.8	47903.4	66738.6
Required Level of Education - Bachelors degree	14387.1	14774.6	15755.8	19991.5	23552.1	29435.4	43855.4
Required Level of Education - Doctoral degree	504.592	500.034	503.964	654.892	789.405	1005.2	1549.2
Required Level of Education - High school diploma or less	29770.5	30861.4	33823.5	42897.2	50491.8	62360.3	86719.3
Required Level of Education - Masters or professional degree	3468.6	3525.5	3672.6	4816.9	5738.2	7188.4	10828.6
Wage income - All	4821703200	5028041773	5416322558	7171059118	8620180700	10808517086	15766702846

Table 18: *RE- scenario - PILLAR 6: Land carbon sinks - Agriculture*

variable_name	2050
Carbon sink enhancement potential - Accelerate regeneration	670.208
Carbon sink enhancement potential - All (not counting overlap)	51871
Carbon sink enhancement potential - Avoid deforestation	4357.6
Carbon sink enhancement potential - corn-ethanol to energy grasses	-527.186
Carbon sink enhancement potential - cropland measures	-3545.682
Carbon sink enhancement potential - Extend rotation length	20064.2
Carbon sink enhancement potential - Improve plantations	1054.658
Carbon sink enhancement potential - Increase retention of HWP	9106.2
Carbon sink enhancement potential - Increase trees outside forests	1795.735
Carbon sink enhancement potential - permanent conservation cover	-134.487
Carbon sink enhancement potential - Reforest cropland	477.532
Carbon sink enhancement potential - Reforest pasture	8483.1
Carbon sink enhancement potential - Restore productivity	5861.6
Carbon sink enhancement potential - total	-4207.354
Land impacted for carbon sink enhancement - Accelerate regeneration	270.118
Land impacted for carbon sink enhancement - All (not counting overlap)	9447.6
Land impacted for carbon sink enhancement - Avoid deforestation	1169.749
Land impacted for carbon sink enhancement - corn-ethanol to energy grasses	171.494
Land impacted for carbon sink enhancement - cropland measures	2274.559
Land impacted for carbon sink enhancement - Extend rotation length	11053
Land impacted for carbon sink enhancement - Improve plantations	586.157
Land impacted for carbon sink enhancement - Increase retention of HWP	1821.2
Land impacted for carbon sink enhancement - Increase trees outside forests	506.545
Land impacted for carbon sink enhancement - permanent conservation cover	244.607
Land impacted for carbon sink enhancement - Reforest cropland	158.99
Land impacted for carbon sink enhancement - Reforest pasture	641.46
Land impacted for carbon sink enhancement - Restore productivity	3307.78
Land impacted for carbon sink enhancement - total	2690.642
Land impacted for carbon sink enhancement - Total impacted (over 30 years)	10067.4

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

variable_name	2050
Business-as-usual carbon sink - Accelerate regeneration	62.636
Business-as-usual carbon sink - Avoid deforestation	372.627
Business-as-usual carbon sink - Extend rotation length	6046.7
Business-as-usual carbon sink - Improve plantations	222.591
Business-as-usual carbon sink - Increase retention of HWP	0
Business-as-usual carbon sink - Increase trees outside forests	101.845
Business-as-usual carbon sink - Reforest cropland	18.041

Table 19: *RE- scenario - PILLAR 6: Land carbon sinks - Forests (continued)*

variable_name	2050
Business-as-usual carbon sink - Reforest pasture	156.708
Business-as-usual carbon sink - Restore productivity	1164.4
Business-as-usual carbon sink - Total impacted (over 30 years)	18.041

Table 20: *RE- scenario - IMPACTS - Fossil fuel industries*

variable_name	2020	2025	2030	2035	2040	2045	2050
Natural gas consumption	1030036	1045333	881157.1	706724.3	532011.5	334723.8	232155.7
Oil consumption	240980.6	230264.6	201760.4	160150.5	121656	91275.7	66253.5

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

variable_name	2020	2025	2030	2035	2040	2045	2050
Final energy demand by sector - commercial	0.69	0.677	0.65	0.604	0.56	0.538	0.533
Final energy demand by sector - industry	0.488	0.505	0.512	0.521	0.523	0.53	0.532
Final energy demand by sector - residential	0.88	0.819	0.735	0.612	0.496	0.413	0.364
Final energy demand by sector - transportation	1.161	1.104	0.995	0.858	0.731	0.647	0.604

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	89683681799	98037190768	0	0	0	0
Sales of cooking units - Electric Resistance	0.185	0.337	0.753	0.835	0.839	0.84	0.84
Sales of cooking units - Gas	0.815	0.663	0.247	0.165	0.161	0.16	0.16
Sales of space heating units - Electric Heat Pump	0.006	0.156	0.511	0.763	0.798	0.803	0.802
Sales of space heating units - Electric Resistance	0.021	0.047	0.128	0.18	0.191	0.188	0.189
Sales of space heating units - Fossil	0.191	0.145	0.029	0.001	0	0	0
Sales of space heating units - Gas Furnace	0.782	0.652	0.332	0.056	0.011	0.009	0.009
Sales of water heating units - Electric Heat Pump	0.002	0.073	0.41	0.587	0.61	0.612	0.612
Sales of water heating units - Electric Resistance	0.013	0.051	0.223	0.364	0.385	0.387	0.387
Sales of water heating units - Gas Furnace	0.97	0.863	0.363	0.047	0.003	0	0
Sales of water heating units - Other	0.015	0.012	0.004	0.002	0.002	0.002	0.002

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	7.59	7.79	18.211	19.627	18.397	19.498

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	14.308	16.262	0	0	0	0
Sale of space heating units by type - Electric Heat Pump	0.036	0.075	0.129	0.289	0.552	0.753	0.837
Sale of space heating units by type - Electric Resistance	0.085	0.112	0.106	0.092	0.067	0.047	0.038
Sale of space heating units by type - Fossil	0.242	0.363	0.34	0.272	0.166	0.096	0.07
Sale of space heating units by type - Gas	0.637	0.451	0.424	0.347	0.215	0.104	0.055
Sales of cooking units - Electric Resistance	0.344	0.361	0.421	0.579	0.799	0.935	0.983
Sales of cooking units - Gas	0.656	0.639	0.579	0.421	0.2	0.065	0.017
Sales of water heating units by type - Electric Heat Pump	0	0.012	0.046	0.147	0.312	0.439	0.493
Sales of water heating units by type - Electric Resistance	0.187	0.353	0.356	0.369	0.396	0.426	0.442
Sales of water heating units by type - Gas Furnace	0.711	0.568	0.536	0.437	0.267	0.124	0.06
Sales of water heating units by type - Other	0.103	0.067	0.062	0.047	0.025	0.011	0.006

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	0.05	0.124	0.268	0.494	0.727	0.878
End-use technology sales by technology - LDV - gasoline	0.914	0.869	0.787	0.655	0.451	0.242	0.107
End-use technology sales by technology - LDV - hybrid	0.05	0.057	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	362921326	742360770	2526429355	7888870614	11514390721
Number of public EV charging plugs - DC Fast Charging	560	0	1170.9	0	5614.7	0	15449.4
Number of public EV charging plugs - L2 Charging	4226	0	28128.2	0	134874.8	0	371123.6

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

variable_name	2050
Carbon sink enhancement potential - Accelerate regeneration	670.208
Carbon sink enhancement potential - All (not counting overlap)	51871
Carbon sink enhancement potential - Avoid deforestation	4357.6
Carbon sink enhancement potential - corn-ethanol to energy grasses	-527.186
Carbon sink enhancement potential - cropland measures	-3545.682
Carbon sink enhancement potential - Extend rotation length	20064.2
Carbon sink enhancement potential - Improve plantations	1054.658
Carbon sink enhancement potential - Increase retention of HWP	9106.2
Carbon sink enhancement potential - Increase trees outside forests	1795.735
Carbon sink enhancement potential - permanent conservation cover	-134.487
Carbon sink enhancement potential - Reforest cropland	477.532
Carbon sink enhancement potential - Reforest pasture	8483.1
Carbon sink enhancement potential - Restore productivity	5861.6
Carbon sink enhancement potential - total	-4207.354
Land impacted for carbon sink enhancement - Accelerate regeneration	270.118
Land impacted for carbon sink enhancement - All (not counting overlap)	9447.6
Land impacted for carbon sink enhancement - Avoid deforestation	1169.749
Land impacted for carbon sink enhancement - corn-ethanol to energy grasses	171.494
Land impacted for carbon sink enhancement - cropland measures	2274.559
Land impacted for carbon sink enhancement - Extend rotation length	11053
Land impacted for carbon sink enhancement - Improve plantations	586.157
Land impacted for carbon sink enhancement - Increase retention of HWP	1821.2
Land impacted for carbon sink enhancement - Increase trees outside forests	506.545
Land impacted for carbon sink enhancement - permanent conservation cover	244.607
Land impacted for carbon sink enhancement - Reforest cropland	158.99
Land impacted for carbon sink enhancement - Reforest pasture	641.46
Land impacted for carbon sink enhancement - Restore productivity	3307.78
Land impacted for carbon sink enhancement - total	2690.642
Land impacted for carbon sink enhancement - Total impacted (over 30 years)	10067.4

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

variable_name	2050
Business-as-usual carbon sink - Accelerate regeneration	62.636
Business-as-usual carbon sink - Avoid deforestation	372.627
Business-as-usual carbon sink - Extend rotation length	6046.7
Business-as-usual carbon sink - Improve plantations	222.591
Business-as-usual carbon sink - Increase retention of HWP	0
Business-as-usual carbon sink - Increase trees outside forests	101.845
Business-as-usual carbon sink - Reforest cropland	18.041
Business-as-usual carbon sink - Reforest pasture	156.708
Business-as-usual carbon sink - Restore productivity	1164.4
Business-as-usual carbon sink - Total impacted (over 30 years)	18.041

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

variable_name	2020	2025	2030	2035	2040	2045	2050
Final energy demand by sector - commercial	0.69	0.679	0.673	0.667	0.654	0.636	0.618
Final energy demand by sector - industry	0.488	0.505	0.514	0.526	0.531	0.538	0.538
Final energy demand by sector - residential	0.88	0.823	0.783	0.735	0.664	0.579	0.494
Final energy demand by sector - transportation	1.163	1.112	1.033	0.964	0.905	0.837	0.757

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	89636567441	97820121886	0	0	0	0
Sales of cooking units - Electric Resistance	0.185	0.216	0.275	0.43	0.645	0.777	0.823
Sales of cooking units - Gas	0.815	0.784	0.725	0.57	0.355	0.223	0.177
Sales of space heating units - Electric Heat Pump	0.006	0.1	0.139	0.255	0.459	0.639	0.722
Sales of space heating units - Electric Resistance	0.021	0.034	0.043	0.07	0.117	0.154	0.173
Sales of space heating units - Fossil	0.191	0.168	0.162	0.128	0.07	0.029	0.016
Sales of space heating units - Gas Furnace	0.782	0.698	0.656	0.547	0.353	0.178	0.089
Sales of water heating units - Electric Heat Pump	0.002	0.017	0.054	0.164	0.349	0.495	0.558
Sales of water heating units - Electric Resistance	0.013	0.026	0.045	0.101	0.203	0.296	0.34
Sales of water heating units - Gas Furnace	0.97	0.944	0.888	0.724	0.441	0.206	0.098
Sales of water heating units - Other	0.015	0.013	0.013	0.01	0.006	0.004	0.003

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	6.028	6.041	8.856	9.203	14.685	15.644

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	0.393	0.409	25.674	17.311	18.57	28.414
Power generation capital investment - Solar PV - Base	8.725	8.167	9.853	8.953	12.065	4.29
Power generation capital investment - Wind - Base	0	5.054	8.668	2.975	8.082	5.031

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	2544.6	4957.1	26645.6	45455.3	72272.1	129134.2
HV transmission for wind and solar - base other intra-state	0	1220.6	2289.4	15264.5	24258.5	34268	52887.9
HV transmission for wind and solar - base spur intra-state	0	1232.1	2223.2	9732.2	18259	30373.7	62127.7

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

variable_name	2050
Carbon sink enhancement potential - Accelerate regeneration	670.208
Carbon sink enhancement potential - All (not counting overlap)	51871
Carbon sink enhancement potential - Avoid deforestation	4357.6
Carbon sink enhancement potential - corn-ethanol to energy grasses	-527.186
Carbon sink enhancement potential - cropland measures	-3545.682
Carbon sink enhancement potential - Extend rotation length	20064.2
Carbon sink enhancement potential - Improve plantations	1054.658
Carbon sink enhancement potential - Increase retention of HWP	9106.2
Carbon sink enhancement potential - Increase trees outside forests	1795.735
Carbon sink enhancement potential - permanent conservation cover	-134.487
Carbon sink enhancement potential - Reforest cropland	477.532
Carbon sink enhancement potential - Reforest pasture	8483.1
Carbon sink enhancement potential - Restore productivity	5861.6
Carbon sink enhancement potential - total	-4207.354
Land impacted for carbon sink enhancement - Accelerate regeneration	270.118
Land impacted for carbon sink enhancement - All (not counting overlap)	9447.6
Land impacted for carbon sink enhancement - Avoid deforestation	1169.749
Land impacted for carbon sink enhancement - corn-ethanol to energy grasses	171.494
Land impacted for carbon sink enhancement - cropland measures	2274.559
Land impacted for carbon sink enhancement - Extend rotation length	11053
Land impacted for carbon sink enhancement - Improve plantations	586.157
Land impacted for carbon sink enhancement - Increase retention of HWP	1821.2
Land impacted for carbon sink enhancement - Increase trees outside forests	506.545
Land impacted for carbon sink enhancement - permanent conservation cover	244.607
Land impacted for carbon sink enhancement - Reforest cropland	158.99
Land impacted for carbon sink enhancement - Reforest pasture	641.46
Land impacted for carbon sink enhancement - Restore productivity	3307.78
Land impacted for carbon sink enhancement - total	2690.642
Land impacted for carbon sink enhancement - Total impacted (over 30 years)	10067.4

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

variable_name	2050
Business-as-usual carbon sink - Accelerate regeneration	62.636
Business-as-usual carbon sink - Avoid deforestation	372.627
Business-as-usual carbon sink - Extend rotation length	6046.7
Business-as-usual carbon sink - Improve plantations	222.591
Business-as-usual carbon sink - Increase retention of HWP	0
Business-as-usual carbon sink - Increase trees outside forests	101.845
Business-as-usual carbon sink - Reforest cropland	18.041
Business-as-usual carbon sink - Reforest pasture	156.708
Business-as-usual carbon sink - Restore productivity	1164.4
Business-as-usual carbon sink - Total impacted (over 30 years)	18.041

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	0.005	0.001	0	0.011
Power generation capital investment - biomass w/ccu power plant	0	0	0.007	0	0.001	0	0.011

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	4.488	5.235	5.453	16.869
Power generation by technology - biomass w/ccu power plant	0	0	8.382	8.382	9.011	9.121	21.734

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

variable_name	2020	2025	2030	2035	2040	2045	2050
Biomass purchases	0	0	0.001	0.002	0.002	0.006	1.008
Capital investment	0	0	0.007	0	0.025	0	11.584
Number of facilities - allam power w ccu	0	0	0	1	1	1	1
Number of facilities - beccs hydrogen	0	0	0	1	1	1	1
Number of facilities - diesel	0	0	0	0	0	1	1
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	1	1	1	1	1
Number of facilities - pyrolysis	0	0	0	0	0	1	13
Number of facilities - pyrolysis ccu	0	0	0	1	1	1	1
Number of facilities - sng	0	0	0	0	0	0	0
Number of facilities - sng ccu	0	0	1	1	1	1	1

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

variable_name	2025	2030	2035	2040	2045	2050
Annual - All	0	0.01	3.38	3.35	3.45	3.67
Annual - BECCS	0	0.01	0.02	0.02	0.03	0.12
Annual - Cement	0	0	3.35	3.32	3.42	3.53
Annual - NGCC	0	0	0.01	0.01	0.01	0.01
Cumulative - All	0	0.01	3.39	6.74	10.19	13.86
Cumulative - BECCS	0	0.01	0.03	0.05	0.08	0.2
Cumulative - Cement	0	0	3.35	6.67	10.09	13.62
Cumulative - NGCC	0	0	0.01	0.02	0.03	0.04

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	223650.286	490510.105	489404.205	400650.005	499429.805
CO2 pipelines - Spur	0	109643.921	376503.74	375397.84	286643.64	385423.44
CO2 pipelines - Trunk	0	114006.365	114006.365	114006.365	114006.365	114006.365

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

variable_name	2050
Carbon sink enhancement potential - Accelerate regeneration	670.208
Carbon sink enhancement potential - All (not counting overlap)	51871
Carbon sink enhancement potential - Avoid deforestation	4357.6
Carbon sink enhancement potential - corn-ethanol to energy grasses	-827.668
Carbon sink enhancement potential - cropland measures	-3359.284
Carbon sink enhancement potential - Cropland to woody energy crops	0
Carbon sink enhancement potential - Extend rotation length	20064.2
Carbon sink enhancement potential - Improve plantations	1054.658
Carbon sink enhancement potential - Increase retention of HWP	9106.2
Carbon sink enhancement potential - Increase trees outside forests	1795.735
Carbon sink enhancement potential - pasture to energy crops	0
Carbon sink enhancement potential - permanent conservation cover	-127.289
Carbon sink enhancement potential - Reforest cropland	477.532
Carbon sink enhancement potential - Reforest pasture	8483.1
Carbon sink enhancement potential - Restore productivity	5861.6

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

variable_name	2050
Carbon sink enhancement potential - total	-4314.24
Land impacted for carbon sink enhancement - Accelerate regeneration	270.118
Land impacted for carbon sink enhancement - All (not counting overlap)	9447.6
Land impacted for carbon sink enhancement - Avoid deforestation	1169.749
Land impacted for carbon sink enhancement - corn-ethanol to energy grasses	343.458
Land impacted for carbon sink enhancement - cropland measures	4226.903
Land impacted for carbon sink enhancement - Cropland to woody energy crops	2.612
Land impacted for carbon sink enhancement - Extend rotation length	11053
Land impacted for carbon sink enhancement - Improve plantations	586.157
Land impacted for carbon sink enhancement - Increase retention of HWP	1821.2
Land impacted for carbon sink enhancement - Increase trees outside forests	506.545
Land impacted for carbon sink enhancement - pasture to energy crops	156.608
Land impacted for carbon sink enhancement - permanent conservation cover	231.516
Land impacted for carbon sink enhancement - Reforest cropland	158.99
Land impacted for carbon sink enhancement - Reforest pasture	641.46
Land impacted for carbon sink enhancement - Restore productivity	3307.78
Land impacted for carbon sink enhancement - total	4961.1
Land impacted for carbon sink enhancement - Total impacted (over 30 years)	10067.4

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

variable_name	2050
Business-as-usual carbon sink - Accelerate regeneration	62.636
Business-as-usual carbon sink - Avoid deforestation	372.627
Business-as-usual carbon sink - Extend rotation length	6046.7
Business-as-usual carbon sink - Improve plantations	222.591
Business-as-usual carbon sink - Increase retention of HWP	0
Business-as-usual carbon sink - Increase trees outside forests	101.845
Business-as-usual carbon sink - Reforest cropland	18.041
Business-as-usual carbon sink - Reforest pasture	156.708
Business-as-usual carbon sink - Restore productivity	1164.4
Business-as-usual carbon sink - Total impacted (over 30 years)	18.041

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

variable_name	2050
Carbon sink enhancement potential - Accelerate regeneration	670.208
Carbon sink enhancement potential - All (not counting overlap)	51871
Carbon sink enhancement potential - Avoid deforestation	4357.6
Carbon sink enhancement potential - corn-ethanol to energy grasses	-527.186
Carbon sink enhancement potential - cropland measures	-3545.682
Carbon sink enhancement potential - Extend rotation length	20064.2
Carbon sink enhancement potential - Improve plantations	1054.658
Carbon sink enhancement potential - Increase retention of HWP	9106.2
Carbon sink enhancement potential - Increase trees outside forests	1795.735
Carbon sink enhancement potential - permanent conservation cover	-134.487
Carbon sink enhancement potential - Reforest cropland	477.532
Carbon sink enhancement potential - Reforest pasture	8483.1
Carbon sink enhancement potential - Restore productivity	5861.6
Carbon sink enhancement potential - total	-4207.354
Land impacted for carbon sink enhancement - Accelerate regeneration	270.118
Land impacted for carbon sink enhancement - All (not counting overlap)	9447.6
Land impacted for carbon sink enhancement - Avoid deforestation	1169.749
Land impacted for carbon sink enhancement - corn-ethanol to energy grasses	171.494
Land impacted for carbon sink enhancement - cropland measures	2274.559
Land impacted for carbon sink enhancement - Extend rotation length	11053
Land impacted for carbon sink enhancement - Improve plantations	586.157
Land impacted for carbon sink enhancement - Increase retention of HWP	1821.2
Land impacted for carbon sink enhancement - Increase trees outside forests	506.545
Land impacted for carbon sink enhancement - permanent conservation cover	244.607

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

variable_name	2050
Land impacted for carbon sink enhancement - Reforest cropland	158.99
Land impacted for carbon sink enhancement - Reforest pasture	641.46
Land impacted for carbon sink enhancement - Restore productivity	3307.78
Land impacted for carbon sink enhancement - total	2690.642
Land impacted for carbon sink enhancement - Total impacted (over 30 years)	10067.4

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

variable_name	2050
Business-as-usual carbon sink - Accelerate regeneration	62.636
Business-as-usual carbon sink - Avoid deforestation	372.627
Business-as-usual carbon sink - Extend rotation length	6046.7
Business-as-usual carbon sink - Improve plantations	222.591
Business-as-usual carbon sink - Increase retention of HWP	0
Business-as-usual carbon sink - Increase trees outside forests	101.845
Business-as-usual carbon sink - Reforest cropland	18.041
Business-as-usual carbon sink - Reforest pasture	156.708
Business-as-usual carbon sink - Restore productivity	1164.4
Business-as-usual carbon sink - Total Impacted (over 30 years)	18.041