Net-Zero America - illinois 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	10.775	14.442	0	0	0	0
Sale of space heating units by type - Electric Heat Pump	0.035	0.107	0.396	0.858	0.939	0.944	0.942
Sale of space heating units by type - Electric Resistance	0.127	0.184	0.138	0.062	0.048	0.047	0.049
Sale of space heating units by type - Fossil	0.024	0.045	0.032	0.011	0.007	0.007	0.007
Sale of space heating units by type - Gas	0.814	0.665	0.434	0.069	0.006	0.002	0.002
Sales of cooking units - Electric Resistance	0.508	0.613	0.934	0.997	1	1	1
Sales of cooking units - Gas	0.492	0.387	0.066	0.003	0	0	0
Sales of water heating units by type - Electric Heat Pump	0	0.018	0.159	0.373	0.41	0.412	0.412
Sales of water heating units by type - Electric Resistance	0.227	0.385	0.439	0.563	0.586	0.587	0.586
Sales of water heating units by type - Gas Furnace	0.773	0.596	0.4	0.063	0.004	0	0
Sales of water heating units by type - Other	0	0.001	0.001	0.001	0.001	0.001	0.001

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	0.014	0.017	0.012	0.004	0.001	0	0
End-use technology sales by technology - LDV - EV	0.044	0.167	0.488	0.827	0.964	0.993	1
End-use technology sales by technology - LDV - gasoline	0.891	0.763	0.464	0.156	0.032	0.006	0
End-use technology sales by technology - LDV - hybrid	0.049	0.049	0.034	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	2022115055	5214219104	8398681446	12742524025	13846596898	13213837639
Number of public EV charging plugs - DC Fast Charging	299	0	3242	0	13889.2	0	22397.3
Number of public EV charging plugs - L2 Charging	1406	0	77953.9	0	333962.2	0	538540.2

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	0.024	0	0	0
Power generation capital investment - biomass w/ccu power plant	0	0	0.199	0	0	0	0
Power generation capital investment - Solar PV - Base	0	2.637	1.726	5.313	8.407	4.985	2.341
Power generation capital investment - Solar PV - Constrained	0	1.164	2.496	7.754	8.559	5.432	1.469
Power generation capital investment - Wind - Base	0	10.086	29.033	25.648	30.091	28.005	30.808
Power generation capital investment - Wind - Constrained	0	3.547	6.588	4.414	2.678	0.201	66.016

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	24.195	24.195	24.195	24.195
Power generation by technology - biomass w/ccu power plant	0	0	223.589	223.589	223.589	223.589	223.589

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	1718.8	5811.7	11539.2	19767.5	28622.6	39109.9
HV transmission for wind and solar - base other intra-state	0	762.557	3006.8	6315.1	10976.9	15760.3	21059.5
HV transmission for wind and solar - base spur intra-state	0	727.919	2329.8	4199.8	6812.2	9485.5	12480.1
HV transmission for wind and solar - constrained all	0	2724.4	6151.6	10563.6	14409.9	16631.5	17248.7
HV transmission for wind and solar - constrained other intra-state	0	379.368	984.273	1883.1	3023.1	4313.4	4669
HV transmission for wind and solar - constrained spur intra-state	0	310.567	750.987	1407.3	1931.6	2445.2	2610.4

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

variable_name	2020	2025	2030	2035	2040	2045	2050
Biomass purchases	0	0	0.011	1.913	3.159	3.538	3.538
Capital investment	0	0	0.173	0	45.611	0	5.482
Number of facilities - allam power w ccu	0	0	0	1	1	1	1
Number of facilities - beccs hydrogen	0	0	0	33	56	63	63
Number of facilities - diesel	0	0	0	0	0	0	0
Number of facilities - diesel ccu	0	0	0	1	1	1	1

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	2	2	2	2	2
Number of facilities - pyrolysis	0	0	0	0	0	0	0
Number of facilities - pyrolysis ccu	0	0	0	1	1	1	1
Number of facilities - sng	0	0	0	0	0	0	0
Number of facilities - sng ccu	0	0	2	2	2	2	2

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

variable_name	2025	2030	2035	2040	2045	2050
Annual - All	0	0.24	41.53	66.78	74.1	74.77
Annual - BECCS	0	0.22	37.79	62.39	69.86	69.86
Annual - Cement	0	0	3.35	3.32	3.42	3.53
Annual - NGCC	0	0.02	0.38	1.08	0.81	1.38
Cumulative - All	0	0.24	41.77	108.55	182.65	257.42
Cumulative - BECCS	0	0.22	38.01	100.4	170.26	240.12
Cumulative - Cement	0	0	3.35	6.67	10.09	13.62
Cumulative - NGCC	0	0.02	0.4	1.48	2.29	3.67

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

variable_name	2025	2030	2035	2040	2045	2050
Annual	0	1.1	3.52	7.23	11.19	14.91
Injection wells	0	2	9	15	26	32
Resource characterization, appraisal and permitting costs cumulative	100.33	280.93	361.2	361.2	361.2	361.2
Wells and facilities construction costs cumulative	0	66.81	260.36	463.98	775.82	963.19

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

variable_name	2025	2030	2035	2040	2045	2050
CO2 pipelines - All	0	6205833.5	9978485.5	10947098.4	12510139.6	13171397.9
CO2 pipelines - Spur	0	304625.54	1826937.5	2795550.3	4358591.6	5019849.8
CO2 pipelines - Trunk	0	5901207.622	8151548.1	8151548.1	8151548.1	8151548.1

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

variable_name	2020	2025	2030	2035	2040	2045	2050
Jobs by economic sector - agriculture	2965	2969.2	3009.3	6026.7	6096.5	4421.1	3485.6
Jobs by economic sector - construction	12369.6	17401.6	25542.3	34707.8	42720.1	45856.1	51094.3
Jobs by economic sector - manufacturing	11251.3	19744.8	23393.3	31659.9	31380.9	26513.2	32791
Jobs by economic sector - mining	11564.3	7211.1	4725.9	3489.8	2423.1	1769.1	1287.7
Jobs by economic sector - other	737.453	1356.9	1978.8	3434.2	5037.9	5492.7	6238.8
Jobs by economic sector - pipeline	1070.1	1058.2	1600.5	1065.8	631.719	556.413	656.565
Jobs by economic sector - professional	8625.8	10709.9	15141.7	24612.7	32319	36422.5	40855.9
Jobs by economic sector - trade	8227.2	8058.6	9492.7	12933.4	16399.2	18500.9	21341.1
Jobs by economic sector - utilities	20126.9	21943.6	26956.1	32994.1	38326	40915.3	46284
Jobs by resource sector - Biomass	7201.8	7011.2	6881.7	15394.7	17313.7	16261.5	15366.3
Jobs by resource sector - CO2	0	53.083	5822.9	3017.7	973.998	1978.1	3799.3
Jobs by resource sector - Coal	11280.9	4620.5	1584.3	1161.6	1003.9	899.919	796.189
Jobs by resource sector - Grid	20170.4	24328.6	31295.7	49021	61863.3	71239.8	83397.1
Jobs by resource sector - Natural Gas	10579.8	10687.3	8662.2	7320.3	7748.8	4220.8	3147.3
Jobs by resource sector - Nuclear	6368.9	6266.3	5515.9	3870	2680.2	1367.8	0
Jobs by resource sector - Oil	13013.3	11530	9557.2	7422.7	5282.3	3773.6	2520.9
Jobs by resource sector - Solar	3308.1	9776.9	10623.4	18308.2	23642	20303.4	23475.3
Jobs by resource sector - Wind	5014.3	16180.1	31897.3	45408.3	54826.1	60402.3	71532.4
Median wages - All	64497.5	64976.6	66410.5	67017.9	68533.4	70361.6	71319.8
Required Level of Education - Associates degree or some college	22609.2	27318.7	34621.6	46468	54488	56651.1	64673.8
Required Level of Education - Bachelors degree	15946.6	18781.2	23003.5	30907.5	36166.3	37733.5	42705.8
Required Level of Education - Doctoral degree	526.371	620.943	798.304	1159.7	1442.1	1569.9	1748.7
Required Level of Education - High school diploma or less	34002.4	39240.4	47835	64702.6	74037.7	74716.6	83892.1
Required Level of Education - Masters or professional degree	3853.1	4492.7	5582.3	7686.7	9200.2	9776.2	11014.4
Wage income - All	4962469567	5877690503	7427835864	10115408306	12017357781	12697801358	14553157052

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

variable_name	2050
Carbon sink enhancement potential - Accelerate regeneration	167.319
Carbon sink enhancement potential - All (not counting overlap)	35819.5
Carbon sink enhancement potential - Avoid deforestation	4261.6
Carbon sink enhancement potential - corn-ethanol to energy grasses	-7671.856
Carbon sink enhancement potential - cropland measures	-26788.613
Carbon sink enhancement potential - Extend rotation length	4104.6
Carbon sink enhancement potential - Improve plantations	189.111
Carbon sink enhancement potential - Increase retention of HWP	2272.501
Carbon sink enhancement potential - Increase trees outside forests	5823.5
Carbon sink enhancement potential - permanent conservation cover	-642.218
Carbon sink enhancement potential - Reforest cropland	9503.4
Carbon sink enhancement potential - Reforest pasture	7430.3

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

variable_name	2050
Carbon sink enhancement potential - Restore productivity	2067.184
Carbon sink enhancement potential - total	-35102.687
Land impacted for carbon sink enhancement - Accelerate regeneration	67.436
Land impacted for carbon sink enhancement - All (not counting overlap)	6653.6
Land impacted for carbon sink enhancement - Avoid deforestation	1143.972
Land impacted for carbon sink enhancement - corn-ethanol to energy grasses	3467.4
Land impacted for carbon sink enhancement - cropland measures	11007.9
Land impacted for carbon sink enhancement - Extend rotation length	2261.164
Land impacted for carbon sink enhancement - Improve plantations	105.104
Land impacted for carbon sink enhancement - Increase retention of HWP	454.5
Land impacted for carbon sink enhancement - Increase trees outside forests	1642.693
Land impacted for carbon sink enhancement - permanent conservation cover	1168.078
Land impacted for carbon sink enhancement - Reforest cropland	3164.001
Land impacted for carbon sink enhancement - Reforest pasture	561.843
Land impacted for carbon sink enhancement - Restore productivity	1166.558
Land impacted for carbon sink enhancement - total	15643.4
Land impacted for carbon sink enhancement - Total impacted (over 30 years)	3913.7

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

variable_name	2050
Business-as-usual carbon sink - Accelerate regeneration	15.637
Business-as-usual carbon sink - Avoid deforestation	364.416
Business-as-usual carbon sink - Extend rotation length	1237
Business-as-usual carbon sink - Improve plantations	39.913
Business-as-usual carbon sink - Increase retention of HWP	0
Business-as-usual carbon sink - Increase trees outside forests	330.285
Business-as-usual carbon sink - Reforest cropland	359.041
Business-as-usual carbon sink - Reforest pasture	137.258
Business-as-usual carbon sink - Restore productivity	410.662
Business-as-usual carbon sink - Total impacted (over 30 years)	359.041

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

variable_name	2020	2025	2030	2035	2040	2045	2050
Natural gas consumption	845554.2	858111.7	723339.7	580148.3	436727	274774	190576
Oil consumption	215299.8	204066.5	179367.3	142818.6	108459	81263.1	59583.2

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

variable_name	2020	2025	2030	2035	2040	2045	2050
Final energy demand by sector - commercial	0.441	0.434	0.415	0.383	0.346	0.319	0.305
Final energy demand by sector - industry	0.634	0.66	0.671	0.671	0.678	0.686	0.694
Final energy demand by sector - residential	0.591	0.551	0.512	0.443	0.367	0.307	0.269
Final energy demand by sector - transportation	1.043	0.977	0.873	0.748	0.634	0.562	0.53

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	40927191193	44679831557	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	0.008	0.083	0.353	0.81	0.89	0.895	0.895
Sales of space heating units - Electric Resistance	0.029	0.035	0.053	0.094	0.101	0.102	0.102
Sales of space heating units - Fossil	0	0.021	0.004	0	0	0	0
Sales of space heating units - Gas Furnace	0.964	0.862	0.59	0.096	0.009	0.004	0.004
Sales of water heating units - Electric Heat Pump	0.003	0.025	0.194	0.461	0.507	0.51	0.51
Sales of water heating units - Electric Resistance	0.027	0.046	0.183	0.44	0.485	0.488	0.488
Sales of water heating units - Gas Furnace	0.969	0.927	0.622	0.097	0.006	0	0
Sales of water heating units - Other	0.002	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	6.628	6.83	11.646	12.398	12.333	12.987

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	10.253	11.101	0	0	0	0
Sale of space heating units by type - Electric Heat Pump	0.024	0.129	0.135	0.143	0.15	0.156	0.165
Sale of space heating units by type - Electric Resistance	0.129	0.178	0.176	0.174	0.168	0.16	0.152
Sale of space heating units by type - Fossil	0.026	0.041	0.042	0.041	0.042	0.042	0.042
Sale of space heating units by type - Gas	0.821	0.652	0.648	0.642	0.641	0.642	0.64
Sales of cooking units - Electric Resistance	0.502	0.502	0.502	0.502	0.502	0.502	0.502
Sales of cooking units - Gas	0.498	0.498	0.498	0.498	0.498	0.498	0.498
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	0.227	0.381	0.379	0.378	0.378	0.377	0.377
Sales of water heating units by type - Gas Furnace	0.773	0.618	0.62	0.621	0.621	0.622	0.622
Sales of water heating units by type - Other	0	0.001	0.001	0.001	0.001	0.001	0.001

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	0.014	0.018	0.022	0.02	0.018	0.017	0.016
End-use technology sales by technology - LDV - EV	0.041	0.062	0.071	0.087	0.106	0.121	0.133
End-use technology sales by technology - LDV - gasoline	0.894	0.857	0.833	0.813	0.792	0.772	0.757
End-use technology sales by technology - LDV - hybrid	0.049	0.058	0.07	0.076	0.081	0.086	0.089
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	167.319
Carbon sink enhancement potential - All (not counting overlap)	0	0	35819.5
Carbon sink enhancement potential - Avoid deforestation	0	0	4261.6
Carbon sink enhancement potential - Extend rotation length	0	0	4104.6
Carbon sink enhancement potential - Improve plantations	0	0	189.111
Carbon sink enhancement potential - Increase retention of HWP	0	0	2272.501
Carbon sink enhancement potential - Increase trees outside forests	0	0	5823.5
Carbon sink enhancement potential - Reforest cropland	0	0	9503.4
Carbon sink enhancement potential - Reforest pasture	0	0	7430.3
Carbon sink enhancement potential - Restore productivity	0	0	2067.184
Land impacted for carbon sink enhancement - Accelerate regeneration	0	0	67.436
Land impacted for carbon sink enhancement - All (not counting overlap)	0	0	6653.6
Land impacted for carbon sink enhancement - Avoid deforestation	0	0	1143.972
Land impacted for carbon sink enhancement - Extend rotation length	0	0	2261.164
Land impacted for carbon sink enhancement - Improve plantations	0	0	105.104
Land impacted for carbon sink enhancement - Increase retention of HWP	0	0	454.5
Land impacted for carbon sink enhancement - Increase trees outside forests	0	0	1642.693
Land impacted for carbon sink enhancement - Natural uptake	-11.08	-4.334	-3.875
Land impacted for carbon sink enhancement - Reforest cropland	0	0	3164.001
Land impacted for carbon sink enhancement - Reforest pasture	0	0	561.843
Land impacted for carbon sink enhancement - Restore productivity	0	0	1166.558
Land impacted for carbon sink enhancement - Retained in Hardwood Products	-0.371	-0.667	-0.694
Land impacted for carbon sink enhancement - Total	-11.451	-5.001	-4.569
Land impacted for carbon sink enhancement - Total impacted (over 30 years)	0	0	3913.7

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

variable_name	2050
Business-as-usual carbon sink - Accelerate regeneration	15.637
Business-as-usual carbon sink - Avoid deforestation	364.416
Business-as-usual carbon sink - Extend rotation length	1237
Business-as-usual carbon sink - Improve plantations	39.913

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	330.285
Business-as-usual carbon sink - Reforest cropland	359.041
Business-as-usual carbon sink - Reforest pasture	137.258
Business-as-usual carbon sink - Restore productivity	410.662
Business-as-usual carbon sink - Total impacted (over 30 years)	359.041

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

variable_name	2020	2025	2030	2035	2040	2045	2050
Final energy demand by sector - commercial	0.441	0.441	0.437	0.426	0.415	0.414	0.426
Final energy demand by sector - industry	0.634	0.673	0.695	0.715	0.742	0.766	0.795
Final energy demand by sector - residential	0.591	0.553	0.532	0.516	0.507	0.501	0.496
Final energy demand by sector - transportation	1.044	0.993	0.935	0.904	0.914	0.947	0.988

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	40482882398	41989514888	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	0.008	0.125	0.447	0.711	0.755	0.759	0.759
Sales of space heating units - Electric Resistance	0.029	0.043	0.089	0.171	0.227	0.236	0.237
Sales of space heating units - Fossil	0	0.022	0.011	0.002	0	0	0
Sales of space heating units - Gas Furnace	0.964	0.81	0.452	0.116	0.018	0.004	0.004
Sales of water heating units - Electric Heat Pump	0.003	0.003	0.003	0.003	0.003	0.003	0.003
Sales of water heating units - Electric Resistance	0.027	0.032	0.032	0.032	0.032	0.032	0.032
Sales of water heating units - Gas Furnace	0.969	0.963	0.963	0.963	0.963	0.963	0.963
Sales of water heating units - Other	0.002	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	5.738	5.834	7.975	8.315	10.345	10.886

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	10.737	14.265	0	0	0	0
Sale of space heating units by type - Electric Heat Pump	0.035	0.082	0.116	0.222	0.455	0.723	0.872
Sale of space heating units by type - Electric Resistance	0.127	0.187	0.181	0.164	0.125	0.082	0.059
Sale of space heating units by type - Fossil	0.024	0.046	0.045	0.04	0.029	0.017	0.01
Sale of space heating units by type - Gas	0.814	0.685	0.659	0.574	0.39	0.178	0.059
Sales of cooking units - Electric Resistance	0.506	0.519	0.564	0.683	0.849	0.951	0.987
Sales of cooking units - Gas	0.494	0.481	0.436	0.317	0.151	0.049	0.013
Sales of water heating units by type - Electric Heat Pump	0	0.006	0.022	0.073	0.184	0.309	0.379
Sales of water heating units by type - Electric Resistance	0.227	0.383	0.388	0.409	0.462	0.528	0.567
Sales of water heating units by type - Gas Furnace	0.773	0.61	0.589	0.517	0.353	0.161	0.052
Sales of water heating units by type - Other	0	0.001	0.001	0.001	0.001	0.001	0.001

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	0.014	0.018	0.02	0.016	0.01	0.005	0.002
End-use technology sales by technology - LDV - EV	0.021	0.051	0.126	0.271	0.497	0.729	0.879
End-use technology sales by technology - LDV - gasoline	0.912	0.867	0.784	0.651	0.447	0.239	0.106
End-use technology sales by technology - LDV - hybrid	0.051	0.059	0.065	0.059	0.043	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	332584368	686694425	2330660285	7297319153	10644108124
Number of public EV charging plugs - DC Fast Charging	299	0	1048.2	0	5186.5	0	14345.5
Number of public EV charging plugs - L2 Charging	1406	0	25202.9	0	124709.5	0	344934.6

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

variable_name	2050
Carbon sink enhancement potential - Accelerate regeneration	167.319
Carbon sink enhancement potential - All (not counting overlap)	35819.5
Carbon sink enhancement potential - Avoid deforestation	4261.6
Carbon sink enhancement potential - corn-ethanol to energy grasses	-7671.856
Carbon sink enhancement potential - cropland measures	-26788.613
Carbon sink enhancement potential - Extend rotation length	4104.6
Carbon sink enhancement potential - Improve plantations	189.111
Carbon sink enhancement potential - Increase retention of HWP	2272.501
Carbon sink enhancement potential - Increase trees outside forests	5823.5
Carbon sink enhancement potential - permanent conservation cover	-642.218
Carbon sink enhancement potential - Reforest cropland	9503.4
Carbon sink enhancement potential - Reforest pasture	7430.3
Carbon sink enhancement potential - Restore productivity	2067.184
Carbon sink enhancement potential - total	-35102.687
Land impacted for carbon sink enhancement - Accelerate regeneration	67.436
Land impacted for carbon sink enhancement - All (not counting overlap)	6653.6
Land impacted for carbon sink enhancement - Avoid deforestation	1143.972
Land impacted for carbon sink enhancement - corn-ethanol to energy grasses	3467.4
Land impacted for carbon sink enhancement - cropland measures	11007.9
Land impacted for carbon sink enhancement - Extend rotation length	2261.164
Land impacted for carbon sink enhancement - Improve plantations	105.104
Land impacted for carbon sink enhancement - Increase retention of HWP	454.5
Land impacted for carbon sink enhancement - Increase trees outside forests	1642.693
Land impacted for carbon sink enhancement - permanent conservation cover	1168.078
Land impacted for carbon sink enhancement - Reforest cropland	3164.001
Land impacted for carbon sink enhancement - Reforest pasture	561.843
Land impacted for carbon sink enhancement - Restore productivity	1166.558
Land impacted for carbon sink enhancement - total	15643.4
Land impacted for carbon sink enhancement - Total impacted (over 30 years)	3913.7

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

variable_name	2050
Business-as-usual carbon sink - Accelerate regeneration	15.637
Business-as-usual carbon sink - Avoid deforestation	364.416
Business-as-usual carbon sink - Extend rotation length	1237
Business-as-usual carbon sink - Improve plantations	39.913
Business-as-usual carbon sink - Increase retention of HWP	0
Business-as-usual carbon sink - Increase trees outside forests	330.285
Business-as-usual carbon sink - Reforest cropland	359.041
Business-as-usual carbon sink - Reforest pasture	137.258
Business-as-usual carbon sink - Restore productivity	410.662
Business-as-usual carbon sink - Total impacted (over 30 years)	359.041

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

variable_name	2020	2025	2030	2035	2040	2045	2050
Final energy demand by sector - commercial	0.441	0.434	0.424	0.414	0.399	0.379	0.356
Final energy demand by sector - industry	0.634	0.66	0.674	0.68	0.693	0.701	0.708
Final energy demand by sector - residential	0.591	0.552	0.524	0.495	0.458	0.408	0.352
Final energy demand by sector - transportation	1.044	0.984	0.908	0.847	0.798	0.74	0.672

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	40921808258	44665689358	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	0.008	0.062	0.093	0.193	0.416	0.676	0.824
Sales of space heating units - Electric Resistance	0.029	0.034	0.036	0.043	0.06	0.083	0.095
Sales of space heating units - Fossil	0	0.024	0.023	0.017	0.009	0.003	0.001
Sales of space heating units - Gas Furnace	0.964	0.88	0.848	0.746	0.515	0.238	0.08
Sales of water heating units - Electric Heat Pump	0.003	0.01	0.03	0.092	0.227	0.382	0.469
Sales of water heating units - Electric Resistance	0.027	0.038	0.053	0.105	0.223	0.366	0.448
Sales of water heating units - Gas Furnace	0.969	0.95	0.915	0.801	0.548	0.25	0.081
Sales of water heating units - Other	0.002	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	5.407	5.464	7.273	7.539	10.383	10.956

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	1.93	6.22	10.659	7.779	9.392	13.636
Power generation capital investment - Wind - Base	10.492	29.933	38.793	42.747	38.65	18.641

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	1599.3	6437.1	16223.4	28151.7	42338.6	50889.8
HV transmission for wind and solar - base other intra-state	0	772.941	3289.1	9142.8	15594.1	22765	26526.4
HV transmission for wind and solar - base spur intra-state	0	572.777	2532.2	5659.4	9186.4	13478.4	16021.4

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

variable_name	2050
Carbon sink enhancement potential - Accelerate regeneration	167.319
Carbon sink enhancement potential - All (not counting overlap)	35819.5
Carbon sink enhancement potential - Avoid deforestation	4261.6
Carbon sink enhancement potential - corn-ethanol to energy grasses	-7671.856
Carbon sink enhancement potential - cropland measures	-26788.613
Carbon sink enhancement potential - Extend rotation length	4104.6
Carbon sink enhancement potential - Improve plantations	189.111
Carbon sink enhancement potential - Increase retention of HWP	2272.501
Carbon sink enhancement potential - Increase trees outside forests	5823.5
Carbon sink enhancement potential - permanent conservation cover	-642.218
Carbon sink enhancement potential - Reforest cropland	9503.4
Carbon sink enhancement potential - Reforest pasture	7430.3
Carbon sink enhancement potential - Restore productivity	2067.184
Carbon sink enhancement potential - total	-35102.687
Land impacted for carbon sink enhancement - Accelerate regeneration	67.436
Land impacted for carbon sink enhancement - All (not counting overlap)	6653.6
Land impacted for carbon sink enhancement - Avoid deforestation	1143.972
Land impacted for carbon sink enhancement - corn-ethanol to energy grasses	3467.4
Land impacted for carbon sink enhancement - cropland measures	11007.9
Land impacted for carbon sink enhancement - Extend rotation length	2261.164
Land impacted for carbon sink enhancement - Improve plantations	105.104
Land impacted for carbon sink enhancement - Increase retention of HWP	454.5
Land impacted for carbon sink enhancement - Increase trees outside forests	1642.693
Land impacted for carbon sink enhancement - permanent conservation cover	1168.078
Land impacted for carbon sink enhancement - Reforest cropland	3164.001
Land impacted for carbon sink enhancement - Reforest pasture	561.843
Land impacted for carbon sink enhancement - Restore productivity	1166.558
Land impacted for carbon sink enhancement - total	15643.4
Land impacted for carbon sink enhancement - Total impacted (over 30 years)	3913.7

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

variable_name	2050
Business-as-usual carbon sink - Accelerate regeneration	15.637
Business-as-usual carbon sink - Avoid deforestation	364.416
Business-as-usual carbon sink - Extend rotation length	1237
Business-as-usual carbon sink - Improve plantations	39.913
Business-as-usual carbon sink - Increase retention of HWP	0
Business-as-usual carbon sink - Increase trees outside forests	330.285
Business-as-usual carbon sink - Reforest cropland	359.041
Business-as-usual carbon sink - Reforest pasture	137.258
Business-as-usual carbon sink - Restore productivity	410.662
Business-as-usual carbon sink - Total impacted (over 30 years)	359.041

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	0.075	0	0	0
Power generation capital investment - biomass w/ccu power plant	0	0	1.903	1.402	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	74.599	74.599	74.599	74.599
Power generation by technology - biomass w/ccu power plant	0	0	2135.8	3709.5	3709.5	3709.5	3709.5

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

variable_name	2020	2025	2030	2035	2040	2045	2050
Biomass purchases	0	0	0.142	5.808	10.101	10.101	10.101
Capital investment	0	0	1.646	0	100.524	0	0
Number of facilities - allam power w ccu	0	0	0	2	2	2	2
Number of facilities - beccs hydrogen	0	0	0	70	124	124	124
Number of facilities - diesel	0	0	0	0	0	0	0
Number of facilities - diesel ccu	0	0	0	2	2	2	2
Number of facilities - power	0	0	0	0	0	0	0
Number of facilities - power ccu	0	0	2	4	4	4	4
Number of facilities - pyrolysis	0	0	0	0	0	0	0
Number of facilities - pyrolysis ccu	0	0	0	2	2	2	2
Number of facilities - sng	0	0	0	0	0	0	0
Number of facilities - sng ccu	0	0	2	2	2	2	2

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

variable_name	2025	2030	2035	2040	2045	2050
Annual - All	0	2.13	83.48	142.43	142.5	142.55
Annual - BECCS	0	2.12	80.04	139.01	139.01	138.99
Annual - Cement	0	0	3.35	3.32	3.42	3.53
Annual - NGCC	0	0.01	0.09	0.11	0.08	0.03
Cumulative - All	0	2.13	85.61	228.04	370.54	513.09
Cumulative - BECCS	0	2.12	82.16	221.17	360.18	499.17
Cumulative - Cement	0	0	3.35	6.67	10.09	13.62
Cumulative - NGCC	0	0.01	0.1	0.21	0.29	0.32

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

variable_name	2025	2030	2035	2040	2045	2050
Annual	0	2.77	13.91	27.33	38.41	40.13
Injection wells	0	7	26	46	78	96
Resource characterization, appraisal and permitting costs cumulative	100.33	441.46	682.26	682.26	682.26	682.26
Wells and facilities construction costs cumulative	0	200.42	781.08	1391.9	2327.4	2889.6

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

variable_name	2025	2030	2035	2040	2045	2050
CO2 pipelines - All	0	6510659.3	13046142.3	20377020.4	21562048.3	21686873.1
CO2 pipelines - Spur	0	240321.894	4156336.3	6974242.7	8159271.6	8284096.4
CO2 pipelines - Trunk	0	6270336.622	8889806.1	13402776.6	13402776.6	13402776.6

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

variable_name	2050
Carbon sink enhancement potential - Accelerate regeneration	167.319
Carbon sink enhancement potential - All (not counting overlap)	35819.5
Carbon sink enhancement potential - Avoid deforestation	4261.6
Carbon sink enhancement potential - corn-ethanol to energy grasses	-9986.974
Carbon sink enhancement potential - cropland measures	-24284.653
Carbon sink enhancement potential - Cropland to woody energy crops	0
Carbon sink enhancement potential - Extend rotation length	4104.6
Carbon sink enhancement potential - Improve plantations	189.111
Carbon sink enhancement potential - Increase retention of HWP	2272.501
Carbon sink enhancement potential - Increase trees outside forests	5823.5
Carbon sink enhancement potential - pasture to energy crops	0
Carbon sink enhancement potential - permanent conservation cover	-580.164
Carbon sink enhancement potential - Reforest cropland	9503.4
Carbon sink enhancement potential - Reforest pasture	7430.3
Carbon sink enhancement potential - Restore productivity	2067.184

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

variable_name	2050
Carbon sink enhancement potential - total	-34851.789
Land impacted for carbon sink enhancement - Accelerate regeneration	67.436
Land impacted for carbon sink enhancement - All (not counting overlap)	6653.6
Land impacted for carbon sink enhancement - Avoid deforestation	1143.972
Land impacted for carbon sink enhancement - corn-ethanol to energy grasses	4921
Land impacted for carbon sink enhancement - cropland measures	19569.2
Land impacted for carbon sink enhancement - Cropland to woody energy crops	1643.92
Land impacted for carbon sink enhancement - Extend rotation length	2261.164
Land impacted for carbon sink enhancement - Improve plantations	105.104
Land impacted for carbon sink enhancement - Increase retention of HWP	454.5
Land impacted for carbon sink enhancement - Increase trees outside forests	1642.693
Land impacted for carbon sink enhancement - pasture to energy crops	226.632
Land impacted for carbon sink enhancement - permanent conservation cover	1055.212
Land impacted for carbon sink enhancement - Reforest cropland	3164.001
Land impacted for carbon sink enhancement - Reforest pasture	561.843
Land impacted for carbon sink enhancement - Restore productivity	1166.558
Land impacted for carbon sink enhancement - total	27415.9
Land impacted for carbon sink enhancement - Total impacted (over 30 years)	3913.7

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

variable_name	2050
Business-as-usual carbon sink - Accelerate regeneration	15.637
Business-as-usual carbon sink - Avoid deforestation	364.416
Business-as-usual carbon sink - Extend rotation length	1237
Business-as-usual carbon sink - Improve plantations	39.913
Business-as-usual carbon sink - Increase retention of HWP	0
Business-as-usual carbon sink - Increase trees outside forests	330.285
Business-as-usual carbon sink - Reforest cropland	359.041
Business-as-usual carbon sink - Reforest pasture	137.258
Business-as-usual carbon sink - Restore productivity	410.662
Business-as-usual carbon sink - Total impacted (over 30 years)	359.041

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

variable_name	2050
Carbon sink enhancement potential - Accelerate regeneration	167.319
Carbon sink enhancement potential - All (not counting overlap)	35819.5
Carbon sink enhancement potential - Avoid deforestation	4261.6
Carbon sink enhancement potential - corn-ethanol to energy grasses	-7671.856
Carbon sink enhancement potential - cropland measures	-26788.613
Carbon sink enhancement potential - Extend rotation length	4104.6
Carbon sink enhancement potential - Improve plantations	189.111
Carbon sink enhancement potential - Increase retention of HWP	2272.501
Carbon sink enhancement potential - Increase trees outside forests	5823.5
Carbon sink enhancement potential - permanent conservation cover	-642.218
Carbon sink enhancement potential - Reforest cropland	9503.4
Carbon sink enhancement potential - Reforest pasture	7430.3
Carbon sink enhancement potential - Restore productivity	2067.184
Carbon sink enhancement potential - total	-35102.687
Land impacted for carbon sink enhancement - Accelerate regeneration	67.436
Land impacted for carbon sink enhancement - All (not counting overlap)	6653.6
Land impacted for carbon sink enhancement - Avoid deforestation	1143.972
Land impacted for carbon sink enhancement - corn-ethanol to energy grasses	3467.4
Land impacted for carbon sink enhancement - cropland measures	11007.9
Land impacted for carbon sink enhancement - Extend rotation length	2261.164
Land impacted for carbon sink enhancement - Improve plantations	105.104
Land impacted for carbon sink enhancement - Increase retention of HWP	454.5
Land impacted for carbon sink enhancement - Increase trees outside forests	1642.693
Land impacted for carbon sink enhancement - permanent conservation cover	1168.078

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

variable_name	2050
Land impacted for carbon sink enhancement - Reforest cropland	3164.001
Land impacted for carbon sink enhancement - Reforest pasture	561.843
Land impacted for carbon sink enhancement - Restore productivity	1166.558
Land impacted for carbon sink enhancement - total	15643.4
Land impacted for carbon sink enhancement - Total impacted (over 30 years)	3913.7

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

variable_name	2050
Business-as-usual carbon sink - Accelerate regeneration	15.637
Business-as-usual carbon sink - Avoid deforestation	364.416
Business-as-usual carbon sink - Extend rotation length	1237
Business-as-usual carbon sink - Improve plantations	39.913
Business-as-usual carbon sink - Increase retention of HWP	0
Business-as-usual carbon sink - Increase trees outside forests	330.285
Business-as-usual carbon sink - Reforest cropland	359.041
Business-as-usual carbon sink - Reforest pasture	137.258
Business-as-usual carbon sink - Restore productivity	410.662
Business-as-usual carbon sink - Total impacted (over 30 years)	359.041