Net-Zero America - arizona 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	9.026	12.922	0	0	0	0
Sale of space heating units by type - Electric Heat Pump	0.205	0.398	0.779	0.879	0.887	0.886	0.885
Sale of space heating units by type - Electric Resistance	0.251	0.294	0.129	0.087	0.084	0.085	0.086
Sale of space heating units by type - Fossil	0.038	0.047	0.028	0.022	0.019	0.019	0.02
Sale of space heating units by type - Gas	0.506	0.261	0.063	0.013	0.01	0.01	0.01
Sales of cooking units - Electric Resistance	0.828	0.865	0.977	0.999	1	1	1
Sales of cooking units - Gas	0.172	0.135	0.023	0.001	0	0	0
Sales of water heating units by type - Electric Heat Pump	0	0.111	0.591	0.705	0.711	0.711	0.711
Sales of water heating units by type - Electric Resistance	0.467	0.564	0.314	0.258	0.256	0.256	0.256
Sales of water heating units by type - Gas Furnace	0.497	0.292	0.063	0.004	0	0	0
Sales of water heating units by type - Other	0.036	0.032	0.032	0.032	0.032	0.032	0.032

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	0.015	0.018	0.012	0.004	0.001	0	0
End-use technology sales by technology - LDV - EV	0.04	0.155	0.469	0.82	0.963	0.993	1
End-use technology sales by technology - LDV - gasoline	0.897	0.777	0.484	0.163	0.033	0.006	0
End-use technology sales by technology - LDV - hybrid	0.045	0.046	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	1095749414	2868373077	4551101211	6932525540	7503233015	7176610622
Number of public EV charging plugs - DC Fast Charging	323	0	1880.2	0	7602.7	0	12175.6
Number of public EV charging plugs - L2 Charging	1112	0	45227.6	0	182884.1	0	292886.4

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	0.005	0.135	0	0	0	0
Power generation capital investment - biomass w/ccu allam power plant	0	0	0	0	0	0	0.057
Power generation capital investment - biomass w/ccu power plant	0	0	0	0	0	0	0.315
Power generation capital investment - Solar PV - Base	0	0	0	0	0	0	1.175
Power generation capital investment - Solar PV - Constrained	0	1.032	0	0	1.129	0.159	6.008
Power generation capital investment - Wind - Base	0	0	0.096	0.499	0.141	0.13	0.33
Power generation capital investment - Wind - Constrained	0	0.159	0.739	5.986	10.715	12.656	9.895

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	10.099	276.049	276.049	276.049	276.049	276.049
Power generation by technology - biomass w/ccu allam power plant	0	0	0	0	0	0	57.206
Power generation by technology - biomass w/ccu power plant	0	0	0	0	0	0	353.67

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	3943.3	7537.2	12104.8	15477.2	18191.1	21062.1
HV transmission for wind and solar - base other intra-state	0	199.813	370.587	586.634	746.428	877.385	1013.7
HV transmission for wind and solar - base spur intra-state	0	17.148	23.339	39.082	43.616	50.471	339.924
HV transmission for wind and solar - constrained all	0	131.526	387.643	1761.9	3829.6	6654	9324
HV transmission for wind and solar - constrained other intra-state	0	21.474	21.474	286.195	689.843	1738.6	2528.2
HV transmission for wind and solar - constrained spur intra-state	0	36.878	61.597	515.979	1735	3453.3	5071.6

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

variable_name	2020	2025	2030	2035	2040	2045	2050
Biomass purchases	0	0.001	0.012	0.014	0.014	0.014	0.042
Capital investment	0	0	0.148	0	0.032	0	0.631
Number of facilities - allam power w ccu	0	0	0	0	0	0	2
Number of facilities - beccs hydrogen	0	0	0	0	0	0	1
Number of facilities - diesel	0	0	0	2	2	2	2
Number of facilities - diesel ccu	0	0	0	0	0	0	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	2	2	2	2	2	2
Number of facilities - power ccu	0	0	0	0	0	0	2
Number of facilities - pyrolysis	0	0	0	2	2	2	2
Number of facilities - pyrolysis ccu	0	0	0	0	0	0	1
Number of facilities - sng	0	2	2	2	2	2	2
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	0.01	0.01	3.33	3.5	4.27
Annual - BECCS	0	0	0	0	0	0.67
Annual - Cement	0	0	0	3.32	3.42	3.53
Annual - NGCC	0	0.01	0.01	0.01	0.08	0.07
Cumulative - All	0	0.01	0.02	3.35	6.85	11.12
Cumulative - BECCS	0	0	0	0	0	0.67
Cumulative - Cement	0	0	0	3.32	6.74	10.27
Cumulative - NGCC	0	0.01	0.02	0.03	0.11	0.18

Table 8: *E- 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 9: *E- scenario - PILLAR 4: CO2 capture, use, storage - CO2 transportation*

variable_name	2025	2030	2035	2040	2045	2050
CO2 pipelines - All	0	445218.829	445215.029	531118.863	537764.627	740970.731
CO2 pipelines - Spur	0	5146.364	5142.464	91046.298	97692.162	300898.265
CO2 pipelines - Trunk	0	440072.565	440072.565	440072.565	440072.565	440072.565

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

variable_name	2020	2025	2030	2035	2040	2045	2050
Jobs by economic sector - agriculture	95.075	96.569	117.907	119.714	76.487	32.724	55.51
Jobs by economic sector - construction	14633.6	12180.5	11583.9	11952.1	12452.6	11946.5	16075.6
Jobs by economic sector - manufacturing	4868.6	5140.3	7178.2	8642.9	7913.8	6751.1	7448.9
Jobs by economic sector - mining	2552.9	1940.4	1239.4	773.926	443.433	226.344	105.816
Jobs by economic sector - other	2050.8	1529.3	1564.7	1826.7	2127.6	2391.5	4296.9
Jobs by economic sector - pipeline	411.261	400.237	390.119	260.215	197.071	119.225	104.094
Jobs by economic sector - professional	5870.1	5260.5	4877.9	5036.3	5274.8	5283.6	7560.5
Jobs by economic sector - trade	4501.1	3776.9	3305.9	3376.9	3548.7	3634.5	5563.9
Jobs by economic sector - utilities	10372.7	12548.9	11868	11463.6	11412	10290.8	9630.6
Jobs by resource sector - Biomass	246.334	248.003	283.99	289.561	200.087	123.33	251.027
Jobs by resource sector - CO2	0	0	442.383	9.807	95.912	38.972	273.474
Jobs by resource sector - Coal	1749.7	1308.7	390.603	4.064	2.999	2.324	1.943
Jobs by resource sector - Grid	11765.4	17763.7	17024.6	18372.5	18856.4	16842.8	17400
Jobs by resource sector - Natural Gas	5546.7	4562.8	3873.4	3719.4	4691.6	4264.9	1995.6
Jobs by resource sector - Nuclear	2159.5	2124.7	2090.8	1212.7	0.031	0.093	0.136
Jobs by resource sector - Oil	5035.8	4241.4	3276.3	2217.7	1371.4	775.569	370.796
Jobs by resource sector - Solar	17899.9	10848.9	11170.6	13760.2	15000.1	16322.1	28123.7
Jobs by resource sector - Wind	952.863	1775.5	3573.3	3866.5	3227.9	2306.3	2425.2
Median wages - All	57399.5	59133	59518.8	59798	60498.4	61285.1	61296.9
Required Level of Education - Associates degree or some college	14321.6	13646.3	13473.8	13996.9	14169.5	13306.5	16555.2
Required Level of Education - Bachelors degree	9095.5	8644.9	8407.3	8512.4	8358	7824.2	9779.2
Required Level of Education - Doctoral degree	326.05	290.819	272.492	270.609	268.085	261.469	360.932
Required Level of Education - High school diploma or less	19405.5	18186.5	17953.6	18643	18642.5	17380	21717.8
Required Level of Education - Masters or professional degree	2207.6	2105	2018.7	2029.5	2008.4	1904.1	2428.8
Wage income - All	2603738470	2535495712	2507534570	2598658213	2628783853	2493234453	3117122029

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

variable_name	2050
Carbon sink enhancement potential - Accelerate regeneration	3153.6
Carbon sink enhancement potential - All (not counting overlap)	27370.8
Carbon sink enhancement potential - Avoid deforestation	2940.6
Carbon sink enhancement potential - corn-ethanol to energy grasses	0
Carbon sink enhancement potential - cropland measures	-677.222
Carbon sink enhancement potential - Extend rotation length	11877.2
Carbon sink enhancement potential - Improve plantations	0
Carbon sink enhancement potential - Increase retention of HWP	240.377
Carbon sink enhancement potential - Increase trees outside forests	686.48
Carbon sink enhancement potential - permanent conservation cover	-14.886
Carbon sink enhancement potential - Reforest cropland	0
Carbon sink enhancement potential - Reforest pasture	148.551

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

variable_name	2050
Carbon sink enhancement potential - Restore productivity	8324
Carbon sink enhancement potential - total	-692.107
Land impacted for carbon sink enhancement - Accelerate regeneration	1271.031
Land impacted for carbon sink enhancement - All (not counting overlap)	5788.8
Land impacted for carbon sink enhancement - Avoid deforestation	789.368
Land impacted for carbon sink enhancement - corn-ethanol to energy grasses	0
Land impacted for carbon sink enhancement - cropland measures	762.607
Land impacted for carbon sink enhancement - Extend rotation length	6542.9
Land impacted for carbon sink enhancement - Improve plantations	0
Land impacted for carbon sink enhancement - Increase retention of HWP	48.075
Land impacted for carbon sink enhancement - Increase trees outside forests	193.649
Land impacted for carbon sink enhancement - permanent conservation cover	22.839
Land impacted for carbon sink enhancement - Reforest cropland	0
Land impacted for carbon sink enhancement - Reforest pasture	11.233
Land impacted for carbon sink enhancement - Restore productivity	4697.3
Land impacted for carbon sink enhancement - total	785.445
Land impacted for carbon sink enhancement - Total impacted (over 30 years)	7764.8

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

variable_name	2050
Business-as-usual carbon sink - Accelerate regeneration	294.732
Business-as-usual carbon sink - Avoid deforestation	251.456
Business-as-usual carbon sink - Extend rotation length	3579.4
Business-as-usual carbon sink - Improve plantations	0
Business-as-usual carbon sink - Increase retention of HWP	0
Business-as-usual carbon sink - Increase trees outside forests	38.935
Business-as-usual carbon sink - Reforest cropland	0
Business-as-usual carbon sink - Reforest pasture	2.744
Business-as-usual carbon sink - Restore productivity	1653.6
Business-as-usual carbon sink - Total impacted (over 30 years)	0

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

variable_name	2020	2025	2030	2035	2040	2045	2050
Natural gas consumption	293476.8	297835.3	251058.3	201359.1	151580.1	95369.1	66145.5
Oil consumption	103239.7	95331.9	80239.3	58810.7	39150.6	23689.6	12050

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

variable_name	2020	2025	2030	2035	2040	2045	2050
Final energy demand by sector - commercial	0.154	0.154	0.15	0.142	0.136	0.133	0.134
Final energy demand by sector - industry	0.138	0.138	0.137	0.143	0.157	0.161	0.165
Final energy demand by sector - residential	0.19	0.187	0.18	0.168	0.158	0.153	0.152
Final energy demand by sector - transportation	0.577	0.543	0.484	0.411	0.345	0.303	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	15690931350	17430259888	0	0	0	0
Sales of cooking units - Electric Resistance	0.419	0.546	0.83	0.886	0.889	0.889	0.889
Sales of cooking units - Gas	0.581	0.454	0.17	0.114	0.111	0.111	0.111
Sales of space heating units - Electric Heat Pump	0.094	0.247	0.745	0.913	0.93	0.931	0.931
Sales of space heating units - Electric Resistance	0.088	0.037	0.042	0.06	0.064	0.064	0.063
Sales of space heating units - Fossil	0	0.002	0	0	0	0	0
Sales of space heating units - Gas Furnace	0.817	0.714	0.213	0.028	0.006	0.005	0.005
Sales of water heating units - Electric Heat Pump	0.001	0.105	0.561	0.674	0.681	0.681	0.681
Sales of water heating units - Electric Resistance	0.041	0.06	0.256	0.311	0.315	0.315	0.315
Sales of water heating units - Gas Furnace	0.947	0.831	0.18	0.011	0	0	0
Sales of water heating units - Other	0.011	0.004	0.004	0.004	0.004	0.004	0.004

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	5.562	5.847	7.135	7.539	7.138	7.446

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	8.977	12.675	0	0	0	0
Sale of space heating units by type - Electric Heat Pump	0.205	0.325	0.368	0.494	0.692	0.823	0.869
Sale of space heating units by type - Electric Resistance	0.251	0.325	0.306	0.252	0.168	0.112	0.092
Sale of space heating units by type - Fossil	0.038	0.051	0.051	0.042	0.029	0.021	0.021
Sale of space heating units by type - Gas	0.506	0.299	0.276	0.211	0.111	0.043	0.018
Sales of cooking units - Electric Resistance	0.828	0.832	0.848	0.89	0.947	0.983	0.995
Sales of cooking units - Gas	0.172	0.168	0.152	0.11	0.053	0.017	0.005
Sales of water heating units by type - Electric Heat Pump	0	0.019	0.074	0.231	0.474	0.634	0.691
Sales of water heating units by type - Electric Resistance	0.467	0.612	0.585	0.503	0.377	0.295	0.266
Sales of water heating units by type - Gas Furnace	0.497	0.336	0.309	0.233	0.117	0.039	0.01
Sales of water heating units by type - Other	0.036	0.032	0.032	0.033	0.033	0.032	0.032

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	0.974	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	0.02	0.021	0.016	0.01	0.005	0.002
End-use technology sales by technology - LDV - EV	0.019	0.048	0.12	0.261	0.486	0.722	0.876
End-use technology sales by technology - LDV - gasoline	0.916	0.873	0.794	0.664	0.459	0.247	0.109
End-use technology sales by technology - LDV - hybrid	0.047	0.055	0.061	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	187734601	371206831	1275981331	3944716339	5771377027
Number of public EV charging plugs - DC Fast Charging	323	0	668.786	0	2887.7	0	7798.5
Number of public EV charging plugs - L2 Charging	1112	0	16087.7	0	69463.6	0	187593.5

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

variable_name	2050
Carbon sink enhancement potential - Accelerate regeneration	3153.6
Carbon sink enhancement potential - All (not counting overlap)	27370.8
Carbon sink enhancement potential - Avoid deforestation	2940.6
Carbon sink enhancement potential - corn-ethanol to energy grasses	0
Carbon sink enhancement potential - cropland measures	-677.222
Carbon sink enhancement potential - Extend rotation length	11877.2
Carbon sink enhancement potential - Improve plantations	0
Carbon sink enhancement potential - Increase retention of HWP	240.377
Carbon sink enhancement potential - Increase trees outside forests	686.48
Carbon sink enhancement potential - permanent conservation cover	-14.886
Carbon sink enhancement potential - Reforest cropland	0
Carbon sink enhancement potential - Reforest pasture	148.551
Carbon sink enhancement potential - Restore productivity	8324
Carbon sink enhancement potential - total	-692.107
Land impacted for carbon sink enhancement - Accelerate regeneration	1271.031
Land impacted for carbon sink enhancement - All (not counting overlap)	5788.8
Land impacted for carbon sink enhancement - Avoid deforestation	789.368
Land impacted for carbon sink enhancement - corn-ethanol to energy grasses	0
Land impacted for carbon sink enhancement - cropland measures	762.607
Land impacted for carbon sink enhancement - Extend rotation length	6542.9
Land impacted for carbon sink enhancement - Improve plantations	0
Land impacted for carbon sink enhancement - Increase retention of HWP	48.075
Land impacted for carbon sink enhancement - Increase trees outside forests	193.649
Land impacted for carbon sink enhancement - permanent conservation cover	22.839
Land impacted for carbon sink enhancement - Reforest cropland	0
Land impacted for carbon sink enhancement - Reforest pasture	11.233
Land impacted for carbon sink enhancement - Restore productivity	4697.3
Land impacted for carbon sink enhancement - total	785.445
Land impacted for carbon sink enhancement - Total impacted (over 30 years)	7764.8

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

variable_name	2050
Business-as-usual carbon sink - Accelerate regeneration	294.732
Business-as-usual carbon sink - Avoid deforestation	251.456
Business-as-usual carbon sink - Extend rotation length	3579.4
Business-as-usual carbon sink - Improve plantations	0
Business-as-usual carbon sink - Increase retention of HWP	0
Business-as-usual carbon sink - Increase trees outside forests	38.935
Business-as-usual carbon sink - Reforest cropland	0
Business-as-usual carbon sink - Reforest pasture	2.744
Business-as-usual carbon sink - Restore productivity	1653.6
Business-as-usual carbon sink - Total impacted (over 30 years)	0

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

variable_name	2020	2025	2030	2035	2040	2045	2050
Final energy demand by sector - commercial	0.154	0.154	0.154	0.153	0.15	0.146	0.143
Final energy demand by sector - industry	0.138	0.139	0.137	0.144	0.16	0.164	0.168
Final energy demand by sector - residential	0.19	0.188	0.187	0.184	0.176	0.167	0.161
Final energy demand by sector - transportation	0.578	0.547	0.504	0.469	0.441	0.408	0.369

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	15683156288	17443336559	0	0	0	0
Sales of cooking units - Electric Resistance	0.419	0.462	0.502	0.608	0.754	0.846	0.878
Sales of cooking units - Gas	0.581	0.538	0.498	0.392	0.246	0.154	0.122
Sales of space heating units - Electric Heat Pump	0.094	0.154	0.212	0.377	0.639	0.828	0.903
Sales of space heating units - Electric Resistance	0.088	0.037	0.038	0.039	0.046	0.055	0.061
Sales of space heating units - Fossil	0	0.002	0.002	0.002	0.001	0	0
Sales of space heating units - Gas Furnace	0.817	0.806	0.748	0.582	0.315	0.117	0.037
Sales of water heating units - Electric Heat Pump	0.001	0.019	0.07	0.22	0.451	0.606	0.661
Sales of water heating units - Electric Resistance	0.041	0.023	0.045	0.11	0.211	0.28	0.305
Sales of water heating units - Gas Furnace	0.947	0.955	0.88	0.666	0.334	0.111	0.03
Sales of water heating units - Other	0.011	0.004	0.004	0.004	0.004	0.004	0.004

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	5.078	5.306	5.56	5.791	6.907	7.243

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	8.414	8.884	0	0	0	0
Sale of space heating units by type - Electric Heat Pump	0.195	0.399	0.406	0.417	0.432	0.452	0.479
Sale of space heating units by type - Electric Resistance	0.254	0.296	0.292	0.286	0.275	0.257	0.23
Sale of space heating units by type - Fossil	0.038	0.039	0.04	0.04	0.036	0.034	0.036
Sale of space heating units by type - Gas	0.513	0.265	0.262	0.257	0.257	0.257	0.256
Sales of cooking units - Electric Resistance	0.826	0.826	0.826	0.826	0.826	0.826	0.826
Sales of cooking units - Gas	0.174	0.174	0.174	0.174	0.174	0.174	0.174
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	0.467	0.622	0.624	0.624	0.624	0.625	0.625
Sales of water heating units by type - Gas Furnace	0.497	0.345	0.344	0.343	0.343	0.343	0.342
Sales of water heating units by type - Other	0.036	0.032	0.032	0.033	0.033	0.033	0.033

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	0.981	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	0.057	0.065	0.08	0.097	0.113	0.124
End-use technology sales by technology - LDV - gasoline	0.901	0.865	0.843	0.824	0.803	0.784	0.768
End-use technology sales by technology - LDV - hybrid	0.045	0.054	0.066	0.071	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 26: *REF scenario - PILLAR 6: Land carbon sinks - Agriculture*

variable_name	2020	2030	2050
Carbon sink enhancement potential - Accelerate regeneration	0	0	3153.6
Carbon sink enhancement potential - All (not counting overlap)	0	0	27370.8
Carbon sink enhancement potential - Avoid deforestation	0	0	2940.6
Carbon sink enhancement potential - Extend rotation length	0	0	11877.2
Carbon sink enhancement potential - Improve plantations	0	0	0
Carbon sink enhancement potential - Increase retention of HWP	0	0	240.377
Carbon sink enhancement potential - Increase trees outside forests	0	0	686.48
Carbon sink enhancement potential - Reforest cropland	0	0	0
Carbon sink enhancement potential - Reforest pasture	0	0	148.551
Carbon sink enhancement potential - Restore productivity	0	0	8324
Land impacted for carbon sink enhancement - Accelerate regeneration	0	0	1271.031
Land impacted for carbon sink enhancement - All (not counting overlap)	0	0	5788.8
Land impacted for carbon sink enhancement - Avoid deforestation	0	0	789.368
Land impacted for carbon sink enhancement - Extend rotation length	0	0	6542.9
Land impacted for carbon sink enhancement - Improve plantations	0	0	0
Land impacted for carbon sink enhancement - Increase retention of HWP	0	0	48.075
Land impacted for carbon sink enhancement - Increase trees outside forests	0	0	193.649
Land impacted for carbon sink enhancement - Natural uptake	7.56	2.193	0.629
Land impacted for carbon sink enhancement - Reforest cropland	0	0	0
Land impacted for carbon sink enhancement - Reforest pasture	0	0	11.233
Land impacted for carbon sink enhancement - Restore productivity	0	0	4697.3
Land impacted for carbon sink enhancement - Retained in Hardwood Products	-0.039	-0.082	-0.086
Land impacted for carbon sink enhancement - Total	7.521	2.111	0.543
Land impacted for carbon sink enhancement - Total impacted (over 30 years)	0	0	7764.8

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

variable_name	2050
Business-as-usual carbon sink - Accelerate regeneration	294.732
Business-as-usual carbon sink - Avoid deforestation	251.456
Business-as-usual carbon sink - Extend rotation length	3579.4
Business-as-usual carbon sink - Improve plantations	0
Business-as-usual carbon sink - Increase retention of HWP	0
Business-as-usual carbon sink - Increase trees outside forests	38.935
Business-as-usual carbon sink - Reforest cropland	0
Business-as-usual carbon sink - Reforest pasture	2.744
Business-as-usual carbon sink - Restore productivity	1653.6
Business-as-usual carbon sink - Total impacted (over 30 years)	0

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

variable_name	2020	2025	2030	2035	2040	2045	2050
Final energy demand by sector - commercial	0.154	0.157	0.16	0.162	0.165	0.172	0.181
Final energy demand by sector - industry	0.138	0.144	0.147	0.154	0.162	0.173	0.185
Final energy demand by sector - residential	0.19	0.19	0.195	0.202	0.212	0.222	0.23
Final energy demand by sector - transportation	0.577	0.551	0.515	0.496	0.5	0.516	0.537

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	15479249632	16145151841	0	0	0	0
Sales of cooking units - Electric Resistance	0.419	0.447	0.447	0.446	0.444	0.445	0.446
Sales of cooking units - Gas	0.581	0.553	0.553	0.554	0.556	0.555	0.554
Sales of space heating units - Electric Heat Pump	0.094	0.273	0.682	0.78	0.787	0.788	0.788
Sales of space heating units - Electric Resistance	0.088	0.055	0.113	0.162	0.2	0.206	0.206
Sales of space heating units - Fossil	0	0.002	0.001	0	0	0	0
Sales of space heating units - Gas Furnace	0.817	0.67	0.204	0.058	0.012	0.006	0.005
Sales of water heating units - Electric Heat Pump	0.001	0	0	0	0	0	0
Sales of water heating units - Electric Resistance	0.041	0.015	0.015	0.015	0.015	0.015	0.015
Sales of water heating units - Gas Furnace	0.947	0.981	0.981	0.981	0.981	0.981	0.981
Sales of water heating units - Other	0.011	0.004	0.004	0.004	0.004	0.004	0.004

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	5.568	5.854	6.552	6.887	7.443	7.805

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	3.765	5.433	4.095
Power generation capital investment - Wind - Base	0	0.196	0.451	0.325	0.263	1.53

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	1471.3	2999.3	4689.7	7040	10376.5	13597.5
HV transmission for wind and solar - base other intra-state	0	55.023	98.282	145.557	193.08	269.976	549.653
HV transmission for wind and solar - base spur intra-state	0	17.148	26.89	42.139	832.2	1653.7	2363.7

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

variable_name	2050
Carbon sink enhancement potential - Accelerate regeneration	3153.6
Carbon sink enhancement potential - All (not counting overlap)	27370.8
Carbon sink enhancement potential - Avoid deforestation	2940.6
Carbon sink enhancement potential - corn-ethanol to energy grasses	0
Carbon sink enhancement potential - cropland measures	-677.222
Carbon sink enhancement potential - Extend rotation length	11877.2
Carbon sink enhancement potential - Improve plantations	0
Carbon sink enhancement potential - Increase retention of HWP	240.377
Carbon sink enhancement potential - Increase trees outside forests	686.48
Carbon sink enhancement potential - permanent conservation cover	-14.886
Carbon sink enhancement potential - Reforest cropland	0
Carbon sink enhancement potential - Reforest pasture	148.551
Carbon sink enhancement potential - Restore productivity	8324
Carbon sink enhancement potential - total	-692.107
Land impacted for carbon sink enhancement - Accelerate regeneration	1271.031
Land impacted for carbon sink enhancement - All (not counting overlap)	5788.8
Land impacted for carbon sink enhancement - Avoid deforestation	789.368
Land impacted for carbon sink enhancement - corn-ethanol to energy grasses	0
Land impacted for carbon sink enhancement - cropland measures	762.607
Land impacted for carbon sink enhancement - Extend rotation length	6542.9
Land impacted for carbon sink enhancement - Improve plantations	0
Land impacted for carbon sink enhancement - Increase retention of HWP	48.075
Land impacted for carbon sink enhancement - Increase trees outside forests	193.649
Land impacted for carbon sink enhancement - permanent conservation cover	22.839
Land impacted for carbon sink enhancement - Reforest cropland	0
Land impacted for carbon sink enhancement - Reforest pasture	11.233
Land impacted for carbon sink enhancement - Restore productivity	4697.3
Land impacted for carbon sink enhancement - total	785.445
Land impacted for carbon sink enhancement - Total impacted (over 30 years)	7764.8

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

variable_name	2050
Business-as-usual carbon sink - Accelerate regeneration	294.732
Business-as-usual carbon sink - Avoid deforestation	251.456
Business-as-usual carbon sink - Extend rotation length	3579.4
Business-as-usual carbon sink - Improve plantations	0
Business-as-usual carbon sink - Increase retention of HWP	0
Business-as-usual carbon sink - Increase trees outside forests	38.935
Business-as-usual carbon sink - Reforest cropland	0
Business-as-usual carbon sink - Reforest pasture	2.744
Business-as-usual carbon sink - Restore productivity	1653.6
Business-as-usual carbon sink - Total impacted (over 30 years)	0

Table 35: *RE+ scenario - PILLAR 2: Clean Electricity - Generating capacity*

variable_name	2020	2025	2030	2035	2040	2045	2050
Power generation capital investment - biomass power plant	0	0.002	0.061	0	0	0	0
Power generation capital investment - biomass w/ccu allam power plant	0	0	0	0	0	0.007	0.02
Power generation capital investment - biomass w/ccu power plant	0	0	0	0	0	0.001	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	4.194	123.792	123.792	123.792	123.792	123.792
Power generation by technology - biomass w/ccu allam power plant	0	0	0	0	0	6.99	26.791
Power generation by technology - biomass w/ccu power plant	0	0	0	0	0	1.196	1.196

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

variable_name	2020	2025	2030	2035	2040	2045	2050
Biomass purchases	0	0	0.008	0.01	0.01	0.029	0.038
Capital investment	0	0	0.066	0	0.023	0	0.395
Number of facilities - allam power w ccu	0	0	0	0	0	1	1
Number of facilities - beccs hydrogen	0	0	0	0	0	1	1
Number of facilities - diesel	0	0	0	1	1	1	1
Number of facilities - diesel ccu	0	0	0	0	0	1	1
Number of facilities - power	0	1	1	1	1	1	1
Number of facilities - power ccu	0	0	0	0	0	1	1
Number of facilities - pyrolysis	0	0	0	1	1	1	1
Number of facilities - pyrolysis ccu	0	0	0	0	0	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	0.15	3.44	3.83	4.06
Annual - BECCS	0	0	0	0	0.31	0.44
Annual - Cement	0	0	0	3.32	3.42	3.53
Annual - NGCC	0	0	0.15	0.12	0.1	0.08
Cumulative - All	0	0	0.15	3.59	7.42	11.48
Cumulative - BECCS	0	0	0	0	0.31	0.75
Cumulative - Cement	0	0	0	3.32	6.74	10.27
Cumulative - NGCC	0	0	0.15	0.27	0.37	0.45

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	440072.565	445410.829	531271.163	643826.777	647158.277
CO2 pipelines - Spur	0	0	5338.364	91198.698	203754.211	207085.811
CO2 pipelines - Trunk	0	440072.565	440072.565	440072.565	440072.565	440072.565

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

variable_name	2050
Carbon sink enhancement potential - Accelerate regeneration	3153.6
Carbon sink enhancement potential - All (not counting overlap)	27370.8
Carbon sink enhancement potential - Avoid deforestation	2940.6
Carbon sink enhancement potential - corn-ethanol to energy grasses	0
Carbon sink enhancement potential - cropland measures	-677.222
Carbon sink enhancement potential - Cropland to woody energy crops	0
Carbon sink enhancement potential - Extend rotation length	11877.2
Carbon sink enhancement potential - Improve plantations	0
Carbon sink enhancement potential - Increase retention of HWP	240.377
Carbon sink enhancement potential - Increase trees outside forests	686.48
Carbon sink enhancement potential - pasture to energy crops	0
Carbon sink enhancement potential - permanent conservation cover	-14.886
Carbon sink enhancement potential - Reforest cropland	0
Carbon sink enhancement potential - Reforest pasture	148.551
Carbon sink enhancement potential - Restore productivity	8324
Carbon sink enhancement potential - total	-692.107
Land impacted for carbon sink enhancement - Accelerate regeneration	1271.031
Land impacted for carbon sink enhancement - All (not counting overlap)	5788.8
Land impacted for carbon sink enhancement - Avoid deforestation	789.368
Land impacted for carbon sink enhancement - corn-ethanol to energy grasses	0
Land impacted for carbon sink enhancement - cropland measures	1505.84

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

variable_name	2050
Land impacted for carbon sink enhancement - Cropland to woody energy crops	0
Land impacted for carbon sink enhancement - Extend rotation length	6542.9
Land impacted for carbon sink enhancement - Improve plantations	0
Land impacted for carbon sink enhancement - Increase retention of HWP	48.075
Land impacted for carbon sink enhancement - Increase trees outside forests	193.649
Land impacted for carbon sink enhancement - pasture to energy crops	0
Land impacted for carbon sink enhancement - permanent conservation cover	22.839
Land impacted for carbon sink enhancement - Reforest cropland	0
Land impacted for carbon sink enhancement - Reforest pasture	11.233
Land impacted for carbon sink enhancement - Restore productivity	4697.3
Land impacted for carbon sink enhancement - total	1528.653
Land impacted for carbon sink enhancement - Total impacted (over 30 years)	7764.8

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

variable_name	2050
Business-as-usual carbon sink - Accelerate regeneration	294.732
Business-as-usual carbon sink - Avoid deforestation	251.456
Business-as-usual carbon sink - Extend rotation length	3579.4
Business-as-usual carbon sink - Improve plantations	0
Business-as-usual carbon sink - Increase retention of HWP	0
Business-as-usual carbon sink - Increase trees outside forests	38.935
Business-as-usual carbon sink - Reforest cropland	0
Business-as-usual carbon sink - Reforest pasture	2.744
Business-as-usual carbon sink - Restore productivity	1653.6
Business-as-usual carbon sink - Total impacted (over 30 years)	0

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

variable_name	2050
Carbon sink enhancement potential - Accelerate regeneration	3153.6
Carbon sink enhancement potential - All (not counting overlap)	27370.8
Carbon sink enhancement potential - Avoid deforestation	2940.6
Carbon sink enhancement potential - corn-ethanol to energy grasses	0
Carbon sink enhancement potential - cropland measures	-677.222
Carbon sink enhancement potential - Extend rotation length	11877.2
Carbon sink enhancement potential - Improve plantations	0
Carbon sink enhancement potential - Increase retention of HWP	240.377
Carbon sink enhancement potential - Increase trees outside forests	686.48
Carbon sink enhancement potential - permanent conservation cover	-14.886
Carbon sink enhancement potential - Reforest cropland	0
Carbon sink enhancement potential - Reforest pasture	148.551
Carbon sink enhancement potential - Restore productivity	8324
Carbon sink enhancement potential - total	-692.107
Land impacted for carbon sink enhancement - Accelerate regeneration	1271.031
Land impacted for carbon sink enhancement - All (not counting overlap)	5788.8
Land impacted for carbon sink enhancement - Avoid deforestation	789.368
Land impacted for carbon sink enhancement - corn-ethanol to energy grasses	0
Land impacted for carbon sink enhancement - cropland measures	762.607
Land impacted for carbon sink enhancement - Extend rotation length	6542.9
Land impacted for carbon sink enhancement - Improve plantations	0
Land impacted for carbon sink enhancement - Increase retention of HWP	48.075
Land impacted for carbon sink enhancement - Increase trees outside forests	193.649
Land impacted for carbon sink enhancement - permanent conservation cover	22.839
Land impacted for carbon sink enhancement - Reforest cropland	0
Land impacted for carbon sink enhancement - Reforest pasture	11.233
Land impacted for carbon sink enhancement - Restore productivity	4697.3
Land impacted for carbon sink enhancement - total	785.445
Land impacted for carbon sink enhancement - Total impacted (over 30 years)	7764.8

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

variable_name	2050
Business-as-usual carbon sink - Accelerate regeneration	294.732
Business-as-usual carbon sink - Avoid deforestation	251.456
Business-as-usual carbon sink - Extend rotation length	3579.4
Business-as-usual carbon sink - Improve plantations	0
Business-as-usual carbon sink - Increase retention of HWP	0
Business-as-usual carbon sink - Increase trees outside forests	38.935
Business-as-usual carbon sink - Reforest cropland	0
Business-as-usual carbon sink - Reforest pasture	2.744
Business-as-usual carbon sink - Restore productivity	1653.6
Business-as-usual carbon sink - Total impacted (over 30 years)	0