Net-Zero America - west virginia state report v2

Larson et al. 2020

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Reading guide

IN DRAFT

List of Tables

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

variable_name	2020	2025	2030	2035	2040	2045	2050
Residential HVAC investment in 2020s vs. REF - Cumulative 5-yr	0	0.676	0.631	0	0	0	0
Sale of space heating units by type - Electric Heat Pump	0.191	0.382	0.389	0.399	0.406	0.416	0.429
Sale of space heating units by type - Electric Resistance	0.187	0.19	0.189	0.182	0.173	0.165	0.15
Sale of space heating units by type - Fossil	0.11	0.142	0.116	0.101	0.099	0.099	0.1
Sale of space heating units by type - Gas	0.511	0.286	0.306	0.319	0.322	0.321	0.32
Sales of cooking units - Electric Resistance	0.621	0.621	0.621	0.621	0.621	0.621	0.621
Sales of cooking units - Gas	0.379	0.379	0.379	0.379	0.379	0.379	0.379
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	0.45	0.613	0.613	0.61	0.607	0.607	0.604
Sales of water heating units by type - Gas Furnace	0.522	0.366	0.366	0.368	0.371	0.372	0.374
Sales of water heating units by type - Other	0.028	0.021	0.021	0.021	0.022	0.022	0.022

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	0.018	0.022	0.022	0.021	0.019	0.017	0.017
End-use technology sales by technology - LDV - EV	0.028	0.046	0.053	0.064	0.079	0.093	0.104
End-use technology sales by technology - LDV - gasoline	0.915	0.882	0.864	0.849	0.83	0.81	0.794
End-use technology sales by technology - LDV - hybrid	0.037	0.046	0.056	0.062	0.068	0.075	0.081
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	188.269
Carbon sink enhancement potential - All (not counting overlap)	0	0	29361.2
Carbon sink enhancement potential - Avoid deforestation	0	0	1146.647
Carbon sink enhancement potential - Extend rotation length	0	0	10810.2
Carbon sink enhancement potential - Improve plantations	0	0	105.816
Carbon sink enhancement potential - Increase retention of HWP	0	0	7401.7
Carbon sink enhancement potential - Increase trees outside forests	0	0	330.497
Carbon sink enhancement potential - Reforest cropland	0	0	0
Carbon sink enhancement potential - Reforest pasture	0	0	4789.4
Carbon sink enhancement potential - Restore productivity	0	0	4588.7
Land impacted for carbon sink enhancement - Accelerate regeneration	0	0	75.88
Land impacted for carbon sink enhancement - All (not counting overlap)	0	0	5371.7
Land impacted for carbon sink enhancement - Avoid deforestation	0	0	307.802
Land impacted for carbon sink enhancement - Extend rotation length	0	0	5955.2
Land impacted for carbon sink enhancement - Improve plantations	0	0	58.81
Land impacted for carbon sink enhancement - Increase retention of HWP	0	0	1480.3
Land impacted for carbon sink enhancement - Increase trees outside forests	0	0	93.23
Land impacted for carbon sink enhancement - Natural uptake	-5.21	-10.511	-9.398
Land impacted for carbon sink enhancement - Reforest cropland	0	0	0
Land impacted for carbon sink enhancement - Reforest pasture	0	0	362.158
Land impacted for carbon sink enhancement - Restore productivity	0	0	2589.476
Land impacted for carbon sink enhancement - Retained in Hardwood Products	-1.208	-2.174	-2.259
Land impacted for carbon sink enhancement - Total	-6.418	-12.684	-11.658
Land impacted for carbon sink enhancement - Total impacted (over 30 years)	0	0	5551

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

variable_name	2050
Business-as-usual carbon sink - Accelerate regeneration	17.595
Business-as-usual carbon sink - Avoid deforestation	98.051
Business-as-usual carbon sink - Extend rotation length	3257.9
Business-as-usual carbon sink - Improve plantations	22.333

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	18.745
Business-as-usual carbon sink - Reforest cropland	0
Business-as-usual carbon sink - Reforest pasture	88.475
Business-as-usual carbon sink - Restore productivity	911.557
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	0.049	0.049	0.05	0.05	0.051	0.052	0.055
Final energy demand by sector - industry	0.186	0.2	0.21	0.215	0.221	0.226	0.233
Final energy demand by sector - residential	0.038	0.036	0.036	0.036	0.036	0.037	0.038
Final energy demand by sector - transportation	0.151	0.143	0.13	0.122	0.122	0.126	0.13

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	5742563995	5973248427	0	0	0	0
Sales of cooking units - Electric Resistance	0.32	0.343	0.343	0.343	0.344	0.343	0.343
Sales of cooking units - Gas	0.68	0.657	0.657	0.657	0.656	0.657	0.657
Sales of space heating units - Electric Heat Pump	0.033	0.212	0.471	0.684	0.72	0.723	0.723
Sales of space heating units - Electric Resistance	0.032	0.087	0.127	0.199	0.249	0.257	0.258
Sales of space heating units - Fossil	0.041	0.046	0.034	0.014	0.002	0	0
Sales of space heating units - Gas Furnace	0.894	0.656	0.369	0.102	0.029	0.02	0.019
Sales of water heating units - Electric Heat Pump	0.001	0.003	0.003	0.003	0.003	0.003	0.003
Sales of water heating units - Electric Resistance	0.029	0.067	0.067	0.067	0.067	0.067	0.067
Sales of water heating units - Gas Furnace	0.945	0.887	0.887	0.887	0.887	0.887	0.887
Sales of water heating units - Other	0.024	0.043	0.044	0.043	0.044	0.044	0.044

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	0.92	0.94	1.054	1.085	1.202	1.243

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	0.682	0.676	0	0	0	0
Sale of space heating units by type - Electric Heat Pump	0.206	0.346	0.643	0.828	0.854	0.855	0.855
Sale of space heating units by type - Electric Resistance	0.183	0.201	0.12	0.063	0.053	0.054	0.054
Sale of space heating units by type - Fossil	0.108	0.157	0.091	0.063	0.06	0.06	0.059
Sale of space heating units by type - Gas	0.502	0.296	0.146	0.046	0.032	0.032	0.031
Sales of cooking units - Electric Resistance	0.626	0.705	0.95	0.997	1	1	1
Sales of cooking units - Gas	0.374	0.295	0.05	0.003	0	0	0
Sales of water heating units by type - Electric Heat Pump	0	0.053	0.304	0.433	0.45	0.451	0.452
Sales of water heating units by type - Electric Resistance	0.45	0.597	0.532	0.531	0.532	0.533	0.532
Sales of water heating units by type - Gas Furnace	0.522	0.33	0.147	0.02	0.001	0	0
Sales of water heating units by type - Other	0.028	0.02	0.017	0.016	0.016	0.016	0.016

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	0.018	0.02	0.014	0.004	0.001	0	0
End-use technology sales by technology - LDV - EV	0.031	0.128	0.427	0.803	0.961	0.993	1
End-use technology sales by technology - LDV - gasoline	0.912	0.807	0.527	0.18	0.035	0.006	0
End-use technology sales by technology - LDV - hybrid	0.037	0.04	0.029	0.011	0.003	0.001	0
End-use technology sales by technology - LDV - hydrogen FC	0.001	0.004	0.002	0.001	0	0	0
End-use technology sales by technology - LDV - other	0.001	0.001	0.001	0	0	0	0
End-use technology sales by technology - MDV - diesel	0.647	0.597	0.423	0.144	0.026	0.004	0
End-use technology sales by technology - MDV - EV	0.008	0.051	0.253	0.608	0.765	0.795	0.8
End-use technology sales by technology - MDV - gasoline	0.337	0.333	0.255	0.093	0.018	0.003	0
End-use technology sales by technology - MDV - hybrid	0.004	0.004	0.003	0.001	0	0	0
End-use technology sales by technology - MDV - hydrogen FC	0.002	0.013	0.063	0.152	0.191	0.199	0.2
End-use technology sales by technology - MDV - other	0.003	0.003	0.002	0.001	0	0	0
Light-duty vehicle capital costs - Cumulative 5-yr	0	326147195	832116613	1354624400	2049529866	2233319378	2127892213
Number of public EV charging plugs - DC Fast Charging	60	0	707.774	0	3167.6	0	5133.2
Number of public EV charging plugs - L2 Charging	164	0	17010	0	76126.6	0	123367.1

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
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	2.447	5.413	6.373	4.593
Power generation capital investment - Solar PV - Constrained	0	0	0	1.907	3.945	5.572	3.302
Power generation capital investment - Wind - Base	0	0	8.359	8.421	14.665	0.853	2.177
Power generation capital investment - Wind - Constrained	0	0	26.519	33.659	0.092	0	2.313

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	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	7.093	633.155	1827.8	4657.5	5900.1	7093.8
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	239.534	676.864	2035.3	2417.4	2922.9
HV transmission for wind and solar - constrained all	0	7.093	2962.2	8979.1	9476.8	10296	10909.7
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	1500.8	5043.1	5215.6	5375.9	5618

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	0.128
Capital investment	0	0	0	0	0	0	2.779
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	4
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 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	7.32
Annual - BECCS	0	0	0	0	0	3.79
Annual - Cement	0	0	0	0	0	3.53
Annual - NGCC	0	0	0	0	0	0
Cumulative - All	0	0	0	0	0	7.32
Cumulative - BECCS	0	0	0	0	0	3.79
Cumulative - Cement	0	0	0	0	0	3.53
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	223298.758
CO2 pipelines - Spur	0	0	0	0	0	223298.758
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	0	0	0	0	0	0	187.408
Jobs by economic sector - construction	4138.9	3000	4786	8330.2	13767.7	13606	14092
Jobs by economic sector - manufacturing	5882.3	8240.9	9292.1	11902.8	11720.7	9648.3	11803.1

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

variable_name	2020	2025	2030	2035	2040	2045	2050
Jobs by economic sector - mining	15090.5	9226.7	6030.1	4762.4	3440.8	2533.7	1767.7
Jobs by economic sector - other	194.675	100.582	282.462	883.092	1890.7	2238.2	2475.9
Jobs by economic sector - pipeline	569.963	575.809	497.89	404.538	305.166	201.97	169.647
Jobs by economic sector - professional	4264.4	2754.8	3602.3	5765.5	9371.3	9332.1	9924
Jobs by economic sector - trade	5407.9	3087.7	2895.3	3916.5	5799.4	5886.2	6179.5
Jobs by economic sector - utilities	6504.5	3826.4	3995.2	5997.4	9624.7	9271.6	10485.4
Jobs by resource sector - Biomass	0	0	0	0	0	0	800.306
Jobs by resource sector - CO2	0	0	0	0	0	0	413.95
Jobs by resource sector - Coal	19595.8	9539.9	4431.1	3660.4	3186.7	2872.3	2544.5
Jobs by resource sector - Grid	5808.3	1780.8	3818.9	8462	15816.2	16344.5	19154.6
Jobs by resource sector - Natural Gas	7319.2	7104.9	5935.5	4650.4	3639.3	2140.8	1247.2
Jobs by resource sector - Nuclear	0	0	0	0	0	0	0
Jobs by resource sector - Oil	7331.3	6959.6	6170.3	5396.9	3868.1	2839.2	1734.9
Jobs by resource sector - Solar	1063.9	2471.8	2916.2	6843.9	10893.9	12317.3	14312.6
Jobs by resource sector - Wind	934.739	2955.9	8109.4	12948.7	18516.3	16204	16876.6
Median wages - All	53933	54948	55704.9	55935	56689.4	57386.1	57960
Required Level of Education - Associates degree or some college	12399.7	9179.8	9560	13054.3	17709.3	16762.4	18203.8
Required Level of Education - Bachelors degree	8289.6	6443.8	6701.8	8803.6	11602.1	10886.8	11716.6
Required Level of Education - Doctoral degree	256.49	189.68	214.156	300.441	438.758	424.895	447.168
Required Level of Education - High school diploma or less	19168.5	13537.9	13358	17727.4	23309.6	21919.1	23799.5
Required Level of Education - Masters or professional degree	1938.9	1461.8	1547.4	2076.6	2860.7	2724.9	2917.6
Wage income - All	2268113352	1693144780	1748160175	2347322229	3170419227	3025658555	3309038448

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

variable_name	2050
Carbon sink enhancement potential - Accelerate regeneration	188.269
Carbon sink enhancement potential - All (not counting overlap)	29361.2
Carbon sink enhancement potential - Avoid deforestation	1146.647
Carbon sink enhancement potential - corn-ethanol to energy grasses	0
Carbon sink enhancement potential - cropland measures	-790.706
Carbon sink enhancement potential - Extend rotation length	10810.2
Carbon sink enhancement potential - Improve plantations	105.816
Carbon sink enhancement potential - Increase retention of HWP	7401.7
Carbon sink enhancement potential - Increase trees outside forests	330.497
Carbon sink enhancement potential - permanent conservation cover	-31.598
Carbon sink enhancement potential - Reforest cropland	0
Carbon sink enhancement potential - Reforest pasture	4789.4
Carbon sink enhancement potential - Restore productivity	4588.7
Carbon sink enhancement potential - total	-822.305
Land impacted for carbon sink enhancement - Accelerate regeneration	75.88
Land impacted for carbon sink enhancement - All (not counting overlap)	5371.7
Land impacted for carbon sink enhancement - Avoid deforestation	307.802
Land impacted for carbon sink enhancement - corn-ethanol to energy grasses	0
Land impacted for carbon sink enhancement - cropland measures	527.816
Land impacted for carbon sink enhancement - Extend rotation length	5955.2
Land impacted for carbon sink enhancement - Improve plantations	58.81
Land impacted for carbon sink enhancement - Increase retention of HWP	1480.3
Land impacted for carbon sink enhancement - Increase trees outside forests	93.23
Land impacted for carbon sink enhancement - permanent conservation cover	57.471
Land impacted for carbon sink enhancement - Reforest cropland	0
Land impacted for carbon sink enhancement - Reforest pasture	362.158
Land impacted for carbon sink enhancement - Restore productivity	2589.476
Land impacted for carbon sink enhancement - total	585.287
Land impacted for carbon sink enhancement - Total impacted (over 30 years)	5551

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

variable_name	2050
Business-as-usual carbon sink - Accelerate regeneration	17.595
Business-as-usual carbon sink - Avoid deforestation	98.051
Business-as-usual carbon sink - Extend rotation length	3257.9
Business-as-usual carbon sink - Improve plantations	22.333
Business-as-usual carbon sink - Increase retention of HWP	0
Business-as-usual carbon sink - Increase trees outside forests	18.745
Business-as-usual carbon sink - Reforest cropland	0
Business-as-usual carbon sink - Reforest pasture	88.475
Business-as-usual carbon sink - Restore productivity	911.557
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	155818	158132.1	133296.4	106909.2	80479.7	50635.1	35119.2
Oil consumption	32962.2	31033.2	26758.1	20420.2	14354.7	9601.4	5675.1

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

variable_name	2020	2025	2030	2035	2040	2045	2050
Final energy demand by sector - commercial	0.049	0.049	0.047	0.044	0.042	0.041	0.041
Final energy demand by sector - industry	0.185	0.197	0.201	0.206	0.212	0.214	0.218
Final energy demand by sector - residential	0.038	0.036	0.033	0.031	0.028	0.026	0.025
Final energy demand by sector - transportation	0.151	0.141	0.123	0.101	0.081	0.069	0.064

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	5825978129	6487979558	0	0	0	0
Sales of cooking units - Electric Resistance	0.32	0.46	0.799	0.865	0.869	0.869	0.869
Sales of cooking units - Gas	0.68	0.54	0.201	0.135	0.131	0.131	0.131
Sales of space heating units - Electric Heat Pump	0.033	0.214	0.54	0.799	0.84	0.842	0.842
Sales of space heating units - Electric Resistance	0.032	0.083	0.108	0.134	0.139	0.139	0.139
Sales of space heating units - Fossil	0.041	0.041	0.008	0	0	0	0
Sales of space heating units - Gas Furnace	0.894	0.663	0.344	0.066	0.022	0.019	0.019
Sales of water heating units - Electric Heat Pump	0.001	0.064	0.365	0.54	0.563	0.565	0.565
Sales of water heating units - Electric Resistance	0.029	0.095	0.247	0.385	0.407	0.408	0.408
Sales of water heating units - Gas Furnace	0.945	0.801	0.358	0.048	0.003	0	0
Sales of water heating units - Other	0.024	0.04	0.03	0.027	0.027	0.027	0.027

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	0.954	0.978	1.948	2.084	1.752	1.833

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	0.678	0.66	0	0	0	0
Sale of space heating units by type - Electric Heat Pump	0.206	0.299	0.333	0.434	0.609	0.757	0.826
Sale of space heating units by type - Electric Resistance	0.183	0.213	0.205	0.174	0.123	0.081	0.062
Sale of space heating units by type - Fossil	0.108	0.169	0.162	0.14	0.104	0.076	0.065
Sale of space heating units by type - Gas	0.502	0.319	0.3	0.252	0.165	0.086	0.048
Sales of cooking units - Electric Resistance	0.624	0.634	0.668	0.759	0.885	0.963	0.99
Sales of cooking units - Gas	0.376	0.366	0.332	0.241	0.115	0.037	0.01
Sales of water heating units by type - Electric Heat Pump	0	0.01	0.039	0.124	0.266	0.38	0.431
Sales of water heating units by type - Electric Resistance	0.45	0.611	0.603	0.58	0.549	0.535	0.532
Sales of water heating units by type - Gas Furnace	0.522	0.358	0.337	0.277	0.167	0.068	0.021
Sales of water heating units by type - Other	0.028	0.021	0.021	0.02	0.018	0.017	0.017

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	0.018	0.022	0.021	0.017	0.011	0.006	0.002
End-use technology sales by technology - LDV - EV	0.016	0.041	0.106	0.238	0.461	0.705	0.87
End-use technology sales by technology - LDV - gasoline	0.926	0.886	0.816	0.692	0.487	0.264	0.116
End-use technology sales by technology - LDV - hybrid	0.038	0.046	0.053	0.049	0.038	0.023	0.011
End-use technology sales by technology - LDV - hydrogen FC	0.001	0.004	0.003	0.003	0.002	0.001	0
End-use technology sales by technology - LDV - other	0.001	0.001	0.001	0.001	0.001	0	0
End-use technology sales by technology - MDV - diesel	0.648	0.622	0.577	0.494	0.356	0.196	0.084
End-use technology sales by technology - MDV - EV	0.007	0.019	0.055	0.143	0.314	0.526	0.68
End-use technology sales by technology - MDV - gasoline	0.338	0.347	0.347	0.319	0.244	0.142	0.063
End-use technology sales by technology - MDV - hybrid	0.004	0.004	0.005	0.005	0.004	0.003	0.001
End-use technology sales by technology - MDV - hydrogen FC	0.002	0.005	0.014	0.036	0.079	0.132	0.17
End-use technology sales by technology - MDV - other	0.003	0.003	0.003	0.003	0.003	0.002	0.001
Light-duty vehicle capital costs - Cumulative 5-yr	0	0	52085691	110943762	373210933	1178969877	1716060590
Number of public EV charging plugs - DC Fast Charging	60	0	210.582	0	1168.3	0	3287.8
Number of public EV charging plugs - L2 Charging	164	0	5060.9	0	28077.3	0	79016.6

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

variable_name	2050
Carbon sink enhancement potential - Accelerate regeneration	188.269
Carbon sink enhancement potential - All (not counting overlap)	29361.2
Carbon sink enhancement potential - Avoid deforestation	1146.647
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	-790.706
Carbon sink enhancement potential - Extend rotation length	10810.2
Carbon sink enhancement potential - Improve plantations	105.816
Carbon sink enhancement potential - Increase retention of HWP	7401.7
Carbon sink enhancement potential - Increase trees outside forests	330.497
Carbon sink enhancement potential - permanent conservation cover	-31.598
Carbon sink enhancement potential - Reforest cropland	0
Carbon sink enhancement potential - Reforest pasture	4789.4
Carbon sink enhancement potential - Restore productivity	4588.7
Carbon sink enhancement potential - total	-822.305
Land impacted for carbon sink enhancement - Accelerate regeneration	75.88
Land impacted for carbon sink enhancement - All (not counting overlap)	5371.7
Land impacted for carbon sink enhancement - Avoid deforestation	307.802
Land impacted for carbon sink enhancement - corn-ethanol to energy grasses	0
Land impacted for carbon sink enhancement - cropland measures	527.816
Land impacted for carbon sink enhancement - Extend rotation length	5955.2
Land impacted for carbon sink enhancement - Improve plantations	58.81
Land impacted for carbon sink enhancement - Increase retention of HWP	1480.3
Land impacted for carbon sink enhancement - Increase trees outside forests	93.23
Land impacted for carbon sink enhancement - permanent conservation cover	57.471
Land impacted for carbon sink enhancement - Reforest cropland	0
Land impacted for carbon sink enhancement - Reforest pasture	362.158
Land impacted for carbon sink enhancement - Restore productivity	2589.476
Land impacted for carbon sink enhancement - total	585.287
Land impacted for carbon sink enhancement - Total impacted (over 30 years)	5551

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

variable_name	2050
Business-as-usual carbon sink - Accelerate regeneration	17.595
Business-as-usual carbon sink - Avoid deforestation	98.051
Business-as-usual carbon sink - Extend rotation length	3257.9
Business-as-usual carbon sink - Improve plantations	22.333
Business-as-usual carbon sink - Increase retention of HWP	0
Business-as-usual carbon sink - Increase trees outside forests	18.745
Business-as-usual carbon sink - Reforest cropland	0
Business-as-usual carbon sink - Reforest pasture	88.475
Business-as-usual carbon sink - Restore productivity	911.557
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	0.049	0.049	0.048	0.048	0.046	0.045	0.045
Final energy demand by sector - industry	0.185	0.197	0.202	0.207	0.214	0.216	0.219
Final energy demand by sector - residential	0.038	0.036	0.035	0.034	0.032	0.03	0.028
Final energy demand by sector - transportation	0.151	0.143	0.129	0.118	0.11	0.1	0.089

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	5822538645	6480054505	0	0	0	0
Sales of cooking units - Electric Resistance	0.32	0.362	0.409	0.534	0.71	0.817	0.855
Sales of cooking units - Gas	0.68	0.638	0.591	0.466	0.29	0.183	0.145
Sales of space heating units - Electric Heat Pump	0.033	0.165	0.202	0.314	0.519	0.708	0.8
Sales of space heating units - Electric Resistance	0.032	0.08	0.083	0.092	0.108	0.126	0.135
Sales of space heating units - Fossil	0.041	0.047	0.044	0.033	0.016	0.005	0.001
Sales of space heating units - Gas Furnace	0.894	0.709	0.672	0.561	0.356	0.161	0.063
Sales of water heating units - Electric Heat Pump	0.001	0.015	0.049	0.151	0.326	0.471	0.537
Sales of water heating units - Electric Resistance	0.029	0.073	0.09	0.143	0.243	0.338	0.386
Sales of water heating units - Gas Furnace	0.945	0.869	0.818	0.668	0.399	0.162	0.05
Sales of water heating units - Other	0.024	0.042	0.042	0.038	0.032	0.029	0.027

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

variable_name	2025	2030	2035	2040	2045	2050
Electricity distribution peak load (capital invested) - Cumulative 5-yr	0.829	0.837	1.157	1.202	1.725	1.828

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	0.106	0.219	7.289	6.452	15.131	0
Power generation capital investment - Wind - Base	0	10.938	16.076	27.17	10.376	0.041

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	11.574	879.472	4045.7	9730.2	15832.8	16048.9
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	317.968	1923.6	4841.4	8005	8005

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

variable_name	2050
Carbon sink enhancement potential - Accelerate regeneration	188.269
Carbon sink enhancement potential - All (not counting overlap)	29361.2
Carbon sink enhancement potential - Avoid deforestation	1146.647
Carbon sink enhancement potential - corn-ethanol to energy grasses	0
Carbon sink enhancement potential - cropland measures	-790.706
Carbon sink enhancement potential - Extend rotation length	10810.2
Carbon sink enhancement potential - Improve plantations	105.816
Carbon sink enhancement potential - Increase retention of HWP	7401.7
Carbon sink enhancement potential - Increase trees outside forests	330.497
Carbon sink enhancement potential - permanent conservation cover	-31.598
Carbon sink enhancement potential - Reforest cropland	0
Carbon sink enhancement potential - Reforest pasture	4789.4
Carbon sink enhancement potential - Restore productivity	4588.7
Carbon sink enhancement potential - total	-822.305
Land impacted for carbon sink enhancement - Accelerate regeneration	75.88
Land impacted for carbon sink enhancement - All (not counting overlap)	5371.7
Land impacted for carbon sink enhancement - Avoid deforestation	307.802
Land impacted for carbon sink enhancement - corn-ethanol to energy grasses	0
Land impacted for carbon sink enhancement - cropland measures	527.816
Land impacted for carbon sink enhancement - Extend rotation length	5955.2
Land impacted for carbon sink enhancement - Improve plantations	58.81
Land impacted for carbon sink enhancement - Increase retention of HWP	1480.3
Land impacted for carbon sink enhancement - Increase trees outside forests	93.23
Land impacted for carbon sink enhancement - permanent conservation cover	57.471
Land impacted for carbon sink enhancement - Reforest cropland	0
Land impacted for carbon sink enhancement - Reforest pasture	362.158
Land impacted for carbon sink enhancement - Restore productivity	2589.476
Land impacted for carbon sink enhancement - total	585.287
Land impacted for carbon sink enhancement - Total impacted (over 30 years)	5551

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

variable_name	2050
Business-as-usual carbon sink - Accelerate regeneration	17.595
Business-as-usual carbon sink - Avoid deforestation	98.051
Business-as-usual carbon sink - Extend rotation length	3257.9
Business-as-usual carbon sink - Improve plantations	22.333
Business-as-usual carbon sink - Increase retention of HWP	0
Business-as-usual carbon sink - Increase trees outside forests	18.745
Business-as-usual carbon sink - Reforest cropland	0
Business-as-usual carbon sink - Reforest pasture	88.475
Business-as-usual carbon sink - Restore productivity	911.557
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
Capital investment	0	0	0	0	0	0	0
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	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	3.53
Annual - BECCS	0	0	0	0	0	0
Annual - Cement	0	0	0	0	0	3.53
Annual - NGCC	0	0	0	0	0	0
Cumulative - All	0	0	0	0	0	3.53
Cumulative - BECCS	0	0	0	0	0	0
Cumulative - Cement	0	0	0	0	0	3.53
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	35999.331
CO2 pipelines - Spur	0	0	0	0	0	35999.331
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	188.269
Carbon sink enhancement potential - All (not counting overlap)	29361.2
Carbon sink enhancement potential - Avoid deforestation	1146.647
Carbon sink enhancement potential - corn-ethanol to energy grasses	-34.038
Carbon sink enhancement potential - cropland measures	-777.188
Carbon sink enhancement potential - Cropland to woody energy crops	0
Carbon sink enhancement potential - Extend rotation length	10810.2
Carbon sink enhancement potential - Improve plantations	105.816
Carbon sink enhancement potential - Increase retention of HWP	7401.7
Carbon sink enhancement potential - Increase trees outside forests	330.497
Carbon sink enhancement potential - pasture to energy crops	0
Carbon sink enhancement potential - permanent conservation cover	-31.055
Carbon sink enhancement potential - Reforest cropland	0
Carbon sink enhancement potential - Reforest pasture	4789.4
Carbon sink enhancement potential - Restore productivity	4588.7
Carbon sink enhancement potential - total	-842.281
Land impacted for carbon sink enhancement - Accelerate regeneration	75.88
Land impacted for carbon sink enhancement - All (not counting overlap)	5371.7
Land impacted for carbon sink enhancement - Avoid deforestation	307.802
Land impacted for carbon sink enhancement - corn-ethanol to energy grasses	13.064
Land impacted for carbon sink enhancement - cropland measures	1017.615

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	0.116
Land impacted for carbon sink enhancement - Extend rotation length	5955.2
Land impacted for carbon sink enhancement - Improve plantations	58.81
Land impacted for carbon sink enhancement - Increase retention of HWP	1480.3
Land impacted for carbon sink enhancement - Increase trees outside forests	93.23
Land impacted for carbon sink enhancement - pasture to energy crops	219.708
Land impacted for carbon sink enhancement - permanent conservation cover	56.483
Land impacted for carbon sink enhancement - Reforest cropland	0
Land impacted for carbon sink enhancement - Reforest pasture	362.158
Land impacted for carbon sink enhancement - Restore productivity	2589.476
Land impacted for carbon sink enhancement - total	1306.987
Land impacted for carbon sink enhancement - Total impacted (over 30 years)	5551

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

variable_name	2050
Business-as-usual carbon sink - Accelerate regeneration	17.595
Business-as-usual carbon sink - Avoid deforestation	98.051
Business-as-usual carbon sink - Extend rotation length	3257.9
Business-as-usual carbon sink - Improve plantations	22.333
Business-as-usual carbon sink - Increase retention of HWP	0
Business-as-usual carbon sink - Increase trees outside forests	18.745
Business-as-usual carbon sink - Reforest cropland	0
Business-as-usual carbon sink - Reforest pasture	88.475
Business-as-usual carbon sink - Restore productivity	911.557
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	188.269
Carbon sink enhancement potential - All (not counting overlap)	29361.2
Carbon sink enhancement potential - Avoid deforestation	1146.647
Carbon sink enhancement potential - corn-ethanol to energy grasses	0
Carbon sink enhancement potential - cropland measures	-790.706
Carbon sink enhancement potential - Extend rotation length	10810.2
Carbon sink enhancement potential - Improve plantations	105.816
Carbon sink enhancement potential - Increase retention of HWP	7401.7
Carbon sink enhancement potential - Increase trees outside forests	330.497
Carbon sink enhancement potential - permanent conservation cover	-31.598
Carbon sink enhancement potential - Reforest cropland	0
Carbon sink enhancement potential - Reforest pasture	4789.4
Carbon sink enhancement potential - Restore productivity	4588.7
Carbon sink enhancement potential - total	-822.305
Land impacted for carbon sink enhancement - Accelerate regeneration	75.88
Land impacted for carbon sink enhancement - All (not counting overlap)	5371.7
Land impacted for carbon sink enhancement - Avoid deforestation	307.802
Land impacted for carbon sink enhancement - corn-ethanol to energy grasses	0
Land impacted for carbon sink enhancement - cropland measures	527.816
Land impacted for carbon sink enhancement - Extend rotation length	5955.2
Land impacted for carbon sink enhancement - Improve plantations	58.81
Land impacted for carbon sink enhancement - Increase retention of HWP	1480.3
Land impacted for carbon sink enhancement - Increase trees outside forests	93.23
Land impacted for carbon sink enhancement - permanent conservation cover	57.471
Land impacted for carbon sink enhancement - Reforest cropland	0
Land impacted for carbon sink enhancement - Reforest pasture	362.158
Land impacted for carbon sink enhancement - Restore productivity	2589.476
Land impacted for carbon sink enhancement - total	585.287
Land impacted for carbon sink enhancement - Total impacted (over 30 years)	5551

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

variable_name	2050
Business-as-usual carbon sink - Accelerate regeneration	17.595
Business-as-usual carbon sink - Avoid deforestation	98.051
Business-as-usual carbon sink - Extend rotation length	3257.9
Business-as-usual carbon sink - Improve plantations	22.333
Business-as-usual carbon sink - Increase retention of HWP	0
Business-as-usual carbon sink - Increase trees outside forests	18.745
Business-as-usual carbon sink - Reforest cropland	0
Business-as-usual carbon sink - Reforest pasture	88.475
Business-as-usual carbon sink - Restore productivity	911.557
Business-as-usual carbon sink - Total impacted (over 30 years)	0