Net-Zero America - washington state report v2

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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	4.097	3.826	0	0	0	0
Sale of space heating units by type - Electric Heat Pump	0.124	0.298	0.305	0.317	0.332	0.353	0.385
Sale of space heating units by type - Electric Resistance	0.362	0.369	0.364	0.356	0.345	0.325	0.292
Sale of space heating units by type - Fossil	0.09	0.127	0.115	0.108	0.106	0.105	0.106
Sale of space heating units by type - Gas	0.423	0.207	0.216	0.219	0.217	0.217	0.217
Sales of cooking units - Electric Resistance	0.702	0.702	0.702	0.702	0.702	0.702	0.702
Sales of cooking units - Gas	0.298	0.298	0.298	0.298	0.298	0.298	0.298
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	0.455	0.617	0.617	0.616	0.616	0.616	0.616
Sales of water heating units by type - Gas Furnace	0.475	0.327	0.328	0.328	0.328	0.328	0.328
Sales of water heating units by type - Other	0.069	0.056	0.056	0.056	0.056	0.056	0.056

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	0.015	0.019	0.022	0.02	0.018	0.017	0.016
End-use technology sales by technology - LDV - EV	0.037	0.058	0.066	0.081	0.098	0.113	0.125
End-use technology sales by technology - LDV - gasoline	0.9	0.864	0.842	0.823	0.802	0.783	0.767
End-use technology sales by technology - LDV - hybrid	0.046	0.054	0.066	0.072	0.077	0.083	0.087
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	3799.3
Carbon sink enhancement potential - All (not counting overlap)	0	0	120736.3
Carbon sink enhancement potential - Avoid deforestation	0	0	3014.7
Carbon sink enhancement potential - Extend rotation length	0	0	16064.7
Carbon sink enhancement potential - Improve plantations	0	0	7121.9
Carbon sink enhancement potential - Increase retention of HWP	0	0	49650.2
Carbon sink enhancement potential - Increase trees outside forests	0	0	1806.473
Carbon sink enhancement potential - Reforest cropland	0	0	26216.9
Carbon sink enhancement potential - Reforest pasture	0	0	3809.8
Carbon sink enhancement potential - Restore productivity	0	0	9252.4
Land impacted for carbon sink enhancement - Accelerate regeneration	0	0	1531.24
Land impacted for carbon sink enhancement - All (not counting overlap)	0	0	26982.2
Land impacted for carbon sink enhancement - Avoid deforestation	0	0	809.236
Land impacted for carbon sink enhancement - Extend rotation length	0	0	8849.7
Land impacted for carbon sink enhancement - Improve plantations	0	0	3958.153
Land impacted for carbon sink enhancement - Increase retention of HWP	0	0	9930
Land impacted for carbon sink enhancement - Increase trees outside forests	0	0	509.581
Land impacted for carbon sink enhancement - Natural uptake	-27.24	-5.368	-4.47
Land impacted for carbon sink enhancement - Reforest cropland	0	0	8728.71
Land impacted for carbon sink enhancement - Reforest pasture	0	0	288.081
Land impacted for carbon sink enhancement - Restore productivity	0	0	5221.3
Land impacted for carbon sink enhancement - Retained in Hardwood Products	-8.105	-13.602	-14.318
Land impacted for carbon sink enhancement - Total	-35.345	-18.97	-18.788
Land impacted for carbon sink enhancement - Total impacted (over 30 years)	0	0	12843.8

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

variable_name	2050
Business-as-usual carbon sink - Accelerate regeneration	355.072
Business-as-usual carbon sink - Avoid deforestation	257.785
Business-as-usual carbon sink - Extend rotation length	4841.4
Business-as-usual carbon sink - Improve plantations	1503.1

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	102.455
Business-as-usual carbon sink - Reforest cropland	990.488
Business-as-usual carbon sink - Reforest pasture	70.378
Business-as-usual carbon sink - Restore productivity	1838
Business-as-usual carbon sink - Total impacted (over 30 years)	990.488

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

variable_name	2020	2025	2030	2035	2040	2045	2050
Final energy demand by sector - commercial	0.16	0.165	0.169	0.173	0.178	0.188	0.201
Final energy demand by sector - industry	0.342	0.367	0.387	0.404	0.428	0.457	0.49
Final energy demand by sector - residential	0.246	0.227	0.21	0.196	0.186	0.179	0.172
Final energy demand by sector - transportation	0.656	0.659	0.625	0.605	0.608	0.624	0.642

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	22575452404	23159242611	0	0	0	0
Sales of cooking units - Electric Resistance	0.275	0.29	0.29	0.29	0.29	0.289	0.289
Sales of cooking units - Gas	0.725	0.71	0.71	0.71	0.71	0.711	0.711
Sales of space heating units - Electric Heat Pump	0.027	0.214	0.538	0.641	0.652	0.653	0.653
Sales of space heating units - Electric Resistance	0.183	0.161	0.252	0.303	0.335	0.339	0.34
Sales of space heating units - Fossil	0	0	0	0	0	0	0
Sales of space heating units - Gas Furnace	0.79	0.625	0.21	0.055	0.013	0.007	0.007
Sales of water heating units - Electric Heat Pump	0.011	0.008	0.008	0.008	0.008	0.008	0.008
Sales of water heating units - Electric Resistance	0.034	0.024	0.024	0.024	0.024	0.024	0.024
Sales of water heating units - Gas Furnace	0.946	0.961	0.961	0.961	0.961	0.961	0.961
Sales of water heating units - Other	0.009	0.006	0.006	0.006	0.006	0.006	0.006

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	3.377	3.436	3.991	4.11	3.95	4.035

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	4.119	4.095	0	0	0	0
Sale of space heating units by type - Electric Heat Pump	0.14	0.252	0.476	0.591	0.607	0.607	0.606
Sale of space heating units by type - Electric Resistance	0.356	0.41	0.355	0.307	0.3	0.302	0.303
Sale of space heating units by type - Fossil	0.089	0.132	0.099	0.089	0.086	0.084	0.084
Sale of space heating units by type - Gas	0.415	0.206	0.069	0.013	0.007	0.007	0.007
Sales of cooking units - Electric Resistance	0.706	0.768	0.96	0.998	1	1	1
Sales of cooking units - Gas	0.294	0.232	0.04	0.002	0	0	0
Sales of water heating units by type - Electric Heat Pump	0	0.069	0.375	0.476	0.486	0.486	0.486
Sales of water heating units by type - Electric Resistance	0.455	0.591	0.482	0.461	0.461	0.461	0.461
Sales of water heating units by type - Gas Furnace	0.475	0.285	0.091	0.01	0	0	0
Sales of water heating units by type - Other	0.069	0.055	0.053	0.053	0.053	0.053	0.053

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	0.015	0.018	0.012	0.004	0.001	0	0
End-use technology sales by technology - LDV - EV	0.041	0.156	0.471	0.821	0.964	0.993	1
End-use technology sales by technology - LDV - gasoline	0.897	0.775	0.481	0.163	0.033	0.006	0
End-use technology sales by technology - LDV - hybrid	0.046	0.046	0.033	0.012	0.003	0.001	0
End-use technology sales by technology - LDV - hydrogen FC	0.001	0.003	0.002	0.001	0	0	0
End-use technology sales by technology - LDV - other	0.001	0.001	0.001	0	0	0	0
End-use technology sales by technology - MDV - diesel	0.647	0.597	0.423	0.144	0.026	0.004	0
End-use technology sales by technology - MDV - EV	0.008	0.051	0.253	0.608	0.765	0.795	0.8
End-use technology sales by technology - MDV - gasoline	0.337	0.333	0.255	0.093	0.018	0.003	0
End-use technology sales by technology - MDV - hybrid	0.004	0.004	0.003	0.001	0	0	0
End-use technology sales by technology - MDV - hydrogen FC	0.002	0.013	0.063	0.152	0.191	0.199	0.2
End-use technology sales by technology - MDV - other	0.003	0.003	0.002	0.001	0	0	0
Light-duty vehicle capital costs - Cumulative 5-yr	0	1331125276	3546524922	5528714664	8461556350	9114988324	8741715829
Number of public EV charging plugs - DC Fast Charging	551	0	2624.8	0	9973.7	0	15846.3
Number of public EV charging plugs - L2 Charging	2369	0	63103.3	0	239784.4	0	380971.4

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	0.003	0.249	0	0	0	0
Power generation capital investment - biomass w/ccu allam power plant	0	0	0	0	0	0.008	0.044
Power generation capital investment - biomass w/ccu power plant	0	0	0	0	0	0.02	0.172
Power generation capital investment - Solar PV - Base	0	0	0	0	0	0	0
Power generation capital investment - Solar PV - Constrained	0	0.2	0	0	0	0	0
Power generation capital investment - Wind - Base	0	0	0.826	0.787	0.706	0.738	0.057
Power generation capital investment - Wind - Constrained	0	0	2.112	3.351	11.636	9.507	1.16

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	6.637	495.078	495.078	495.078	495.078	495.078
Power generation by technology - biomass w/ccu allam power plant	0	0	0	0	0	7.506	51.08
Power generation by technology - biomass w/ccu power plant	0	0	0	0	0	22.342	215.885

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	400.276	2188.9	4906.4	9596.2	13041.8	13474.1
HV transmission for wind and solar - base other intra-state	0	118.729	127.679	161.902	196.479	319.093	338.002
HV transmission for wind and solar - base spur intra-state	0	43.325	59.084	80.982	99.386	143.716	146.296
HV transmission for wind and solar - constrained all	0	393.414	2480.1	6640.5	14714.2	21991.2	22779
HV transmission for wind and solar - constrained other intra-state	0	116.332	209.917	582.914	1600.2	2516.5	2650.3
HV transmission for wind and solar - constrained spur intra-state	0	43.36	111.075	224.196	798.337	1205.5	1286.1

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

variable_name	2020	2025	2030	2035	2040	2045	2050
Biomass purchases	0	0.046	0.14	0.141	0.141	0.188	0.607
Capital investment	0	0	0.265	0	0.021	0	8.519
Number of facilities - allam power w ccu	0	0	0	0	0	1	2
Number of facilities - beccs hydrogen	0	0	0	0	0	1	8
Number of facilities - diesel	0	0	0	1	1	1	1
Number of facilities - diesel ccu	0	0	0	0	0	1	2
Number of facilities - power	0	1	1	1	1	1	1
Number of facilities - power ccu	0	0	0	0	0	1	2
Number of facilities - pyrolysis	0	0	0	1	1	1	1
Number of facilities - pyrolysis ccu	0	0	0	0	0	1	3
Number of facilities - sng	0	1	1	1	1	1	1
Number of facilities - sng ccu	0	0	0	0	0	1	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	3.35	3.32	4.6	15.02
Annual - BECCS	0	0	0	0	1.17	11.48
Annual - Cement	0	0	3.35	3.32	3.42	3.53
Annual - NGCC	0	0	0	0	0	0
Cumulative - All	0	0	3.35	6.67	11.27	26.29
Cumulative - BECCS	0	0	0	0	1.17	12.65
Cumulative - Cement	0	0	3.35	6.67	10.09	13.62
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	1802512.619	1801927.619	1948938.4	2740475.1
CO2 pipelines - Spur	0	0	99948.663	99363.163	246374.312	1037911.2
CO2 pipelines - Trunk	0	0	1702563.956	1702563.956	1702563.956	1702563.956

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

variable_name	2020	2025	2030	2035	2040	2045	2050
Jobs by economic sector - agriculture	108.583	125.182	363.588	388.64	328.655	333.508	782.645
Jobs by economic sector - construction	11840.9	8570.4	8392.1	10288.6	10284.1	9831.1	13351.6
Jobs by economic sector - manufacturing	4798.1	4849.9	7540	9471.5	8742.4	7530.5	8676

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

variable_name	2020	2025	2030	2035	2040	2045	2050
Jobs by economic sector - mining	2792.3	2249	1645.3	1105.1	711.906	447.779	268.957
Jobs by economic sector - other	1709.1	1146.3	1192.1	1469	1725.7	1923.9	3451
Jobs by economic sector - pipeline	420.503	417.882	361.031	502.223	228.617	169.05	209.902
Jobs by economic sector - professional	4697.9	3915.4	4129.6	4718.1	5032	5150.1	7795.6
Jobs by economic sector - trade	3859.2	3139.5	2993.4	3186.5	3344	3410.5	5119
Jobs by economic sector - utilities	4095.6	4449.9	5095.5	7657	7723.2	6900.1	7083.9
Jobs by resource sector - Biomass	450.106	537.266	1002.5	1106.9	989.361	1216.3	3342.2
Jobs by resource sector - CO2	0	0	0	1741	53.499	90.008	814.067
Jobs by resource sector - Coal	408.705	98.751	0	0	0	0	0
Jobs by resource sector - Grid	4121.6	5670.7	7560.6	11492.8	14008.6	12552.4	11879.5
Jobs by resource sector - Natural Gas	2966.6	2549.4	2063.8	2014.1	1795.6	1379.6	1365.8
Jobs by resource sector - Nuclear	615.6	605.675	596.002	345.706	0.015	0.019	0.038
Jobs by resource sector - Oil	6733.4	6005.6	4868.3	3624.3	2611.9	1888	1283.9
Jobs by resource sector - Solar	16332.1	9420.1	9517.6	12164	13095	14031.7	23686.1
Jobs by resource sector - Wind	2694	3976	6103.8	6297.8	5566.6	4538.4	4366.9
Median wages - All	66752.1	68135.5	68415	69492.1	70588.1	71566.9	71976.6
Required Level of Education - Associates degree or some college	10601.4	8906.2	9837.8	12303.7	12151.5	11388.2	14823.4
Required Level of Education - Bachelors degree	6994.9	6016.3	6501.9	7699.8	7522.7	7058.4	9267.1
Required Level of Education - Doctoral degree	262.504	217.165	223.17	250.216	251.984	248.922	361.024
Required Level of Education - High school diploma or less	14791.4	12287.1	13618.6	16727.6	16400.8	15289.7	19982.1
Required Level of Education - Masters or professional degree	1671.9	1436.7	1531.1	1805.2	1793.7	1711.3	2304.9
Wage income - All	2291383186	1966843557	2169842411	2695644480	2691195760	2555059195	3364732359

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

variable_name	2050
Carbon sink enhancement potential - Accelerate regeneration	3799.3
Carbon sink enhancement potential - All (not counting overlap)	120736.3
Carbon sink enhancement potential - Avoid deforestation	3014.7
Carbon sink enhancement potential - corn-ethanol to energy grasses	0
Carbon sink enhancement potential - cropland measures	-3008.67
Carbon sink enhancement potential - Extend rotation length	16064.7
Carbon sink enhancement potential - Improve plantations	7121.9
Carbon sink enhancement potential - Increase retention of HWP	49650.2
Carbon sink enhancement potential - Increase trees outside forests	1806.473
Carbon sink enhancement potential - permanent conservation cover	-220.798
Carbon sink enhancement potential - Reforest cropland	26216.9
Carbon sink enhancement potential - Reforest pasture	3809.8
Carbon sink enhancement potential - Restore productivity	9252.4
Carbon sink enhancement potential - total	-3229.469
Land impacted for carbon sink enhancement - Accelerate regeneration	1531.24
Land impacted for carbon sink enhancement - All (not counting overlap)	26982.2
Land impacted for carbon sink enhancement - Avoid deforestation	809.236
Land impacted for carbon sink enhancement - corn-ethanol to energy grasses	0
Land impacted for carbon sink enhancement - cropland measures	4255.7
Land impacted for carbon sink enhancement - Extend rotation length	8849.7
Land impacted for carbon sink enhancement - Improve plantations	3958.153
Land impacted for carbon sink enhancement - Increase retention of HWP	9930
Land impacted for carbon sink enhancement - Increase trees outside forests	509.581
Land impacted for carbon sink enhancement - permanent conservation cover	352.305
Land impacted for carbon sink enhancement - Reforest cropland	8728.71
Land impacted for carbon sink enhancement - Reforest pasture	288.081
Land impacted for carbon sink enhancement - Restore productivity	5221.3
Land impacted for carbon sink enhancement - total	4608.1
Land impacted for carbon sink enhancement - Total impacted (over 30 years)	12843.8

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

variable_name	2050
Business-as-usual carbon sink - Accelerate regeneration	355.072
Business-as-usual carbon sink - Avoid deforestation	257.785
Business-as-usual carbon sink - Extend rotation length	4841.4
Business-as-usual carbon sink - Improve plantations	1503.1
Business-as-usual carbon sink - Increase retention of HWP	0
Business-as-usual carbon sink - Increase trees outside forests	102.455
Business-as-usual carbon sink - Reforest cropland	990.488
Business-as-usual carbon sink - Reforest pasture	70.378
Business-as-usual carbon sink - Restore productivity	1838
Business-as-usual carbon sink - Total impacted (over 30 years)	990.488

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

variable_name	2020	2025	2030	2035	2040	2045	2050
Natural gas consumption	234898.9	238387.4	200947.1	161167.9	121324.8	76333.5	52942.9
Oil consumption	138133.1	135087.3	119335.5	96230.4	74668.9	57777.5	41826.5

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

variable_name	2020	2025	2030	2035	2040	2045	2050
Final energy demand by sector - commercial	0.16	0.162	0.16	0.153	0.146	0.145	0.146
Final energy demand by sector - industry	0.342	0.354	0.359	0.361	0.368	0.377	0.387
Final energy demand by sector - residential	0.246	0.227	0.199	0.17	0.144	0.128	0.117
Final energy demand by sector - transportation	0.656	0.65	0.592	0.519	0.454	0.412	0.391

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	22776425317	24705420289	0	0	0	0
Sales of cooking units - Electric Resistance	0.275	0.417	0.782	0.854	0.858	0.858	0.858
Sales of cooking units - Gas	0.725	0.583	0.218	0.146	0.142	0.142	0.142
Sales of space heating units - Electric Heat Pump	0.027	0.157	0.399	0.565	0.59	0.591	0.591
Sales of space heating units - Electric Resistance	0.183	0.171	0.342	0.396	0.402	0.402	0.402
Sales of space heating units - Fossil	0	0	0	0	0	0	0
Sales of space heating units - Gas Furnace	0.79	0.672	0.259	0.039	0.008	0.007	0.007
Sales of water heating units - Electric Heat Pump	0.011	0.095	0.486	0.629	0.643	0.644	0.644
Sales of water heating units - Electric Resistance	0.034	0.062	0.242	0.336	0.349	0.349	0.35
Sales of water heating units - Gas Furnace	0.946	0.837	0.266	0.028	0.001	0	0
Sales of water heating units - Other	0.009	0.006	0.006	0.006	0.006	0.006	0.006

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	3.771	3.877	6.498	6.904	5.905	6.143

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	4.102	4.037	0	0	0	0
Sale of space heating units by type - Electric Heat Pump	0.14	0.213	0.239	0.314	0.441	0.541	0.584
Sale of space heating units by type - Electric Resistance	0.356	0.418	0.411	0.392	0.358	0.327	0.31
Sale of space heating units by type - Fossil	0.089	0.138	0.135	0.124	0.106	0.092	0.088
Sale of space heating units by type - Gas	0.415	0.23	0.215	0.17	0.096	0.04	0.018
Sales of cooking units - Electric Resistance	0.704	0.712	0.739	0.811	0.91	0.971	0.992
Sales of cooking units - Gas	0.296	0.288	0.261	0.189	0.09	0.029	0.008
Sales of water heating units by type - Electric Heat Pump	0	0.012	0.047	0.148	0.309	0.423	0.467
Sales of water heating units by type - Electric Resistance	0.455	0.613	0.6	0.564	0.51	0.476	0.465
Sales of water heating units by type - Gas Furnace	0.475	0.319	0.298	0.233	0.128	0.049	0.016
Sales of water heating units by type - Other	0.069	0.056	0.055	0.055	0.054	0.053	0.053

Table 25: *REF scenario - PILLAR 1: Efficiency/Electrification - Transportation*

variable_name	2020	2025	2030	2035	2040	2045	2050
End-use technology sales by technology - HDV - diesel	0.974	0.96	0.913	0.798	0.582	0.321	0.137
End-use technology sales by technology - HDV - EV	0.005	0.015	0.041	0.108	0.236	0.394	0.51
End-use technology sales by technology - HDV - gasoline	0.002	0.002	0.002	0.002	0.002	0.001	0.001
End-use technology sales by technology - HDV - hybrid	0.001	0.001	0.001	0.001	0.001	0.001	0
End-use technology sales by technology - HDV - hydrogen FC	0.003	0.01	0.027	0.072	0.157	0.263	0.34
End-use technology sales by technology - HDV - other	0.015	0.013	0.015	0.019	0.022	0.02	0.011
End-use technology sales by technology - LDV - diesel	0.015	0.019	0.02	0.016	0.01	0.005	0.002
End-use technology sales by technology - LDV - EV	0.019	0.048	0.121	0.262	0.488	0.723	0.877
End-use technology sales by technology - LDV - gasoline	0.916	0.873	0.793	0.662	0.458	0.246	0.109
End-use technology sales by technology - LDV - hybrid	0.047	0.055	0.062	0.056	0.042	0.025	0.012
End-use technology sales by technology - LDV - hydrogen FC	0.001	0.004	0.003	0.002	0.002	0.001	0
End-use technology sales by technology - LDV - other	0.001	0.001	0.001	0.001	0.001	0	0
End-use technology sales by technology - MDV - diesel	0.648	0.622	0.577	0.494	0.356	0.196	0.084
End-use technology sales by technology - MDV - EV	0.007	0.019	0.055	0.143	0.314	0.526	0.68
End-use technology sales by technology - MDV - gasoline	0.338	0.347	0.347	0.319	0.244	0.142	0.063
End-use technology sales by technology - MDV - hybrid	0.004	0.004	0.005	0.005	0.004	0.003	0.001
End-use technology sales by technology - MDV - hydrogen FC	0.002	0.005	0.014	0.036	0.079	0.132	0.17
End-use technology sales by technology - MDV - other	0.003	0.003	0.003	0.003	0.003	0.002	0.001
Light-duty vehicle capital costs - Cumulative 5-yr	0	0	238925345	449642073	1568923772	4778226815	7016202293
Number of public EV charging plugs - DC Fast Charging	551	0	1019.9	0	3861.2	0	10149.6
Number of public EV charging plugs - L2 Charging	2369	0	24519	0	92829.3	0	244011.9

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

variable_name	2050
Carbon sink enhancement potential - Accelerate regeneration	3799.3
Carbon sink enhancement potential - All (not counting overlap)	120736.3
Carbon sink enhancement potential - Avoid deforestation	3014.7
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	-3008.67
Carbon sink enhancement potential - Extend rotation length	16064.7
Carbon sink enhancement potential - Improve plantations	7121.9
Carbon sink enhancement potential - Increase retention of HWP	49650.2
Carbon sink enhancement potential - Increase trees outside forests	1806.473
Carbon sink enhancement potential - permanent conservation cover	-220.798
Carbon sink enhancement potential - Reforest cropland	26216.9
Carbon sink enhancement potential - Reforest pasture	3809.8
Carbon sink enhancement potential - Restore productivity	9252.4
Carbon sink enhancement potential - total	-3229.469
Land impacted for carbon sink enhancement - Accelerate regeneration	1531.24
Land impacted for carbon sink enhancement - All (not counting overlap)	26982.2
Land impacted for carbon sink enhancement - Avoid deforestation	809.236
Land impacted for carbon sink enhancement - corn-ethanol to energy grasses	0
Land impacted for carbon sink enhancement - cropland measures	4255.7
Land impacted for carbon sink enhancement - Extend rotation length	8849.7
Land impacted for carbon sink enhancement - Improve plantations	3958.153
Land impacted for carbon sink enhancement - Increase retention of HWP	9930
Land impacted for carbon sink enhancement - Increase trees outside forests	509.581
Land impacted for carbon sink enhancement - permanent conservation cover	352.305
Land impacted for carbon sink enhancement - Reforest cropland	8728.71
Land impacted for carbon sink enhancement - Reforest pasture	288.081
Land impacted for carbon sink enhancement - Restore productivity	5221.3
Land impacted for carbon sink enhancement - total	4608.1
Land impacted for carbon sink enhancement - Total impacted (over 30 years)	12843.8

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

variable_name	2050
Business-as-usual carbon sink - Accelerate regeneration	355.072
Business-as-usual carbon sink - Avoid deforestation	257.785
Business-as-usual carbon sink - Extend rotation length	4841.4
Business-as-usual carbon sink - Improve plantations	1503.1
Business-as-usual carbon sink - Increase retention of HWP	0
Business-as-usual carbon sink - Increase trees outside forests	102.455
Business-as-usual carbon sink - Reforest cropland	990.488
Business-as-usual carbon sink - Reforest pasture	70.378
Business-as-usual carbon sink - Restore productivity	1838
Business-as-usual carbon sink - Total impacted (over 30 years)	990.488

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

variable_name	2020	2025	2030	2035	2040	2045	2050
Final energy demand by sector - commercial	0.16	0.163	0.165	0.166	0.164	0.162	0.16
Final energy demand by sector - industry	0.342	0.355	0.361	0.367	0.376	0.385	0.395
Final energy demand by sector - residential	0.246	0.227	0.207	0.188	0.169	0.15	0.133
Final energy demand by sector - transportation	0.657	0.654	0.611	0.573	0.544	0.51	0.47

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	22723151143	24348346703	0	0	0	0
Sales of cooking units - Electric Resistance	0.275	0.31	0.361	0.497	0.686	0.802	0.843
Sales of cooking units - Gas	0.725	0.69	0.639	0.503	0.314	0.198	0.157
Sales of space heating units - Electric Heat Pump	0.027	0.119	0.146	0.228	0.372	0.498	0.558
Sales of space heating units - Electric Resistance	0.183	0.139	0.158	0.216	0.306	0.368	0.393
Sales of space heating units - Fossil	0	0	0	0	0	0	0
Sales of space heating units - Gas Furnace	0.79	0.743	0.695	0.556	0.322	0.133	0.049
Sales of water heating units - Electric Heat Pump	0.011	0.024	0.068	0.198	0.406	0.557	0.617
Sales of water heating units - Electric Resistance	0.034	0.031	0.052	0.112	0.213	0.295	0.331
Sales of water heating units - Gas Furnace	0.946	0.938	0.873	0.684	0.375	0.142	0.047
Sales of water heating units - Other	0.009	0.006	0.006	0.006	0.006	0.006	0.006

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	2.955	2.964	4.081	4.221	5.762	6.069

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	0	0	6.649
Power generation capital investment - Wind - Base	0	0.898	1.323	2.711	4.505	10.57

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	394.503	2345.6	8653.1	18209.7	29298.3	46687.8
HV transmission for wind and solar - base other intra-state	0	110.052	122.909	177.834	569.92	995.358	2919.8
HV transmission for wind and solar - base spur intra-state	0	41.822	60.391	95.324	213.318	418.743	1369.1

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

variable_name	2050
Carbon sink enhancement potential - Accelerate regeneration	3799.3
Carbon sink enhancement potential - All (not counting overlap)	120736.3
Carbon sink enhancement potential - Avoid deforestation	3014.7
Carbon sink enhancement potential - corn-ethanol to energy grasses	0
Carbon sink enhancement potential - cropland measures	-3008.67
Carbon sink enhancement potential - Extend rotation length	16064.7
Carbon sink enhancement potential - Improve plantations	7121.9
Carbon sink enhancement potential - Increase retention of HWP	49650.2
Carbon sink enhancement potential - Increase trees outside forests	1806.473
Carbon sink enhancement potential - permanent conservation cover	-220.798
Carbon sink enhancement potential - Reforest cropland	26216.9
Carbon sink enhancement potential - Reforest pasture	3809.8
Carbon sink enhancement potential - Restore productivity	9252.4
Carbon sink enhancement potential - total	-3229.469
Land impacted for carbon sink enhancement - Accelerate regeneration	1531.24
Land impacted for carbon sink enhancement - All (not counting overlap)	26982.2
Land impacted for carbon sink enhancement - Avoid deforestation	809.236
Land impacted for carbon sink enhancement - corn-ethanol to energy grasses	0
Land impacted for carbon sink enhancement - cropland measures	4255.7
Land impacted for carbon sink enhancement - Extend rotation length	8849.7
Land impacted for carbon sink enhancement - Improve plantations	3958.153
Land impacted for carbon sink enhancement - Increase retention of HWP	9930
Land impacted for carbon sink enhancement - Increase trees outside forests	509.581
Land impacted for carbon sink enhancement - permanent conservation cover	352.305
Land impacted for carbon sink enhancement - Reforest cropland	8728.71
Land impacted for carbon sink enhancement - Reforest pasture	288.081
Land impacted for carbon sink enhancement - Restore productivity	5221.3
Land impacted for carbon sink enhancement - total	4608.1
Land impacted for carbon sink enhancement - Total impacted (over 30 years)	12843.8

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

variable_name	2050
Business-as-usual carbon sink - Accelerate regeneration	355.072
Business-as-usual carbon sink - Avoid deforestation	257.785
Business-as-usual carbon sink - Extend rotation length	4841.4
Business-as-usual carbon sink - Improve plantations	1503.1
Business-as-usual carbon sink - Increase retention of HWP	0
Business-as-usual carbon sink - Increase trees outside forests	102.455
Business-as-usual carbon sink - Reforest cropland	990.488
Business-as-usual carbon sink - Reforest pasture	70.378
Business-as-usual carbon sink - Restore productivity	1838
Business-as-usual carbon sink - Total impacted (over 30 years)	990.488

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	0.004	0.227	0	0	0	0
Power generation capital investment - biomass w/ccu allam power plant	0	0	0	0	0.008	0	0
Power generation capital investment - biomass w/ccu power plant	0	0	0	0	0.063	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	7.385	452.48	452.48	452.48	452.48	452.48
Power generation by technology - biomass w/ccu allam power plant	0	0	0	0	8.398	8.398	8.398
Power generation by technology - biomass w/ccu power plant	0	0	0	0	70.383	70.383	70.383

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

variable_name	2020	2025	2030	2035	2040	2045	2050
Biomass purchases	0	0.06	0.181	0.183	0.274	0.644	0.687
Capital investment	0	0	0.242	0	1.297	0	5.699
Number of facilities - allam power w ccu	0	0	0	0	1	1	1
Number of facilities - beccs hydrogen	0	0	0	0	1	6	7
Number of facilities - diesel	0	0	0	1	1	1	1
Number of facilities - diesel ccu	0	0	0	0	1	1	1
Number of facilities - power	0	1	1	1	1	1	1
Number of facilities - power ccu	0	0	0	0	1	1	1
Number of facilities - pyrolysis	0	0	0	1	1	1	1
Number of facilities - pyrolysis ccu	0	0	0	0	1	1	1
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	3.35	5.03	12.11	13.02
Annual - BECCS	0	0	0	1.71	8.69	9.49
Annual - Cement	0	0	3.35	3.32	3.42	3.53
Annual - NGCC	0	0	0	0	0	0
Cumulative - All	0	0	3.35	8.38	20.49	33.51
Cumulative - BECCS	0	0	0	1.71	10.4	19.89
Cumulative - Cement	0	0	3.35	6.67	10.09	13.62
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	1801271.619	1936114.368	2314810.7	2444421.7
CO2 pipelines - Spur	0	0	98706.863	233549.912	612246.984	741857.1
CO2 pipelines - Trunk	0	0	1702563.956	1702563.956	1702563.956	1702563.956

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

variable_name	2050
Carbon sink enhancement potential - Accelerate regeneration	3799.3
Carbon sink enhancement potential - All (not counting overlap)	120736.3
Carbon sink enhancement potential - Avoid deforestation	3014.7
Carbon sink enhancement potential - corn-ethanol to energy grasses	-0.07
Carbon sink enhancement potential - cropland measures	-3008.61
Carbon sink enhancement potential - Cropland to woody energy crops	0
Carbon sink enhancement potential - Extend rotation length	16064.7
Carbon sink enhancement potential - Improve plantations	7121.9
Carbon sink enhancement potential - Increase retention of HWP	49650.2
Carbon sink enhancement potential - Increase trees outside forests	1806.473
Carbon sink enhancement potential - pasture to energy crops	0
Carbon sink enhancement potential - permanent conservation cover	-220.792
Carbon sink enhancement potential - Reforest cropland	26216.9
Carbon sink enhancement potential - Reforest pasture	3809.8
Carbon sink enhancement potential - Restore productivity	9252.4
Carbon sink enhancement potential - total	-3229.472
Land impacted for carbon sink enhancement - Accelerate regeneration	1531.24
Land impacted for carbon sink enhancement - All (not counting overlap)	26982.2
Land impacted for carbon sink enhancement - Avoid deforestation	809.236
Land impacted for carbon sink enhancement - corn-ethanol to energy grasses	0.124
Land impacted for carbon sink enhancement - cropland measures	8366.2

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	0.032
Land impacted for carbon sink enhancement - Extend rotation length	8849.7
Land impacted for carbon sink enhancement - Improve plantations	3958.153
Land impacted for carbon sink enhancement - Increase retention of HWP	9930
Land impacted for carbon sink enhancement - Increase trees outside forests	509.581
Land impacted for carbon sink enhancement - pasture to energy crops	5.626
Land impacted for carbon sink enhancement - permanent conservation cover	352.293
Land impacted for carbon sink enhancement - Reforest cropland	8728.71
Land impacted for carbon sink enhancement - Reforest pasture	288.081
Land impacted for carbon sink enhancement - Restore productivity	5221.3
Land impacted for carbon sink enhancement - total	8724.3
Land impacted for carbon sink enhancement - Total impacted (over 30 years)	12843.8

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

variable_name	2050
Business-as-usual carbon sink - Accelerate regeneration	355.072
Business-as-usual carbon sink - Avoid deforestation	257.785
Business-as-usual carbon sink - Extend rotation length	4841.4
Business-as-usual carbon sink - Improve plantations	1503.1
Business-as-usual carbon sink - Increase retention of HWP	0
Business-as-usual carbon sink - Increase trees outside forests	102.455
Business-as-usual carbon sink - Reforest cropland	990.488
Business-as-usual carbon sink - Reforest pasture	70.378
Business-as-usual carbon sink - Restore productivity	1838
Business-as-usual carbon sink - Total impacted (over 30 years)	990.488

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

variable_name	2050
Carbon sink enhancement potential - Accelerate regeneration	3799.3
Carbon sink enhancement potential - All (not counting overlap)	120736.3
Carbon sink enhancement potential - Avoid deforestation	3014.7
Carbon sink enhancement potential - corn-ethanol to energy grasses	0
Carbon sink enhancement potential - cropland measures	-3008.67
Carbon sink enhancement potential - Extend rotation length	16064.7
Carbon sink enhancement potential - Improve plantations	7121.9
Carbon sink enhancement potential - Increase retention of HWP	49650.2
Carbon sink enhancement potential - Increase trees outside forests	1806.473
Carbon sink enhancement potential - permanent conservation cover	-220.798
Carbon sink enhancement potential - Reforest cropland	26216.9
Carbon sink enhancement potential - Reforest pasture	3809.8
Carbon sink enhancement potential - Restore productivity	9252.4
Carbon sink enhancement potential - total	-3229.469
Land impacted for carbon sink enhancement - Accelerate regeneration	1531.24
Land impacted for carbon sink enhancement - All (not counting overlap)	26982.2
Land impacted for carbon sink enhancement - Avoid deforestation	809.236
Land impacted for carbon sink enhancement - corn-ethanol to energy grasses	0
Land impacted for carbon sink enhancement - cropland measures	4255.7
Land impacted for carbon sink enhancement - Extend rotation length	8849.7
Land impacted for carbon sink enhancement - Improve plantations	3958.153
Land impacted for carbon sink enhancement - Increase retention of HWP	9930
Land impacted for carbon sink enhancement - Increase trees outside forests	509.581
Land impacted for carbon sink enhancement - permanent conservation cover	352.305
Land impacted for carbon sink enhancement - Reforest cropland	8728.71
Land impacted for carbon sink enhancement - Reforest pasture	288.081
Land impacted for carbon sink enhancement - Restore productivity	5221.3
Land impacted for carbon sink enhancement - total	4608.1
Land impacted for carbon sink enhancement - Total impacted (over 30 years)	12843.8

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

variable_name	2050
Business-as-usual carbon sink - Accelerate regeneration	355.072
Business-as-usual carbon sink - Avoid deforestation	257.785
Business-as-usual carbon sink - Extend rotation length	4841.4
Business-as-usual carbon sink - Improve plantations	1503.1
Business-as-usual carbon sink - Increase retention of HWP	0
Business-as-usual carbon sink - Increase trees outside forests	102.455
Business-as-usual carbon sink - Reforest cropland	990.488
Business-as-usual carbon sink - Reforest pasture	70.378
Business-as-usual carbon sink - Restore productivity	1838
Business-as-usual carbon sink - Total impacted (over 30 years)	990.488