

# Emission Impacts From Wisconsin Electric Vehicle Adoption Scenarios

THE HOLLOWAY  
GROUP @ SAGE



Report to the Wisconsin Department of Natural Resources  
January 10, 2022

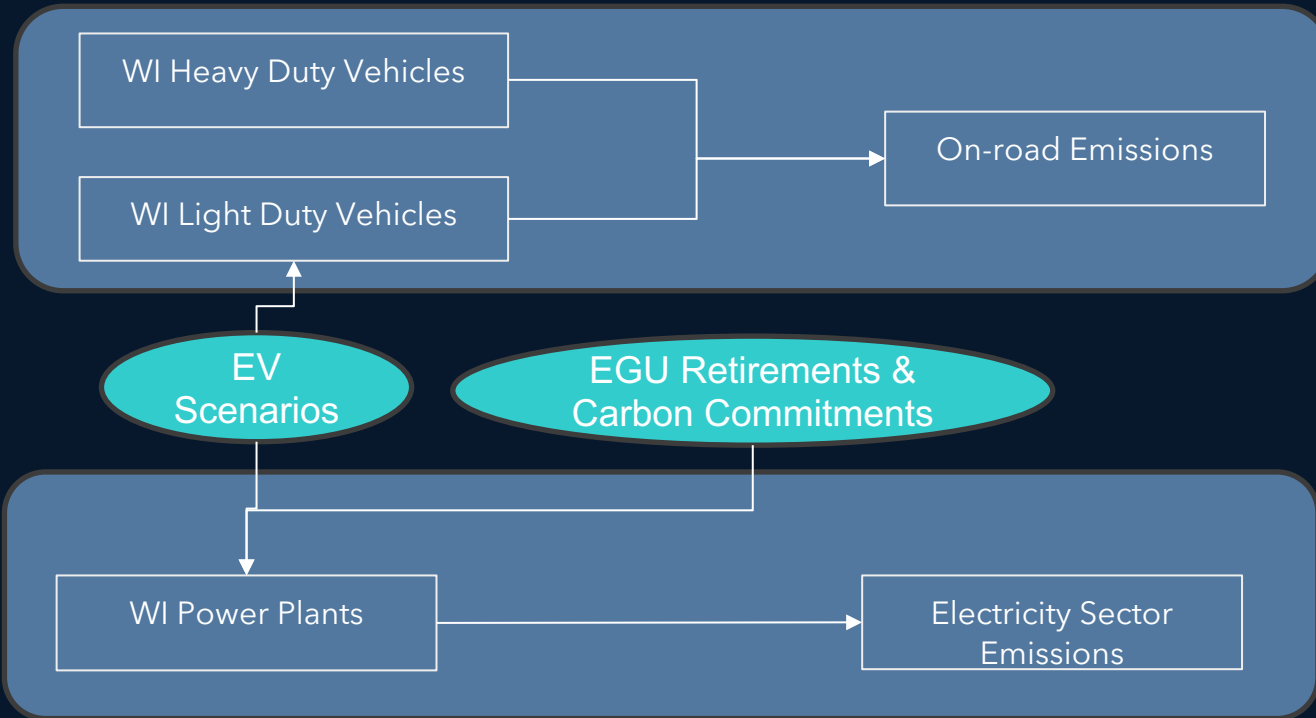
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University of Wisconsin – Madison

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Citation: P. Meier, T. Holloway (2022) *Emission Impacts From Wisconsin Electric Vehicle Adoption Scenarios*. Nelson Institute for Environmental Studies, UW-Madison Center for Sustainability and Global Environment. [HollowayGroup.org](https://www.hollowaygroup.org).



# Overview of research questions



By 2030

What is the anticipated change in emissions?

What is the potential influence of EVs?

# MOVES Heavy Duty Forecast - Wisconsin

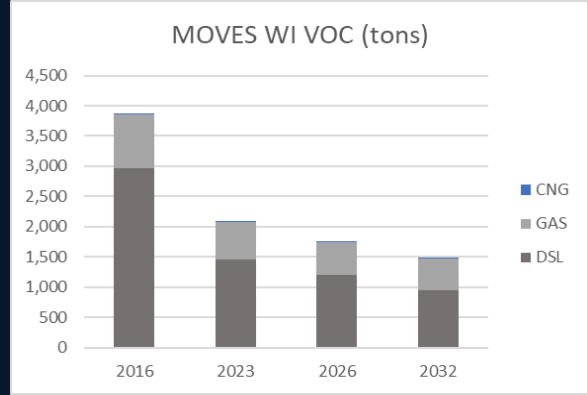
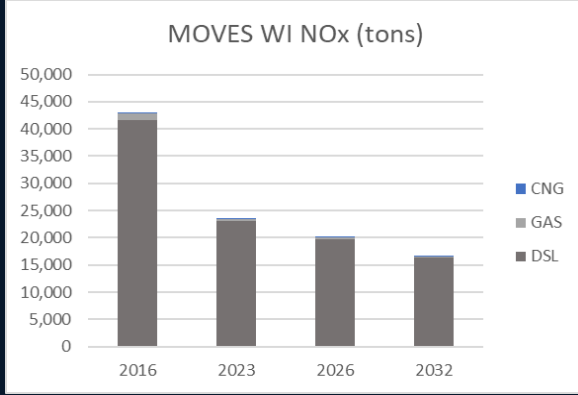
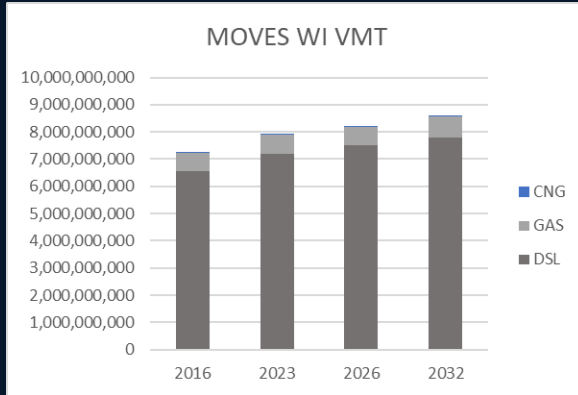


MOVES projects increased miles travelled for on-road heavy duty vehicles in Wisconsin increasing 18% between 2016 and 2032.

Emissions of NOx and VOC are projected to decline by over 60% over the same period.

The fuel mix remains constant at 91% diesel, 9% gasoline, and 0.2% CNG. Therefore, emission reductions can be attributed to vehicle emission control.

## Heavy Duty Vehicles



# MOVES Light Duty Forecast - Wisconsin

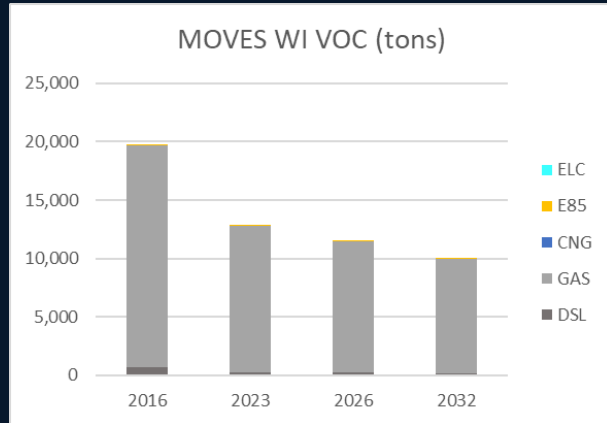
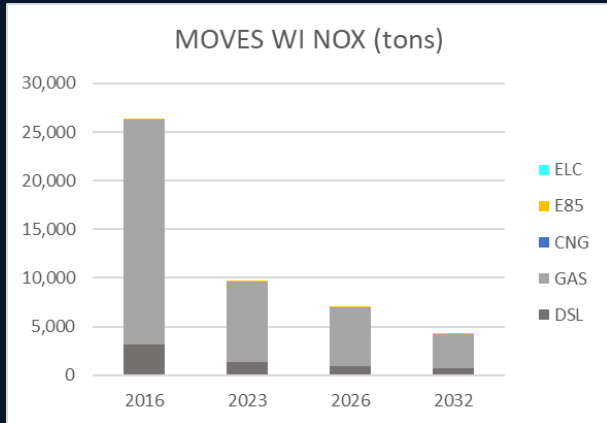
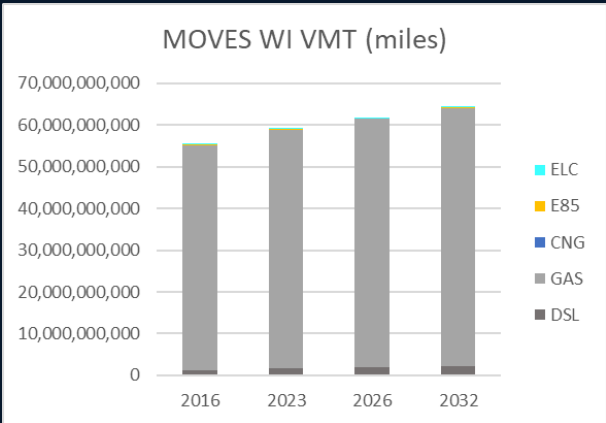


MOVES heavy duty VMT in Wisconsin increases 16% between 2016 and 2032.

Emissions of NOx and VOC are projected to decline by 84% and 50%, respectively, over the same period.

The fuel mix changes only slightly from 97.5% gasoline in 2016 to 96.2% gasoline in 2032. As such, emission reductions can be attributed to vehicle emission control.

## Light Duty Vehicles





# How do electricity emissions change based on planned retirements and stated commitments?




## Emissions Inventory Approach

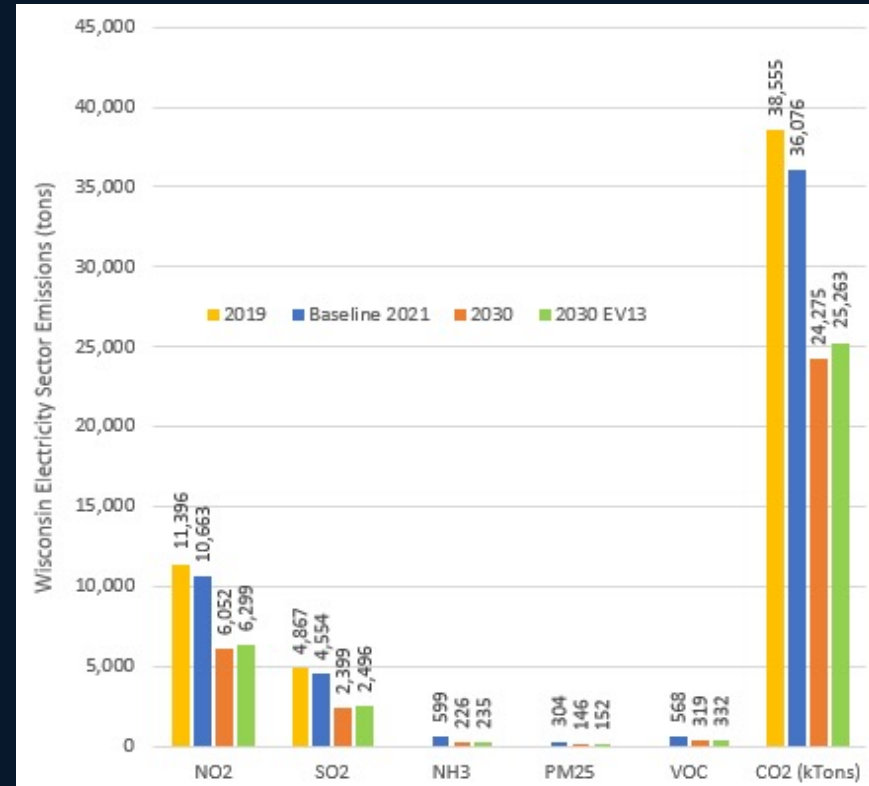
Wisconsin's electricity-sector emissions were based on EPA CAMD reported emissions for 2019. Emissions from planned retirements were removed from the inventory in the appropriate year. 2030 carbon reduction commitments were considered by scaling company level emissions linearly from their 2005 baseline emission levels. If the "residual CO2" exceeds stated commitments, additional scaling applied to remaining units at state level (not company level).

 BASELINE 2021 - Planned retirements and commitments through 2021 are removed from the baseline.

 BASELINE 2030 - Planned retirements through 2030 are removed from the emissions inventory. Emission reductions from retirements exceed commitments.

 EV Scenario (2030) - 2030 Baseline emissions increased in proportion to the increase in statewide electricity demand resulting from EVs.

Scaling using an average emission rate for adjusted future inventory.  
Alternate approaches: AVERT (marginal rate of historic emissions) or Power Sector Model.



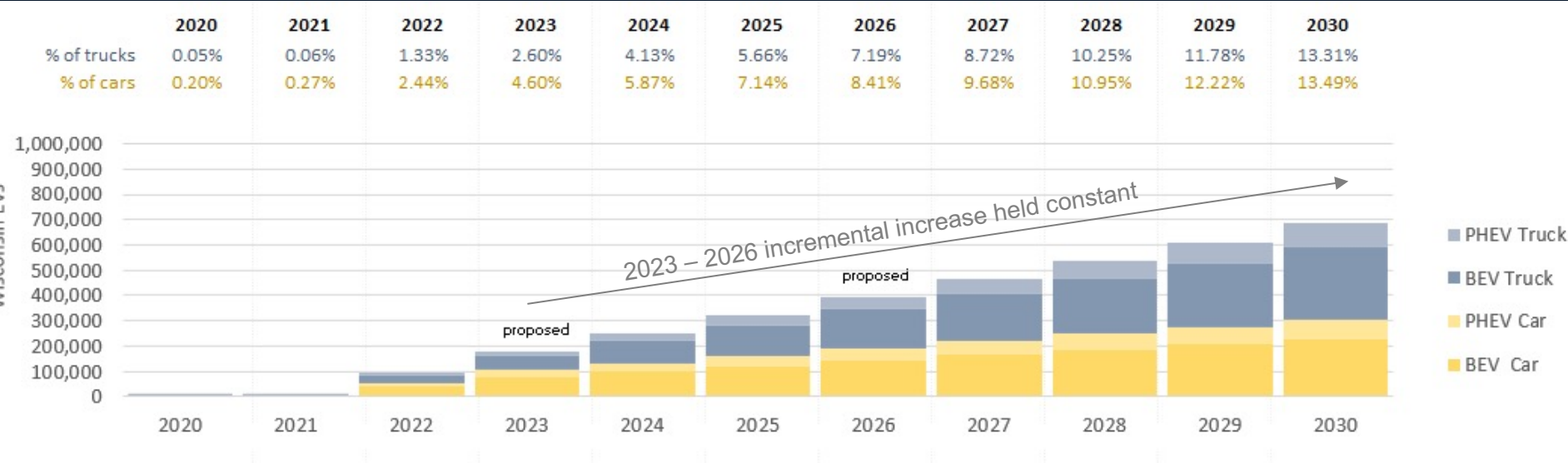
# Reference Case emissions trajectory (tons) MOVES & Adjusted\* Historic EGU emissions



■ Electricity Sector ■ Light Duty Cars & Trucks ■ Heavy Duty Trucks

\*See assumptions in previous slide. EGU NH3, PM, VOC based on ratio to NOx in 2017 NEI.

# EV13 Scenario: 13% Penetration based on EPA Light- Duty Vehicle GHG Emissions Standards



Assumptions

2021 vehicle inventory from merged Moves / [WisDOT](#) data (E. Cleveland 9/29/21).

0.8%/yr - growth in vehicle fleet based on MOVES 2016v2 fj scenario.

3.56%/yr – Existing vehicle attrition based on 10-year average depletion from [NHTSA Vehicle Survivability Schedule](#)

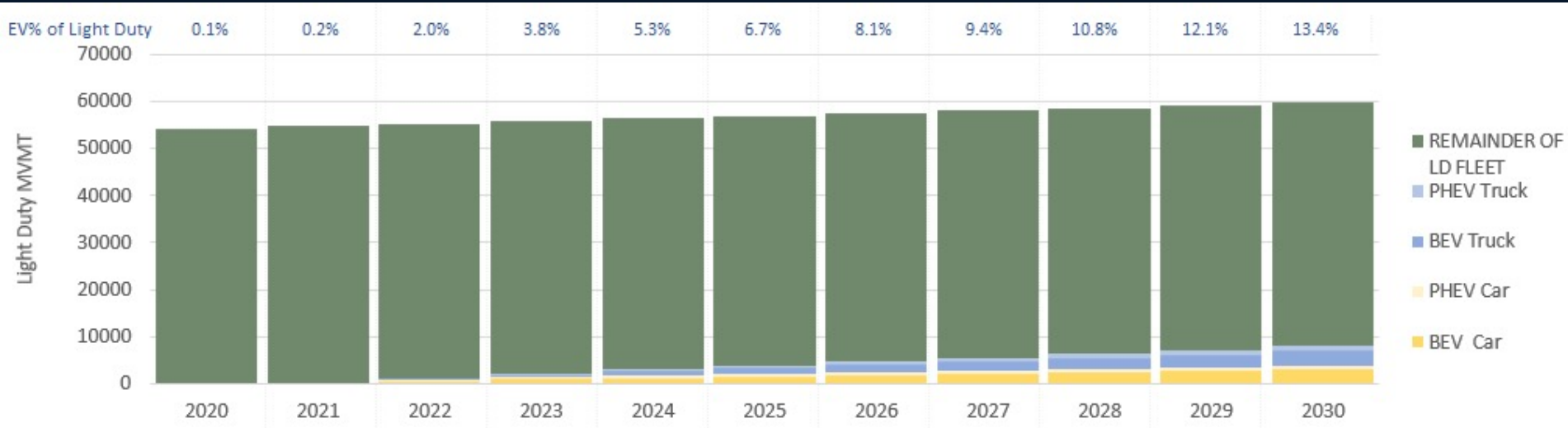
EV 2023 and 2026 fleet penetration based on EPA RIA for Light- Duty Vehicle GHG Emissions Standards EPA-420-R-21-018

75/25 – BEV/PHEV split for cars and trucks

# What resulting proportion of light duty miles travelled are from BEV and PHEVs?



## EV13Scenario: 13% penetration based on EPA Light- Duty Vehicle GHG Emissions Standards



### Assumptions

0.95%/yr - Light Duty VMT growth based on based on MOVES 2016v2 fj scenario.

Annual VMT for LD cars and trucks from MOVES.

EV 2023 and 2026 fleet penetration based on EPA RIA for Light- Duty Vehicle GHG Emissions Standards EPA-420-R-21-018

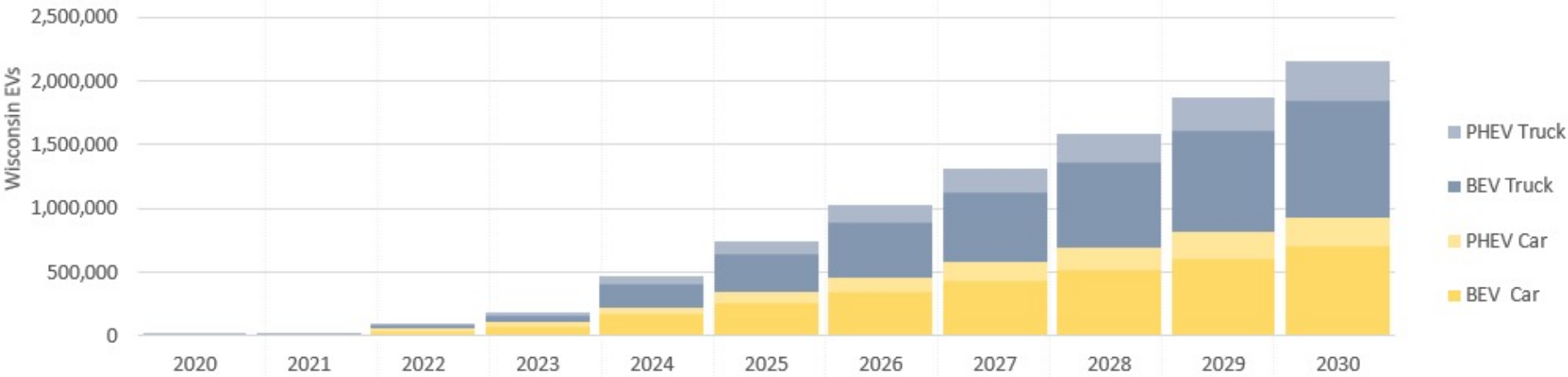
75/25 – BEV/PHEV split for cars and trucks



# EV40 Scenario: 40% Penetration 3X EPA Light- Duty Vehicle GHG Emissions Standards



|             |       |       |       |       |       |        |        |        |        |        |        |
|-------------|-------|-------|-------|-------|-------|--------|--------|--------|--------|--------|--------|
| % of trucks | 0.04% | 0.05% | 1.33% | 2.60% | 7.81% | 13.02% | 18.23% | 23.44% | 28.65% | 33.86% | 39.07% |
| % of cars   | 0.20% | 0.27% | 2.44% | 4.60% | 9.81% | 15.02% | 20.23% | 25.44% | 30.65% | 35.86% | 41.07% |



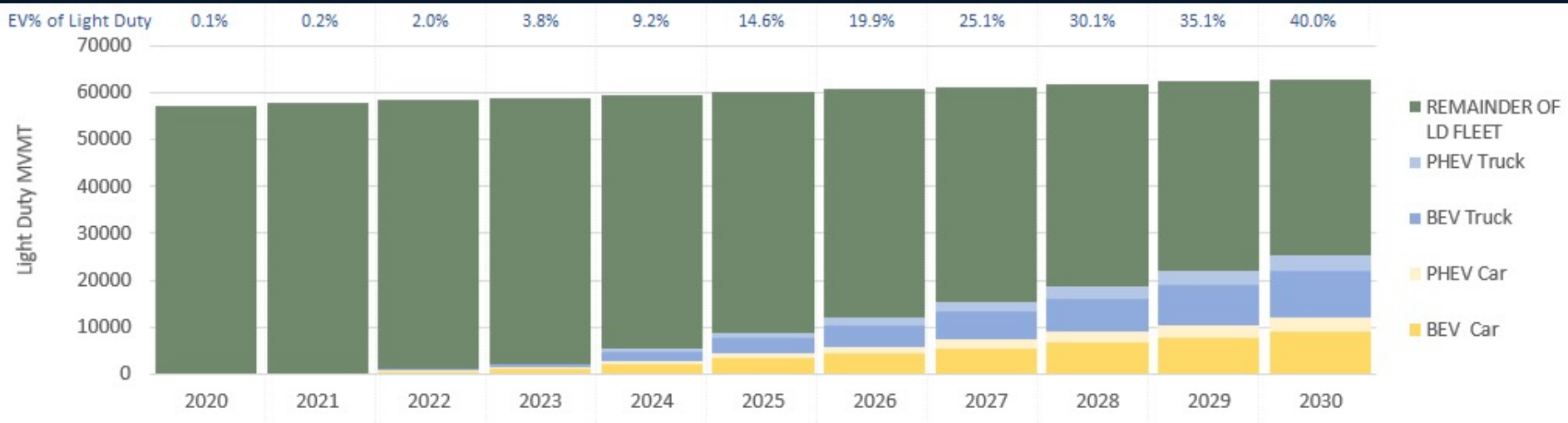
Assumptions

- 2021 vehicle inventory from merged Moves / WisDOT data (E. Cleveland 9/29/21).
- 0.8%/yr - growth in vehicle fleet based on MOVES 2016v2 fj scenario.
- 3.56%/yr - Existing vehicle attrition based on 10-year average depletion from NHTSA Vehicle Survivability Schedule
- EV Penetration forced to 40%
- 75/25 - BEV/PHEV split for cars and trucks

# What resulting proportion of light duty miles travelled are from BEV and PHEVs?



## EV40 Scenario: 40% penetration based on EPA Light- Duty Vehicle GHG Emissions Standards



### Assumptions

0.95%/yr - Light Duty VMT growth based on based on MOVES 2016v2 fj scenario.

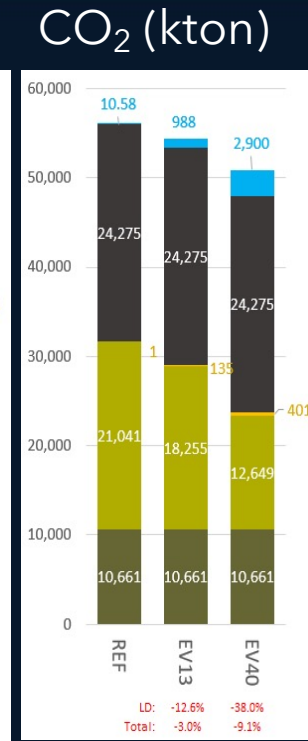
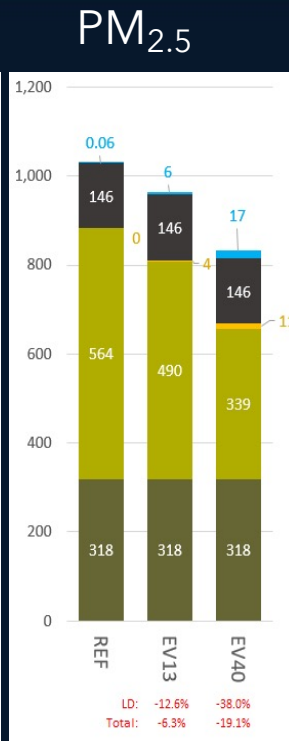
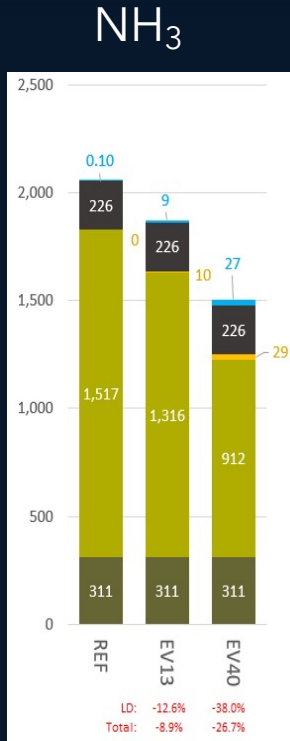
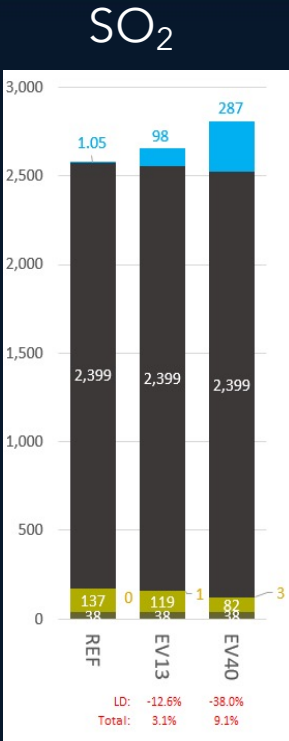
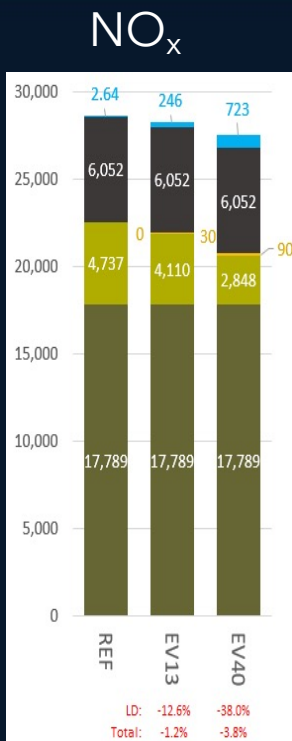
Annual VMT for LD cars and trucks from MOVES.

EV Penetration forced to 40%

75/25 – BEV/PHEV split for cars and trucks

# 2030 emissions comparison (tons)

## Reference vs EV13 vs EV40



■ Electricity EVs 
 ■ Electricity Rest of Sector 
 ■ Light Duty PHEV 
 ■ Light Duty Cars & Trucks 
 ■ Heavy Duty Trucks

\*Ignores PM from EV braking. Underestimates emissions savings due to newer cars driving higher miles.

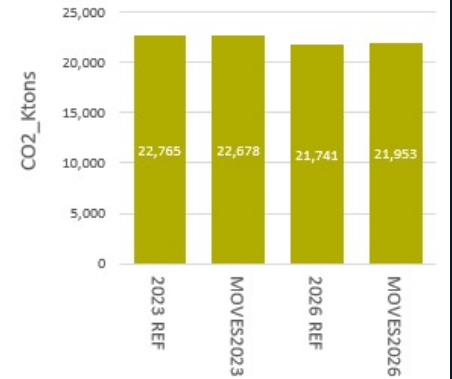
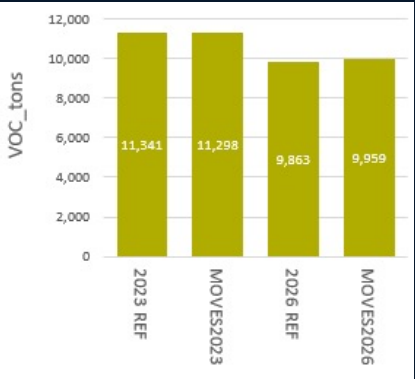
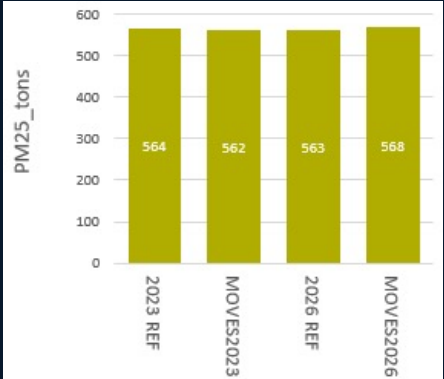
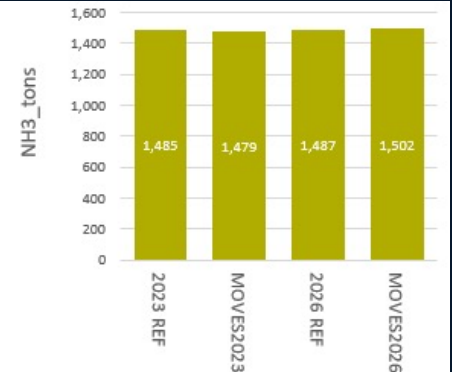
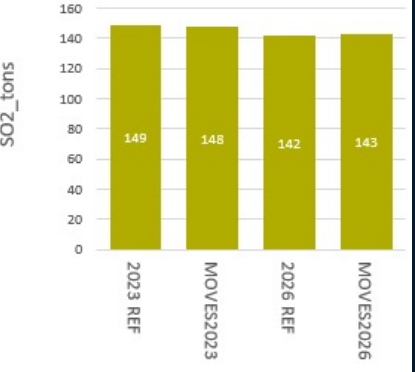
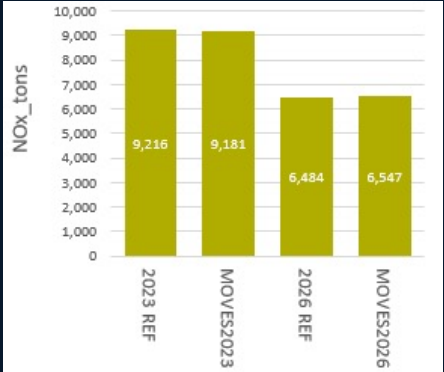
# Appendix

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# MOVES Reported vs MOVES based estimate (REF)

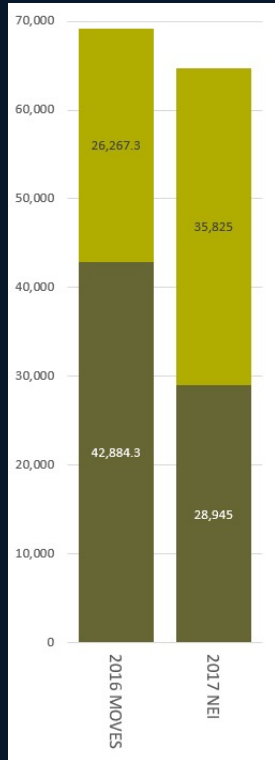


■ Light Duty Cars & Trucks

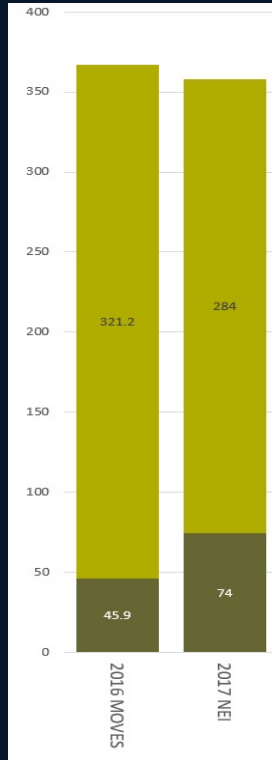
# On-road Emission Estimates - Wisconsin 2016 MOVES versus 2017 NEI (tons)



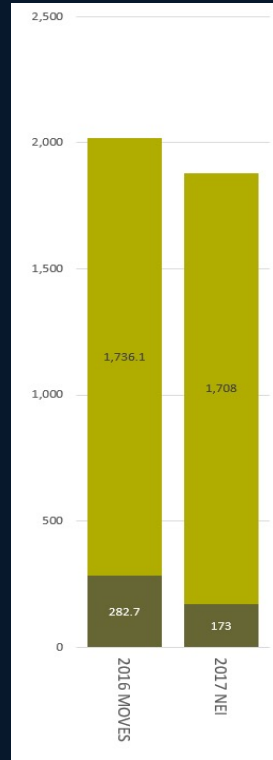
NO<sub>x</sub>



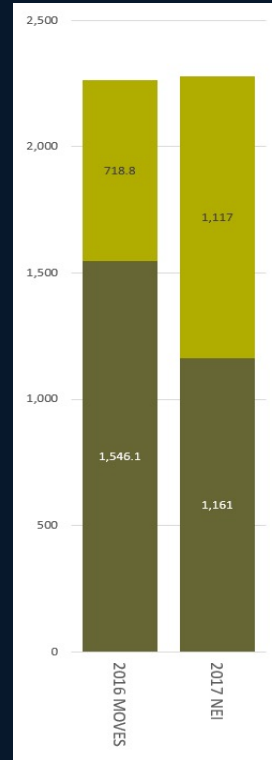
SO<sub>2</sub>



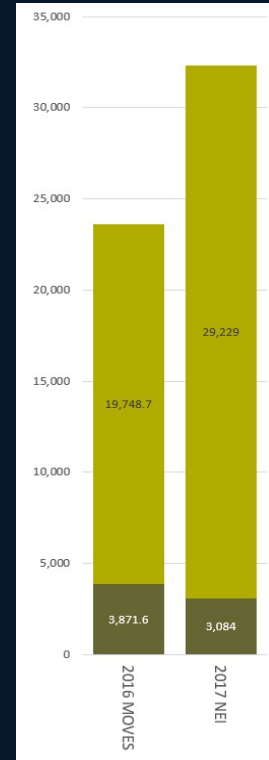
NH<sub>3</sub>



PM<sub>2.5</sub>



VOC



■ Light Duty Cars  
& Trucks

■ Heavy Duty  
Trucks