Net-Zero America - new hampshire 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	1.132	1.166	0	0	0	0
Sale of space heating units by type - Electric Heat Pump	0.038	0.063	0.066	0.07	0.071	0.071	0.073
Sale of space heating units by type - Electric Resistance	0.021	0.023	0.023	0.024	0.023	0.023	0.022
Sale of space heating units by type - Fossil	0.753	0.745	0.501	0.333	0.323	0.321	0.322
Sale of space heating units by type - Gas	0.187	0.169	0.409	0.573	0.583	0.585	0.584
Sales of cooking units - Electric Resistance	0.55	0.55	0.55	0.55	0.55	0.55	0.55
Sales of cooking units - Gas	0.45	0.45	0.45	0.45	0.45	0.45	0.45
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	0.253	0.396	0.394	0.394	0.393	0.393	0.392
Sales of water heating units by type - Gas Furnace	0.515	0.443	0.445	0.445	0.446	0.447	0.448
Sales of water heating units by type - Other	0.232	0.161	0.161	0.16	0.16	0.16	0.16

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	0.016	0.02	0.022	0.02	0.018	0.017	0.016
End-use technology sales by technology - LDV - EV	0.035	0.056	0.064	0.078	0.095	0.11	0.122
End-use technology sales by technology - LDV - gasoline	0.903	0.867	0.846	0.827	0.806	0.787	0.771
End-use technology sales by technology - LDV - hybrid	0.044	0.053	0.065	0.07	0.076	0.082	0.086
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	60.736
Carbon sink enhancement potential - All (not counting overlap)	0	0	11544.4
Carbon sink enhancement potential - Avoid deforestation	0	0	744.988
Carbon sink enhancement potential - Extend rotation length	0	0	5215.6
Carbon sink enhancement potential - Improve plantations	0	0	26.266
Carbon sink enhancement potential - Increase retention of HWP	0	0	3577.8
Carbon sink enhancement potential - Increase trees outside forests	0	0	149.453
Carbon sink enhancement potential - Reforest cropland	0	0	0
Carbon sink enhancement potential - Reforest pasture	0	0	324.872
Carbon sink enhancement potential - Restore productivity	0	0	1444.657
Land impacted for carbon sink enhancement - Accelerate regeneration	0	0	24.478
Land impacted for carbon sink enhancement - All (not counting overlap)	0	0	2342.1
Land impacted for carbon sink enhancement - Avoid deforestation	0	0	199.982
Land impacted for carbon sink enhancement - Extend rotation length	0	0	2873.19
Land impacted for carbon sink enhancement - Improve plantations	0	0	14.598
Land impacted for carbon sink enhancement - Increase retention of HWP	0	0	715.569
Land impacted for carbon sink enhancement - Increase trees outside forests	0	0	42.159
Land impacted for carbon sink enhancement - Natural uptake	1.14	-4.141	-3.703
Land impacted for carbon sink enhancement - Reforest cropland	0	0	0
Land impacted for carbon sink enhancement - Reforest pasture	0	0	24.566
Land impacted for carbon sink enhancement - Restore productivity	0	0	815.235
Land impacted for carbon sink enhancement - Retained in Hardwood Products	-0.584	-1.051	-1.092
Land impacted for carbon sink enhancement - Total	0.556	-5.192	-4.795
Land impacted for carbon sink enhancement - Total impacted (over 30 years)	0	0	2367.658

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

variable_name	2050
Business-as-usual carbon sink - Accelerate regeneration	5.676
Business-as-usual carbon sink - Avoid deforestation	63.705
Business-as-usual carbon sink - Extend rotation length	1571.8
Business-as-usual carbon sink - Improve plantations	5.543

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	8.476
Business-as-usual carbon sink - Reforest cropland	0
Business-as-usual carbon sink - Reforest pasture	6.001
Business-as-usual carbon sink - Restore productivity	286.986
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	0.039	0.038	0.037	0.037	0.036	0.037	0.038
Final energy demand by sector - industry	0.021	0.021	0.022	0.023	0.024	0.025	0.026
Final energy demand by sector - residential	0.068	0.062	0.058	0.055	0.053	0.051	0.05
Final energy demand by sector - transportation	0.094	0.087	0.08	0.075	0.074	0.076	0.079

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	2646543758	2720762356	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	0.032	0.13	0.412	0.643	0.679	0.682	0.683
Sales of space heating units - Electric Resistance	0.016	0.026	0.074	0.197	0.299	0.317	0.317
Sales of space heating units - Fossil	0.574	0.356	0.25	0.098	0.014	0.001	0
Sales of space heating units - Gas Furnace	0.377	0.488	0.265	0.063	0.008	0	0
Sales of water heating units - Electric Heat Pump	0.026	0.024	0.024	0.024	0.023	0.024	0.024
Sales of water heating units - Electric Resistance	0.128	0.113	0.11	0.113	0.112	0.111	0.112
Sales of water heating units - Gas Furnace	0.772	0.816	0.821	0.819	0.819	0.822	0.822
Sales of water heating units - Other	0.074	0.046	0.045	0.044	0.045	0.043	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	0.457	0.459	0.61	0.629	0.612	0.627

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	1.149	1.227	0	0	0	0
Sale of space heating units by type - Electric Heat Pump	0.04	0.114	0.554	0.816	0.852	0.855	0.855
Sale of space heating units by type - Electric Resistance	0.021	0.024	0.019	0.009	0.006	0.006	0.007
Sale of space heating units by type - Fossil	0.752	0.762	0.355	0.164	0.14	0.138	0.137
Sale of space heating units by type - Gas	0.187	0.1	0.072	0.012	0.002	0.001	0.001
Sales of cooking units - Electric Resistance	0.556	0.65	0.94	0.997	1	1	1
Sales of cooking units - Gas	0.444	0.35	0.06	0.003	0	0	0
Sales of water heating units by type - Electric Heat Pump	0	0.019	0.155	0.346	0.378	0.38	0.381
Sales of water heating units by type - Electric Resistance	0.253	0.412	0.504	0.602	0.618	0.619	0.618
Sales of water heating units by type - Gas Furnace	0.515	0.434	0.315	0.05	0.003	0	0
Sales of water heating units by type - Other	0.232	0.135	0.026	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	0.016	0.018	0.013	0.004	0.001	0	0
End-use technology sales by technology - LDV - EV	0.039	0.151	0.464	0.818	0.963	0.993	1
End-use technology sales by technology - LDV - gasoline	0.899	0.781	0.489	0.165	0.033	0.006	0
End-use technology sales by technology - LDV - hybrid	0.044	0.045	0.032	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	257962740	662348894	1071426115	1623751752	1766420791	1684624962
Number of public EV charging plugs - DC Fast Charging	60	0	527.592	0	2299.6	0	3715.6
Number of public EV charging plugs - L2 Charging	188	0	12679.6	0	55265.6	0	89296.4

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	0	0	0.021
Power generation capital investment - biomass w/ccu power plant	0	0	0	0	0	0	0.027
Power generation capital investment - Solar PV - Base	0	0	0	1.314	0.08	3.488	7.459
Power generation capital investment - Solar PV - Constrained	0	0	0.656	2.352	0	1.97	6.026
Power generation capital investment - Wind - Base	0	0.375	2.991	0.454	0.711	0.14	0.786
Power generation capital investment - Wind - Constrained	0	0.184	3.52	1.132	0.606	0.256	0.389

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	0	0	0	20.772
Power generation by technology - biomass w/ccu power plant	0	0	0	0	0	0	29.978

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	112.053	405.608	631.8	759.278	3732.1	25208.7
HV transmission for wind and solar - base other intra-state	0	9.791	51.896	103.832	139.708	274.686	640.035
HV transmission for wind and solar - base spur intra-state	0	24.581	165.46	301.568	349.898	647.061	1754.3
HV transmission for wind and solar - constrained all	0	112.053	425.173	654.169	843.522	1518.7	28301.4
HV transmission for wind and solar - constrained other intra-state	0	9.791	57.245	115.474	149.941	290.249	615.885
HV transmission for wind and solar - constrained spur intra-state	0	24.581	180.561	231.746	314.109	596.946	1696.4

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	0	0	0.065
Capital investment	0	0	0	0	0	0	1.499
Number of facilities - allam power w ccu	0	0	0	0	0	0	1
Number of facilities - beccs hydrogen	0	0	0	0	0	0	2
Number of facilities - diesel	0	0	0	0	0	0	0
Number of facilities - diesel ccu	0	0	0	0	0	0	1
Number of facilities - power	0	0	0	0	0	0	0
Number of facilities - power ccu	0	0	0	0	0	0	1
Number of facilities - pyrolysis	0	0	0	0	0	0	0
Number of facilities - pyrolysis ccu	0	0	0	0	0	0	1
Number of facilities - sng	0	0	0	0	0	0	0
Number of facilities - sng ccu	0	0	0	0	0	0	1

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	1.88
Annual - BECCS	0	0	0	0	0	1.88
Annual - Cement	0	0	0	0	0	0
Annual - NGCC	0	0	0	0	0	0
Cumulative - All	0	0	0	0	0	1.88
Cumulative - BECCS	0	0	0	0	0	1.88
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	101113.144	101113.144	101113.144	101113.144	223624.419
CO2 pipelines - Spur	0	0	0	0	0	122511.375
CO2 pipelines - Trunk	0	101113.144	101113.144	101113.144	101113.144	101113.144

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

variable_name	2020	2025	2030	2035	2040	2045	2050
Jobs by economic sector - agriculture	74.774	86.205	175.026	66.899	51.895	38.143	123.814
Jobs by economic sector - construction	1629.6	1488.3	1683.2	2534.8	1965.4	4286.3	13179.4
Jobs by economic sector - manufacturing	792.759	1077.5	1750.1	1648.3	1758.7	2522.3	4942.9

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

variable_name	2020	2025	2030	2035	2040	2045	2050
Jobs by economic sector - mining	661.783	521.9	395.382	278.128	190.817	130.482	91.332
Jobs by economic sector - other	185.153	162.336	149.079	365.701	248.649	852.547	2402.3
Jobs by economic sector - pipeline	86.129	86.035	89.048	63.888	51.53	40.063	56.072
Jobs by economic sector - professional	926.567	919.092	1145.4	1366.3	1171.2	2141.6	5797.9
Jobs by economic sector - trade	729.063	657.159	693.563	883.784	726.546	1436.9	3882.8
Jobs by economic sector - utilities	1537.5	1539.3	1871.8	2225.1	2142.6	3360.9	12884.3
Jobs by resource sector - Biomass	309.959	369.98	482.591	190.538	156.22	139.112	528.732
Jobs by resource sector - CO2	0	0	101.339	0	0	0	196.35
Jobs by resource sector - Coal	207.586	62.127	0	0	0	0	0
Jobs by resource sector - Grid	1581.3	1673.2	2306.7	3180.6	2966.2	5971.3	26703.6
Jobs by resource sector - Natural Gas	525.93	517.118	449.642	385.028	437.647	335.205	68.917
Jobs by resource sector - Nuclear	637.146	626.874	616.863	607.104	597.588	346.727	0
Jobs by resource sector - Oil	1623.5	1463.6	1230.4	963.439	742.522	580.599	463.215
Jobs by resource sector - Solar	1564.1	1508.7	1264.1	2336.7	1630.5	5748.6	12794.3
Jobs by resource sector - Wind	173.722	316.231	1500.9	1769.4	1776.7	1687.7	2605.5
Median wages - All	62094.5	62868.9	63270.1	63633.6	64894.5	64605.8	66185.1
Required Level of Education - Associates degree or some college	1989.1	1970.1	2423.8	2957.3	2613.1	4758.5	14138.2
Required Level of Education - Bachelors degree	1466.8	1447.1	1717.7	1955.3	1741.3	2933.2	8250.5
Required Level of Education - Doctoral degree	54.035	52.516	61.211	71.009	60.983	104.865	276.953
Required Level of Education - High school diploma or less	2754.4	2715.8	3333.3	3969.8	3468.3	6290.5	18637.6
Required Level of Education - Masters or professional degree	358.886	352.336	416.532	479.412	423.757	722.181	2057.5
Wage income - All	411306026	411055487	503191849	600312217	539153996	956909748	2870252964

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

variable_name	2050
Carbon sink enhancement potential - Accelerate regeneration	60.736
Carbon sink enhancement potential - All (not counting overlap)	11544.4
Carbon sink enhancement potential - Avoid deforestation	744.988
Carbon sink enhancement potential - corn-ethanol to energy grasses	0
Carbon sink enhancement potential - cropland measures	-105.231
Carbon sink enhancement potential - Extend rotation length	5215.6
Carbon sink enhancement potential - Improve plantations	26.266
Carbon sink enhancement potential - Increase retention of HWP	3577.8
Carbon sink enhancement potential - Increase trees outside forests	149.453
Carbon sink enhancement potential - permanent conservation cover	-3.534
Carbon sink enhancement potential - Reforest cropland	0
Carbon sink enhancement potential - Reforest pasture	324.872
Carbon sink enhancement potential - Restore productivity	1444.657
Carbon sink enhancement potential - total	-108.764
Land impacted for carbon sink enhancement - Accelerate regeneration	24.478
Land impacted for carbon sink enhancement - All (not counting overlap)	2342.1
Land impacted for carbon sink enhancement - Avoid deforestation	199.982
Land impacted for carbon sink enhancement - corn-ethanol to energy grasses	0
Land impacted for carbon sink enhancement - cropland measures	60.252
Land impacted for carbon sink enhancement - Extend rotation length	2873.19
Land impacted for carbon sink enhancement - Improve plantations	14.598
Land impacted for carbon sink enhancement - Increase retention of HWP	715.569
Land impacted for carbon sink enhancement - Increase trees outside forests	42.159
Land impacted for carbon sink enhancement - permanent conservation cover	6.426
Land impacted for carbon sink enhancement - Reforest cropland	0
Land impacted for carbon sink enhancement - Reforest pasture	24.566
Land impacted for carbon sink enhancement - Restore productivity	815.235
Land impacted for carbon sink enhancement - total	66.678
Land impacted for carbon sink enhancement - Total impacted (over 30 years)	2367.658

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

variable_name	2050
Business-as-usual carbon sink - Accelerate regeneration	5.676
Business-as-usual carbon sink - Avoid deforestation	63.705
Business-as-usual carbon sink - Extend rotation length	1571.8
Business-as-usual carbon sink - Improve plantations	5.543
Business-as-usual carbon sink - Increase retention of HWP	0
Business-as-usual carbon sink - Increase trees outside forests	8.476
Business-as-usual carbon sink - Reforest cropland	0
Business-as-usual carbon sink - Reforest pasture	6.001
Business-as-usual carbon sink - Restore productivity	286.986
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	38076.4	38641.9	32573	26124.9	19666.4	12373.4	8581.9
Oil consumption	33305.6	32921.9	30160.5	25580.3	21226.9	17767.7	15090.2

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

variable_name	2020	2025	2030	2035	2040	2045	2050
Final energy demand by sector - commercial	0.039	0.037	0.035	0.033	0.03	0.029	0.028
Final energy demand by sector - industry	0.021	0.021	0.02	0.02	0.02	0.02	0.02
Final energy demand by sector - residential	0.068	0.061	0.055	0.047	0.039	0.033	0.03
Final energy demand by sector - transportation	0.094	0.087	0.075	0.061	0.048	0.04	0.036

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	2679894719	2925886495	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	0.032	0.11	0.396	0.724	0.777	0.779	0.78
Sales of space heating units - Electric Resistance	0.016	0.044	0.166	0.213	0.22	0.221	0.22
Sales of space heating units - Fossil	0.574	0.32	0.061	0.003	0	0	0
Sales of space heating units - Gas Furnace	0.377	0.527	0.377	0.06	0.004	0	0
Sales of water heating units - Electric Heat Pump	0.026	0.035	0.16	0.411	0.456	0.46	0.459
Sales of water heating units - Electric Resistance	0.128	0.124	0.24	0.48	0.523	0.525	0.525
Sales of water heating units - Gas Furnace	0.772	0.799	0.581	0.093	0.005	0	0
Sales of water heating units - Other	0.074	0.042	0.019	0.016	0.016	0.016	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	0.537	0.548	1.067	1.139	1.007	1.055

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	1.151	1.3	0	0	0	0
Sale of space heating units by type - Electric Heat Pump	0.04	0.039	0.081	0.205	0.419	0.6	0.682
Sale of space heating units by type - Electric Resistance	0.021	0.024	0.024	0.023	0.019	0.014	0.011
Sale of space heating units by type - Fossil	0.752	0.835	0.796	0.682	0.494	0.345	0.282
Sale of space heating units by type - Gas	0.187	0.102	0.1	0.09	0.068	0.041	0.025
Sales of cooking units - Electric Resistance	0.554	0.566	0.607	0.714	0.864	0.956	0.988
Sales of cooking units - Gas	0.446	0.434	0.393	0.286	0.136	0.044	0.012
Sales of water heating units by type - Electric Heat Pump	0	0.005	0.018	0.059	0.145	0.241	0.293
Sales of water heating units by type - Electric Resistance	0.253	0.399	0.407	0.434	0.487	0.54	0.568
Sales of water heating units by type - Gas Furnace	0.515	0.439	0.429	0.391	0.297	0.178	0.108
Sales of water heating units by type - Other	0.232	0.157	0.147	0.116	0.071	0.041	0.031

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	0.016	0.02	0.021	0.016	0.01	0.005	0.002
End-use technology sales by technology - LDV - EV	0.019	0.047	0.118	0.258	0.483	0.72	0.876
End-use technology sales by technology - LDV - gasoline	0.918	0.875	0.796	0.667	0.463	0.249	0.11
End-use technology sales by technology - LDV - hybrid	0.046	0.054	0.06	0.055	0.041	0.024	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	41931654	87661660	296462744	931557169	1357644469
Number of public EV charging plugs - DC Fast Charging	60	0	165.276	0	854.483	0	2379.8
Number of public EV charging plugs - L2 Charging	188	0	3972.1	0	20535.8	0	57194.3

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

variable_name	2050
Carbon sink enhancement potential - Accelerate regeneration	60.736
Carbon sink enhancement potential - All (not counting overlap)	11544.4
Carbon sink enhancement potential - Avoid deforestation	744.988
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	-105.231
Carbon sink enhancement potential - Extend rotation length	5215.6
Carbon sink enhancement potential - Improve plantations	26.266
Carbon sink enhancement potential - Increase retention of HWP	3577.8
Carbon sink enhancement potential - Increase trees outside forests	149.453
Carbon sink enhancement potential - permanent conservation cover	-3.534
Carbon sink enhancement potential - Reforest cropland	0
Carbon sink enhancement potential - Reforest pasture	324.872
Carbon sink enhancement potential - Restore productivity	1444.657
Carbon sink enhancement potential - total	-108.764
Land impacted for carbon sink enhancement - Accelerate regeneration	24.478
Land impacted for carbon sink enhancement - All (not counting overlap)	2342.1
Land impacted for carbon sink enhancement - Avoid deforestation	199.982
Land impacted for carbon sink enhancement - corn-ethanol to energy grasses	0
Land impacted for carbon sink enhancement - cropland measures	60.252
Land impacted for carbon sink enhancement - Extend rotation length	2873.19
Land impacted for carbon sink enhancement - Improve plantations	14.598
Land impacted for carbon sink enhancement - Increase retention of HWP	715.569
Land impacted for carbon sink enhancement - Increase trees outside forests	42.159
Land impacted for carbon sink enhancement - permanent conservation cover	6.426
Land impacted for carbon sink enhancement - Reforest cropland	0
Land impacted for carbon sink enhancement - Reforest pasture	24.566
Land impacted for carbon sink enhancement - Restore productivity	815.235
Land impacted for carbon sink enhancement - total	66.678
Land impacted for carbon sink enhancement - Total impacted (over 30 years)	2367.658

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

variable_name	2050
Business-as-usual carbon sink - Accelerate regeneration	5.676
Business-as-usual carbon sink - Avoid deforestation	63.705
Business-as-usual carbon sink - Extend rotation length	1571.8
Business-as-usual carbon sink - Improve plantations	5.543
Business-as-usual carbon sink - Increase retention of HWP	0
Business-as-usual carbon sink - Increase trees outside forests	8.476
Business-as-usual carbon sink - Reforest cropland	0
Business-as-usual carbon sink - Reforest pasture	6.001
Business-as-usual carbon sink - Restore productivity	286.986
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	0.039	0.037	0.036	0.035	0.034	0.033	0.031
Final energy demand by sector - industry	0.021	0.021	0.02	0.02	0.02	0.02	0.02
Final energy demand by sector - residential	0.068	0.062	0.057	0.053	0.049	0.043	0.038
Final energy demand by sector - transportation	0.094	0.087	0.079	0.072	0.066	0.06	0.052

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	2679554033	2928932735	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	0.032	0.074	0.102	0.185	0.35	0.522	0.615
Sales of space heating units - Electric Resistance	0.016	0.021	0.032	0.066	0.122	0.164	0.179
Sales of space heating units - Fossil	0.574	0.371	0.352	0.281	0.17	0.098	0.074
Sales of space heating units - Gas Furnace	0.377	0.533	0.514	0.468	0.358	0.216	0.132
Sales of water heating units - Electric Heat Pump	0.026	0.028	0.04	0.079	0.172	0.288	0.355
Sales of water heating units - Electric Resistance	0.128	0.117	0.126	0.166	0.254	0.362	0.426
Sales of water heating units - Gas Furnace	0.772	0.809	0.792	0.718	0.545	0.328	0.198
Sales of water heating units - Other	0.074	0.046	0.042	0.036	0.029	0.023	0.021

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	0.401	0.397	0.601	0.621	0.904	0.955

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	0.863	2.405	0	5.76	4.949
Power generation capital investment - Wind - Base	0.375	2.991	0.454	0.711	0.14	0.856

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	112.053	495.4	981.28	1573.7	12567.6	42417.7
HV transmission for wind and solar - base other intra-state	0	9.791	75.463	233.365	264.074	498.51	1112.1
HV transmission for wind and solar - base spur intra-state	0	24.581	218.013	486.443	529.097	1280.4	1665.7

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

variable_name	2050
Carbon sink enhancement potential - Accelerate regeneration	60.736
Carbon sink enhancement potential - All (not counting overlap)	11544.4
Carbon sink enhancement potential - Avoid deforestation	744.988
Carbon sink enhancement potential - corn-ethanol to energy grasses	0
Carbon sink enhancement potential - cropland measures	-105.231
Carbon sink enhancement potential - Extend rotation length	5215.6
Carbon sink enhancement potential - Improve plantations	26.266
Carbon sink enhancement potential - Increase retention of HWP	3577.8
Carbon sink enhancement potential - Increase trees outside forests	149.453
Carbon sink enhancement potential - permanent conservation cover	-3.534
Carbon sink enhancement potential - Reforest cropland	0
Carbon sink enhancement potential - Reforest pasture	324.872
Carbon sink enhancement potential - Restore productivity	1444.657
Carbon sink enhancement potential - total	-108.764
Land impacted for carbon sink enhancement - Accelerate regeneration	24.478
Land impacted for carbon sink enhancement - All (not counting overlap)	2342.1
Land impacted for carbon sink enhancement - Avoid deforestation	199.982
Land impacted for carbon sink enhancement - corn-ethanol to energy grasses	0
Land impacted for carbon sink enhancement - cropland measures	60.252
Land impacted for carbon sink enhancement - Extend rotation length	2873.19
Land impacted for carbon sink enhancement - Improve plantations	14.598
Land impacted for carbon sink enhancement - Increase retention of HWP	715.569
Land impacted for carbon sink enhancement - Increase trees outside forests	42.159
Land impacted for carbon sink enhancement - permanent conservation cover	6.426
Land impacted for carbon sink enhancement - Reforest cropland	0
Land impacted for carbon sink enhancement - Reforest pasture	24.566
Land impacted for carbon sink enhancement - Restore productivity	815.235
Land impacted for carbon sink enhancement - total	66.678
Land impacted for carbon sink enhancement - Total impacted (over 30 years)	2367.658

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

variable_name	2050
Business-as-usual carbon sink - Accelerate regeneration	5.676
Business-as-usual carbon sink - Avoid deforestation	63.705
Business-as-usual carbon sink - Extend rotation length	1571.8
Business-as-usual carbon sink - Improve plantations	5.543
Business-as-usual carbon sink - Increase retention of HWP	0
Business-as-usual carbon sink - Increase trees outside forests	8.476
Business-as-usual carbon sink - Reforest cropland	0
Business-as-usual carbon sink - Reforest pasture	6.001
Business-as-usual carbon sink - Restore productivity	286.986
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	0	0	0	0
Power generation capital investment - biomass w/ccu allam power plant	0	0	0	0	0	0	0
Power generation capital investment - biomass w/ccu power plant	0	0	0	0	0	0	0

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

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

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

variable_name	2020	2025	2030	2035	2040	2045	2050
Biomass purchases	0	0	0	0	0	0	0.249
Capital investment	0	0	0	0	0	0	2.97
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	2
Number of facilities - diesel	0	0	0	0	0	0	0
Number of facilities - diesel ccu	0	0	0	0	0	0	0
Number of facilities - power	0	0	0	0	0	0	0
Number of facilities - power ccu	0	0	0	0	0	0	0
Number of facilities - pyrolysis	0	0	0	0	0	0	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	0	0	0	4.05
Annual - BECCS	0	0	0	0	0	4.05
Annual - Cement	0	0	0	0	0	0
Annual - NGCC	0	0	0	0	0	0
Cumulative - All	0	0	0	0	0	4.05
Cumulative - BECCS	0	0	0	0	0	4.05
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	101113.144	101113.144	101113.144	101113.144	252521.319
CO2 pipelines - Spur	0	0	0	0	0	151408.175
CO2 pipelines - Trunk	0	101113.144	101113.144	101113.144	101113.144	101113.144

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

variable_name	2050
Carbon sink enhancement potential - Accelerate regeneration	60.736
Carbon sink enhancement potential - All (not counting overlap)	11544.4
Carbon sink enhancement potential - Avoid deforestation	744.988
Carbon sink enhancement potential - corn-ethanol to energy grasses	0
Carbon sink enhancement potential - cropland measures	-105.231
Carbon sink enhancement potential - Cropland to woody energy crops	0
Carbon sink enhancement potential - Extend rotation length	5215.6
Carbon sink enhancement potential - Improve plantations	26.266
Carbon sink enhancement potential - Increase retention of HWP	3577.8
Carbon sink enhancement potential - Increase trees outside forests	149.453
Carbon sink enhancement potential - pasture to energy crops	0
Carbon sink enhancement potential - permanent conservation cover	-3.534
Carbon sink enhancement potential - Reforest cropland	0
Carbon sink enhancement potential - Reforest pasture	324.872
Carbon sink enhancement potential - Restore productivity	1444.657
Carbon sink enhancement potential - total	-108.764
Land impacted for carbon sink enhancement - Accelerate regeneration	24.478
Land impacted for carbon sink enhancement - All (not counting overlap)	2342.1
Land impacted for carbon sink enhancement - Avoid deforestation	199.982
Land impacted for carbon sink enhancement - corn-ethanol to energy grasses	0
Land impacted for carbon sink enhancement - cropland measures	118.215

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	2873.19
Land impacted for carbon sink enhancement - Improve plantations	14.598
Land impacted for carbon sink enhancement - Increase retention of HWP	715.569
Land impacted for carbon sink enhancement - Increase trees outside forests	42.159
Land impacted for carbon sink enhancement - pasture to energy crops	0.544
Land impacted for carbon sink enhancement - permanent conservation cover	6.426
Land impacted for carbon sink enhancement - Reforest cropland	0
Land impacted for carbon sink enhancement - Reforest pasture	24.566
Land impacted for carbon sink enhancement - Restore productivity	815.235
Land impacted for carbon sink enhancement - total	125.185
Land impacted for carbon sink enhancement - Total impacted (over 30 years)	2367.658

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

variable_name	2050
Business-as-usual carbon sink - Accelerate regeneration	5.676
Business-as-usual carbon sink - Avoid deforestation	63.705
Business-as-usual carbon sink - Extend rotation length	1571.8
Business-as-usual carbon sink - Improve plantations	5.543
Business-as-usual carbon sink - Increase retention of HWP	0
Business-as-usual carbon sink - Increase trees outside forests	8.476
Business-as-usual carbon sink - Reforest cropland	0
Business-as-usual carbon sink - Reforest pasture	6.001
Business-as-usual carbon sink - Restore productivity	286.986
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	60.736
Carbon sink enhancement potential - All (not counting overlap)	11544.4
Carbon sink enhancement potential - Avoid deforestation	744.988
Carbon sink enhancement potential - corn-ethanol to energy grasses	0
Carbon sink enhancement potential - cropland measures	-105.231
Carbon sink enhancement potential - Extend rotation length	5215.6
Carbon sink enhancement potential - Improve plantations	26.266
Carbon sink enhancement potential - Increase retention of HWP	3577.8
Carbon sink enhancement potential - Increase trees outside forests	149.453
Carbon sink enhancement potential - permanent conservation cover	-3.534
Carbon sink enhancement potential - Reforest cropland	0
Carbon sink enhancement potential - Reforest pasture	324.872
Carbon sink enhancement potential - Restore productivity	1444.657
Carbon sink enhancement potential - total	-108.764
Land impacted for carbon sink enhancement - Accelerate regeneration	24.478
Land impacted for carbon sink enhancement - All (not counting overlap)	2342.1
Land impacted for carbon sink enhancement - Avoid deforestation	199.982
Land impacted for carbon sink enhancement - corn-ethanol to energy grasses	0
Land impacted for carbon sink enhancement - cropland measures	60.252
Land impacted for carbon sink enhancement - Extend rotation length	2873.19
Land impacted for carbon sink enhancement - Improve plantations	14.598
Land impacted for carbon sink enhancement - Increase retention of HWP	715.569
Land impacted for carbon sink enhancement - Increase trees outside forests	42.159
Land impacted for carbon sink enhancement - permanent conservation cover	6.426
Land impacted for carbon sink enhancement - Reforest cropland	0
Land impacted for carbon sink enhancement - Reforest pasture	24.566
Land impacted for carbon sink enhancement - Restore productivity	815.235
Land impacted for carbon sink enhancement - total	66.678
Land impacted for carbon sink enhancement - Total impacted (over 30 years)	2367.658

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

variable_name	2050
Business-as-usual carbon sink - Accelerate regeneration	5.676
Business-as-usual carbon sink - Avoid deforestation	63.705
Business-as-usual carbon sink - Extend rotation length	1571.8
Business-as-usual carbon sink - Improve plantations	5.543
Business-as-usual carbon sink - Increase retention of HWP	0
Business-as-usual carbon sink - Increase trees outside forests	8.476
Business-as-usual carbon sink - Reforest cropland	0
Business-as-usual carbon sink - Reforest pasture	6.001
Business-as-usual carbon sink - Restore productivity	286.986
Business-as-usual carbon sink - Total impacted (over 30 years)	0