



Energy+Environmental Economics

Maryland PATHWAYS

2020 MWG Scenario

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Agenda

- + Background
- + Assumptions for the Reference and MWG Scenario
- + MWG Scenario Results
- + Appendix



Background

- + As a part of this project, MDE offered a scenario to be designed by the Mitigation Working Group (MWG)**
 - This scenario is separate from the MWG scenario proposed in 2018 (previously called Policy Scenario 3)
- + In 2020, the MWG selected a set of policies and measures for consideration by the State.**
 - A formal letter was submitted by NRDC, TNC, Sierra Club, and CCAN and a webinar followed to discuss how the assumptions would be translated into the PATHWAYS model.
- + The goal was to model the proposed set of measures and see what the impact would be on emissions and costs**
- + Not all of the input assumptions have a specific associated policy recommendation**
- + This scenario has been defined by the MWG and does not represent any policy recommendations from the State**



Reminder:

Reference Scenario Policies

+ Electricity Generation

- Coal facility retirements from latest RGGI Modeling (New Jersey's rulemaking)
- 50% RPS by 2030 (Clean Energy Jobs Act)*
- 1.5 GW of rooftop solar adoption by 2026*
- RGGI 2030 cap
- Relicense Calvert Cliffs Nuclear Facility

+ Transportation

- CAFE Standards improving through 2026
- Zero Emission Vehicle Mandate*

+ Buildings

- EmPOWER efficiency goals as currently established through 2023
- DHCD Low Income EE Program
- MEA Woodstoves Program

+ Other

- Forest Management and healthy soils sequestration projections

*Updated from 2019 Reference Scenario



MWG Scenario Policies and Measures

+ Electricity Generation

- 50% RPS by 2050, 75% RPS and 100% zero-emissions electricity by 2040
- All in-state coal-fired power plants are retired by 2030
- No new natural gas power plants built after 2020
- Increased net metering cap to 3 GW by 2030
- Accelerated RGGI cap (50% reductions by 2030, 100% reductions by 2040, vs. 2020)

+ Transportation

- CAFE Standards improving through 2026
- Aggressive zero-emission vehicle sales
- Low LDV VMT growth rate (0.6% per year)

+ Buildings and Industry

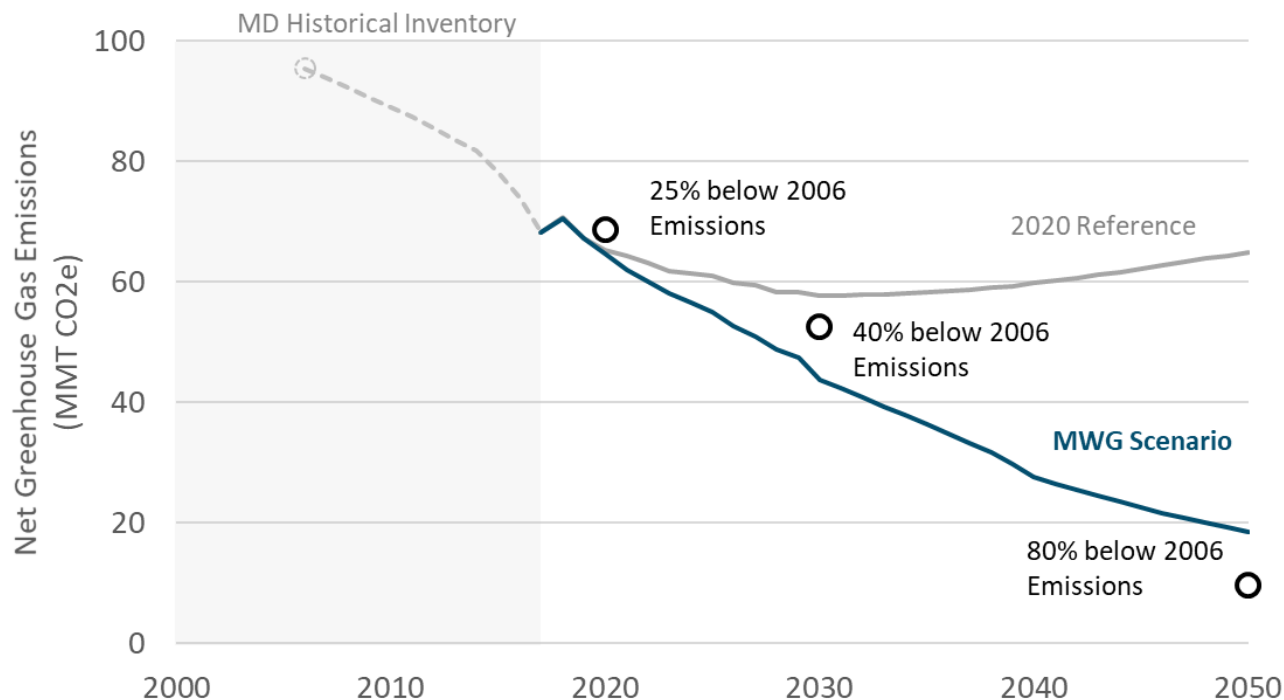
- Increased EmPOWER efficiency goals by 2023 and beyond
- Aggressive building electrification for new construction and retrofits

+ Other

- Methane measures in manure management and enteric fermentation
- Increased forestry sinks by 10% by 2030 (vs. 2017)



Total Net GHG Emissions



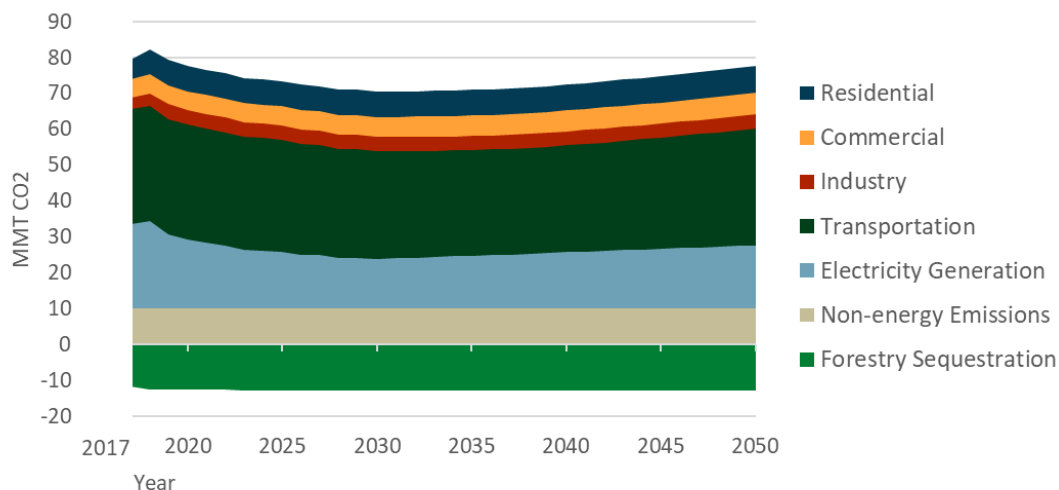
- + The MWG scenario overachieves the near-term GHG targets and is close to meeting the 2050 GHG target.
- + It overachieves the **2020 GHG target by 3.9 MMT CO₂e**, and the **2030 GHG target by 8.7 MMT CO₂e**
- + It gets close to the **2050 GHG target**, but there is still a **gap of 8.9 MMT CO₂**.



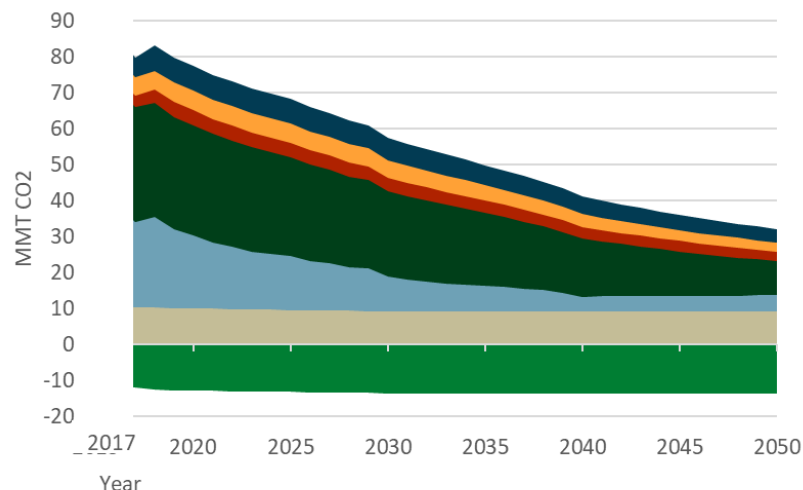
Emissions by Sector

- + MWG Scenario has substantial emission reductions across all sectors.
- + Transportation and electricity generation sectors have the largest emission reductions compared to Reference
 - Electricity generation drops due to new renewable builds, coal phase out (by 2030), and natural gas phase out (by 2040). Remaining electricity emissions are from imports.

2020 Reference



MWG Scenario

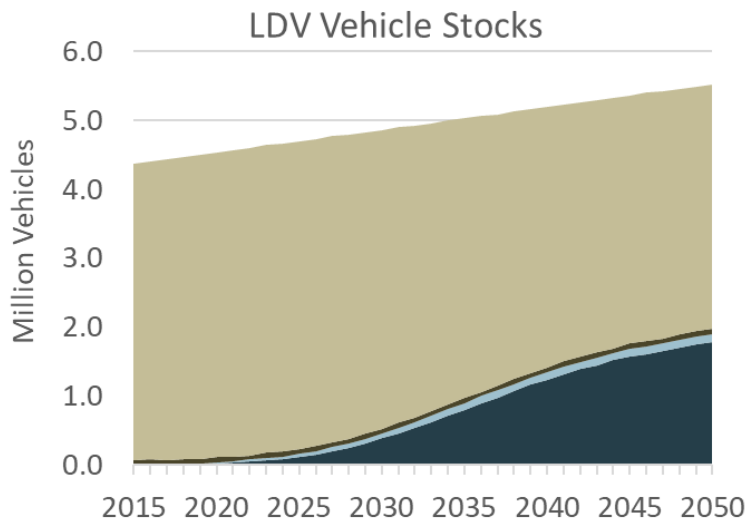




Light-duty Vehicles Stock Share: Previous Reference vs. 2020 Reference

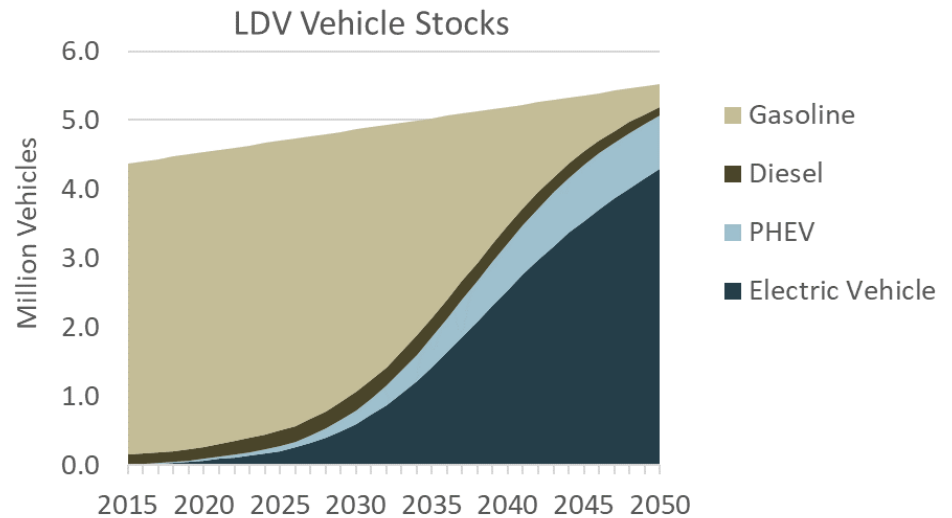
+ In the MWG Scenario, ZEV sales ramp up quickly after 2025 to meet the goal of 800,000 by 2030, 5 million by 2050

2020 Reference



Thousand	2025	2030	2050
BEV	120k	390k	1,800k
PHEV	40k	70k	100k
Total ZEV	160k	460k	1,900k

MWG Scenario



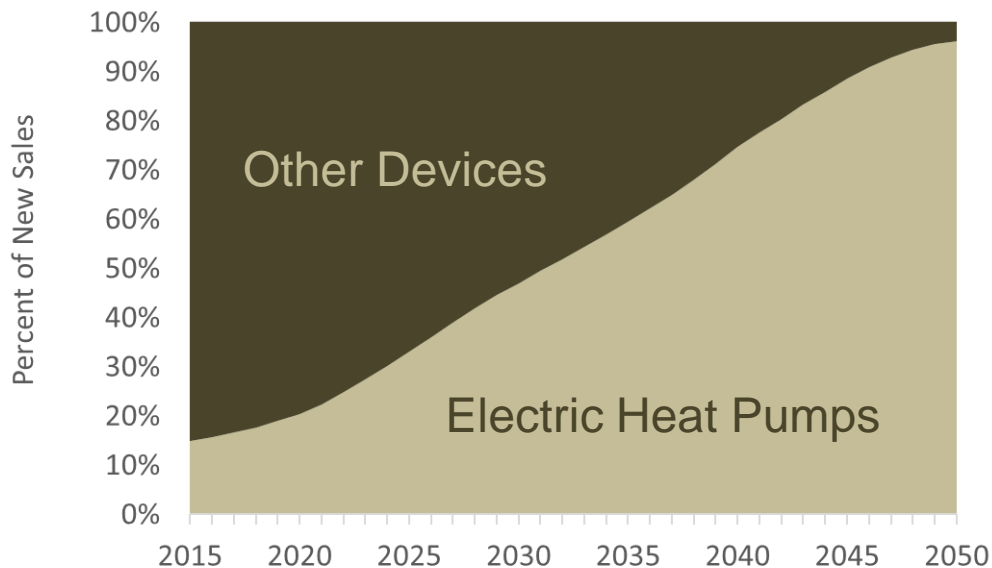
Thousand	2025	2030	2050
BEV	200k	600k	4,300k
PHEV	70k	200k	700k
Total ZEV	270k	800k	5,000k



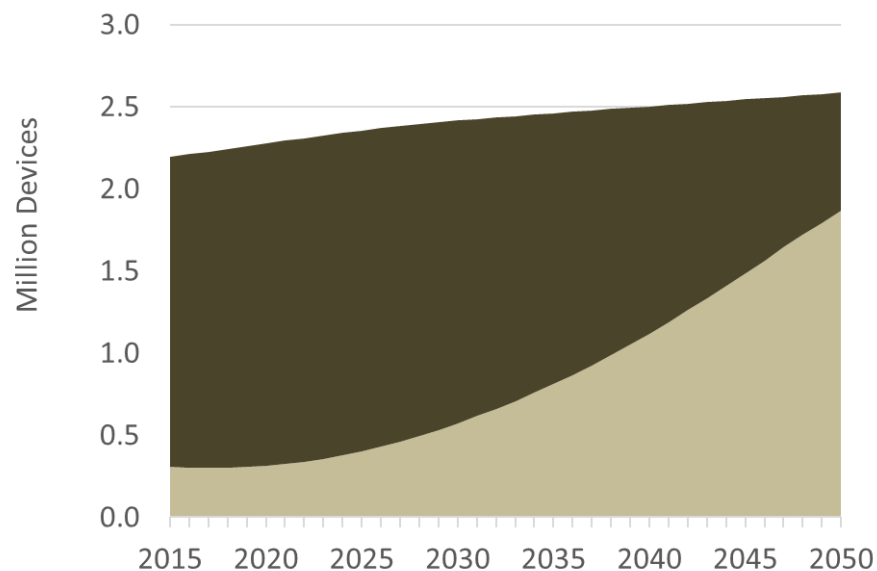
Building Electrification

- + Building electrification adoption increases steadily after 2020; electric appliance sales share reaches 90% by 2050
- + MWG Scenario achieves 100% electric heat pump adoption in all new construction by 2025 and retrofits reach ~1.3 Million by 2050

Residential Space Heaters (Sales Share)



Residential Space Heaters (Total Stock)





Electricity Generation

Approach

- + **We leveraged modeling completed by Resources for the Future (RFF) and their E4ST model and then calibrated to additional requests from the MWG**
 - We assumed that all in-state coal units retire by 2030 and all in-state natural gas units retire by 2040 (no gas units are built after 2020)
 - This results in roughly a 75% RPS by 2040, with the remainder of electricity demand being met by nuclear power (Calvert Cliffs) and imports from PJM
- + **We increased the net metering cap to 3 GW by 2030, modeled as rooftop solar.**
- + **We assumed that the RGGI cap continues to tighten to get to 100% reduction by 2040, which we modeled as a reduction in the imports emission factor, weighted by RGGI states in PJM (incl. PA and NJ).**
 - Remaining emissions from PJM do carry an emissions factor, so though in-state generation is 100% zero-carbon, the total electric sector continues to have emissions associated with non-RGGI imports.

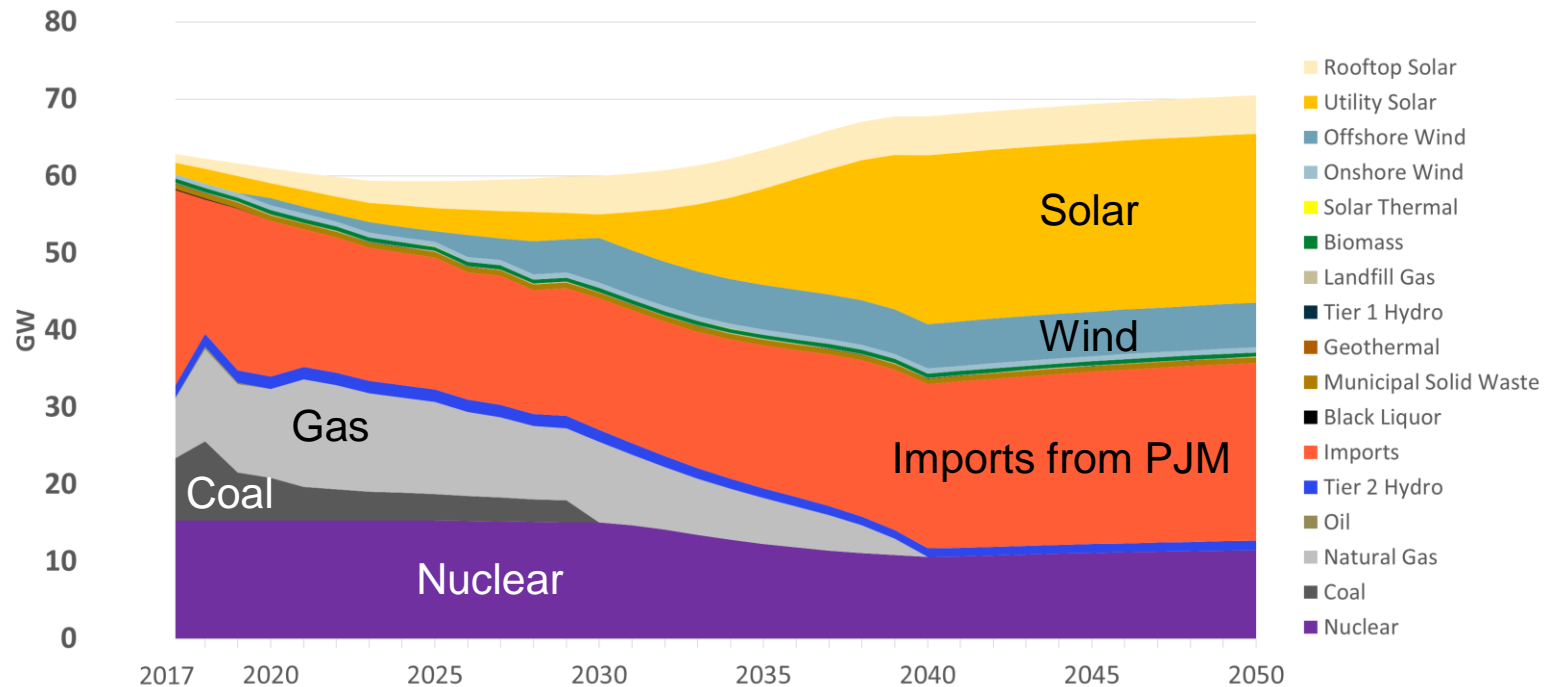
**Neither E4ST or PATHWAYS is a detailed electricity operations model, so neither model can tell us how reliable this system is in a given year, or exactly what renewable integration technologies may be required (e.g. battery storage, long-duration storage, renewable overbuild). For this scenario, we assume that imported power from PJM balances the system to maintain reliability.



Electricity Generation Results

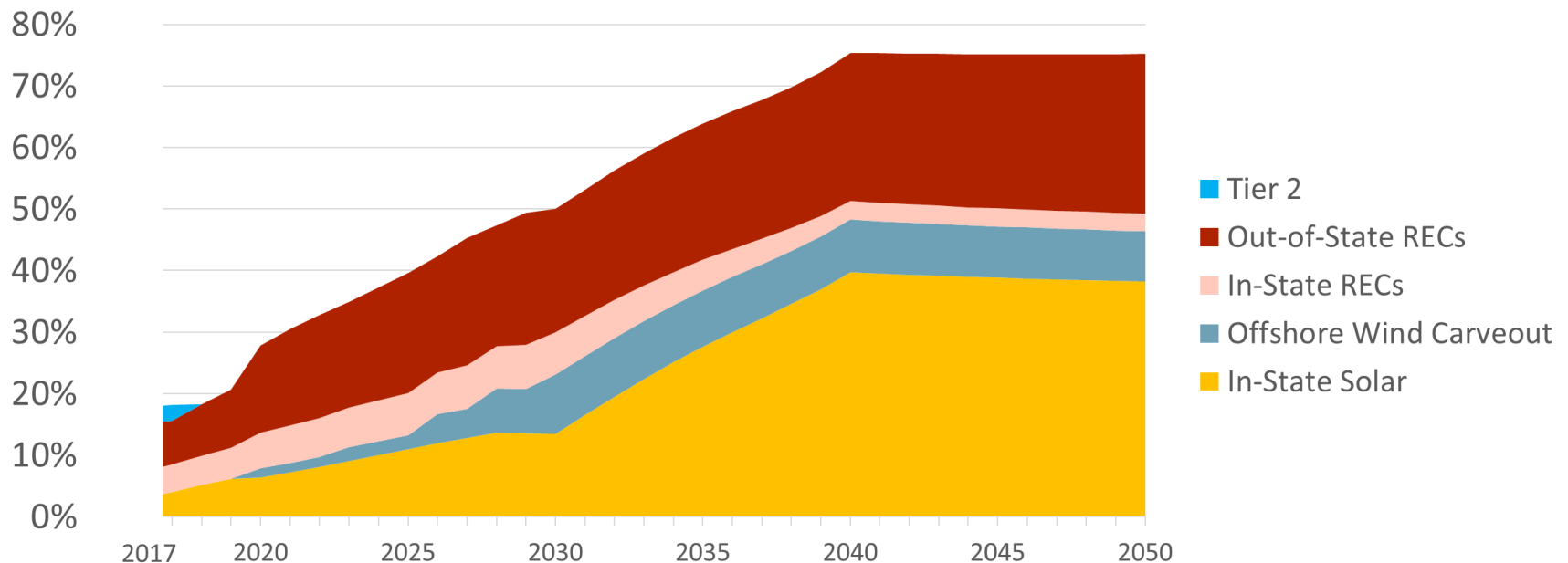
+ Total generation increases to match the increased demands from building and transportation electrification

- Coal generation is phased out in 2030, and gas generation is phased out in 2040
- Solar generation accounts for 40% of total load, and wind generation 8% in 2040
- Nuclear generation declines after 2030. This is because renewable generation is prioritized for dispatch, which results in nuclear not running at full capacity during hours of high renewable output





- + By 2030, 50% RPS is met with the CEJA carve-outs for in-state wind and solar by 2030
- + By 2040, 75% of total load is met by generation attributable to clean renewable energy sources including solar, wind, biomass and hydro:
 - Increase in renewable generation after 2030 is mainly from substantial new solar build and more out-of-state RECs through imports





Solar Capacity and Land-use Estimates

- + Rooftop solar capacity is projected to increase to 3,000 MW by 2030, doubling the existing net metering cap.
- + Utility-scale solar capacity increases substantially after 2030 due to increased demand from electrification, more stringent GHG targets and phase-out of coal and gas.
- + The land-use estimate assumes utility-scale solar is ground-mounted and takes up 8ac per MW of installed capacity.

	2025	2030	2035	2040
Rooftop Solar (MW)	2,072	3,000	3,000	3,000
Utility-scale Solar (MW)	1,336	1,667	5,522	9,691
Estimated Land-use (acre)	10,690	13,336	44,173	77,530



Next Steps

- + Update GGRA Plan scenario modeling
- + Work with RESI at Towson University to update macroeconomic modeling
- + Finish modeling in Summer 2020



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Appendix



Additional EmPOWER Achievements

- + The MWG requested additional EmPOWER achievements for the 2023 program cycle and beyond, referencing PEPCO’s 3% achievement in their last filing.
- + E3 modeled this by updating our PATHWAYS assumptions, which are a proxy for energy efficiency achievements

Category of EMPOWER Electricity Efficiency	Current Assumption (based on Policy Scenario 1 and 4)	Assumptions for the MWG Scenario
New technology sales	50% of new sales of all electric appliances are assumed to be efficient (e.g. EnergyStar) from 2015-2023 to represent EmPOWER, and continued from 2024-2050	Start from 50% new sales in 2015 through 2023 and ramp up to 100% by 2030 to reflect increased EE targets from utilities
Behavioral conservation and smart devices	5% reduction in energy services demand below Baseline Scenario in residential lighting, space heating, and water heating by 2023, and 10% by 2050	No Change
Other non-stock sectors	10% reduction in electric energy consumption below Baseline Scenario by 2023 and 20% by 2050	No Change
Distribution System Optimization	Reduction in transmission and distribution losses from 5.4% to 4.8%, to represent EmPOWER estimates	Reduction in transmission and distribution losses from 5.4% to 4.6% (based on latest PEPCO filing)



Electricity Generation (1/2)

+ RPS

- 25% x 2020, 50% x 2030, Zero emissions electricity by 2040 with at least 75% attributed to clean, renewable energy sources like wind and solar
 - **E3 leveraged model runs from RFF's E4ST model and made modifications to mirror the assumptions above**

+ Coal and Natural Gas Power Plants

- All in-state coal-fired power plants are phased out by 2030
- A moratorium on new natural gas power plants
 - **E3 leveraged model runs from RFF's E4ST model and made modifications to mirror the assumptions above**



Electricity Generation (2/2)

+ RGGI

- Beginning in 2023, accelerate the carbon cap to achieve 50% reductions (relative to 2020 cap) by 2030 and then 100% cap reduction by 2040
 - **E3 calculated a new import emission factor from PJM that's reflective of the above emissions reductions only from RGGI states**
- Also ensure other RGGI states' clean energy and climate policies are fully reflected in the modeling, including the recently enacted Virginia Clean Energy Act
 - Addressed above

+ Rooftop PV

- Double the existing net metering cap to reach 3000 MW by 2030
 - **E3 Updated**



+ Energy efficiency

- Increase annual savings targets for electric efficiency and conservation programs to 3% annual rate savings for electricity starting in next EmPOWER cycle (2023) [also includes industrial energy]
 - **E3 translated increased EMPOWER savings into new efficient appliance sales, reduction in non-stock sectors, and distribution system optimization. We reviewed recent PEPCO EmPOWER filing to understand their recent 3% annual efficiency achievement.**

+ Building electrification

- Implement an all-electric standard for new buildings by 2025 (no new gas hookups).
 - We do not explicitly model existing vintages of buildings vs. new construction, so we recommend meeting the targets shown below.
- Residential heat pump retrofit deployment -- 400,000 electric heat pump deployment by 2030, 800,000 by 2040, 1.2 million by 2050
 - **E3 modeled based on 2019 PS2 assumptions. Though we do not explicitly model new construction and retrofits separately, approximate HP retrofits deployment in the MWG scenario: 240k by 2030, 700k by 2040, and 1.3 million by 2050**



Transportation (1/2)

+ LDV ZEVs

- Aggressive sales after 2025 (800,000 by 2030, 5 Million by 2050)
 - **E3 assumed same assumption as 2019 PS2**
- including an all-electric state-fleet requirement beginning in 2022 for contracts of purchases and leases to be electric only, excluding emergency vehicles.
 - **E3 assumed that fleet is within numbers above.**

+ TCI

- An emissions cap of at least 25% below projected 2022 levels by 2032
 - Excluded in analysis, but TCI is a policy mechanism that will help achieve the ZEV targets outlined above

+ Fuel Economy Standards

- Federal CAFE standards for LDVs through 2026, with continued annual improvement beyond 2026 at (at least) the same rate
 - Can be addressed in sensitivity analysis



Transportation (2/2)

+ LDV VMT

- 0.6% growth: Additional smart growth and transit measures
 - **Leveraged updated work from MDOT and implemented a 0.6% growth rate for LDV VMT.**

+ HDV ZEVs and diesel hybrids

- Aggressive sales of electric and diesel hybrid HDVs after 2030 (40% new sales of either combined electric vehicle and diesel hybrid, full electric, or other zero-emissions vehicles by 2030 and 95% by 2050 by assuming aggressive ZEV adoption); truck stop electrification and zero-emission truck corridors
 - **E3 used same assumption as 2019 PS2**

+ Other transportation sectors

- Electrification of 70% of transit buses by 2030, 100% by 2035; Electrification of 50% of construction vehicles by 2040, 100% by 2050
 - **E3 modeled the above assumptions**



Other Assumptions

+ Industry

- 30% reduction below Reference Scenario by 2050
 - **E3 used 2019 PS2 assumptions but with updated reference scenario**

+ Biofuels

- Existing ethanol and biodiesel blends
 - **E3 used 2019 PS1/3/4 assumptions**

+ Other sectors

- Reductions in enteric fermentation of 16% below 2014 levels by 2030, and reductions in manure management of 65% below 2014 levels by 2030
 - **E3 used 2019 PS2 assumptions**
- Recycling and composting rates -- need to identify the right rates
 - Not modeled
- Grow forestry sinks by 10% by 2030
 - **E3 modeled 10% reduction from 2017 forestry numbers, which replaces previous soil and forest management reductions.**