MARYLAND COMMISSION ON CLIMATE CHANGE

Mid-project update: Accelerating light-duty ZEV adoption across Maryland

January 30, 2023

energetics
Clean Energy Consulting

veic

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Agenda

- Welcome!
- Task 1 – Reference Case Analysis update and Q&A
- Task 2 – Recommendations for State Action and Q&A
- Task 3 – Recommendations for equitable ZEV charging solutions and Q&A
- Next steps and adjourn

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Project Goals

- Evaluate the current status of Maryland's zero emission vehicle (ZEV) and charging infrastructure plans, programs, and other efforts → **Determine if they are sufficient to meet the State's goal of reducing GHG emissions by at least 60% by 2031**
- Evaluate the effectiveness of existing Maryland programs to determine if: 1) they **can be improved** and 2) **whether they should continue**
- Identify/**develop potential policy frameworks for improved/new programs** to increase adoption to meet/exceed the State's goals

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Stakeholder Interviews

- Maryland Farm Bureau
- Utilities – SMECO. Exelon 1/31
- Auto industry: 1) Alliance of Automotive Innovation (OEs) and 2) MD Auto Dealers Association
- Washington, Maryland, Delaware Service Station and Automotive Repair Association, (WMDA/CAR)
- MAPDA (fuel providers and fueling stations)
- MEA
- NAIOP (being scheduled)
- Maryland Clean Energy Center (MCEC) (being scheduled)

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Task 1 – Evaluate current market trends, forecasts, and projections

- Has been difficult to find robust U.S. data (paywalls); MD-specific projections not available
- Other national studies/projections being evaluated – Consulting firms, financial firms
- Detailed annual snapshot MVA registration data is expected soon – annual sales, inventory; by year, vehicle OE, vehicle type
- Boston Consulting Group (BCG, April 2021) predicted more than half of global light duty vehicle sales will be "electrified"--including BEVs, PHEVs, HEVs and MHEVs—by 2026. This was four years earlier than their projections from January 2020. Predicted ZEVs will represent 34% of LD vehicle sales by 3030.
- PWC analysis predicts U.S. EV adoption rates will climb to 44% by 2035; faster in the EU and China
- Atlas Public Policy noted that June 2022 marked record EV sales and market share nationally, reaching 90,000 sales and 7.9% of light-duty sales in the U.S.
- Calculation tool being developed for ZEV sales, GHG, and NOx estimates. Baseline with MVA data and industry sales projections and for program scenario evaluations.

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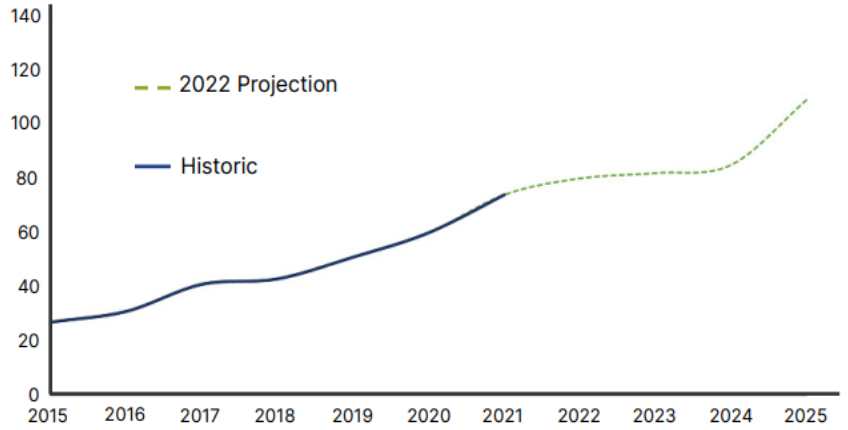
Task 1 – Major LDV OEMs' ZEV plans and prices

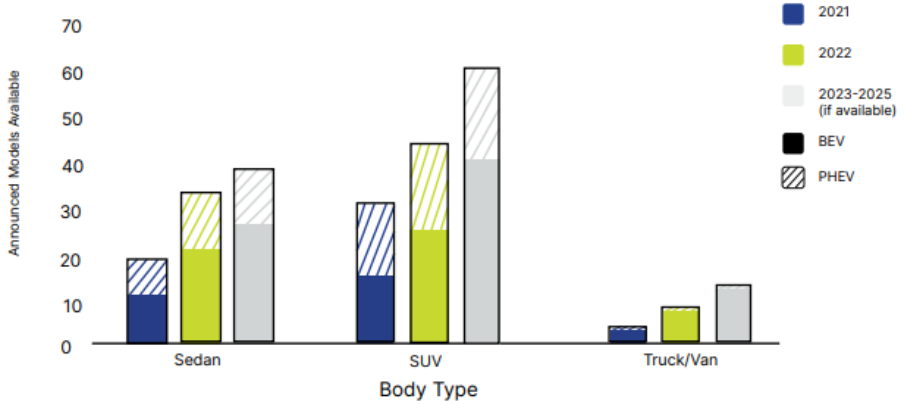
Projected PEV Model Availability

- Driven by upcoming regulations and consumer demand, automakers are investing billions of dollars into ZEV development and production over the next decade
- Almost every major automaker has announced plans to electrify most of their model lines by 2030

Total Light-Duty Vehicle PHEV and BEV U.S. Models Available by Year



Cumulative Announced U.S. Light-Duty BEV and PHEV Models by Body Type



- SUVs and pickup truck segments are projected to have more growth than the sedan segment.
- This follows the general market trends of ICE vehicle segments as well.
- MD Auto dealers excited to have capable product they can (much more easily) sell
- **Takeaway is that OEs are releasing many vehicle options across the brands and vehicle types that matches consumer demand**

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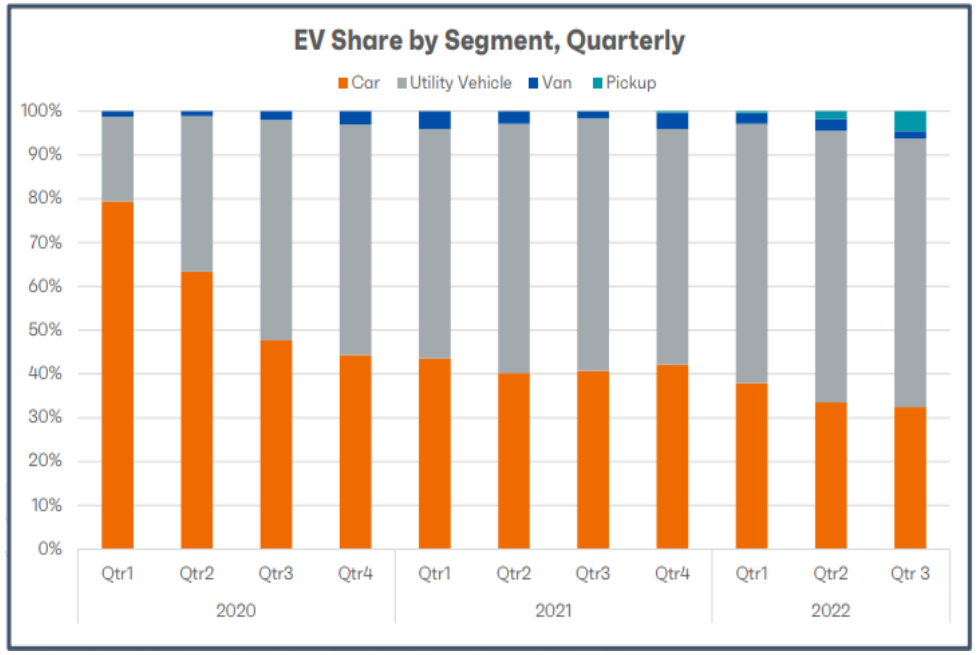
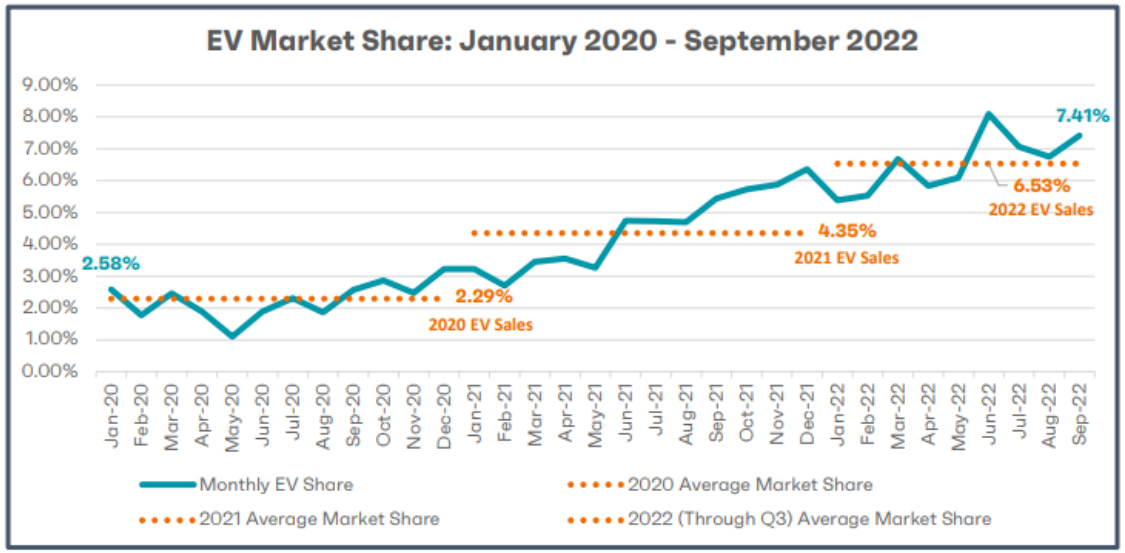
Task 1 – Major LDV OEMs' ZEV plans and prices

Trends in Consumer Demand for PEVs

- EV sales volume increased by 4.2% from 2020 to 2022, despite COVID-related supply chain issues



Source: Alliance for Automotive Innovation Electric Vehicle Quarterly Report



Source: Alliance for Automotive Innovation Electric Vehicle Quarterly Report

- This growth can partially be attributed to a wider variety EV vehicle types that have been brought to market over the last few years
- There was a 42% increase in EV Utility Vehicles (SUVs and crossovers) sales from Q1 2020 to Q3 2022

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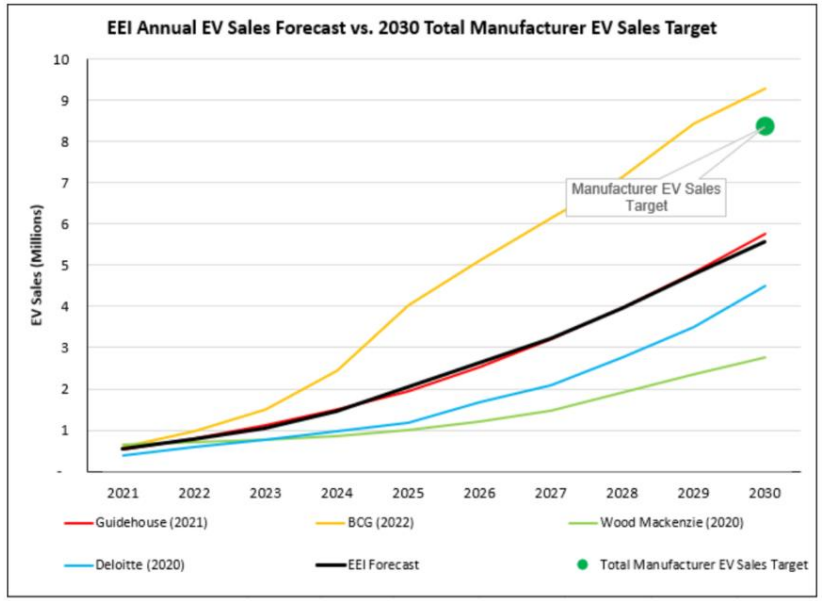
Task 1 – PEV Production Volumes

- Along with expanding model lines for PEVs, manufacturers also have to significantly ramp up production volumes to meet customer demand & ZEV mandates
- The table to the right was created by EEI to estimate of national EV sales volume in the year 2030
    - EEI assumed that manufacturers will hold the same market share and will have 2% year over year growth in sales.



Manufacturer	EEI estimated light-duty vehicle sales in U.S. in 2030	Manufacturer announced EV sales targets in 2030*	Estimated EV sales in 2030
BMW	420,000	50%	210,000
Ford	2,150,000	40%	860,000
General Motors	2,580,000	50%	1,290,000
Honda	1,660,000	40%	664,000
Hyundai-Kia	1,650,000	50%	825,000
Jaguar Land Rover	120,000	100%	120,000
Mazda	370,000	25%	92,500
Mercedes	370,000	100%	370,000
Nissan	1,230,000	40%	492,000
Stellantis	2,010,000	50%	1,005,000
Subaru	680,000	40%	272,000
Tesla	880,000	100%	880,000
Toyota	2,540,000	30%**	762,000
Volkswagen	720,000	55%	396,000
Volvo	140,000	100%	140,000
Total	17,520,000	48%	8,378,500

*Percentages are based on most recently announced sales targets for EVs.
**Estimated based on announced global EV sales target of 3.5 million in 2030.

Source: EEI; Electric Vehicle Sales and the Charging Infrastructure Required Through 2030 (June 2022)

- The line plot on the left show EVs sales projections from 2021 to 2030
- BCG conducted the most recent study and shows the steepest growth
- OEs need to meet ZEV sales targets in CA states (or else fines), so ZEV vehicle availability (#s) will be higher in these states
- **Takeaway is that OEs are increasing models and production. All mass market brands are planning to be ~50% EV by 2030**

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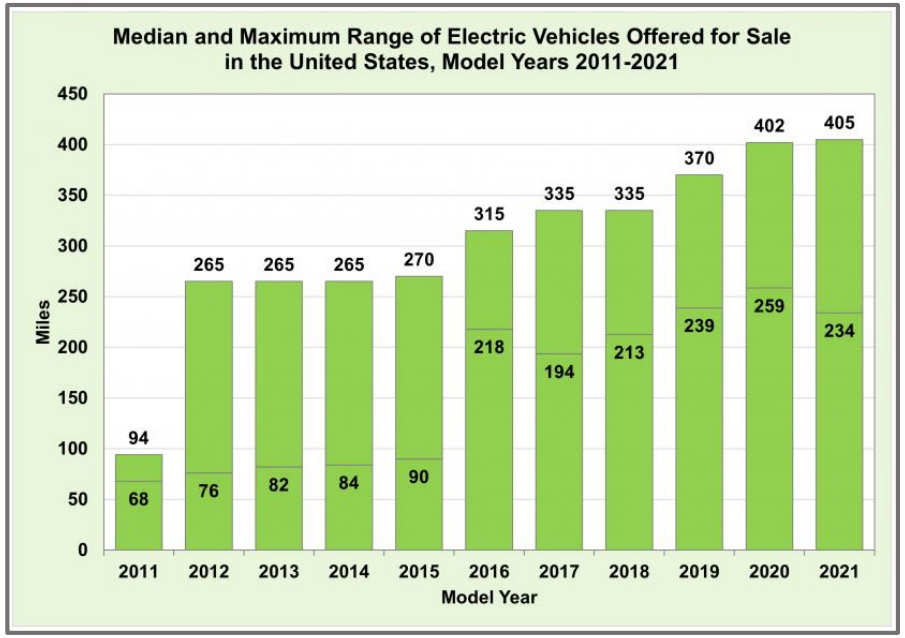
Task 1 – Trends in BEV Range

- Automakers have made significant strides in improving BEV range over the last decade
- The median range was 3.4 times higher in model year 2021 compared to model year 2011
- The average range for EVs is expected to continue increasing over the next few years with battery chemistry and management advances
- **Takeaway is that OEs are releasing vehicles with driving ranges suitable for normal people's use. 200-250 miles includes mass market models; very high range from premium OEs.**



Source: EPA; [In Model Year 2021 the Electric Vehicle with the Longest Range Reached 405 Miles on a Single Charge]

Trip Distances, US Drivers (2021)	
Less than 3 miles	52%
Less than 1 mile	28%
Greater than 50 miles	2%

Source: Bureau of Transportation Statistics / Maryland Transportation Institute

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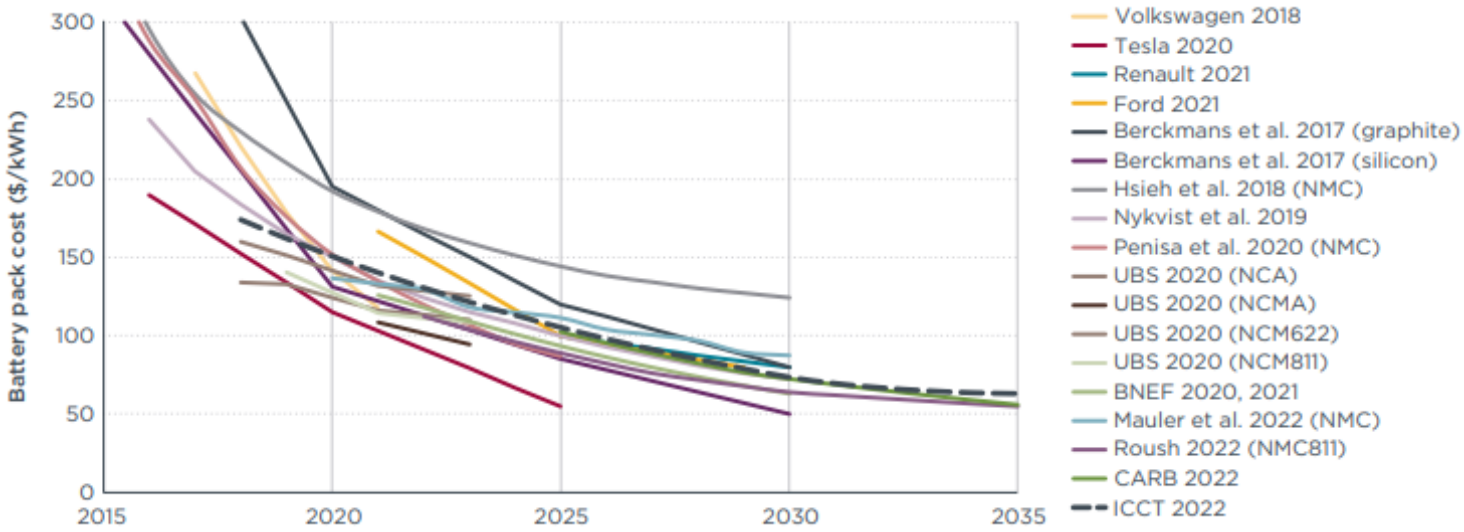
Task 1 – Projected Trends in ZEV Transaction Price

- <u>EV battery components account for the largest proportion of incremental cost over ICE vehicles</u>
- The plot on the right shows the projected cost per kWh from various studies and auto manufacturers.
- Most projections predict battery costs to decrease below $100/kWh by 2030.
    - This point is often cited as the tipping point for when BEVs will with reach upfront cost parity with conventional ICE vehicles.



Source: ICCT; Assessment of Light-Duty Electric Vehicle Costs and Consumer Benefits In The United State In The 2022-2035 Timeframe

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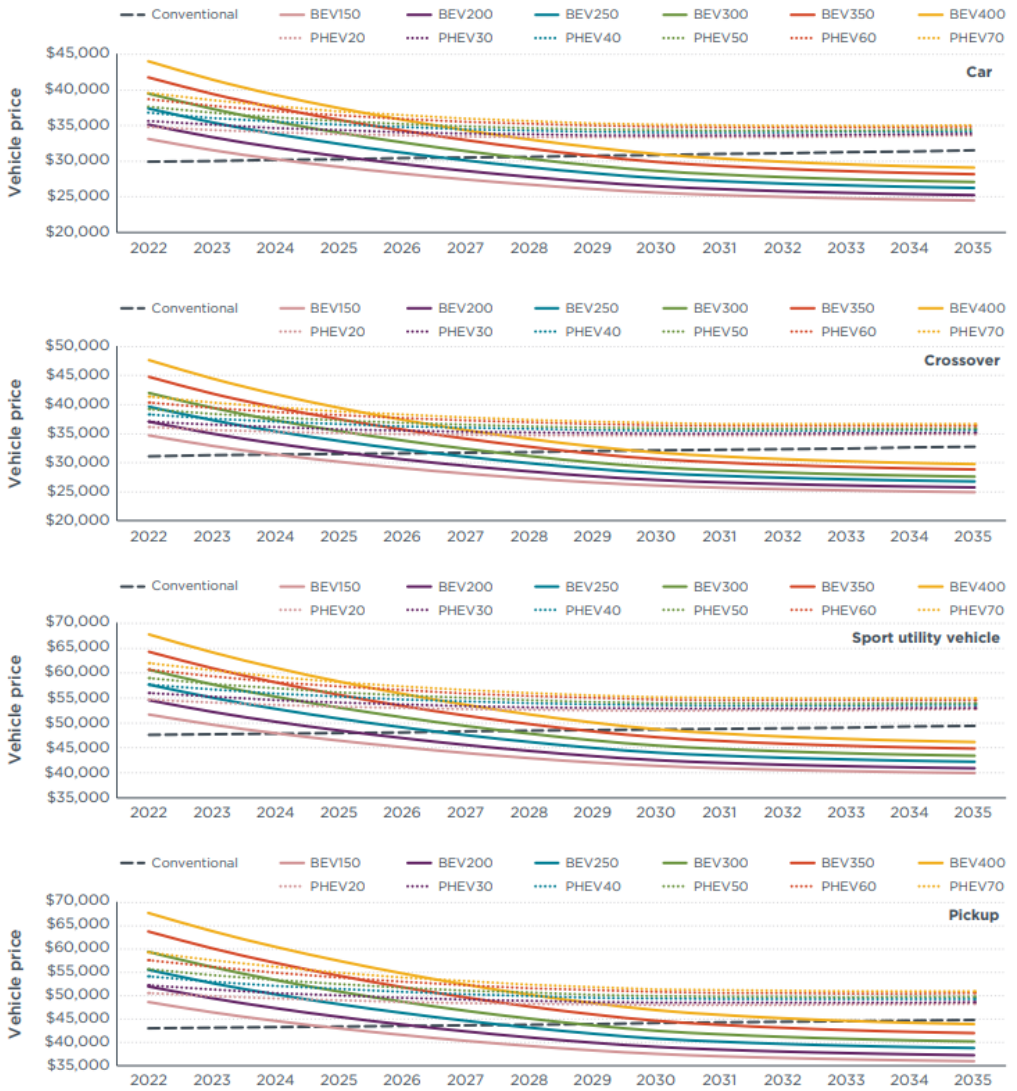
Task 1 – Projected Trends in ZEV Transaction Price

- ICCT predicts significant reduction in BEV prices from 2022-2035
- Reduced battery and R&D costs are cited as the primary drivers for this decrease
- Smaller BEVs with lower range reach cost parity with comparable ICE vehicles sooner than large, long-range BEVs
- Alliance of Automotive Innovation - Does expect price *& utility* parity; but not sure when. Not if; when.
- **Takeaway is that all BEVs are projected to cost less than their ICE counterparts by 2035**



Source: ICCT; Assessment of Light-Duty Electric Vehicle Costs and Consumer Benefits In The United State In The 2022-2035 Timeframe

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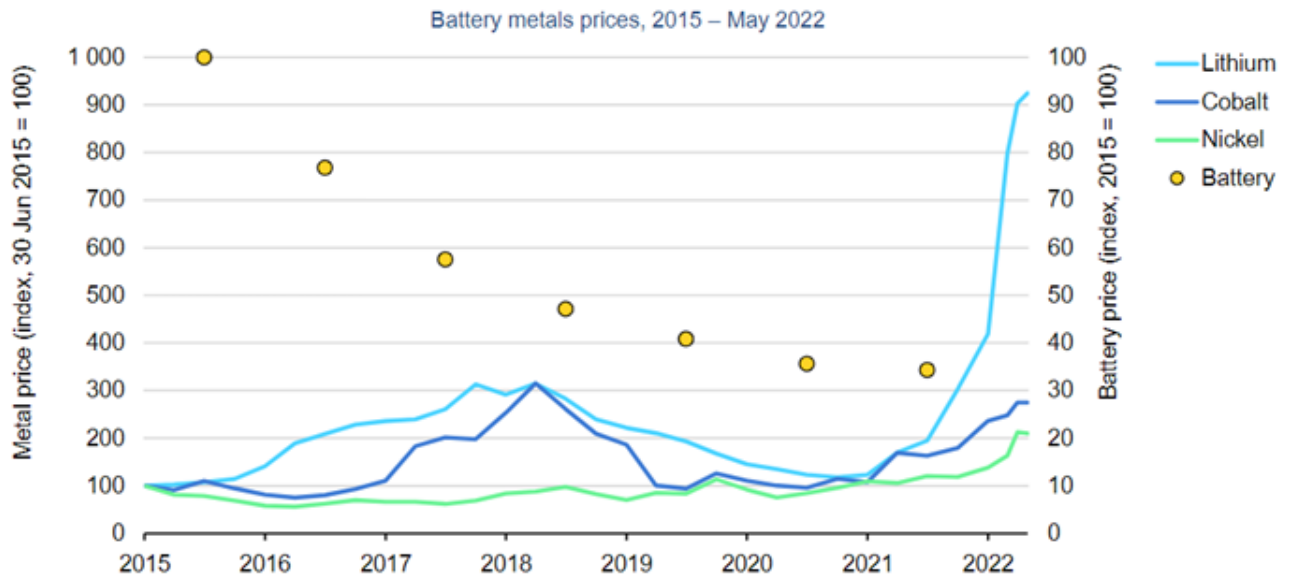
Task 1 – Factors that may limit ZEV adoption

High vehicle/battery costs

- High battery costs as a result of the critical metals in their composition is the main contributor to high vehicle costs
- High battery costs are also a result of high battery cell manufacturing costs
- Battery metal prices increased dramatically in early 2022
- Some costs can be reduced by scale or engineering improvement

Battery metal prices increased dramatically in early 2022, posing a significant challenge to the EV industry



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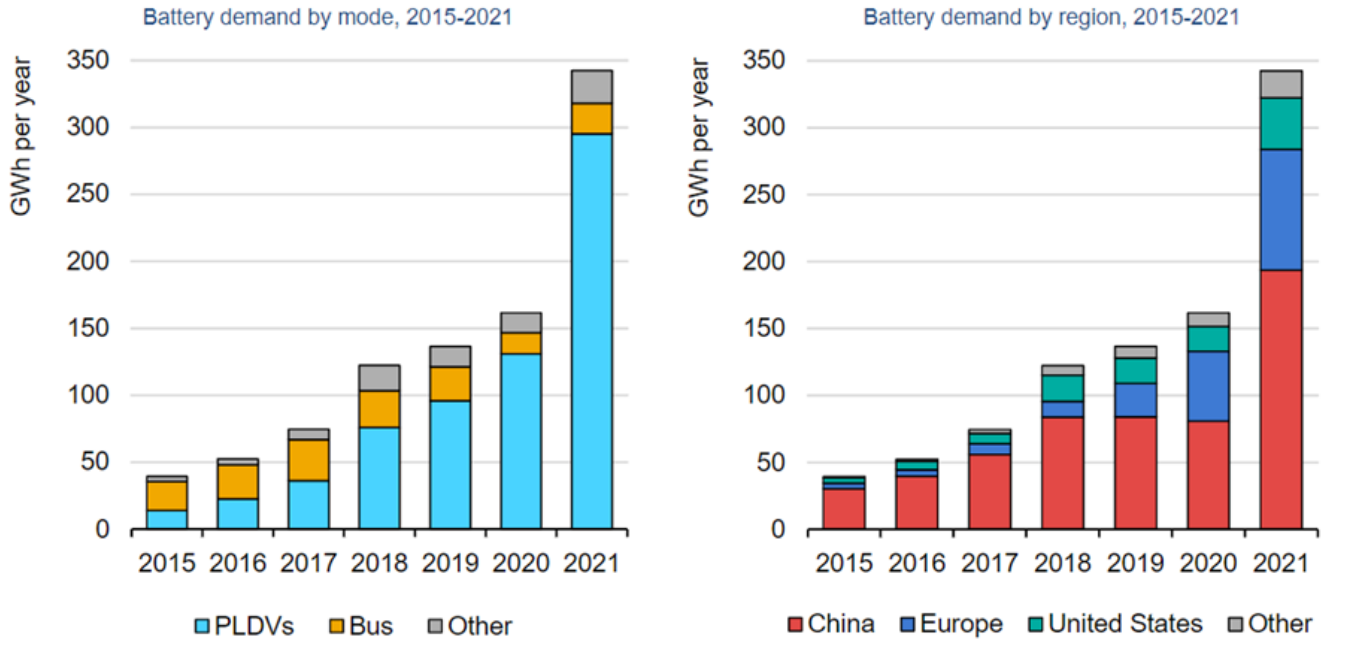
Task 1 – Factors that may limit ZEV adoption

High Demand for EV Batteries

- The rise in demand for EV batteries is outstripping supply
- New mines are being built, but not fast enough in the near-term
- Increase in critical metal prices driven by demand cause battery prices to increase
  - Lithium: Batteries are currently the dominant driver for Li (EV batteries account for 47% of Li demand in 2021) and therefore set the price
  - Cobalt: Over the past few years, there has been a decrease in Co intensity of Li-ion batteries due to expensive costs of Co and higher energy density of higher Ni content chemistries

Global battery demand doubled in 2021, driven by electric car sales in China



Notes: GWh = gigawatt-hours; PLDVs = passenger light-duty vehicles; other includes medium- and heavy-duty trucks and two/three-wheelers. This analysis does not include conventional hybrid vehicles.

Source: IEA analysis based on EV Volumes.

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Task 1 – Factors that may limit ZEV adoption

High Demand for EV Batteries – Raw Materials Supply

- Critical materials make up a large portion of EVs, mainly due to the chemical makeup of batteries
- Challenges with Lithium, Cobalt, and Nickel supply chains and mining
- Strategies to combat raw material supply chain issues
    - Expansion of a circular economy, which emphasizes the re-use and recycling of materials at end of product life reduces the extraction of critical raw materials.
    - Improvements in technology will decrease the reliance on critical raw materials
    - The cathode manufacturing industry anticipates a shift towards nickel-rich cathodes followed by a transition towards cobalt-free chemistries
    - The industry also expects new anode materials to include hybrid graphite/silicon, as well as anodes based on metallic lithium, foils, and films
- ** Increased investment in R&D for de-risking new extraction/purification technologies, circular economy infrastructure, and cathode/anode chemistries will accelerate new technologies that will mitigate the challenges posed by critical material supply chain associated with EVs

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Task 1 – Factors that may limit ZEV adoption

Charging Infrastructure – Many stakeholders mentioned as key barrier

- Vehicle OEs, dealers, MUD, rural population that commutes to work in metro areas
- Even if not need for daily charging → Need mental reassurance that charging is available
- Daily charging (MUD, workplace) & DCFC (fueling stations, charging hubs)

Alliance of Automotive Innovation

- OEs
  - Are prepared to make the vehicles, but are concerned about meeting demand and States' requirements -->
  - Have a ZEV Goal of 40-50% ZEV by 2030, but depends on a lot of outside factors.
- Industry limitations (raw materials, chip shortage, etc.)
  - Near-term – chip issues & supply chain are out of OE industry's control. Expect to ease in ~1-2 years
  - Federal role; onshoring, U.S. mine permitting could impact ZEV production, credit availability, and adoption

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Task 1 – Factors that may limit ZEV adoption

Rural population - MD Farm Bureau interview

- Conservative, drive a lot of miles, home charging not an issue, not a lot of MUD
- ZEV adoption will lag the urban/suburban areas
- Proven vehicle dependability (think Ford F-150) is key
  - Need to see EVs from OEs they use/trust (e.g., Big 3) being used
  - Local/county/state government (lead by example)
- Upcoming EV pickup trucks and SUVs with AWD/4WD and ground clearance is key
- Workplace charging – Many rural folks commute and shop in urban areas. So, charging infrastructure (workplace, etc.) in metro areas is more important near-term.

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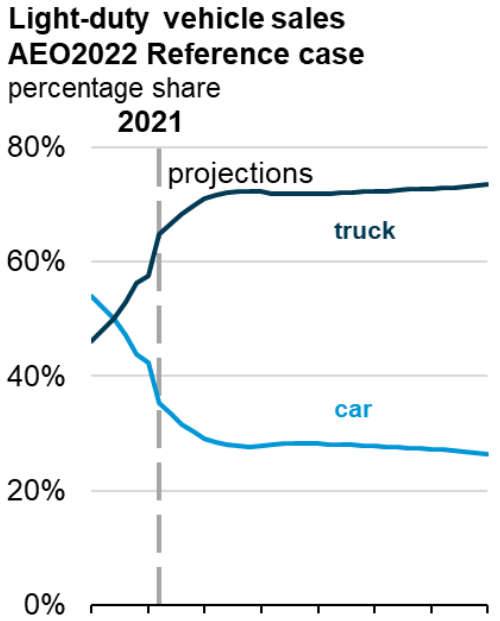
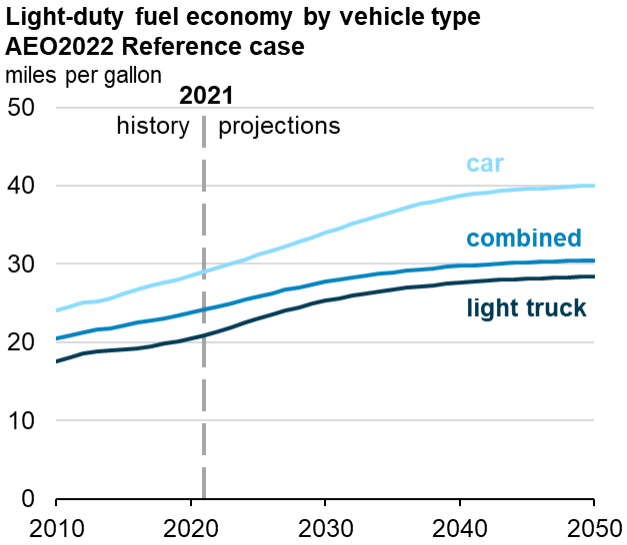
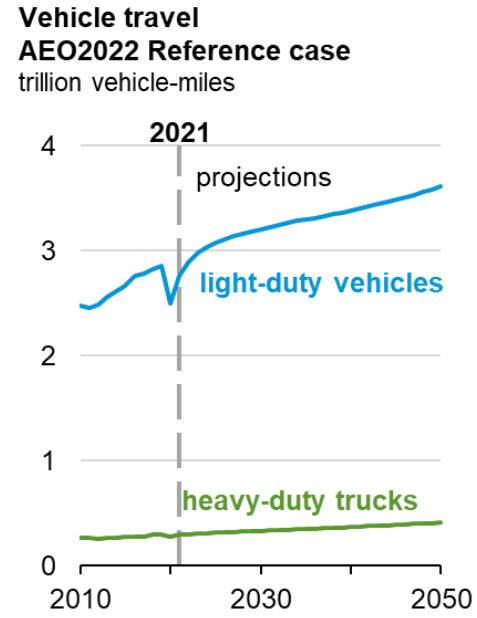
Task 1 – Factors that could increase gasoline use (or negate some gains)

- Continued migration from car to (lower mpg) truck/SUV/crossover – even with increasing fuel economy standards (EIA AEO 2022)
- Increased VMT (personal and business) (EIA AEO 2022)
- Lower fuel costs/high ZEV vehicle costs – Push people to keep their car longer/buy used cars
- Purchase new ICE vehicles in nearby non-ZEV states
- Research continuing in this topic







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Task 2 – Recommendations for State Action

Determine practical actions Maryland could take to achieve the greatest reduction in greenhouse gas emissions from light-duty vehicles by 2031

- Estimate and compare the anticipated emissions impacts and equity implications of various policies, strategies, and actions
- Review current policy/recommend additional policies that could result in greater EV supply/sales in Maryland
- Identify additional ways in which Maryland can encourage vehicle manufacturers to supply and sell ZEVs in Maryland
  - Identify policy and program options to overcome identified barriers to prioritizing Maryland as an attractive ZEV sales market
- Evaluate the benefit of offering ZEV purchase incentives
  - Determine which incentive structure could offer the greatest greenhouse gas emissions reduction by 2031
  - Estimate the cost of any proposed ZEV purchase inventive(s)

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Task 2 – Recommendations for State Action

Use learnings from other states' programs to determine the most appropriate focus for Maryland's program(s)

- Charging Infrastructure, ZEVs, or both
- Evaluate based on environmental/equity benefits and cost-benefit
- Determine which options have the greatest environmental/equity benefit and which have the greatest cost-benefit results
- Determine each potential action's environmental, equity, and other impacts vary by population density, geography, socioeconomic factors and demographic characteristics
- Consider how ZEV incentive programs can be designed to ensure equity
- Determine if ZEV incentives should be universally available or targeted to certain categories of vehicles and/or drivers
- Consider federal ZEV tax credit changes related to vehicle eligibility and determine how Maryland's ZEV incentive program could be designed to address these changes

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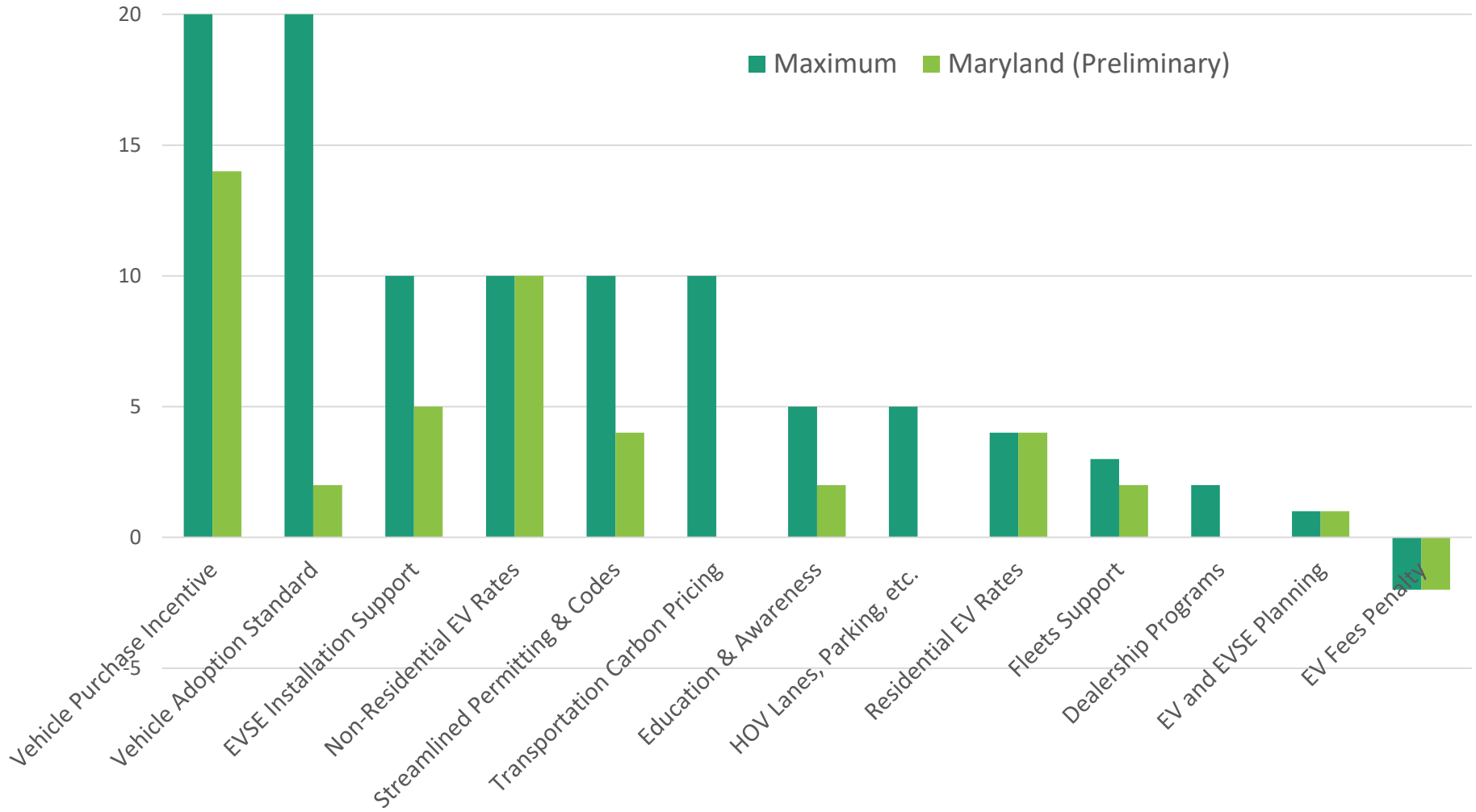
EV Policy & Program Benchmarking

(National Association of State Energy Offices rubric)

PEV_Policy_Impact_Rubric_FINAL.pdf (naseo.org)



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Adopting “Advanced Clean Cars II” rules

- **Likely the single biggest action to accelerate EV adoption**
- **As of December 2022, adopted in California, Delaware, Massachusetts, New York, Oregon, Vermont, and Washington**

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EV Purchase Incentive

Three areas of focus for additional analysis & recommendations:

1. **Incentive amount & funding levels**
   - Point-of-sale incentive (excise tax reduction) = best practice
   - Incentive level = sufficient (based on **qualitative** analysis so far)
   - Funding level & predictability of funding = concern; need for predictability, especially for dealers
   - Equity-issues (next slide)
2. **Dealer engagement & motivation**
   - Dealers play critical role, education/training and dealer incentives can make a difference
3. **Targeting high use vehicles (e.g., fleets)**
   - Incentives can target government or corporate fleets, as well as ride-service vehicles

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EV Purchase Incentive: Equity Issues & Options

A. Low-income bonuses are used in several states

- New vehicles are inherently out of reach for many low-income/disadvantaged households
- However, an equity bonus will make an incremental difference
- Requires efficient method of income verification

B. Used vehicle incentives are offered in a few states

- NJ and WA have sales tax exemption
- Used vehicle markets are extremely limited right now
- Consider phasing in as markets expand (e.g. 2024)

Example: Maine EV Rebates

Type of Vehicle	Any Income	Moderate Income	Low Income
NEW Battery Electric Vehicle (BEV)	$1,000	$3,500	$7,500
NEW Plug-in Hybrid Electric Vehicle (PHEV)	$500	$2,000	$3,000
USED BEV or PHEV	N/A	N/A	$2,500

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Task 2 – Recommendations for State Action

Feedback: Do those seem like the right areas of focus for additional analysis and recommendations for EV purchasing?

If not, what additional focus areas should be considered? Why?

https://forms.gle/6wJ1eKckR7wpP4ux8

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EVSE Installation Support:

- Maryland has multiple existing EVSE programs
- We are gathering data about results and want to understand how they compliment one another or overlap

Three areas of focus for recommendations

1. **Incentive amounts & structure**
   - L2: Fleets, Multifamily
   - DCFC: Corridor, Local hubs
2. **Funding levels needed to achieve sufficient penetration over time**
3. **Access & predictability**
   - Fixed rebates vs competitive/notice of funds

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Additional Policy & Program Areas of Focus:

1. **Financing for Vehicle Purchase**
   - Limited experience elsewhere with financing solutions that increase equity outcomes
2. **Codes & Permitting for EVSE**
   - Requirements for EVSE in residential and commercial new construction
   - Streamlined permitting

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Task 2 – Recommendations for State Action

Feedback:

- Do those seem like the right areas of focus for additional analysis and recommendations for EVSE investment? If not, what additional focus areas should be considered? Why?
    - https://forms.gle/w8WAPCFC99uMA5A46
- How do the multiple state funds (MDOT, MEA) and utility incentives intersect? How should they?
    - https://forms.gle/cREUBqCHzXe9vWNr8

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Task 3 – Recommendations for equitable ZEV charging solutions

Use learnings from other states' programs and community feedback to determine the most appropriate focus for Maryland's program(s)

- Charging Infrastructure, ZEVs, or both
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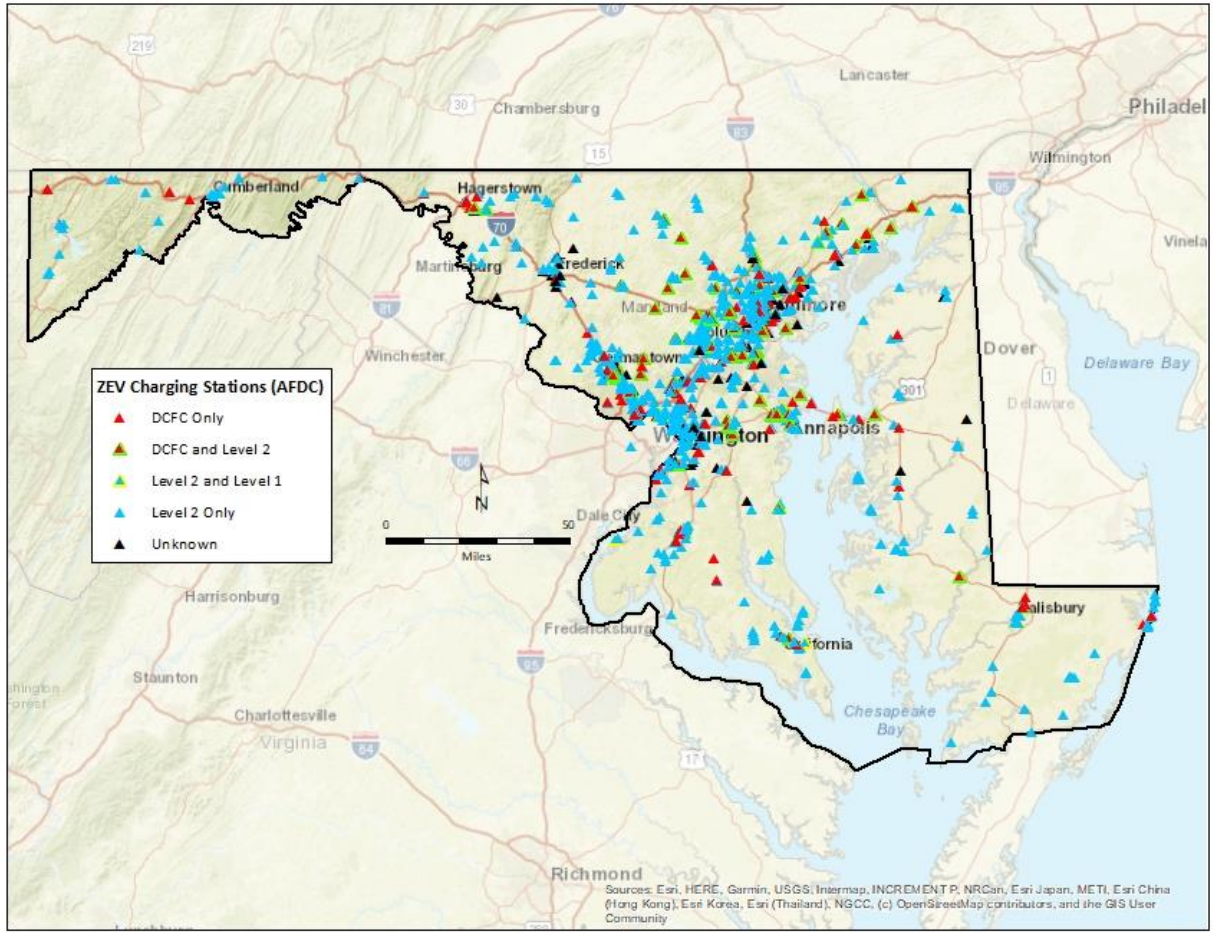

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Task 3 – Recommendations for equitable ZEV charging solutions

- Identify Justice40 identified underserved population regions
- Use data from MVA/other State agencies to estimate
  - Current demand for charging in these areas
  - How public/shared-use charging infrastructure demand could increase as a result of the State's more aggressive ZEV actions
- Determine utilities' interest/timing for supporting V2G (technically and financially)
- Evaluate if focusing on public transit solutions in urban environments would lead to higher environmental benefits, equity benefits, and cost effectiveness rather than charging infrastructure and light-duty ZEVs

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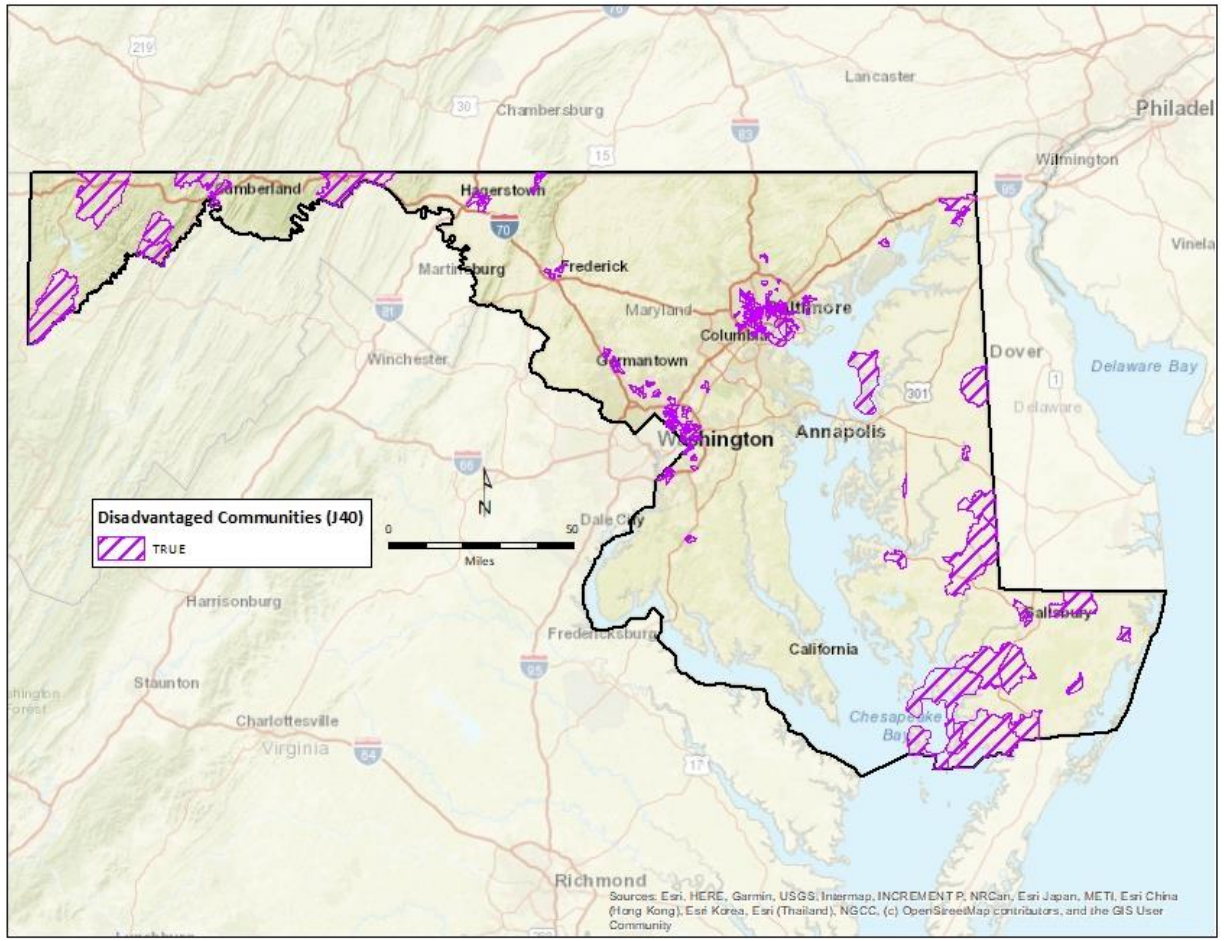
Task 3 – Recommendations for equitable ZEV charging solutions

- Identify Justice40 identified underserved population regions



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Task 3 – Recommendations for equitable ZEV charging solutions

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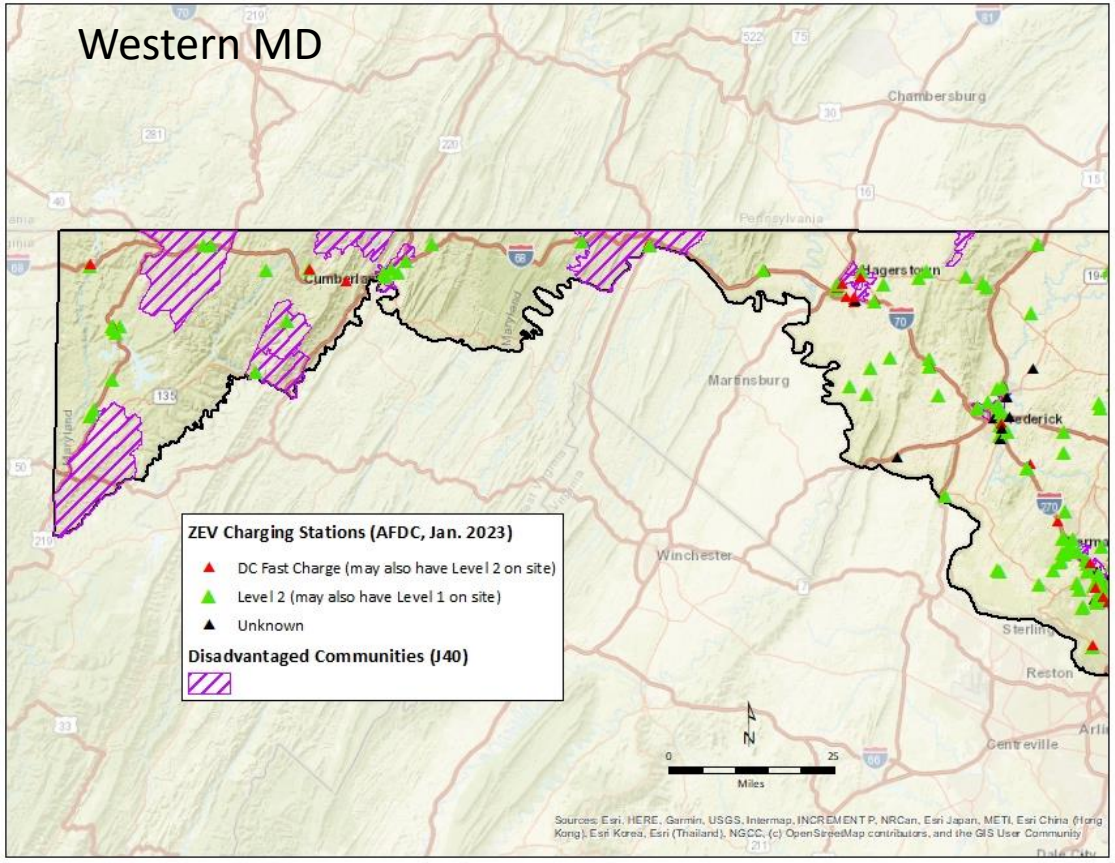

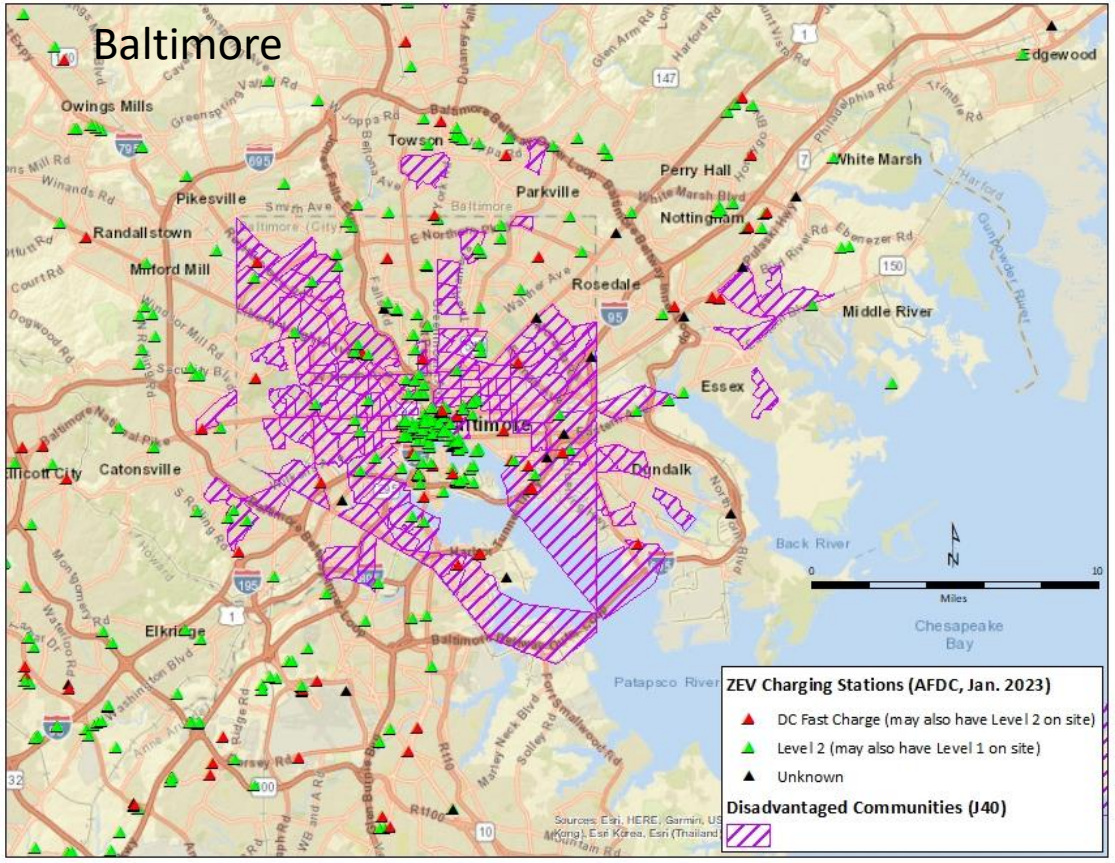

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Discussion

Q&A

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Questions?

Thank you!

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Next Steps

- Next meetings
  - Late February (Final update)
- How to stay involved
  - Join meetings
  - Google Forms will remain open
  - Questions/comments? Contact wzalis@energetics.com