Net-Zero America - indiana 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	5.735	7.817	0	0	0	0
Sale of space heating units by type - Electric Heat Pump	0.071	0.165	0.454	0.849	0.917	0.921	0.919
Sale of space heating units by type - Electric Resistance	0.181	0.242	0.176	0.08	0.063	0.062	0.065
Sale of space heating units by type - Fossil	0.061	0.093	0.061	0.022	0.016	0.015	0.015
Sale of space heating units by type - Gas	0.687	0.499	0.309	0.048	0.004	0.001	0.001
Sales of cooking units - Electric Resistance	0.676	0.745	0.956	0.998	1	1	1
Sales of cooking units - Gas	0.324	0.255	0.044	0.002	0	0	0
Sales of water heating units by type - Electric Heat Pump	0	0.023	0.171	0.349	0.378	0.38	0.381
Sales of water heating units by type - Electric Resistance	0.393	0.554	0.558	0.608	0.617	0.618	0.617
Sales of water heating units by type - Gas Furnace	0.606	0.421	0.268	0.041	0.002	0	0
Sales of water heating units by type - Other	0.001	0.002	0.002	0.002	0.002	0.002	0.002

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	0.972	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	0.038	0.148	0.459	0.816	0.963	0.993	1
End-use technology sales by technology - LDV - gasoline	0.901	0.784	0.494	0.168	0.033	0.006	0
End-use technology sales by technology - LDV - hybrid	0.043	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	1189168297	3043552514	4939108528	7478959824	8142926393	7762154254
Number of public EV charging plugs - DC Fast Charging	168	0	2166.2	0	9567.2	0	15481.4
Number of public EV charging plugs - L2 Charging	430	0	52096.2	0	230090	0	372326.2

Table 3: *E- 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	0.006	0.021	0
Power generation capital investment - biomass w/ccu power plant	0	0	0	0	0	0.909	0
Power generation capital investment - Solar PV - Base	0	0.952	13.194	19.607	8.1	2.027	2.421
Power generation capital investment - Solar PV - Constrained	0	1.786	15.208	19.981	8.269	4.431	1.104
Power generation capital investment - Wind - Base	0	0	28.729	19.553	12.569	0.095	0
Power generation capital investment - Wind - Constrained	0	0	9.948	0	0	0	7.781

Table 4: *E- 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	6.376	27.374	27.374
Power generation by technology - biomass w/ccu power plant	0	0	0	0	0	1020.4	1020.4

Table 5: *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	316.562	5198.9	12160.6	16399.4	17409.4	18481.5
HV transmission for wind and solar - base other intra-state	0	84.038	2382.8	5560	7257.8	7639.7	8115.3
HV transmission for wind and solar - base spur intra-state	0	168.84	2409	5681.8	7479.4	7782.7	8008.4
HV transmission for wind and solar - constrained all	0	335.651	3685.9	6911.2	8341.1	8736.2	8990.6
HV transmission for wind and solar - constrained other intra-state	0	129.695	1274.6	2794.8	3296.5	3484.2	3565.2
HV transmission for wind and solar - constrained spur intra-state	0	144.959	2013	3603.6	4350.4	4531.6	4664.6

Table 6: *E- scenario - PILLAR 3: Bioenergy and Hydrogen - Bioconversion*

variable_name	2020	2025	2030	2035	2040	2045	2050
Biomass purchases	0	0	0	0	0.5	2.714	2.759
Capital investment	0	0	0	0	7.39	0	33.442
Number of facilities - allam power w ccu	0	0	0	0	1	2	2
Number of facilities - beccs hydrogen	0	0	0	0	9	46	47
Number of facilities - diesel	0	0	0	0	0	0	0
Number of facilities - diesel ccu	0	0	0	0	1	2	2

Table 6: *E- scenario - PILLAR 3: Bioenergy and Hydrogen - Bioconversion (continued)*

variable_name	2020	2025	2030	2035	2040	2045	2050
Number of facilities - power	0	0	0	0	0	0	0
Number of facilities - power ccu	0	0	0	0	0	1	1
Number of facilities - pyrolysis	0	0	0	0	0	0	0
Number of facilities - pyrolysis ccu	0	0	0	0	1	2	2
Number of facilities - sng	0	0	0	0	0	0	0
Number of facilities - sng ccu	0	0	0	0	0	0	0

Table 7: *E- scenario - PILLAR 4: CO2 capture, use, storage - CO2 capture*

variable_name	2025	2030	2035	2040	2045	2050
Annual - All	0	0	1.08	11.5	59.53	60.46
Annual - BECCS	0	0	0	10.07	54.66	55.56
Annual - Cement	0	0	0	0	3.42	3.53
Annual - NGCC	0	0	1.08	1.43	1.45	1.36
Cumulative - All	0	0	1.08	12.58	72.11	132.57
Cumulative - BECCS	0	0	0	10.07	64.73	120.29
Cumulative - Cement	0	0	0	0	3.42	6.95
Cumulative - NGCC	0	0	1.08	2.51	3.96	5.32

Table 8: *E- scenario - PILLAR 4: CO2 capture, use, storage - CO2 storage*

variable_name	2025	2030	2035	2040	2045	2050
Annual	0	1.1	1.76	3.61	6.02	7.46
Injection wells	0	1	4	8	13	16
Resource characterization, appraisal and permitting costs cumulative	50.56	141.56	182.01	182.01	182.01	182.01
Wells and facilities construction costs cumulative	0	33.66	131.19	233.8	390.93	485.35

Table 9: *E- scenario - PILLAR 4: CO2 capture, use, storage - CO2 transportation*

variable_name	2025	2030	2035	2040	2045	2050
CO2 pipelines - All	0	2413555.958	2618079.388	2670408.129	4367157.9	4598286.9
CO2 pipelines - Spur	0	57602.245	249643.942	301972.583	1998722.2	2229851.2
CO2 pipelines - Trunk	0	2355953.613	2368435.646	2368435.646	2368435.646	2368435.646

Table 10: *E- scenario - IMPACTS - Jobs*

variable_name	2020	2025	2030	2035	2040	2045	2050
Jobs by economic sector - agriculture	2020.9	2023.9	2048.1	1949.2	1792.2	3431.6	2766.6
Jobs by economic sector - construction	8213.7	8135.5	25156.5	36051.3	33703.9	29553.3	28716.4
Jobs by economic sector - manufacturing	6388.4	10526.6	13063	17489.2	16960.7	14999.4	17931.3
Jobs by economic sector - mining	6382.5	3873	2301	1594.6	1044.7	703.727	485.575
Jobs by economic sector - other	515.482	571.686	3173	5273.9	4739.1	4028.9	4326.3
Jobs by economic sector - pipeline	760.158	750.771	905.233	534.87	409.208	380.765	291.357
Jobs by economic sector - professional	5374.1	4717.3	13008.1	19560.2	20564	21999	21592.7
Jobs by economic sector - trade	5810.3	4346.3	8196.5	11831	11691.9	11187.6	11331.4
Jobs by economic sector - utilities	11392.3	9912.7	17093.6	25224.6	27186.5	25730.6	25199.9
Jobs by resource sector - Biomass	4910.6	4781.6	4682.8	4346	4687.5	12608.9	12142.5
Jobs by resource sector - CO2	0	26.842	2275.4	375.978	439.12	1369.2	1310.7
Jobs by resource sector - Coal	9662	4775.8	1153.3	226.563	191.353	168.315	147.844
Jobs by resource sector - Grid	12826.1	10883.4	24843.7	43681.4	48040.8	46064.4	46682.4
Jobs by resource sector - Natural Gas	7577.9	7694.4	6136.4	5869	5252.2	3344.1	2041.7
Jobs by resource sector - Nuclear	0	0	0	0	0	0	0
Jobs by resource sector - Oil	7004.7	6069.2	4885.1	3582	2433.5	1622	997.894
Jobs by resource sector - Solar	2177	4857.7	19592	30562.4	23628	17532.7	20962.7
Jobs by resource sector - Wind	2699.5	5768.8	21376.3	30865.5	33419.8	29305.5	28355.9
Median wages - All	56417.9	56477.3	57177	57999.9	59270	60369.9	61031.3
Required Level of Education - Associates degree or some college	13988.6	13561.6	26705.8	38007.8	37703.7	35116.5	35462.6
Required Level of Education - Bachelors degree	9426.6	9014.1	16786.8	23650	23750.8	22962.9	23140.2
Required Level of Education - Doctoral degree	299.176	273.084	628.545	906.701	924.05	948.288	935.145
Required Level of Education - High school diploma or less	20901.8	19912.6	36667.7	51006	49682.6	47037.1	47161.8
Required Level of Education - Masters or professional degree	2241.7	2096.4	4156.3	5938.3	6031.3	5950.3	5942
Wage income - All	2643733970	2533559675	4857422645	6932363325	7000151689	6763080881	6875458189

Table 11: *E- scenario - PILLAR 6: Land carbon sinks - Agriculture*

variable_name	2050
Carbon sink enhancement potential - Accelerate regeneration	135.698
Carbon sink enhancement potential - All (not counting overlap)	23821.5
Carbon sink enhancement potential - Avoid deforestation	3090.2
Carbon sink enhancement potential - corn-ethanol to energy grasses	-3689.792
Carbon sink enhancement potential - cropland measures	-11409.664
Carbon sink enhancement potential - Extend rotation length	3651.3
Carbon sink enhancement potential - Improve plantations	293.746
Carbon sink enhancement potential - Increase retention of HWP	3057.4
Carbon sink enhancement potential - Increase trees outside forests	3360.7
Carbon sink enhancement potential - permanent conservation cover	-350.52
Carbon sink enhancement potential - Reforest cropland	2212.71
Carbon sink enhancement potential - Reforest pasture	5877.5

Table 11: *E- scenario - PILLAR 6: Land carbon sinks - Agriculture (continued)*

variable_name	2050
Carbon sink enhancement potential - Restore productivity	2142.385
Carbon sink enhancement potential - total	-15449.975
Land impacted for carbon sink enhancement - Accelerate regeneration	54.691
Land impacted for carbon sink enhancement - All (not counting overlap)	3946.8
Land impacted for carbon sink enhancement - Avoid deforestation	829.504
Land impacted for carbon sink enhancement - corn-ethanol to energy grasses	1616.12
Land impacted for carbon sink enhancement - cropland measures	6099.2
Land impacted for carbon sink enhancement - Extend rotation length	2011.408
Land impacted for carbon sink enhancement - Improve plantations	163.257
Land impacted for carbon sink enhancement - Increase retention of HWP	611.479
Land impacted for carbon sink enhancement - Increase trees outside forests	948.03
Land impacted for carbon sink enhancement - permanent conservation cover	637.532
Land impacted for carbon sink enhancement - Reforest cropland	736.703
Land impacted for carbon sink enhancement - Reforest pasture	444.431
Land impacted for carbon sink enhancement - Restore productivity	1208.953
Land impacted for carbon sink enhancement - total	8352.9
Land impacted for carbon sink enhancement - Total impacted (over 30 years)	3061.6

Table 12: *E- scenario - PILLAR 6: Land carbon sinks - Forests*

variable_name	2050
Business-as-usual carbon sink - Accelerate regeneration	12.682
Business-as-usual carbon sink - Avoid deforestation	264.241
Business-as-usual carbon sink - Extend rotation length	1100.4
Business-as-usual carbon sink - Improve plantations	61.997
Business-as-usual carbon sink - Increase retention of HWP	0
Business-as-usual carbon sink - Increase trees outside forests	190.609
Business-as-usual carbon sink - Reforest cropland	83.598
Business-as-usual carbon sink - Reforest pasture	108.574
Business-as-usual carbon sink - Restore productivity	425.586
Business-as-usual carbon sink - Total impacted (over 30 years)	83.598

Table 13: *E- scenario - IMPACTS - Fossil fuel industries*

variable_name	2020	2025	2030	2035	2040	2045	2050
Natural gas consumption	651359.3	661032.8	557213.3	446908.1	336425.7	211667.8	146807.2
Oil consumption	133365.9	125460.7	108767.2	84253.4	61058.7	42794	28000.3

Table 14: *E- scenario - PILLAR 1: Efficiency/Electrification - Overview*

variable_name	2020	2025	2030	2035	2040	2045	2050
Final energy demand by sector - commercial	0.19	0.187	0.179	0.166	0.151	0.14	0.135
Final energy demand by sector - industry	0.68	0.692	0.706	0.721	0.751	0.767	0.776
Final energy demand by sector - residential	0.311	0.288	0.267	0.232	0.196	0.169	0.152
Final energy demand by sector - transportation	0.652	0.61	0.534	0.441	0.358	0.306	0.285

Table 15: *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	19993970262	21828865111	0	0	0	0
Sales of cooking units - Electric Resistance	0.41	0.542	0.829	0.886	0.889	0.889	0.889
Sales of cooking units - Gas	0.59	0.458	0.171	0.114	0.111	0.111	0.111
Sales of space heating units - Electric Heat Pump	0.021	0.097	0.386	0.818	0.892	0.897	0.897
Sales of space heating units - Electric Resistance	0.06	0.035	0.052	0.092	0.099	0.1	0.099
Sales of space heating units - Fossil	0.03	0.023	0.004	0	0	0	0
Sales of space heating units - Gas Furnace	0.889	0.845	0.557	0.09	0.009	0.004	0.004
Sales of water heating units - Electric Heat Pump	0.006	0.032	0.226	0.479	0.522	0.525	0.525
Sales of water heating units - Electric Resistance	0.057	0.049	0.19	0.429	0.471	0.474	0.474
Sales of water heating units - Gas Furnace	0.933	0.917	0.582	0.09	0.005	0	0
Sales of water heating units - Other	0.003	0.002	0.002	0.002	0.002	0.002	0.002

Table 16: *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	4.813	4.971	8.009	8.51	7.326	7.626

Table 17: *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	5.461	5.934	0	0	0	0
Sale of space heating units by type - Electric Heat Pump	0.057	0.192	0.197	0.207	0.215	0.225	0.237
Sale of space heating units by type - Electric Resistance	0.185	0.234	0.231	0.227	0.219	0.209	0.198
Sale of space heating units by type - Fossil	0.062	0.085	0.082	0.08	0.08	0.08	0.08
Sale of space heating units by type - Gas	0.695	0.49	0.489	0.486	0.486	0.486	0.485
Sales of cooking units - Electric Resistance	0.672	0.672	0.672	0.672	0.672	0.672	0.672
Sales of cooking units - Gas	0.328	0.328	0.328	0.328	0.328	0.328	0.328
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	0.393	0.556	0.555	0.553	0.553	0.552	0.551
Sales of water heating units by type - Gas Furnace	0.606	0.442	0.443	0.445	0.445	0.446	0.447
Sales of water heating units by type - Other	0.001	0.002	0.002	0.002	0.002	0.002	0.002

Table 18: *RE- scenario - PILLAR 1: Efficiency/Electrification - Transportation*

variable_name	2020	2025	2030	2035	2040	2045	2050
End-use technology sales by technology - HDV - diesel	0.981	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	0.034	0.054	0.062	0.076	0.093	0.108	0.12
End-use technology sales by technology - LDV - gasoline	0.904	0.869	0.848	0.83	0.81	0.79	0.774
End-use technology sales by technology - LDV - hybrid	0.043	0.052	0.063	0.069	0.075	0.081	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 19: *RE- scenario - PILLAR 6: Land carbon sinks - Agriculture*

variable_name	2020	2030	2050
Carbon sink enhancement potential - Accelerate regeneration	0	0	135.698
Carbon sink enhancement potential - All (not counting overlap)	0	0	23821.5
Carbon sink enhancement potential - Avoid deforestation	0	0	3090.2
Carbon sink enhancement potential - Extend rotation length	0	0	3651.3
Carbon sink enhancement potential - Improve plantations	0	0	293.746
Carbon sink enhancement potential - Increase retention of HWP	0	0	3057.4
Carbon sink enhancement potential - Increase trees outside forests	0	0	3360.7
Carbon sink enhancement potential - Reforest cropland	0	0	2212.71
Carbon sink enhancement potential - Reforest pasture	0	0	5877.5
Carbon sink enhancement potential - Restore productivity	0	0	2142.385
Land impacted for carbon sink enhancement - Accelerate regeneration	0	0	54.691
Land impacted for carbon sink enhancement - All (not counting overlap)	0	0	3946.8
Land impacted for carbon sink enhancement - Avoid deforestation	0	0	829.504
Land impacted for carbon sink enhancement - Extend rotation length	0	0	2011.408
Land impacted for carbon sink enhancement - Improve plantations	0	0	163.257
Land impacted for carbon sink enhancement - Increase retention of HWP	0	0	611.479
Land impacted for carbon sink enhancement - Increase trees outside forests	0	0	948.03
Land impacted for carbon sink enhancement - Natural uptake	-6.5	-4.243	-3.794
Land impacted for carbon sink enhancement - Reforest cropland	0	0	736.703
Land impacted for carbon sink enhancement - Reforest pasture	0	0	444.431
Land impacted for carbon sink enhancement - Restore productivity	0	0	1208.953
Land impacted for carbon sink enhancement - Retained in Hardwood Products	-0.499	-0.898	-0.933
Land impacted for carbon sink enhancement - Total	-6.999	-5.141	-4.728
Land impacted for carbon sink enhancement - Total impacted (over 30 years)	0	0	3061.6

Table 20: *RE- scenario - PILLAR 6: Land carbon sinks - Forests*

variable_name	2050
Business-as-usual carbon sink - Accelerate regeneration	12.682
Business-as-usual carbon sink - Avoid deforestation	264.241
Business-as-usual carbon sink - Extend rotation length	1100.4
Business-as-usual carbon sink - Improve plantations	61.997

Table 20: *RE- 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	190.609
Business-as-usual carbon sink - Reforest cropland	83.598
Business-as-usual carbon sink - Reforest pasture	108.574
Business-as-usual carbon sink - Restore productivity	425.586
Business-as-usual carbon sink - Total impacted (over 30 years)	83.598

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

variable_name	2020	2025	2030	2035	2040	2045	2050
Final energy demand by sector - commercial	0.19	0.19	0.188	0.184	0.179	0.179	0.183
Final energy demand by sector - industry	0.681	0.703	0.718	0.717	0.727	0.733	0.738
Final energy demand by sector - residential	0.311	0.289	0.277	0.269	0.264	0.262	0.259
Final energy demand by sector - transportation	0.653	0.615	0.563	0.533	0.532	0.548	0.569

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	19774178140	20475376977	0	0	0	0
Sales of cooking units - Electric Resistance	0.41	0.442	0.443	0.443	0.443	0.444	0.445
Sales of cooking units - Gas	0.59	0.558	0.557	0.557	0.557	0.556	0.555
Sales of space heating units - Electric Heat Pump	0.021	0.131	0.45	0.711	0.754	0.759	0.759
Sales of space heating units - Electric Resistance	0.06	0.043	0.089	0.172	0.228	0.237	0.237
Sales of space heating units - Fossil	0.03	0.025	0.013	0.002	0	0	0
Sales of space heating units - Gas Furnace	0.889	0.801	0.448	0.115	0.018	0.004	0.004
Sales of water heating units - Electric Heat Pump	0.006	0.003	0.004	0.004	0.003	0.003	0.003
Sales of water heating units - Electric Resistance	0.057	0.033	0.032	0.032	0.032	0.032	0.032
Sales of water heating units - Gas Furnace	0.933	0.962	0.962	0.962	0.963	0.963	0.963
Sales of water heating units - Other	0.003	0.002	0.002	0.002	0.002	0.002	0.002

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

variable_name	2025	2030	2035	2040	2045	2050
Electricity distribution peak load (capital invested) - Cumulative 5-yr	4.26	4.352	4.692	4.813	5.723	5.939

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	5.715	7.712	0	0	0	0
Sale of space heating units by type - Electric Heat Pump	0.071	0.136	0.169	0.274	0.492	0.73	0.86
Sale of space heating units by type - Electric Resistance	0.181	0.248	0.24	0.216	0.162	0.106	0.077
Sale of space heating units by type - Fossil	0.061	0.097	0.093	0.082	0.059	0.035	0.021
Sale of space heating units by type - Gas	0.687	0.519	0.497	0.429	0.287	0.129	0.042
Sales of cooking units - Electric Resistance	0.675	0.683	0.713	0.791	0.901	0.968	0.991
Sales of cooking units - Gas	0.325	0.317	0.287	0.209	0.099	0.032	0.009
Sales of water heating units by type - Electric Heat Pump	0	0.006	0.023	0.076	0.182	0.293	0.353
Sales of water heating units by type - Electric Resistance	0.393	0.557	0.556	0.558	0.572	0.594	0.61
Sales of water heating units by type - Gas Furnace	0.606	0.435	0.419	0.364	0.244	0.11	0.035
Sales of water heating units by type - Other	0.001	0.002	0.002	0.002	0.002	0.002	0.002

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	0.011	0.005	0.002
End-use technology sales by technology - LDV - EV	0.018	0.046	0.117	0.255	0.48	0.718	0.875
End-use technology sales by technology - LDV - gasoline	0.919	0.876	0.799	0.671	0.466	0.251	0.111
End-use technology sales by technology - LDV - hybrid	0.045	0.053	0.059	0.054	0.041	0.024	0.012
End-use technology sales by technology - LDV - hydrogen FC	0.001	0.004	0.003	0.003	0.002	0.001	0
End-use technology sales by technology - LDV - other	0.001	0.001	0.001	0.001	0.001	0	0
End-use technology sales by technology - MDV - diesel	0.648	0.622	0.577	0.494	0.356	0.196	0.084
End-use technology sales by technology - MDV - EV	0.007	0.019	0.055	0.143	0.314	0.526	0.68
End-use technology sales by technology - MDV - gasoline	0.338	0.347	0.347	0.319	0.244	0.142	0.063
End-use technology sales by technology - MDV - hybrid	0.004	0.004	0.005	0.005	0.004	0.003	0.001
End-use technology sales by technology - MDV - hydrogen FC	0.002	0.005	0.014	0.036	0.079	0.132	0.17
End-use technology sales by technology - MDV - other	0.003	0.003	0.003	0.003	0.003	0.002	0.001
Light-duty vehicle capital costs - Cumulative 5-yr	0	0	191585975	404312075	1363675834	4296516968	6257729024
Number of public EV charging plugs - DC Fast Charging	168	0	661.649	0	3541.7	0	9915.8
Number of public EV charging plugs - L2 Charging	430	0	15912.6	0	85178.1	0	238474.7

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

variable_name	2050
Carbon sink enhancement potential - Accelerate regeneration	135.698
Carbon sink enhancement potential - All (not counting overlap)	23821.5
Carbon sink enhancement potential - Avoid deforestation	3090.2
Carbon sink enhancement potential - corn-ethanol to energy grasses	-3689.792
Carbon sink enhancement potential - cropland measures	-11409.664
Carbon sink enhancement potential - Extend rotation length	3651.3
Carbon sink enhancement potential - Improve plantations	293.746
Carbon sink enhancement potential - Increase retention of HWP	3057.4
Carbon sink enhancement potential - Increase trees outside forests	3360.7
Carbon sink enhancement potential - permanent conservation cover	-350.52
Carbon sink enhancement potential - Reforest cropland	2212.71
Carbon sink enhancement potential - Reforest pasture	5877.5
Carbon sink enhancement potential - Restore productivity	2142.385
Carbon sink enhancement potential - total	-15449.975
Land impacted for carbon sink enhancement - Accelerate regeneration	54.691
Land impacted for carbon sink enhancement - All (not counting overlap)	3946.8
Land impacted for carbon sink enhancement - Avoid deforestation	829.504
Land impacted for carbon sink enhancement - corn-ethanol to energy grasses	1616.12
Land impacted for carbon sink enhancement - cropland measures	6099.2
Land impacted for carbon sink enhancement - Extend rotation length	2011.408
Land impacted for carbon sink enhancement - Improve plantations	163.257
Land impacted for carbon sink enhancement - Increase retention of HWP	611.479
Land impacted for carbon sink enhancement - Increase trees outside forests	948.03
Land impacted for carbon sink enhancement - permanent conservation cover	637.532
Land impacted for carbon sink enhancement - Reforest cropland	736.703
Land impacted for carbon sink enhancement - Reforest pasture	444.431
Land impacted for carbon sink enhancement - Restore productivity	1208.953
Land impacted for carbon sink enhancement - total	8352.9
Land impacted for carbon sink enhancement - Total impacted (over 30 years)	3061.6

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

variable_name	2050
Business-as-usual carbon sink - Accelerate regeneration	12.682
Business-as-usual carbon sink - Avoid deforestation	264.241
Business-as-usual carbon sink - Extend rotation length	1100.4
Business-as-usual carbon sink - Improve plantations	61.997
Business-as-usual carbon sink - Increase retention of HWP	0
Business-as-usual carbon sink - Increase trees outside forests	190.609
Business-as-usual carbon sink - Reforest cropland	83.598
Business-as-usual carbon sink - Reforest pasture	108.574
Business-as-usual carbon sink - Restore productivity	425.586
Business-as-usual carbon sink - Total impacted (over 30 years)	83.598

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

variable_name	2020	2025	2030	2035	2040	2045	2050
Final energy demand by sector - commercial	0.19	0.187	0.183	0.179	0.172	0.164	0.155
Final energy demand by sector - industry	0.68	0.693	0.708	0.728	0.762	0.777	0.784
Final energy demand by sector - residential	0.311	0.289	0.273	0.257	0.238	0.214	0.188
Final energy demand by sector - transportation	0.653	0.615	0.559	0.514	0.48	0.44	0.392

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	19991692071	21841132778	0	0	0	0
Sales of cooking units - Electric Resistance	0.41	0.458	0.498	0.605	0.754	0.845	0.877
Sales of cooking units - Gas	0.59	0.542	0.502	0.395	0.246	0.155	0.123
Sales of space heating units - Electric Heat Pump	0.021	0.07	0.103	0.209	0.435	0.689	0.83
Sales of space heating units - Electric Resistance	0.06	0.035	0.036	0.043	0.06	0.081	0.093
Sales of space heating units - Fossil	0.03	0.027	0.025	0.019	0.01	0.003	0.001
Sales of space heating units - Gas Furnace	0.889	0.869	0.836	0.729	0.496	0.227	0.076
Sales of water heating units - Electric Heat Pump	0.006	0.011	0.034	0.103	0.246	0.401	0.485
Sales of water heating units - Electric Resistance	0.057	0.039	0.054	0.107	0.223	0.359	0.437
Sales of water heating units - Gas Furnace	0.933	0.948	0.91	0.788	0.529	0.238	0.076
Sales of water heating units - Other	0.003	0.002	0.002	0.002	0.002	0.002	0.002

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	4.044	4.111	5.149	5.331	7.043	7.407

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	6.895	19.54	15.426	2.846	5.567	54.939
Power generation capital investment - Wind - Base	0	36.835	24.113	1.13	0	0

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	837.212	7993	15402.1	16952.6	19578.4	27689.1
HV transmission for wind and solar - base other intra-state	0	321.477	3530.2	6681.7	7145.3	8290.3	11259
HV transmission for wind and solar - base spur intra-state	0	401.385	3792	7293.3	7713.7	8690.9	12856.7

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

variable_name	2050
Carbon sink enhancement potential - Accelerate regeneration	135.698
Carbon sink enhancement potential - All (not counting overlap)	23821.5
Carbon sink enhancement potential - Avoid deforestation	3090.2
Carbon sink enhancement potential - corn-ethanol to energy grasses	-3689.792
Carbon sink enhancement potential - cropland measures	-11409.664
Carbon sink enhancement potential - Extend rotation length	3651.3
Carbon sink enhancement potential - Improve plantations	293.746
Carbon sink enhancement potential - Increase retention of HWP	3057.4
Carbon sink enhancement potential - Increase trees outside forests	3360.7
Carbon sink enhancement potential - permanent conservation cover	-350.52
Carbon sink enhancement potential - Reforest cropland	2212.71
Carbon sink enhancement potential - Reforest pasture	5877.5
Carbon sink enhancement potential - Restore productivity	2142.385
Carbon sink enhancement potential - total	-15449.975
Land impacted for carbon sink enhancement - Accelerate regeneration	54.691
Land impacted for carbon sink enhancement - All (not counting overlap)	3946.8
Land impacted for carbon sink enhancement - Avoid deforestation	829.504
Land impacted for carbon sink enhancement - corn-ethanol to energy grasses	1616.12
Land impacted for carbon sink enhancement - cropland measures	6099.2
Land impacted for carbon sink enhancement - Extend rotation length	2011.408
Land impacted for carbon sink enhancement - Improve plantations	163.257
Land impacted for carbon sink enhancement - Increase retention of HWP	611.479
Land impacted for carbon sink enhancement - Increase trees outside forests	948.03
Land impacted for carbon sink enhancement - permanent conservation cover	637.532
Land impacted for carbon sink enhancement - Reforest cropland	736.703
Land impacted for carbon sink enhancement - Reforest pasture	444.431
Land impacted for carbon sink enhancement - Restore productivity	1208.953
Land impacted for carbon sink enhancement - total	8352.9
Land impacted for carbon sink enhancement - Total impacted (over 30 years)	3061.6

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

variable_name	2050
Business-as-usual carbon sink - Accelerate regeneration	12.682
Business-as-usual carbon sink - Avoid deforestation	264.241
Business-as-usual carbon sink - Extend rotation length	1100.4
Business-as-usual carbon sink - Improve plantations	61.997
Business-as-usual carbon sink - Increase retention of HWP	0
Business-as-usual carbon sink - Increase trees outside forests	190.609
Business-as-usual carbon sink - Reforest cropland	83.598
Business-as-usual carbon sink - Reforest pasture	108.574
Business-as-usual carbon sink - Restore productivity	425.586
Business-as-usual carbon sink - Total impacted (over 30 years)	83.598

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	0.009	0	0
Power generation capital investment - biomass w/ccu power plant	0	0	0	0	0.001	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	9.165	9.165	9.165
Power generation by technology - biomass w/ccu power plant	0	0	0	0	0.958	0.958	0.958

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

variable_name	2020	2025	2030	2035	2040	2045	2050
Biomass purchases	0	0	0	1.54	4.279	8.653	8.653
Capital investment	0	0	0	0	42.339	0	43.256
Number of facilities - allam power w ccu	0	0	0	0	1	1	1
Number of facilities - beccs hydrogen	0	0	0	19	52	105	105
Number of facilities - diesel	0	0	0	0	0	0	0
Number of facilities - diesel ccu	0	0	0	0	1	1	1
Number of facilities - power	0	0	0	0	0	0	0
Number of facilities - power ccu	0	0	0	0	1	1	1
Number of facilities - pyrolysis	0	0	0	0	0	0	0
Number of facilities - pyrolysis ccu	0	0	0	0	1	1	1
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	20.77	57.73	120.16	120.27
Annual - BECCS	0	0	20.77	57.73	116.74	116.73
Annual - Cement	0	0	0	0	3.42	3.53
Annual - NGCC	0	0	0	0	0	0
Cumulative - All	0	0	20.77	78.5	198.66	318.93
Cumulative - BECCS	0	0	20.77	78.5	195.24	311.97
Cumulative - Cement	0	0	0	0	3.42	6.95
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	1.85	7.49	14.26	19.7	20.06
Injection wells	0	3	13	23	39	49
Resource characterization, appraisal and permitting costs cumulative	50.56	222.45	343.79	343.79	343.79	343.79
Wells and facilities construction costs cumulative	0	100.99	393.58	701.4	1172.8	1456.1

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

variable_name	2025	2030	2035	2040	2045	2050
CO2 pipelines - All	0	2487890.958	2637671.488	3826531	7046984.6	7507981.9
CO2 pipelines - Spur	0	129889.445	265141.143	1323950.3	4320092.8	4781090.2
CO2 pipelines - Trunk	0	2358001.613	2372530.646	2502580.711	2726891.711	2726891.711

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

variable_name	2050
Carbon sink enhancement potential - Accelerate regeneration	135.698
Carbon sink enhancement potential - All (not counting overlap)	23821.5
Carbon sink enhancement potential - Avoid deforestation	3090.2
Carbon sink enhancement potential - corn-ethanol to energy grasses	-4603.912
Carbon sink enhancement potential - cropland measures	-10374.15
Carbon sink enhancement potential - Cropland to woody energy crops	0
Carbon sink enhancement potential - Extend rotation length	3651.3
Carbon sink enhancement potential - Improve plantations	293.746
Carbon sink enhancement potential - Increase retention of HWP	3057.4
Carbon sink enhancement potential - Increase trees outside forests	3360.7
Carbon sink enhancement potential - pasture to energy crops	0
Carbon sink enhancement potential - permanent conservation cover	-316.137
Carbon sink enhancement potential - Reforest cropland	2212.71
Carbon sink enhancement potential - Reforest pasture	5877.5
Carbon sink enhancement potential - Restore productivity	2142.385

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

variable_name	2050
Carbon sink enhancement potential - total	-15294.198
Land impacted for carbon sink enhancement - Accelerate regeneration	54.691
Land impacted for carbon sink enhancement - All (not counting overlap)	3946.8
Land impacted for carbon sink enhancement - Avoid deforestation	829.504
Land impacted for carbon sink enhancement - corn-ethanol to energy grasses	2408.2
Land impacted for carbon sink enhancement - cropland measures	10844.5
Land impacted for carbon sink enhancement - Cropland to woody energy crops	799.426
Land impacted for carbon sink enhancement - Extend rotation length	2011.408
Land impacted for carbon sink enhancement - Improve plantations	163.257
Land impacted for carbon sink enhancement - Increase retention of HWP	611.479
Land impacted for carbon sink enhancement - Increase trees outside forests	948.03
Land impacted for carbon sink enhancement - pasture to energy crops	135.654
Land impacted for carbon sink enhancement - permanent conservation cover	574.996
Land impacted for carbon sink enhancement - Reforest cropland	736.703
Land impacted for carbon sink enhancement - Reforest pasture	444.431
Land impacted for carbon sink enhancement - Restore productivity	1208.953
Land impacted for carbon sink enhancement - total	14762.8
Land impacted for carbon sink enhancement - Total impacted (over 30 years)	3061.6

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

variable_name	2050
Business-as-usual carbon sink - Accelerate regeneration	12.682
Business-as-usual carbon sink - Avoid deforestation	264.241
Business-as-usual carbon sink - Extend rotation length	1100.4
Business-as-usual carbon sink - Improve plantations	61.997
Business-as-usual carbon sink - Increase retention of HWP	0
Business-as-usual carbon sink - Increase trees outside forests	190.609
Business-as-usual carbon sink - Reforest cropland	83.598
Business-as-usual carbon sink - Reforest pasture	108.574
Business-as-usual carbon sink - Restore productivity	425.586
Business-as-usual carbon sink - Total impacted (over 30 years)	83.598

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

variable_name	2050
Carbon sink enhancement potential - Accelerate regeneration	135.698
Carbon sink enhancement potential - All (not counting overlap)	23821.5
Carbon sink enhancement potential - Avoid deforestation	3090.2
Carbon sink enhancement potential - corn-ethanol to energy grasses	-3689.792
Carbon sink enhancement potential - cropland measures	-11409.664
Carbon sink enhancement potential - Extend rotation length	3651.3
Carbon sink enhancement potential - Improve plantations	293.746
Carbon sink enhancement potential - Increase retention of HWP	3057.4
Carbon sink enhancement potential - Increase trees outside forests	3360.7
Carbon sink enhancement potential - permanent conservation cover	-350.52
Carbon sink enhancement potential - Reforest cropland	2212.71
Carbon sink enhancement potential - Reforest pasture	5877.5
Carbon sink enhancement potential - Restore productivity	2142.385
Carbon sink enhancement potential - total	-15449.975
Land impacted for carbon sink enhancement - Accelerate regeneration	54.691
Land impacted for carbon sink enhancement - All (not counting overlap)	3946.8
Land impacted for carbon sink enhancement - Avoid deforestation	829.504
Land impacted for carbon sink enhancement - corn-ethanol to energy grasses	1616.12
Land impacted for carbon sink enhancement - cropland measures	6099.2
Land impacted for carbon sink enhancement - Extend rotation length	2011.408
Land impacted for carbon sink enhancement - Improve plantations	163.257
Land impacted for carbon sink enhancement - Increase retention of HWP	611.479
Land impacted for carbon sink enhancement - Increase trees outside forests	948.03
Land impacted for carbon sink enhancement - permanent conservation cover	637.532

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

variable_name	2050
Land impacted for carbon sink enhancement - Reforest cropland	736.703
Land impacted for carbon sink enhancement - Reforest pasture	444.431
Land impacted for carbon sink enhancement - Restore productivity	1208.953
Land impacted for carbon sink enhancement - total	8352.9
Land impacted for carbon sink enhancement - Total impacted (over 30 years)	3061.6

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

variable_name	2050
Business-as-usual carbon sink - Accelerate regeneration	12.682
Business-as-usual carbon sink - Avoid deforestation	264.241
Business-as-usual carbon sink - Extend rotation length	1100.4
Business-as-usual carbon sink - Improve plantations	61.997
Business-as-usual carbon sink - Increase retention of HWP	0
Business-as-usual carbon sink - Increase trees outside forests	190.609
Business-as-usual carbon sink - Reforest cropland	83.598
Business-as-usual carbon sink - Reforest pasture	108.574
Business-as-usual carbon sink - Restore productivity	425.586
Business-as-usual carbon sink - Total impacted (over 30 years)	83.598