Net-Zero America - vermont state report v2

Larson et al. 2020

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Reading guide

IN DRAFT

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

variable_name	2020	2025	2030	2035	2040	2045	2050
Residential HVAC investment in 2020s vs. REF - Cumulative 5-yr	0	0.472	0.488	0	0	0	0
Sale of space heating units by type - Electric Heat Pump	0.029	0.062	0.065	0.069	0.07	0.07	0.071
Sale of space heating units by type - Electric Resistance	0.014	0.016	0.016	0.016	0.016	0.015	0.015
Sale of space heating units by type - Fossil	0.779	0.746	0.468	0.276	0.264	0.262	0.263
Sale of space heating units by type - Gas	0.178	0.176	0.452	0.639	0.651	0.653	0.651
Sales of cooking units - Electric Resistance	0.462	0.462	0.462	0.462	0.462	0.462	0.462
Sales of cooking units - Gas	0.538	0.538	0.538	0.538	0.538	0.538	0.538
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	0.193	0.321	0.319	0.319	0.319	0.318	0.317
Sales of water heating units by type - Gas Furnace	0.541	0.489	0.491	0.492	0.492	0.493	0.494
Sales of water heating units by type - Other	0.266	0.19	0.19	0.189	0.189	0.189	0.189

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	0.017	0.021	0.022	0.02	0.018	0.017	0.016
End-use technology sales by technology - LDV - EV	0.032	0.051	0.059	0.072	0.088	0.102	0.114
End-use technology sales by technology - LDV - gasoline	0.908	0.874	0.854	0.837	0.817	0.798	0.782
End-use technology sales by technology - LDV - hybrid	0.041	0.049	0.061	0.066	0.072	0.079	0.084
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 3: *E- scenario - PILLAR 6: Land carbon sinks - Agriculture*

variable_name	2020	2030	2050
Carbon sink enhancement potential - Accelerate regeneration	0	0	25.05
Carbon sink enhancement potential - All (not counting overlap)	0	0	10939.1
Carbon sink enhancement potential - Avoid deforestation	0	0	458.741
Carbon sink enhancement potential - Extend rotation length	0	0	5335.9
Carbon sink enhancement potential - Improve plantations	0	0	45.726
Carbon sink enhancement potential - Increase retention of HWP	0	0	2553.2
Carbon sink enhancement potential - Increase trees outside forests	0	0	189.288
Carbon sink enhancement potential - Reforest cropland	0	0	0
Carbon sink enhancement potential - Reforest pasture	0	0	1105.77
Carbon sink enhancement potential - Restore productivity	0	0	1225.447
Land impacted for carbon sink enhancement - Accelerate regeneration	0	0	10.097
Land impacted for carbon sink enhancement - All (not counting overlap)	0	0	2132.3
Land impacted for carbon sink enhancement - Avoid deforestation	0	0	123.143
Land impacted for carbon sink enhancement - Extend rotation length	0	0	2939.473
Land impacted for carbon sink enhancement - Improve plantations	0	0	25.413
Land impacted for carbon sink enhancement - Increase retention of HWP	0	0	510.646
Land impacted for carbon sink enhancement - Increase trees outside forests	0	0	53.396
Land impacted for carbon sink enhancement - Natural uptake	4.2	-3.926	-3.511
Land impacted for carbon sink enhancement - Reforest cropland	0	0	0
Land impacted for carbon sink enhancement - Reforest pasture	0	0	83.614
Land impacted for carbon sink enhancement - Restore productivity	0	0	691.531
Land impacted for carbon sink enhancement - Retained in Hardwood Products	-0.417	-0.75	-0.779
Land impacted for carbon sink enhancement - Total	3.783	-4.676	-4.29
Land impacted for carbon sink enhancement - Total impacted (over 30 years)	0	0	2304.988

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

variable_name	2050
Business-as-usual carbon sink - Accelerate regeneration	2.341
Business-as-usual carbon sink - Avoid deforestation	39.228
Business-as-usual carbon sink - Extend rotation length	1608.1
Business-as-usual carbon sink - Improve plantations	9.651

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	10.736
Business-as-usual carbon sink - Reforest cropland	0
Business-as-usual carbon sink - Reforest pasture	20.427
Business-as-usual carbon sink - Restore productivity	243.439
Business-as-usual carbon sink - Total impacted (over 30 years)	0

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

variable_name	2020	2025	2030	2035	2040	2045	2050
Final energy demand by sector - commercial	0.019	0.018	0.018	0.018	0.018	0.018	0.018
Final energy demand by sector - industry	0.02	0.021	0.022	0.023	0.024	0.025	0.026
Final energy demand by sector - residential	0.033	0.03	0.028	0.027	0.026	0.025	0.024
Final energy demand by sector - transportation	0.052	0.049	0.044	0.042	0.042	0.043	0.044

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	1332898187	1369757807	0	0	0	0
Sales of cooking units - Electric Resistance	0.369	0.39	0.386	0.385	0.383	0.385	0.384
Sales of cooking units - Gas	0.631	0.61	0.614	0.615	0.617	0.615	0.616
Sales of space heating units - Electric Heat Pump	0.022	0.129	0.411	0.642	0.678	0.681	0.682
Sales of space heating units - Electric Resistance	0.012	0.026	0.074	0.197	0.3	0.318	0.318
Sales of space heating units - Fossil	0.615	0.358	0.251	0.098	0.014	0.001	0
Sales of space heating units - Gas Furnace	0.351	0.487	0.264	0.063	0.008	0	0
Sales of water heating units - Electric Heat Pump	0.021	0.024	0.023	0.023	0.023	0.024	0.023
Sales of water heating units - Electric Resistance	0.103	0.111	0.109	0.111	0.111	0.11	0.11
Sales of water heating units - Gas Furnace	0.796	0.818	0.822	0.82	0.82	0.823	0.823
Sales of water heating units - Other	0.081	0.047	0.045	0.045	0.046	0.044	0.043

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	0.265	0.269	0.352	0.366	0.338	0.346

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	0.48	0.516	0	0	0	0
Sale of space heating units by type - Electric Heat Pump	0.031	0.121	0.616	0.9	0.939	0.941	0.941
Sale of space heating units by type - Electric Resistance	0.014	0.016	0.013	0.006	0.004	0.004	0.005
Sale of space heating units by type - Fossil	0.778	0.766	0.301	0.083	0.056	0.054	0.054
Sale of space heating units by type - Gas	0.178	0.097	0.069	0.012	0.002	0.001	0.001
Sales of cooking units - Electric Resistance	0.469	0.582	0.928	0.996	1	1	1
Sales of cooking units - Gas	0.531	0.418	0.072	0.004	0	0	0
Sales of water heating units by type - Electric Heat Pump	0	0.022	0.17	0.368	0.401	0.403	0.403
Sales of water heating units by type - Electric Resistance	0.193	0.34	0.452	0.575	0.595	0.597	0.596
Sales of water heating units by type - Gas Furnace	0.541	0.478	0.347	0.056	0.003	0	0
Sales of water heating units by type - Other	0.266	0.16	0.031	0.002	0.001	0.001	0.001

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	0.017	0.019	0.013	0.004	0.001	0	0
End-use technology sales by technology - LDV - EV	0.035	0.14	0.447	0.811	0.962	0.993	1
End-use technology sales by technology - LDV - gasoline	0.905	0.793	0.506	0.172	0.034	0.006	0
End-use technology sales by technology - LDV - hybrid	0.041	0.043	0.031	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	117659286	305631636	488687754	742877296	805681509	769711431
Number of public EV charging plugs - DC Fast Charging	47	0	305.004	0	1269.6	0	2040.5
Number of public EV charging plugs - L2 Charging	543	0	7335.2	0	30534.3	0	49072.9

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	0.03	0	0	0	0
Power generation capital investment - biomass w/ccu allam power plant	0	0	0	0	0	0	0
Power generation capital investment - biomass w/ccu power plant	0	0	0	0	0	0	0
Power generation capital investment - Solar PV - Base	0	0	0	0	0	1.028	4.219
Power generation capital investment - Solar PV - Constrained	0	0.025	0.104	0	0	4.356	3.863
Power generation capital investment - Wind - Base	0	0	2.032	0.534	0.524	0.425	0.362
Power generation capital investment - Wind - Constrained	0	0	1.394	0.377	0.727	0.135	0.915

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	59.387	59.387	59.387	59.387	59.387
Power generation by technology - biomass w/ccu allam power plant	0	0	0	0	0	0	0
Power generation by technology - biomass w/ccu power plant	0	0	0	0	0	0	0

Table 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	3.616	402.91	549.476	645.819	1352.4	3758.1
HV transmission for wind and solar - base other intra-state	0	0	0	0	0	0	0
HV transmission for wind and solar - base spur intra-state	0	0.525	158.492	184.558	215.25	298.199	941.155
HV transmission for wind and solar - constrained all	0	0	312.906	469.571	619.62	1767.4	3291.3
HV transmission for wind and solar - constrained other intra-state	0	0	0	0	0	0	0
HV transmission for wind and solar - constrained spur intra-state	0	0	87.526	114.136	149.093	311.176	706.535

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

variable_name	2020	2025	2030	2035	2040	2045	2050
Biomass purchases	0	0	0.002	0.004	0.004	0.005	0.016
Capital investment	0	0	0.032	0	0.034	0	0.253
Number of facilities - allam power w ccu	0	0	0	0	0	0	0
Number of facilities - beccs hydrogen	0	0	0	0	0	0	0
Number of facilities - diesel	0	0	0	1	1	1	1
Number of facilities - diesel ccu	0	0	0	0	0	0	0
Number of facilities - power	0	0	1	1	1	1	1
Number of facilities - power ccu	0	0	0	0	0	0	0
Number of facilities - pyrolysis	0	0	0	1	1	1	1
Number of facilities - pyrolysis ccu	0	0	0	0	0	0	0
Number of facilities - sng	0	1	1	1	1	1	1
Number of facilities - sng ccu	0	0	0	0	0	0	0

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

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

Table 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	0	0	0	0	0
CO2 pipelines - Spur	0	0	0	0	0	0
CO2 pipelines - Trunk	0	0	0	0	0	0

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

variable_name	2020	2025	2030	2035	2040	2045	2050
Jobs by economic sector - agriculture	24.844	28.641	60.24	30.421	25.124	20.518	30.845
Jobs by economic sector - construction	1166.7	944.438	991.817	1021.3	1024.2	1746.9	4856.6
Jobs by economic sector - manufacturing	427.204	645.511	1155.3	1068.8	1169.7	1656.2	2609

Table 17: *RE- scenario - IMPACTS - Jobs (continued)*

variable_name	2020	2025	2030	2035	2040	2045	2050
Jobs by economic sector - mining	358.733	299.942	231.656	167.364	119.254	85.511	63.013
Jobs by economic sector - other	181.112	149.24	117.471	133.853	148.948	342.484	1263.2
Jobs by economic sector - pipeline	41.488	41.865	38.375	33.041	27.921	23.375	20.397
Jobs by economic sector - professional	454.258	422.573	586.798	588.355	616.399	957.352	2451.9
Jobs by economic sector - trade	428.498	384.773	410.522	406.025	410.199	645.238	1766
Jobs by economic sector - utilities	142.022	207.586	569.79	615.226	635.064	1086.5	2759.9
Jobs by resource sector - Biomass	102.984	122.926	166.098	86.642	75.632	74.83	131.719
Jobs by resource sector - CO2	0	0	0	0	0	0	0
Jobs by resource sector - Grid	161.769	313.177	1032.1	1133.7	1185.6	2129.8	5565.6
Jobs by resource sector - Natural Gas	97.573	95.543	78.019	60.834	44.66	27.478	18.682
Jobs by resource sector - Nuclear	0	0	0	0	0	0	0
Jobs by resource sector - Oil	973.088	889.643	759.806	610.034	486.729	394.982	329.888
Jobs by resource sector - Solar	1770.6	1562.9	1146.9	930.322	1133.5	2664.9	7894.2
Jobs by resource sector - Wind	118.762	140.43	979.008	1242.8	1250.7	1272.1	1880.9
Median wages - All	55717.9	56462	57614.5	58444.7	59010.9	59506.9	60403.1
Required Level of Education - Associates degree or some college	966.005	939.305	1277.6	1266.6	1311.7	2094.3	5109.9
Required Level of Education - Bachelors degree	667.937	655.03	872.335	842.734	862.127	1316.1	3086.2
Required Level of Education - Doctoral degree	25.879	23.844	30.22	29.506	30.201	46.231	115.51
Required Level of Education - High school diploma or less	1406.6	1353.5	1777	1725.9	1768.3	2791.9	6743.1
Required Level of Education - Masters or professional degree	158.367	152.906	204.751	199.575	204.482	315.592	766.192
Wage income - All	179706739	176442070	239808524	237563855	246500708	390661607	955828365

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

variable_name	2050
Carbon sink enhancement potential - Accelerate regeneration	25.05
Carbon sink enhancement potential - All (not counting overlap)	10939.1
Carbon sink enhancement potential - Avoid deforestation	458.741
Carbon sink enhancement potential - corn-ethanol to energy grasses	0
Carbon sink enhancement potential - cropland measures	-507.514
Carbon sink enhancement potential - Extend rotation length	5335.9
Carbon sink enhancement potential - Improve plantations	45.726
Carbon sink enhancement potential - Increase retention of HWP	2553.2
Carbon sink enhancement potential - Increase trees outside forests	189.288
Carbon sink enhancement potential - permanent conservation cover	-15.921
Carbon sink enhancement potential - Reforest cropland	0
Carbon sink enhancement potential - Reforest pasture	1105.77
Carbon sink enhancement potential - Restore productivity	1225.447
Carbon sink enhancement potential - total	-523.435
Land impacted for carbon sink enhancement - Accelerate regeneration	10.097
Land impacted for carbon sink enhancement - All (not counting overlap)	2132.3
Land impacted for carbon sink enhancement - Avoid deforestation	123.143
Land impacted for carbon sink enhancement - corn-ethanol to energy grasses	0
Land impacted for carbon sink enhancement - cropland measures	267.275
Land impacted for carbon sink enhancement - Extend rotation length	2939.473
Land impacted for carbon sink enhancement - Improve plantations	25.413
Land impacted for carbon sink enhancement - Increase retention of HWP	510.646
Land impacted for carbon sink enhancement - Increase trees outside forests	53.396
Land impacted for carbon sink enhancement - permanent conservation cover	28.957
Land impacted for carbon sink enhancement - Reforest cropland	0
Land impacted for carbon sink enhancement - Reforest pasture	83.614
Land impacted for carbon sink enhancement - Restore productivity	691.531
Land impacted for carbon sink enhancement - total	296.231
Land impacted for carbon sink enhancement - Total impacted (over 30 years)	2304.988

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

variable_name	2050
Business-as-usual carbon sink - Accelerate regeneration	2.341
Business-as-usual carbon sink - Avoid deforestation	39.228
Business-as-usual carbon sink - Extend rotation length	1608.1
Business-as-usual carbon sink - Improve plantations	9.651
Business-as-usual carbon sink - Increase retention of HWP	0
Business-as-usual carbon sink - Increase trees outside forests	10.736
Business-as-usual carbon sink - Reforest cropland	0
Business-as-usual carbon sink - Reforest pasture	20.427
Business-as-usual carbon sink - Restore productivity	243.439
Business-as-usual carbon sink - Total impacted (over 30 years)	0

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

variable_name	2020	2025	2030	2035	2040	2045	2050
Natural gas consumption	10494	10649.9	8977.3	7200.1	5420.1	3410.2	2365.2
Oil consumption	19962.4	20011.3	18625	16197.1	13914.4	12087.4	10746.8

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

variable_name	2020	2025	2030	2035	2040	2045	2050
Final energy demand by sector - commercial	0.019	0.018	0.017	0.016	0.015	0.014	0.014
Final energy demand by sector - industry	0.02	0.02	0.02	0.02	0.019	0.019	0.019
Final energy demand by sector - residential	0.033	0.03	0.026	0.022	0.018	0.015	0.014
Final energy demand by sector - transportation	0.052	0.048	0.042	0.034	0.027	0.022	0.02

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	1349748555	1473581003	0	0	0	0
Sales of cooking units - Electric Resistance	0.369	0.499	0.812	0.874	0.877	0.877	0.877
Sales of cooking units - Gas	0.631	0.501	0.188	0.126	0.123	0.123	0.123
Sales of space heating units - Electric Heat Pump	0.022	0.109	0.396	0.724	0.776	0.778	0.779
Sales of space heating units - Electric Resistance	0.012	0.044	0.166	0.213	0.22	0.222	0.221
Sales of space heating units - Fossil	0.615	0.321	0.062	0.003	0	0	0
Sales of space heating units - Gas Furnace	0.351	0.526	0.376	0.06	0.004	0	0
Sales of water heating units - Electric Heat Pump	0.021	0.035	0.16	0.412	0.457	0.46	0.46
Sales of water heating units - Electric Resistance	0.103	0.122	0.239	0.48	0.522	0.525	0.525
Sales of water heating units - Gas Furnace	0.796	0.8	0.582	0.093	0.005	0	0
Sales of water heating units - Other	0.081	0.042	0.019	0.016	0.015	0.015	0.016

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

variable_name	2025	2030	2035	2040	2045	2050
Electricity distribution peak load (capital invested) - Cumulative 5-yr	0.313	0.322	0.616	0.66	0.557	0.583

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

variable_name	2020	2025	2030	2035	2040	2045	2050
Residential HVAC investment in 2020s vs. REF - Cumulative 5-yr	0	0.481	0.555	0	0	0	0
Sale of space heating units by type - Electric Heat Pump	0.031	0.029	0.057	0.14	0.284	0.403	0.457
Sale of space heating units by type - Electric Resistance	0.014	0.016	0.016	0.017	0.015	0.012	0.012
Sale of space heating units by type - Fossil	0.778	0.856	0.829	0.75	0.622	0.52	0.477
Sale of space heating units by type - Gas	0.178	0.099	0.098	0.093	0.08	0.065	0.055
Sales of cooking units - Electric Resistance	0.467	0.481	0.529	0.658	0.837	0.947	0.986
Sales of cooking units - Gas	0.533	0.519	0.471	0.342	0.163	0.053	0.014
Sales of water heating units by type - Electric Heat Pump	0	0.003	0.012	0.038	0.093	0.154	0.186
Sales of water heating units by type - Electric Resistance	0.193	0.323	0.328	0.348	0.387	0.426	0.447
Sales of water heating units by type - Gas Furnace	0.541	0.486	0.48	0.455	0.394	0.315	0.269
Sales of water heating units by type - Other	0.266	0.188	0.18	0.158	0.126	0.105	0.097

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	0.017	0.021	0.021	0.017	0.011	0.006	0.002
End-use technology sales by technology - LDV - EV	0.018	0.044	0.113	0.249	0.473	0.713	0.873
End-use technology sales by technology - LDV - gasoline	0.921	0.88	0.805	0.679	0.474	0.256	0.113
End-use technology sales by technology - LDV - hybrid	0.042	0.05	0.057	0.052	0.04	0.024	0.012
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	19743586	39909185	136292153	424104308	619524131
Number of public EV charging plugs - DC Fast Charging	47	0	103.597	0	478.1	0	1306.9
Number of public EV charging plugs - L2 Charging	543	0	2491.5	0	11498	0	31431.2

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

variable_name	2050
Carbon sink enhancement potential - Accelerate regeneration	25.05
Carbon sink enhancement potential - All (not counting overlap)	10939.1
Carbon sink enhancement potential - Avoid deforestation	458.741
Carbon sink enhancement potential - corn-ethanol to energy grasses	0

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

variable_name	2050
Carbon sink enhancement potential - cropland measures	-507.514
Carbon sink enhancement potential - Extend rotation length	5335.9
Carbon sink enhancement potential - Improve plantations	45.726
Carbon sink enhancement potential - Increase retention of HWP	2553.2
Carbon sink enhancement potential - Increase trees outside forests	189.288
Carbon sink enhancement potential - permanent conservation cover	-15.921
Carbon sink enhancement potential - Reforest cropland	0
Carbon sink enhancement potential - Reforest pasture	1105.77
Carbon sink enhancement potential - Restore productivity	1225.447
Carbon sink enhancement potential - total	-523.435
Land impacted for carbon sink enhancement - Accelerate regeneration	10.097
Land impacted for carbon sink enhancement - All (not counting overlap)	2132.3
Land impacted for carbon sink enhancement - Avoid deforestation	123.143
Land impacted for carbon sink enhancement - corn-ethanol to energy grasses	0
Land impacted for carbon sink enhancement - cropland measures	267.275
Land impacted for carbon sink enhancement - Extend rotation length	2939.473
Land impacted for carbon sink enhancement - Improve plantations	25.413
Land impacted for carbon sink enhancement - Increase retention of HWP	510.646
Land impacted for carbon sink enhancement - Increase trees outside forests	53.396
Land impacted for carbon sink enhancement - permanent conservation cover	28.957
Land impacted for carbon sink enhancement - Reforest cropland	0
Land impacted for carbon sink enhancement - Reforest pasture	83.614
Land impacted for carbon sink enhancement - Restore productivity	691.531
Land impacted for carbon sink enhancement - total	296.231
Land impacted for carbon sink enhancement - Total impacted (over 30 years)	2304.988

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

variable_name	2050
Business-as-usual carbon sink - Accelerate regeneration	2.341
Business-as-usual carbon sink - Avoid deforestation	39.228
Business-as-usual carbon sink - Extend rotation length	1608.1
Business-as-usual carbon sink - Improve plantations	9.651
Business-as-usual carbon sink - Increase retention of HWP	0
Business-as-usual carbon sink - Increase trees outside forests	10.736
Business-as-usual carbon sink - Reforest cropland	0
Business-as-usual carbon sink - Reforest pasture	20.427
Business-as-usual carbon sink - Restore productivity	243.439
Business-as-usual carbon sink - Total impacted (over 30 years)	0

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

variable_name	2020	2025	2030	2035	2040	2045	2050
Final energy demand by sector - commercial	0.019	0.018	0.017	0.017	0.016	0.016	0.016
Final energy demand by sector - industry	0.02	0.02	0.021	0.02	0.02	0.02	0.02
Final energy demand by sector - residential	0.033	0.03	0.028	0.026	0.024	0.022	0.02
Final energy demand by sector - transportation	0.052	0.049	0.044	0.04	0.037	0.034	0.029

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	1349572641	1475094459	0	0	0	0
Sales of cooking units - Electric Resistance	0.369	0.407	0.447	0.565	0.727	0.829	0.864
Sales of cooking units - Gas	0.631	0.593	0.553	0.435	0.273	0.171	0.136
Sales of space heating units - Electric Heat Pump	0.022	0.069	0.085	0.133	0.229	0.329	0.382
Sales of space heating units - Electric Resistance	0.012	0.019	0.026	0.046	0.08	0.105	0.114
Sales of space heating units - Fossil	0.615	0.377	0.368	0.326	0.259	0.215	0.202
Sales of space heating units - Gas Furnace	0.351	0.534	0.521	0.495	0.432	0.351	0.301
Sales of water heating units - Electric Heat Pump	0.021	0.026	0.033	0.057	0.113	0.182	0.222
Sales of water heating units - Electric Resistance	0.103	0.114	0.118	0.143	0.196	0.26	0.299
Sales of water heating units - Gas Furnace	0.796	0.813	0.805	0.76	0.656	0.527	0.449
Sales of water heating units - Other	0.081	0.047	0.044	0.04	0.036	0.031	0.03

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

variable_name	2025	2030	2035	2040	2045	2050
Electricity distribution peak load (capital invested) - Cumulative 5-yr	0.233	0.233	0.327	0.339	0.493	0.522

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	0	0	1.638	7.684	8.43
Power generation capital investment - Wind - Base	0	2.032	0.534	0.524	0.425	0.759

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	3.616	402.91	549.476	1338.5	4671.1	10529.8
HV transmission for wind and solar - base other intra-state	0	0	0	0	0	0	0
HV transmission for wind and solar - base spur intra-state	0	0.525	158.492	184.558	287.135	1573.4	4397.6

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

variable_name	2050
Carbon sink enhancement potential - Accelerate regeneration	25.05
Carbon sink enhancement potential - All (not counting overlap)	10939.1
Carbon sink enhancement potential - Avoid deforestation	458.741
Carbon sink enhancement potential - corn-ethanol to energy grasses	0
Carbon sink enhancement potential - cropland measures	-507.514
Carbon sink enhancement potential - Extend rotation length	5335.9
Carbon sink enhancement potential - Improve plantations	45.726
Carbon sink enhancement potential - Increase retention of HWP	2553.2
Carbon sink enhancement potential - Increase trees outside forests	189.288
Carbon sink enhancement potential - permanent conservation cover	-15.921
Carbon sink enhancement potential - Reforest cropland	0
Carbon sink enhancement potential - Reforest pasture	1105.77
Carbon sink enhancement potential - Restore productivity	1225.447
Carbon sink enhancement potential - total	-523.435
Land impacted for carbon sink enhancement - Accelerate regeneration	10.097
Land impacted for carbon sink enhancement - All (not counting overlap)	2132.3
Land impacted for carbon sink enhancement - Avoid deforestation	123.143
Land impacted for carbon sink enhancement - corn-ethanol to energy grasses	0
Land impacted for carbon sink enhancement - cropland measures	267.275
Land impacted for carbon sink enhancement - Extend rotation length	2939.473
Land impacted for carbon sink enhancement - Improve plantations	25.413
Land impacted for carbon sink enhancement - Increase retention of HWP	510.646
Land impacted for carbon sink enhancement - Increase trees outside forests	53.396
Land impacted for carbon sink enhancement - permanent conservation cover	28.957
Land impacted for carbon sink enhancement - Reforest cropland	0
Land impacted for carbon sink enhancement - Reforest pasture	83.614
Land impacted for carbon sink enhancement - Restore productivity	691.531
Land impacted for carbon sink enhancement - total	296.231
Land impacted for carbon sink enhancement - Total impacted (over 30 years)	2304.988

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

variable_name	2050
Business-as-usual carbon sink - Accelerate regeneration	2.341
Business-as-usual carbon sink - Avoid deforestation	39.228
Business-as-usual carbon sink - Extend rotation length	1608.1
Business-as-usual carbon sink - Improve plantations	9.651
Business-as-usual carbon sink - Increase retention of HWP	0
Business-as-usual carbon sink - Increase trees outside forests	10.736
Business-as-usual carbon sink - Reforest cropland	0
Business-as-usual carbon sink - Reforest pasture	20.427
Business-as-usual carbon sink - Restore productivity	243.439
Business-as-usual carbon sink - Total impacted (over 30 years)	0

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	0.049	0	0	0	0
Power generation capital investment - biomass w/ccu allam power plant	0	0	0	0	0	0	0
Power generation capital investment - biomass w/ccu power plant	0	0	0	0	0	0	0

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

variable_name	2020	2025	2030	2035	2040	2045	2050
Power generation by technology - biomass power plant	0	0	95.857	95.857	95.857	95.857	95.857
Power generation by technology - biomass w/ccu allam power plant	0	0	0	0	0	0	0
Power generation by technology - biomass w/ccu power plant	0	0	0	0	0	0	0

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

variable_name	2020	2025	2030	2035	2040	2045	2050
Biomass purchases	0	0	0.007	0.011	0.017	0.157	0.316
Capital investment	0	0	0.051	0	0.108	0	3.327
Number of facilities - allam power w ccu	0	0	0	0	0	0	0
Number of facilities - beccs hydrogen	0	0	0	0	0	0	0
Number of facilities - diesel	0	0	0	1	1	1	1
Number of facilities - diesel ccu	0	0	0	0	0	0	0
Number of facilities - power	0	0	1	1	1	1	1
Number of facilities - power ccu	0	0	0	0	0	0	0
Number of facilities - pyrolysis	0	0	0	1	1	2	4
Number of facilities - pyrolysis ccu	0	0	0	0	0	0	0
Number of facilities - sng	0	1	1	1	1	1	1
Number of facilities - sng ccu	0	0	0	0	0	0	0

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

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

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

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

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

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

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

variable_name	2050
Carbon sink enhancement potential - Accelerate regeneration	25.05
Carbon sink enhancement potential - All (not counting overlap)	10939.1
Carbon sink enhancement potential - Avoid deforestation	458.741
Carbon sink enhancement potential - corn-ethanol to energy grasses	0
Carbon sink enhancement potential - cropland measures	-507.514
Carbon sink enhancement potential - Cropland to woody energy crops	0
Carbon sink enhancement potential - Extend rotation length	5335.9
Carbon sink enhancement potential - Improve plantations	45.726
Carbon sink enhancement potential - Increase retention of HWP	2553.2
Carbon sink enhancement potential - Increase trees outside forests	189.288
Carbon sink enhancement potential - pasture to energy crops	0
Carbon sink enhancement potential - permanent conservation cover	-15.921
Carbon sink enhancement potential - Reforest cropland	0
Carbon sink enhancement potential - Reforest pasture	1105.77
Carbon sink enhancement potential - Restore productivity	1225.447
Carbon sink enhancement potential - total	-523.435
Land impacted for carbon sink enhancement - Accelerate regeneration	10.097
Land impacted for carbon sink enhancement - All (not counting overlap)	2132.3
Land impacted for carbon sink enhancement - Avoid deforestation	123.143
Land impacted for carbon sink enhancement - corn-ethanol to energy grasses	0
Land impacted for carbon sink enhancement - cropland measures	524.323

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	0
Land impacted for carbon sink enhancement - Extend rotation length	2939.473
Land impacted for carbon sink enhancement - Improve plantations	25.413
Land impacted for carbon sink enhancement - Increase retention of HWP	510.646
Land impacted for carbon sink enhancement - Increase trees outside forests	53.396
Land impacted for carbon sink enhancement - pasture to energy crops	32.847
Land impacted for carbon sink enhancement - permanent conservation cover	28.957
Land impacted for carbon sink enhancement - Reforest cropland	0
Land impacted for carbon sink enhancement - Reforest pasture	83.614
Land impacted for carbon sink enhancement - Restore productivity	691.531
Land impacted for carbon sink enhancement - total	586.127
Land impacted for carbon sink enhancement - Total impacted (over 30 years)	2304.988

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

variable_name	2050
Business-as-usual carbon sink - Accelerate regeneration	2.341
Business-as-usual carbon sink - Avoid deforestation	39.228
Business-as-usual carbon sink - Extend rotation length	1608.1
Business-as-usual carbon sink - Improve plantations	9.651
Business-as-usual carbon sink - Increase retention of HWP	0
Business-as-usual carbon sink - Increase trees outside forests	10.736
Business-as-usual carbon sink - Reforest cropland	0
Business-as-usual carbon sink - Reforest pasture	20.427
Business-as-usual carbon sink - Restore productivity	243.439
Business-as-usual carbon sink - Total impacted (over 30 years)	0

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

variable_name	2050
Carbon sink enhancement potential - Accelerate regeneration	25.05
Carbon sink enhancement potential - All (not counting overlap)	10939.1
Carbon sink enhancement potential - Avoid deforestation	458.741
Carbon sink enhancement potential - corn-ethanol to energy grasses	0
Carbon sink enhancement potential - cropland measures	-507.514
Carbon sink enhancement potential - Extend rotation length	5335.9
Carbon sink enhancement potential - Improve plantations	45.726
Carbon sink enhancement potential - Increase retention of HWP	2553.2
Carbon sink enhancement potential - Increase trees outside forests	189.288
Carbon sink enhancement potential - permanent conservation cover	-15.921
Carbon sink enhancement potential - Reforest cropland	0
Carbon sink enhancement potential - Reforest pasture	1105.77
Carbon sink enhancement potential - Restore productivity	1225.447
Carbon sink enhancement potential - total	-523.435
Land impacted for carbon sink enhancement - Accelerate regeneration	10.097
Land impacted for carbon sink enhancement - All (not counting overlap)	2132.3
Land impacted for carbon sink enhancement - Avoid deforestation	123.143
Land impacted for carbon sink enhancement - corn-ethanol to energy grasses	0
Land impacted for carbon sink enhancement - cropland measures	267.275
Land impacted for carbon sink enhancement - Extend rotation length	2939.473
Land impacted for carbon sink enhancement - Improve plantations	25.413
Land impacted for carbon sink enhancement - Increase retention of HWP	510.646
Land impacted for carbon sink enhancement - Increase trees outside forests	53.396
Land impacted for carbon sink enhancement - permanent conservation cover	28.957
Land impacted for carbon sink enhancement - Reforest cropland	0
Land impacted for carbon sink enhancement - Reforest pasture	83.614
Land impacted for carbon sink enhancement - Restore productivity	691.531
Land impacted for carbon sink enhancement - total	296.231
Land impacted for carbon sink enhancement - Total impacted (over 30 years)	2304.988

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

variable_name	2050
Business-as-usual carbon sink - Accelerate regeneration	2.341
Business-as-usual carbon sink - Avoid deforestation	39.228
Business-as-usual carbon sink - Extend rotation length	1608.1
Business-as-usual carbon sink - Improve plantations	9.651
Business-as-usual carbon sink - Increase retention of HWP	0
Business-as-usual carbon sink - Increase trees outside forests	10.736
Business-as-usual carbon sink - Reforest cropland	0
Business-as-usual carbon sink - Reforest pasture	20.427
Business-as-usual carbon sink - Restore productivity	243.439
Business-as-usual carbon sink - Total impacted (over 30 years)	0