GEORGIA
DEPARTMENT OF NATURAL RESOURCES
ENVIRONMENTAL PROTECTION DIVISION

Comparison of Ozone Precursor Emissions From MOVES3 & MOVES2014b

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BACKGROUND AND GOALS

- Ozone Precursors = NOx and VOCs
- The newly released EPA MOVES3 model revising the onroad sector impacts:
  - NEI (2020)
  - SIP revisions (2015 Ozone Maintenance Plan for Atlanta)
  - Future transportation conformity determinations

- The presentation's goals are to:
  - Compare MOVES3 results with MOVES2014b results
  - Q/A MOVES3 model
  - Assess impacts of MOVES3 on NOx and VOC emissions and ability to meet motor vehicle emissions budgets (MVEBs)
  - Identify major impacts and assess efficacy of current planning assumptions for MOVES3 inputs
  - Use most recent conformity determination regional emission analysis with newest data to simulate an analysis with MOVES3

COMPARISON: METHODOLOGY

- Acquired MOVES input/output files from most recent July 2020 transportation conformity regional emissions analysis
  - Years 2020, 2030, 2040, and 2050
  - 13-county and 2-county areas in Atlanta

- Identical inputs used for MOVES3 and MOVES2014b (where possible)
  - Average Speed Distribution
  - Age Distribution
  - VMT
  - I/M program
  - Meteorology
  - Vehicle Population

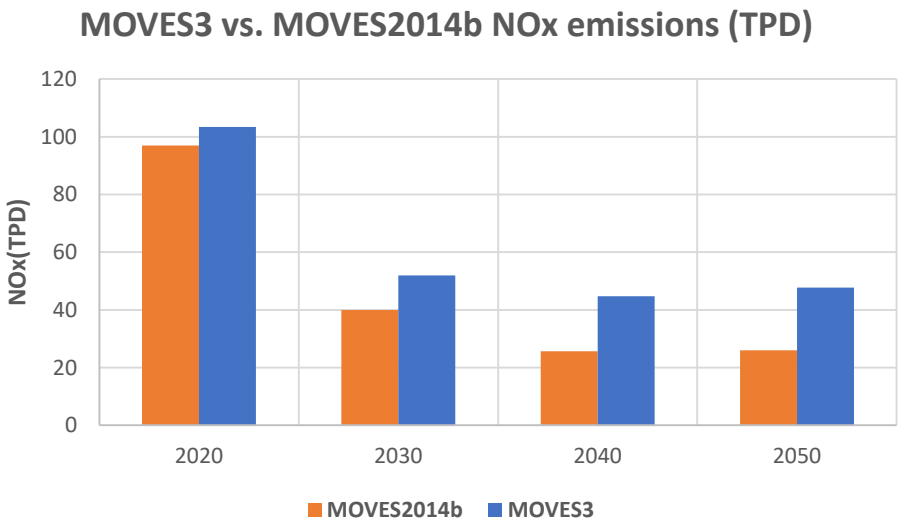
COMPARISON: METHODOLOGY

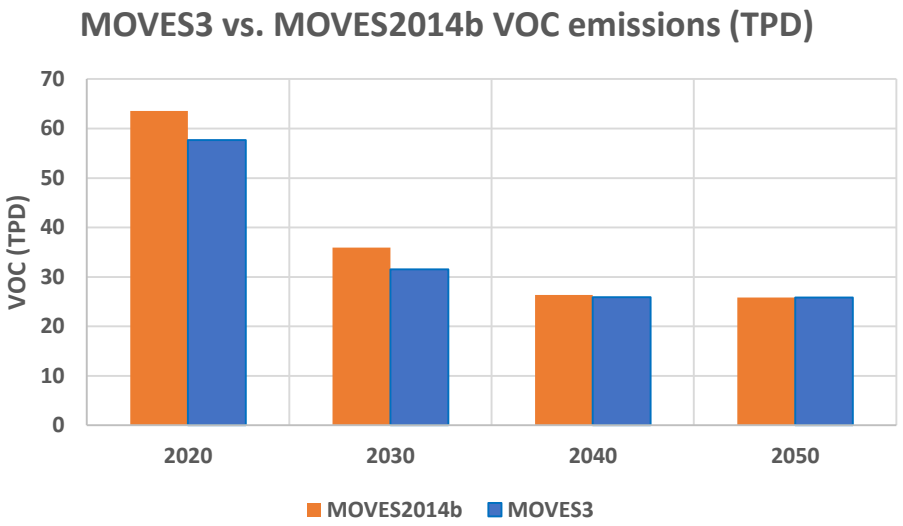
- Incorporated changes with MOVES3 default inputs and emission factors
  - Fuel Characteristics
  - Ramp Fractions (no input table)
  - Startsperday format
  - Idling and Hoteling defaults

- MOVES3 tool converted MOVES2014b input database to cover all other tables in MOVES3
- Modified original MOVES2014b inputs to include recent I/M and vehicle registration data
- Then, re-ran MOVES2014b

OVERALL EMISSIONS COMPARISON

Atlanta 15-county 2008 Ozone NAAQS Maintenance Area





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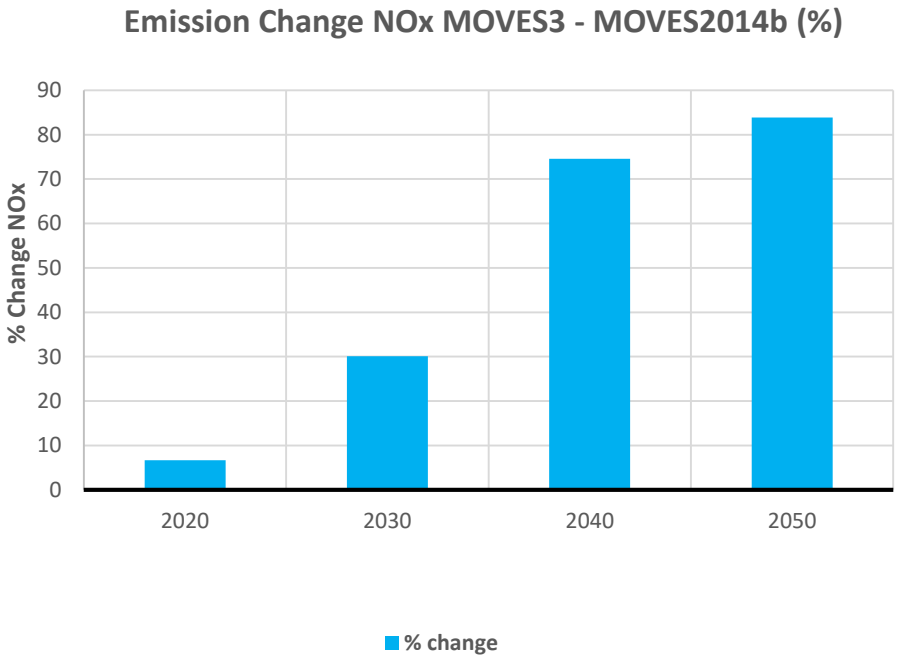
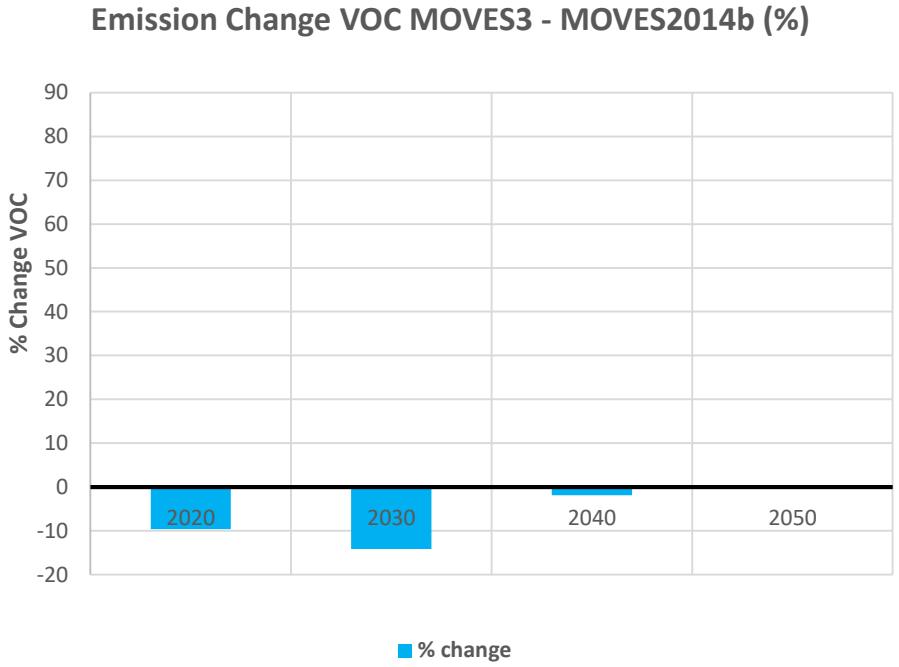
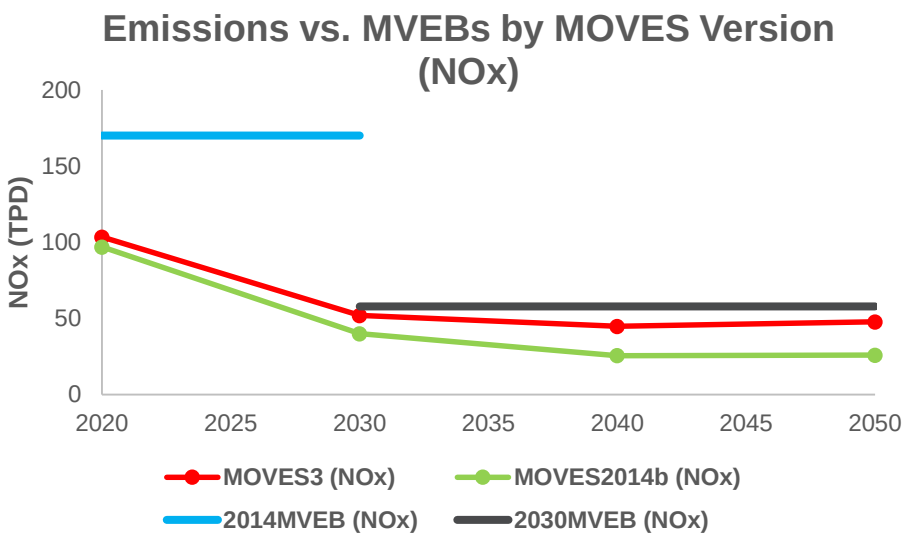
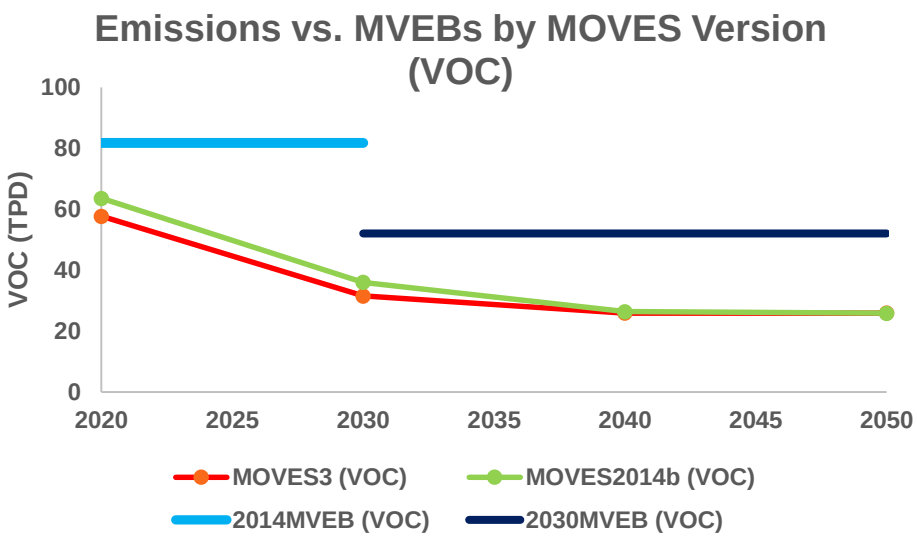




CONFORMITY BUDGETS



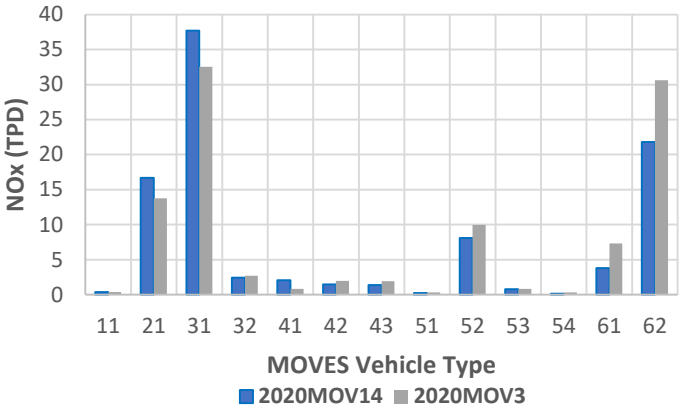


MOVES VEHICLE TYPES

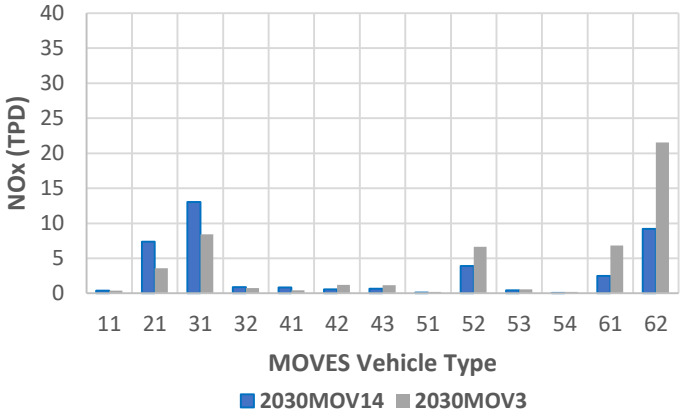
- 11: Motorcycles
- 21: Passenger Cars
- 31: Passenger Trucks
- 32; Commercial Trucks (Light Duty)
- 41: Other Buses
- 42: Transit Buses
- 43: School Buses
- 51: Garbage Trucks
- 52: Single Unit (Straight) Trucks – Short Haul
- 53: Single Unit (Straight) Trucks – Long Haul
- 54: Motor Homes
- 61: Combination Trucks – Short Haul
- 62: Combination Trucks – Long Haul

IMPACT BY VEHICLE TYPE – NOx

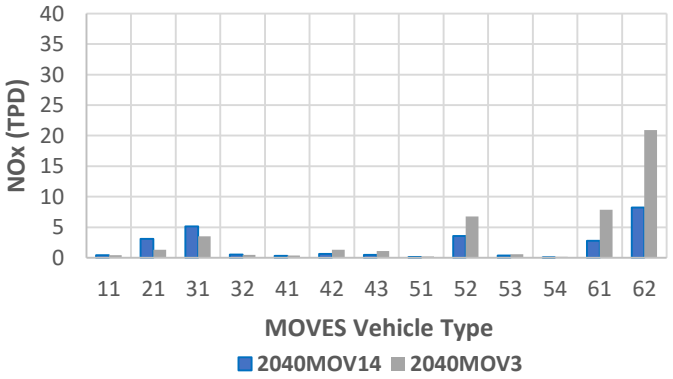
2020 MOVES3 vs. MOVES2014b NOx emissions by vehicle type (TPD)



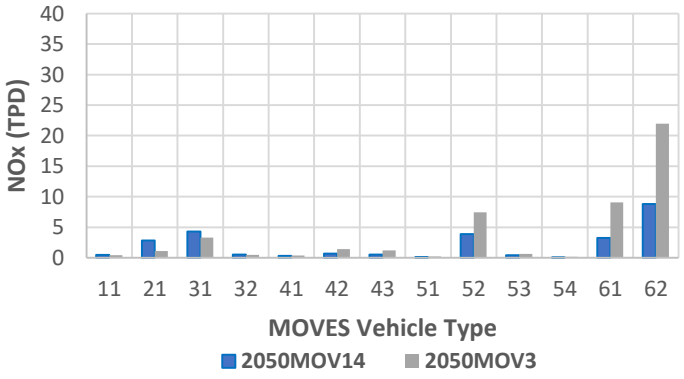
2030 MOVES3 vs. MOVES2014b NOx emissions by vehicle type (TPD)



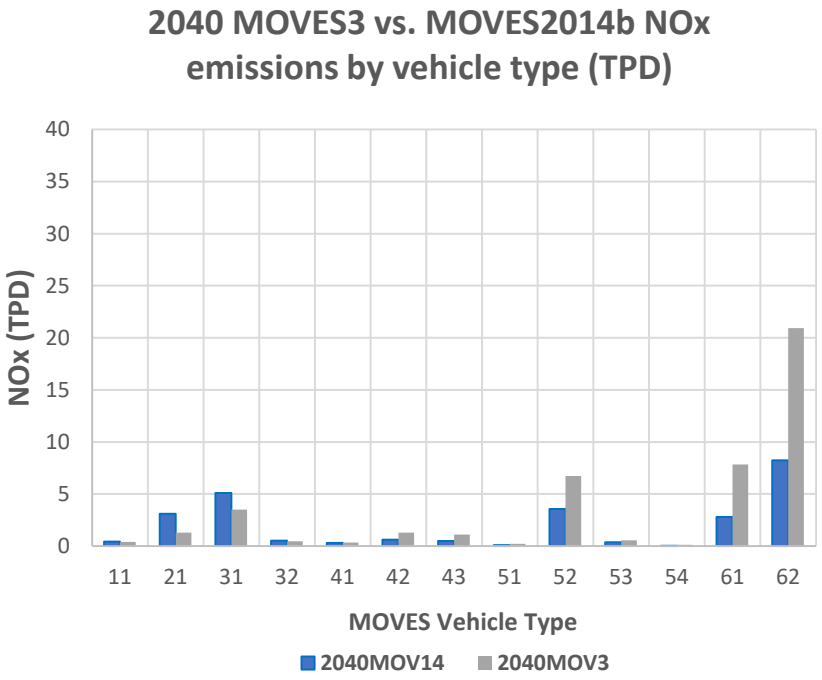
2040 MOVES3 vs. MOVES2014b NOx emissions by vehicle type (TPD)

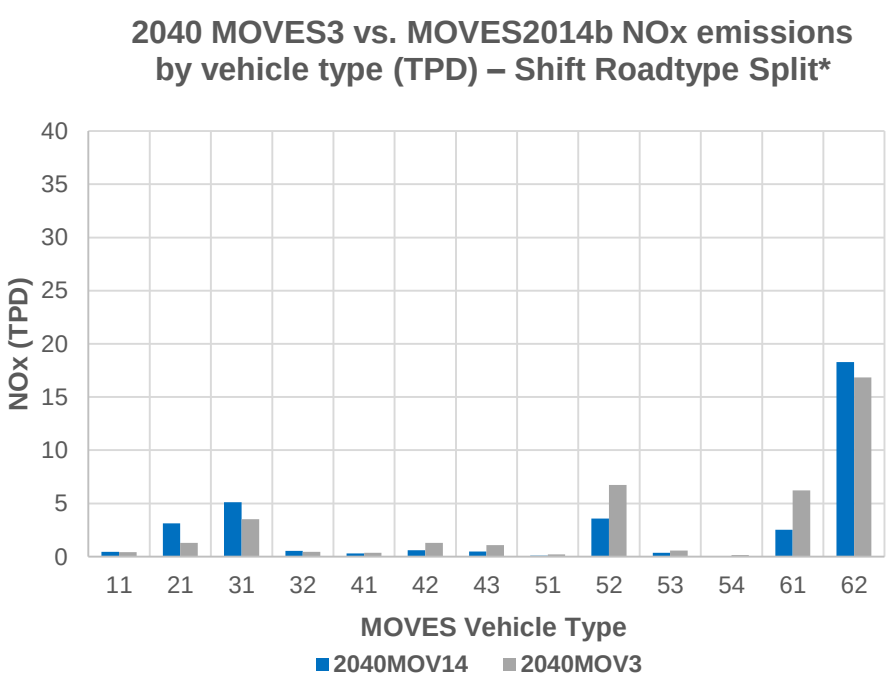


2050 MOVES3 vs. MOVES2014b NOx emissions by vehicle type (TPD)



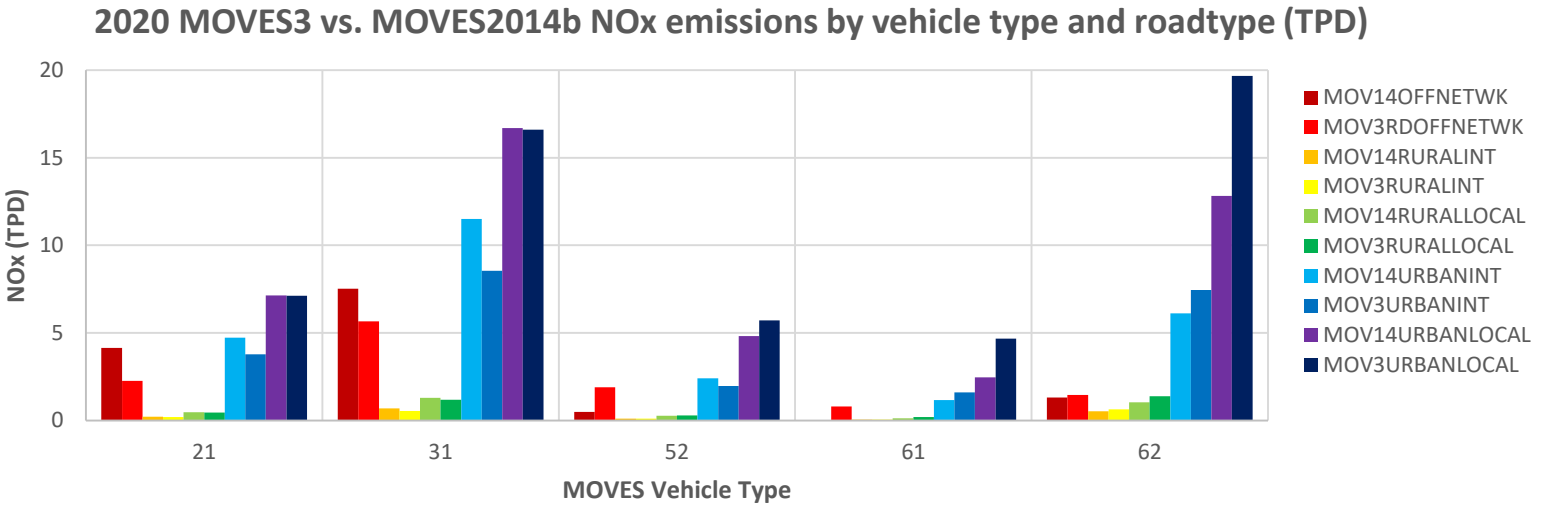
IMPACT OF ROAD TYPE – NOx

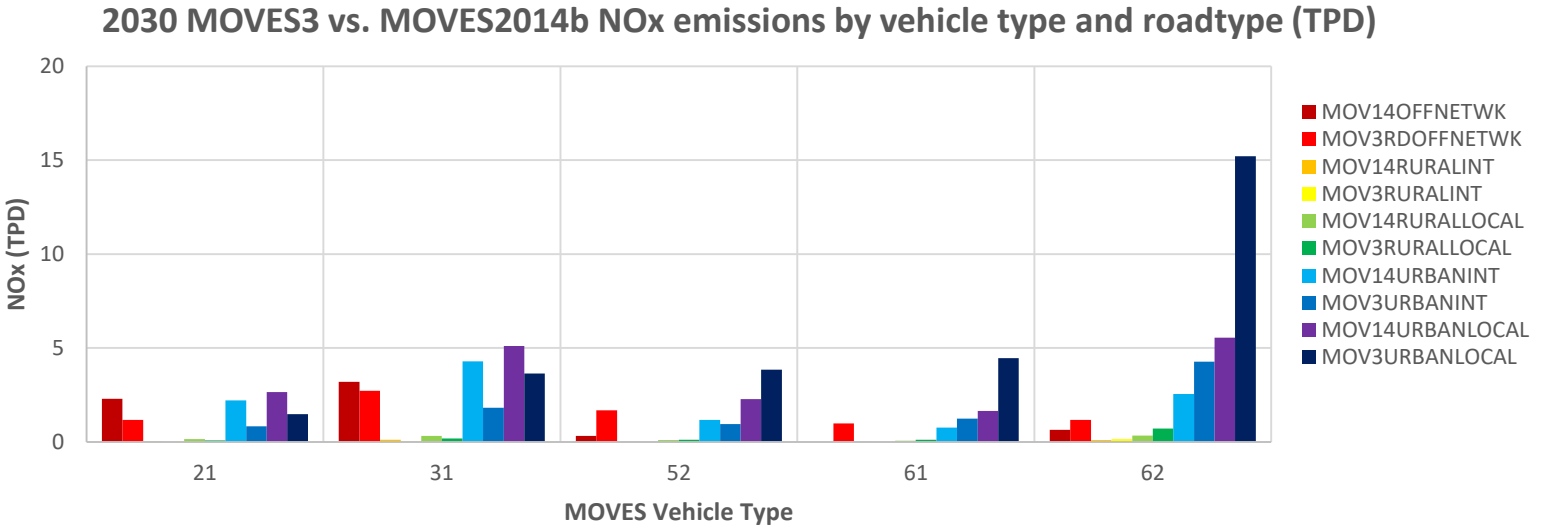




*Shift 30% of VMT from local urban roads to rural interstates (original fraction <1%)

NOx EVALUATION BY ROADTYPE





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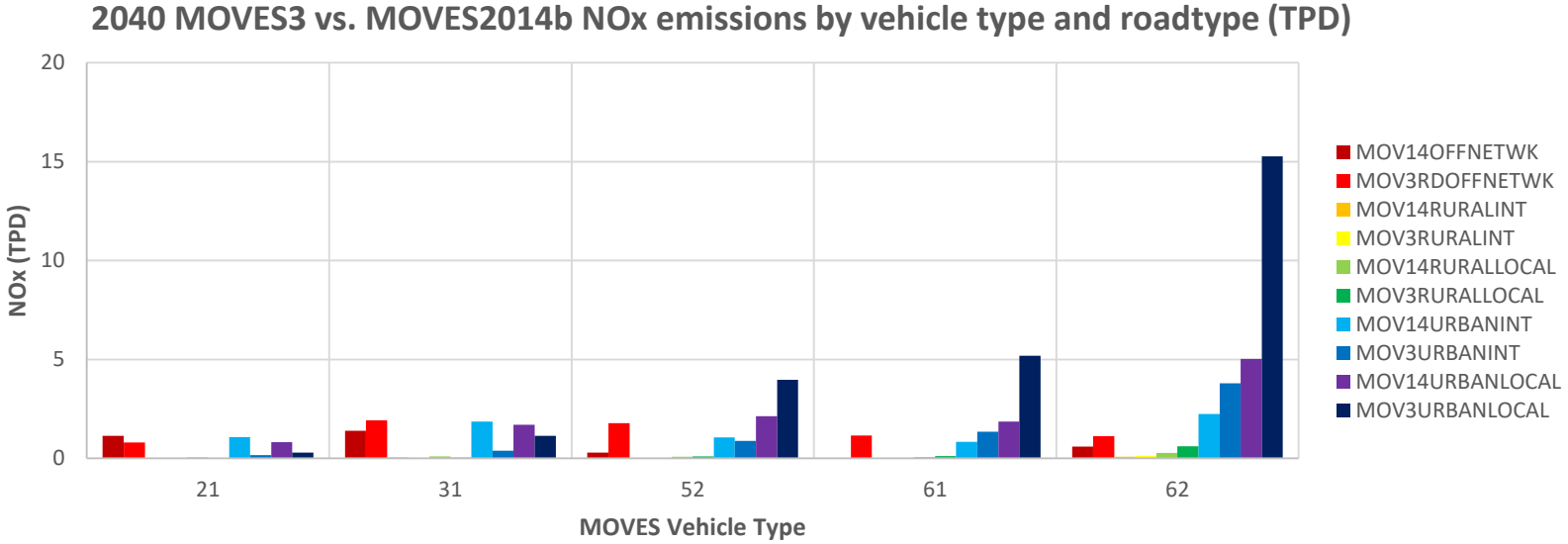
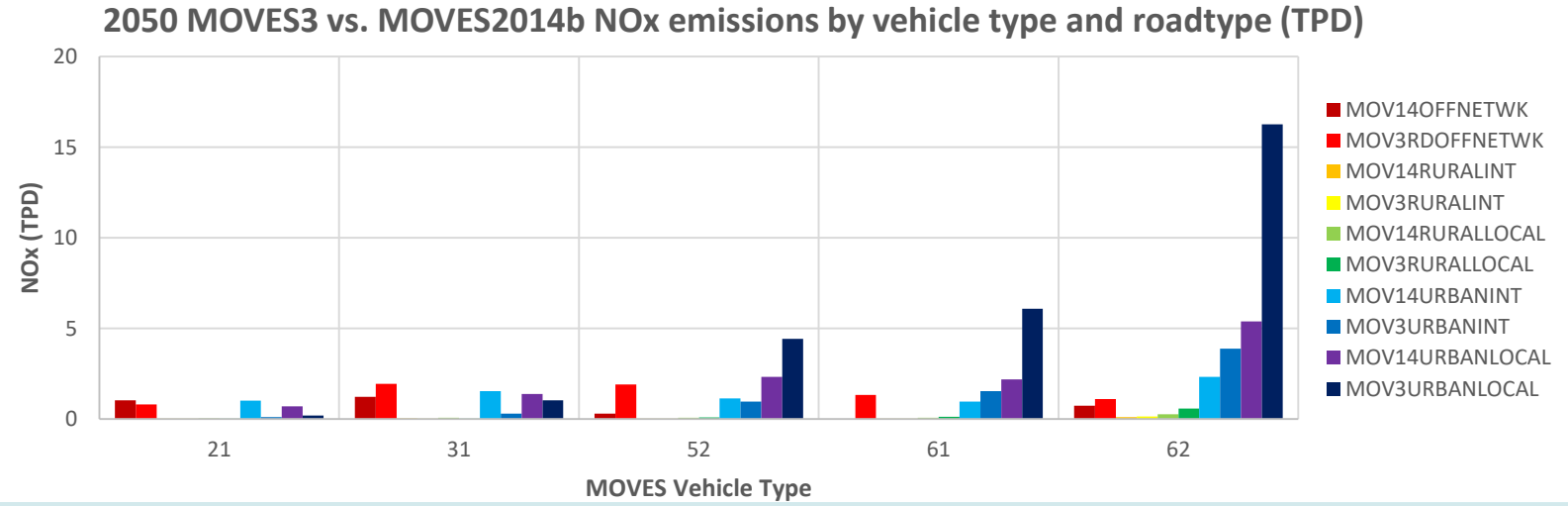
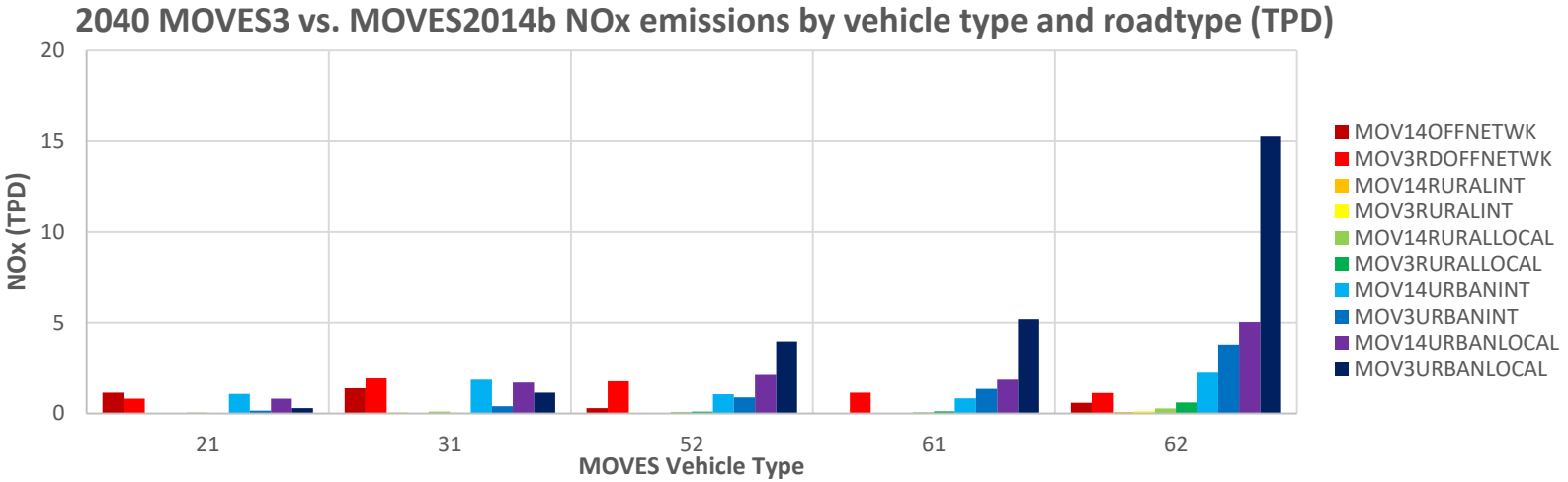
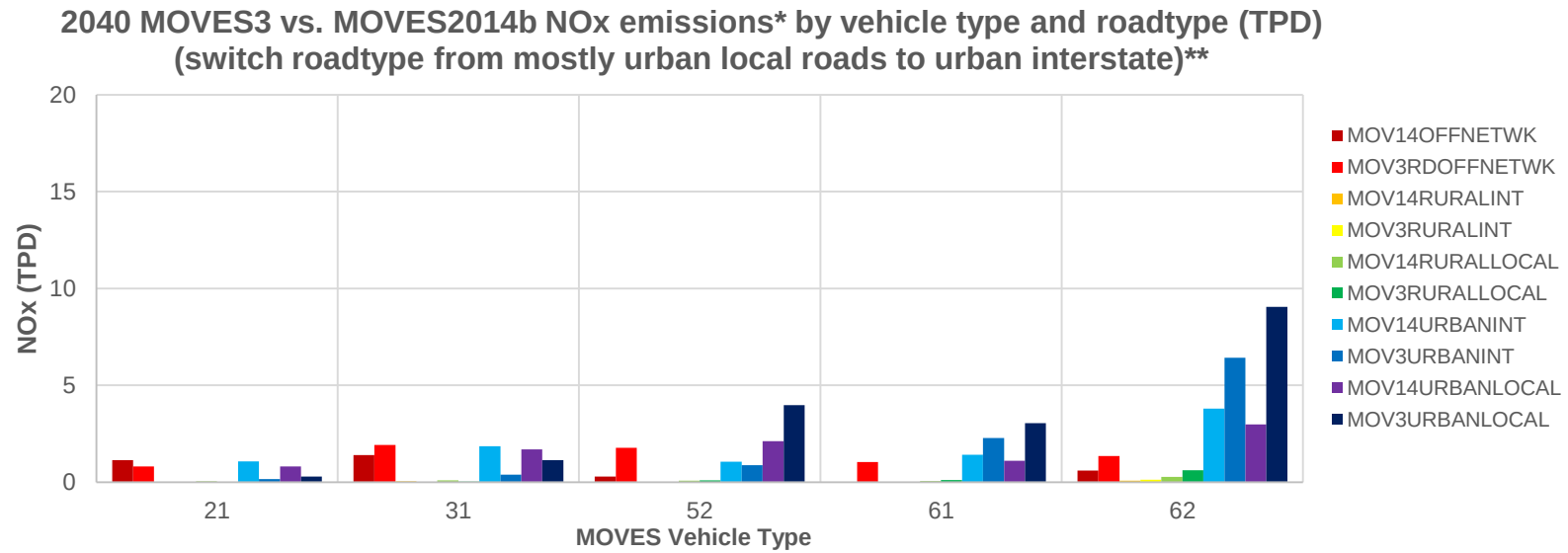




ROADTYPE DIFFERENCES - NOx

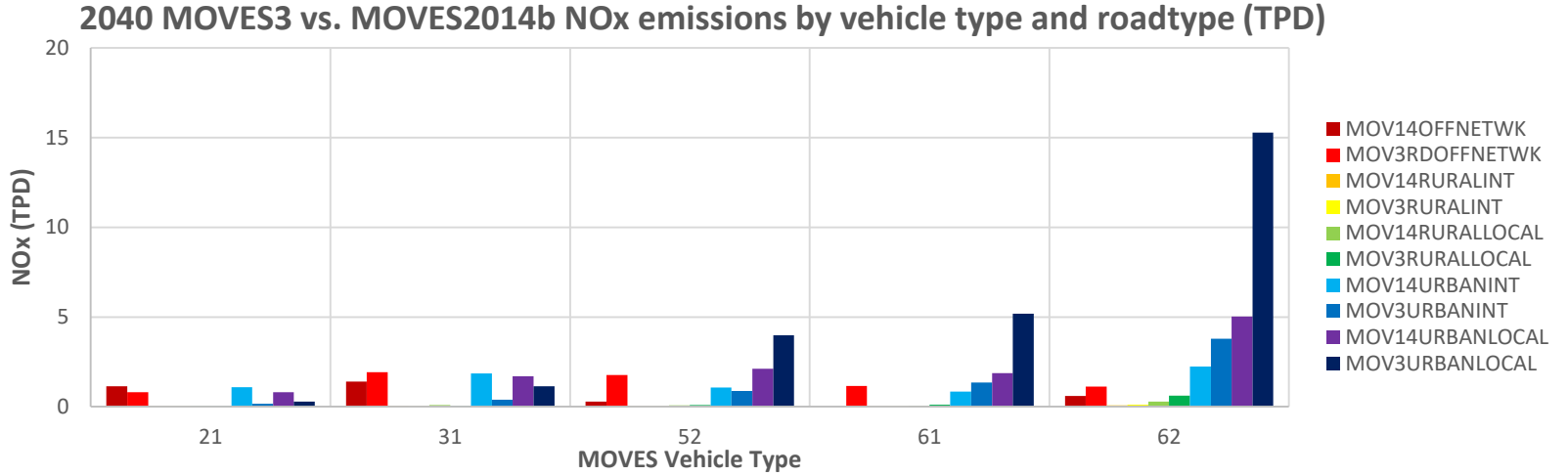


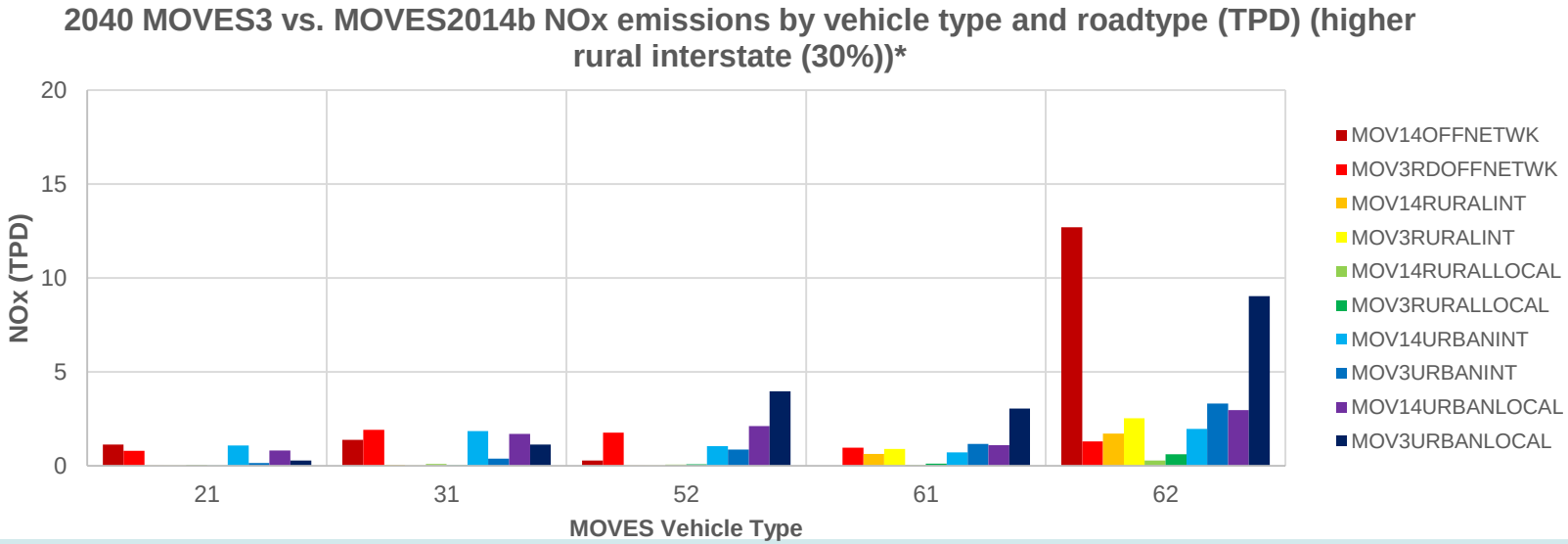


*Total NOx emissions including all vehicle types decreased by 10% with only combination truck roadtype shift

**Combination truck roadtype split switched from 61%/36% to 36%/61% urban local/interstate
(2.5% from rural local and 0.5% rural interstate unchanged)

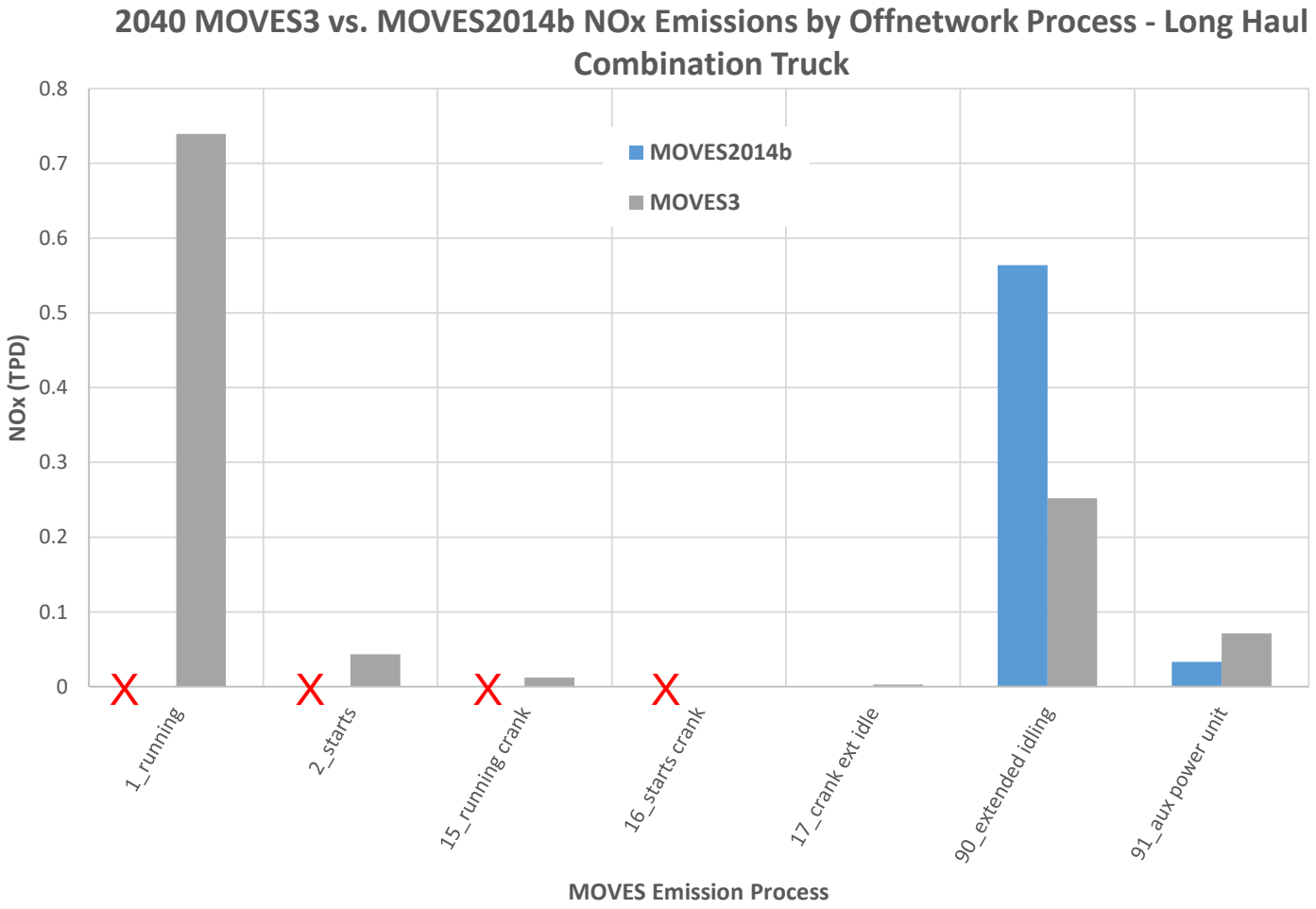
ROADTYPE DIFFERENCES - NOx





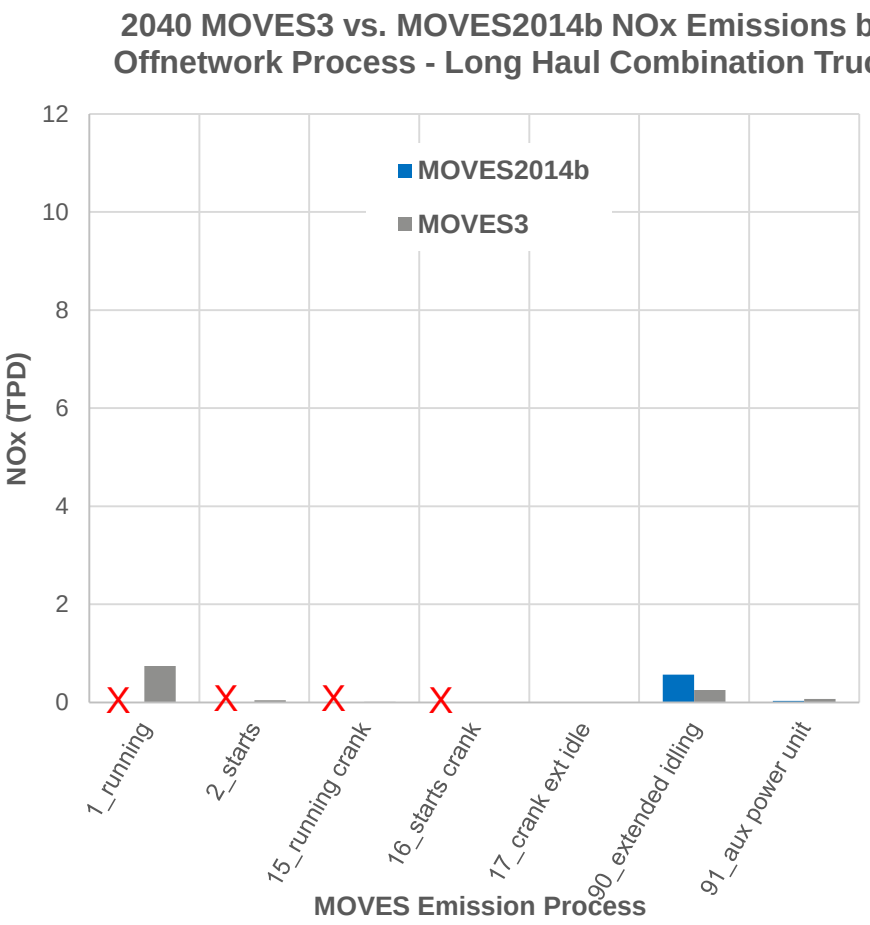
*Combination truck roadtype fractions further switched from 36%/61% urban local/interstate and 2.5%/0.5% rural local/interstate to 36%/31% urban local/interstate and 2.5%/30.5% rural local/interstate. This resulted in an increase in MOVES2014b overall emissions by 40%.

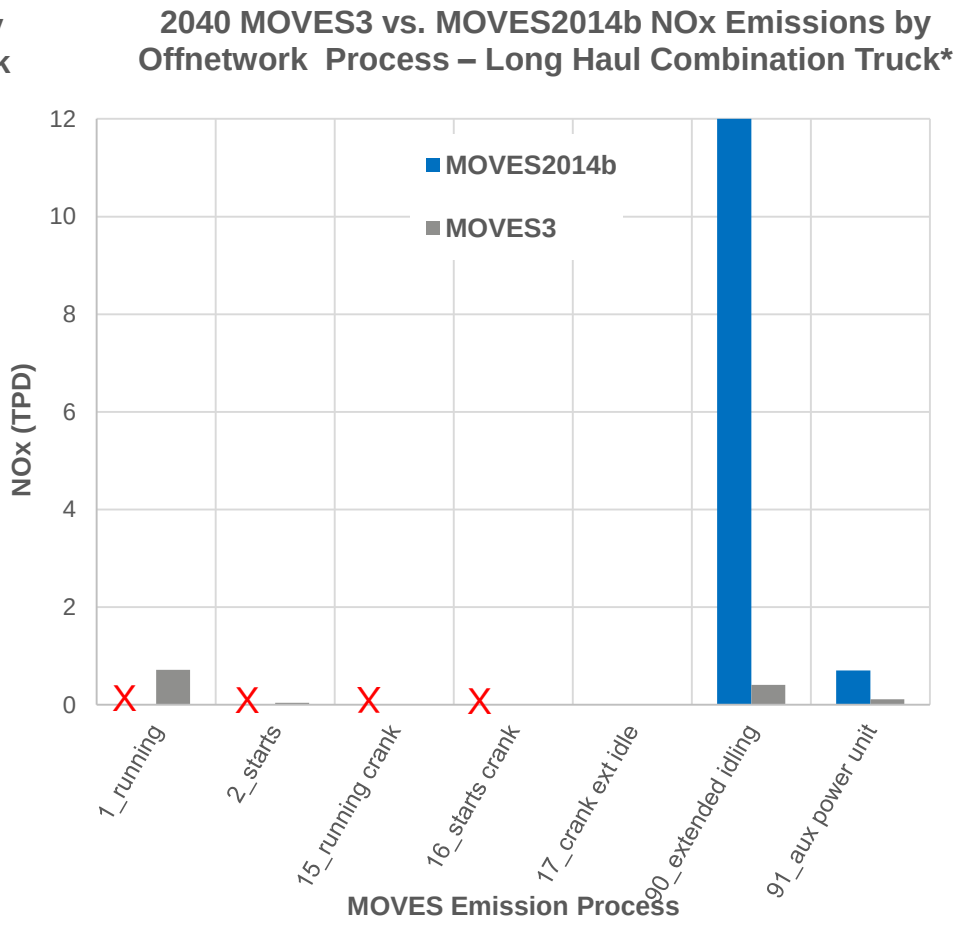
OFF-NETWORK PROCESSES (Long Haul Combination Truck)



X – Emissions processes not included in model for long haul combination trucks in MOVES2014b

ROAD TYPE IMPACTS - NOx



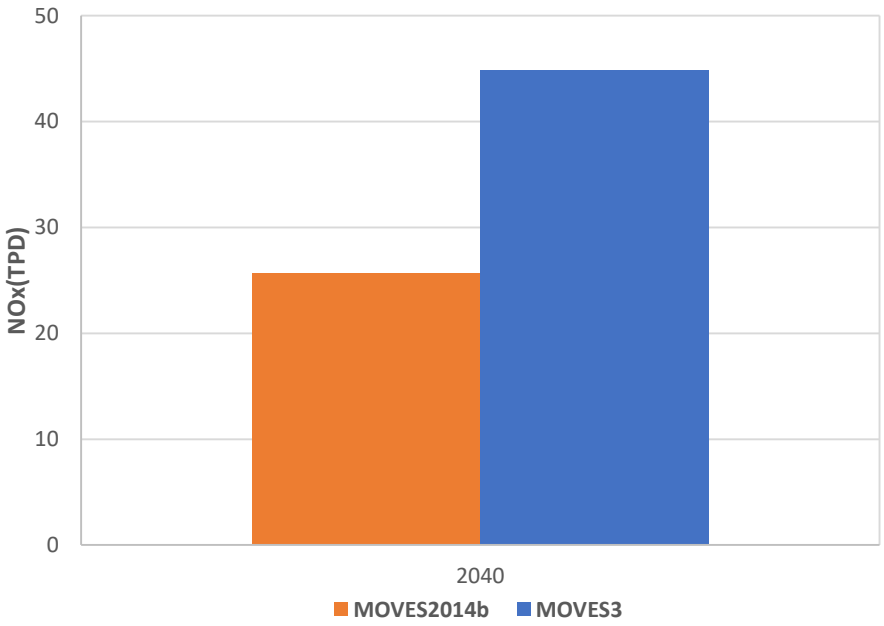


X – Emissions processes not included in model for long haul combination trucks in MOVES2014b

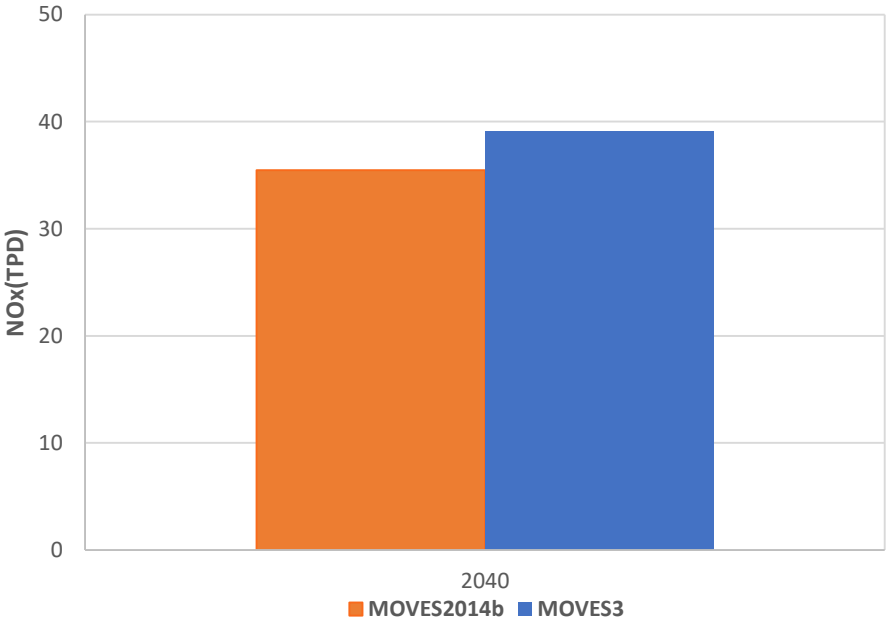
* Switched Roadtype VMT so 30% from rural interstate versus 0.5%

ROADTYPE IMPACTS OVERALL - NOx

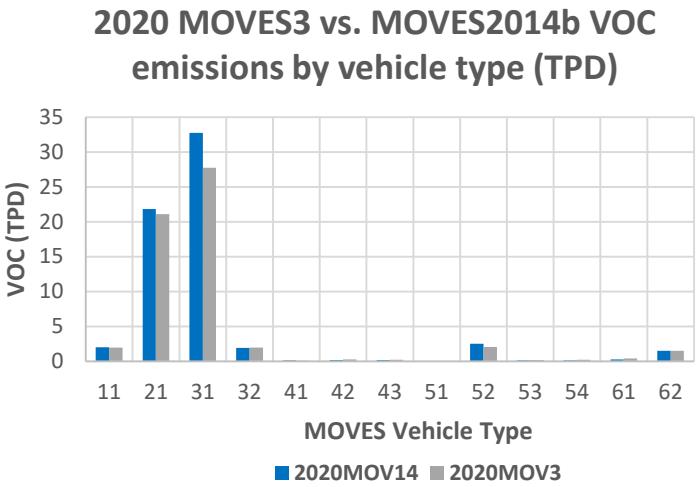
2040 MOVES3 vs. MOVES2014b NOx emissions (TPD)

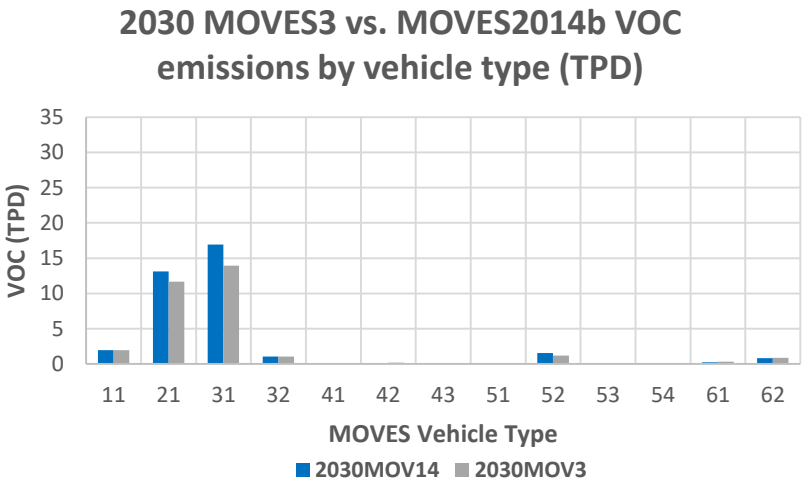


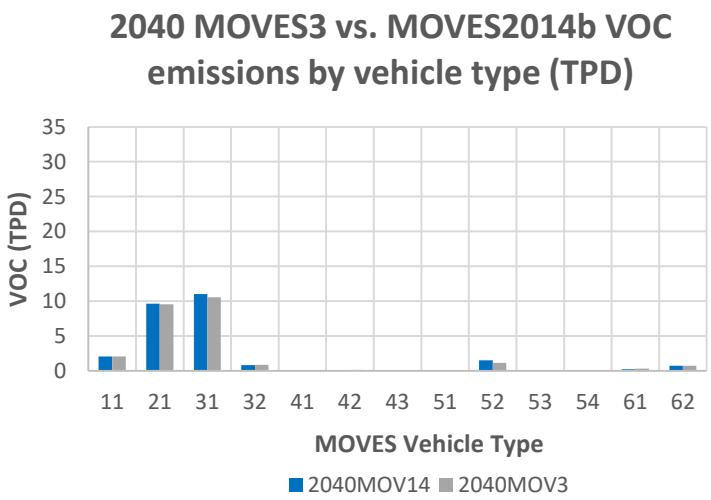
2040 MOVES3 vs. MOVES2014b NOx emissions (TPD) (shifting to 30% rural interstate VMT)

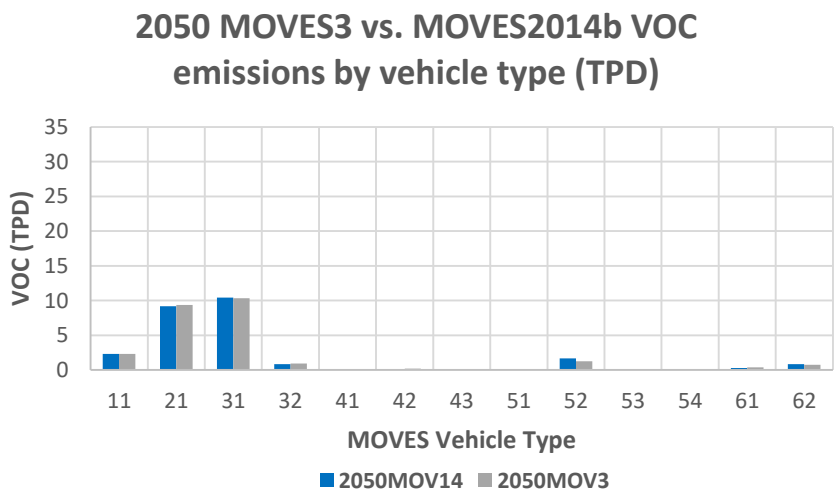


IMPACT BY VEHICLE TYPE – VOC



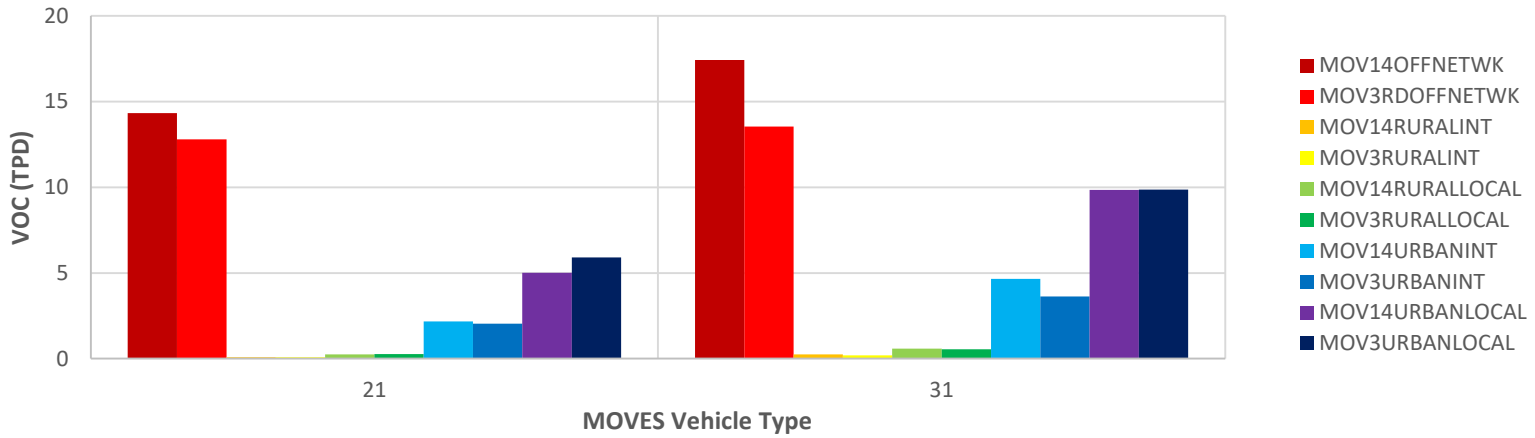






VOC EVALUATION BY ROADTYPE

2020 MOVES3 vs. MOVES2014b VOC emissions by vehicle type and roadtype (TPD)



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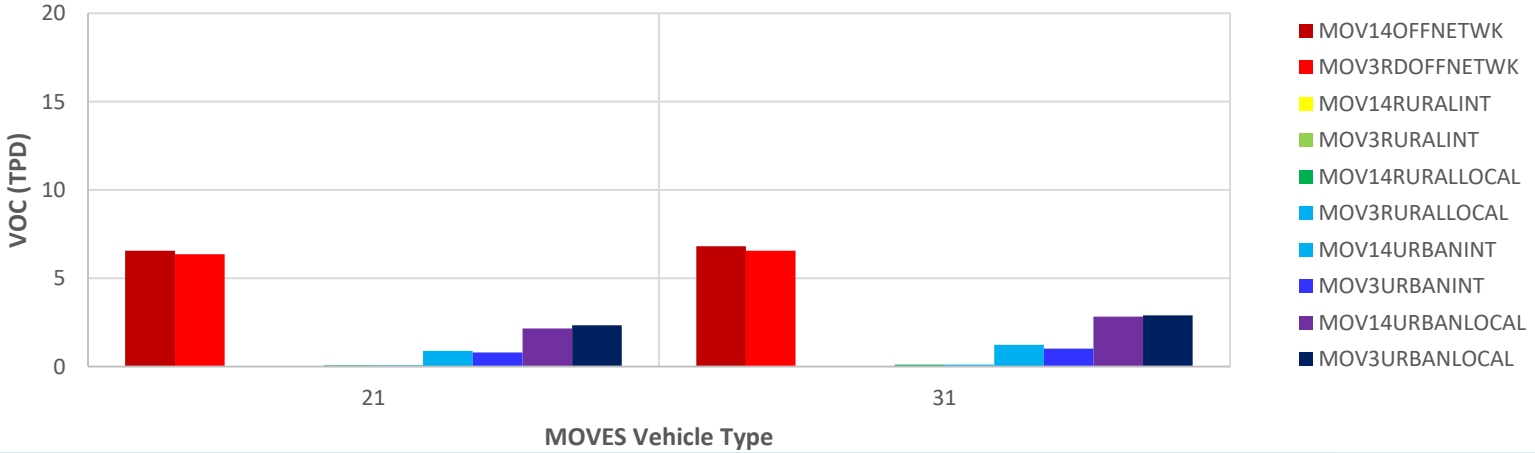
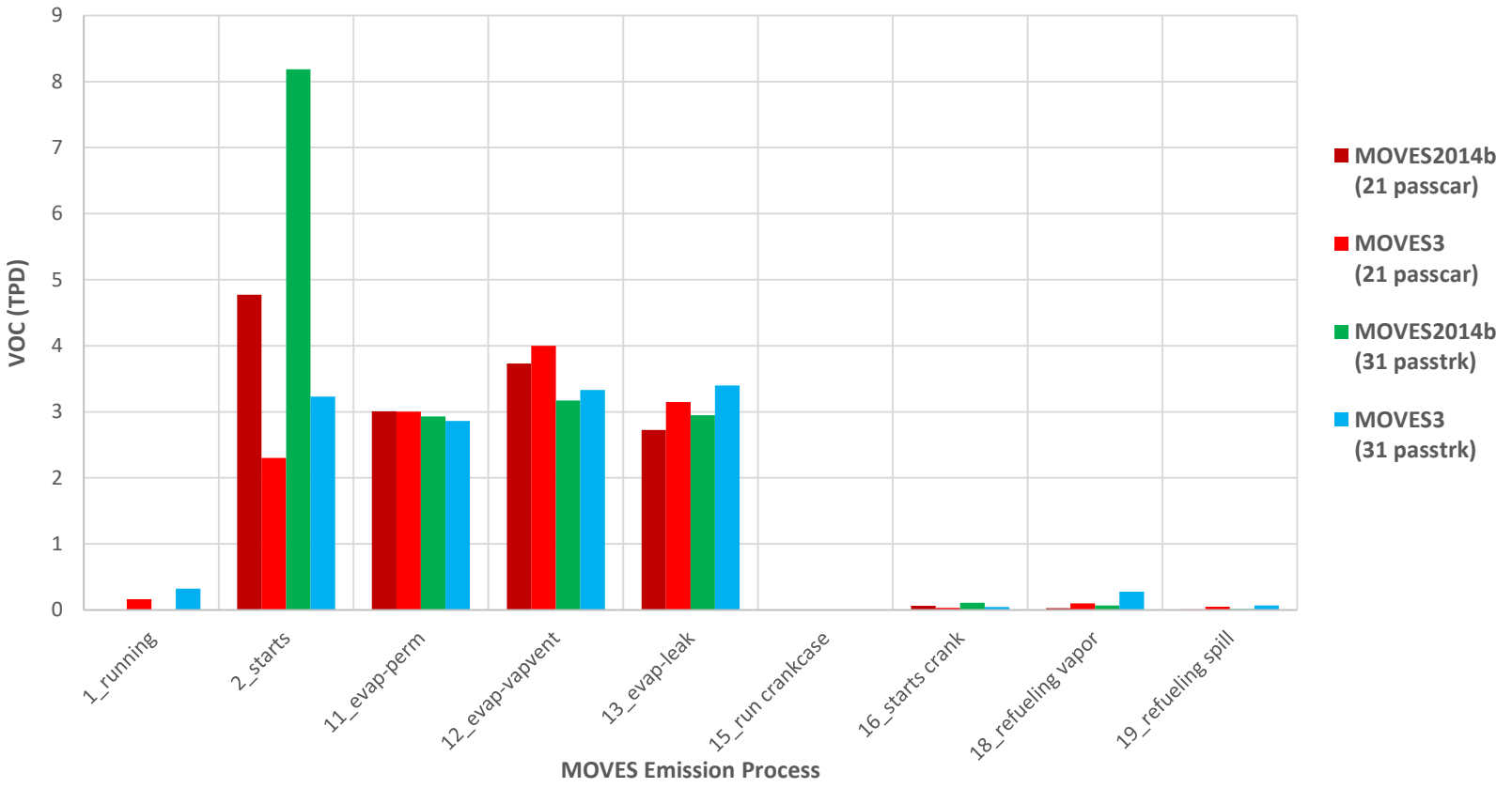


OFF-NETWORK PROCESSES (Passenger Vehicles)



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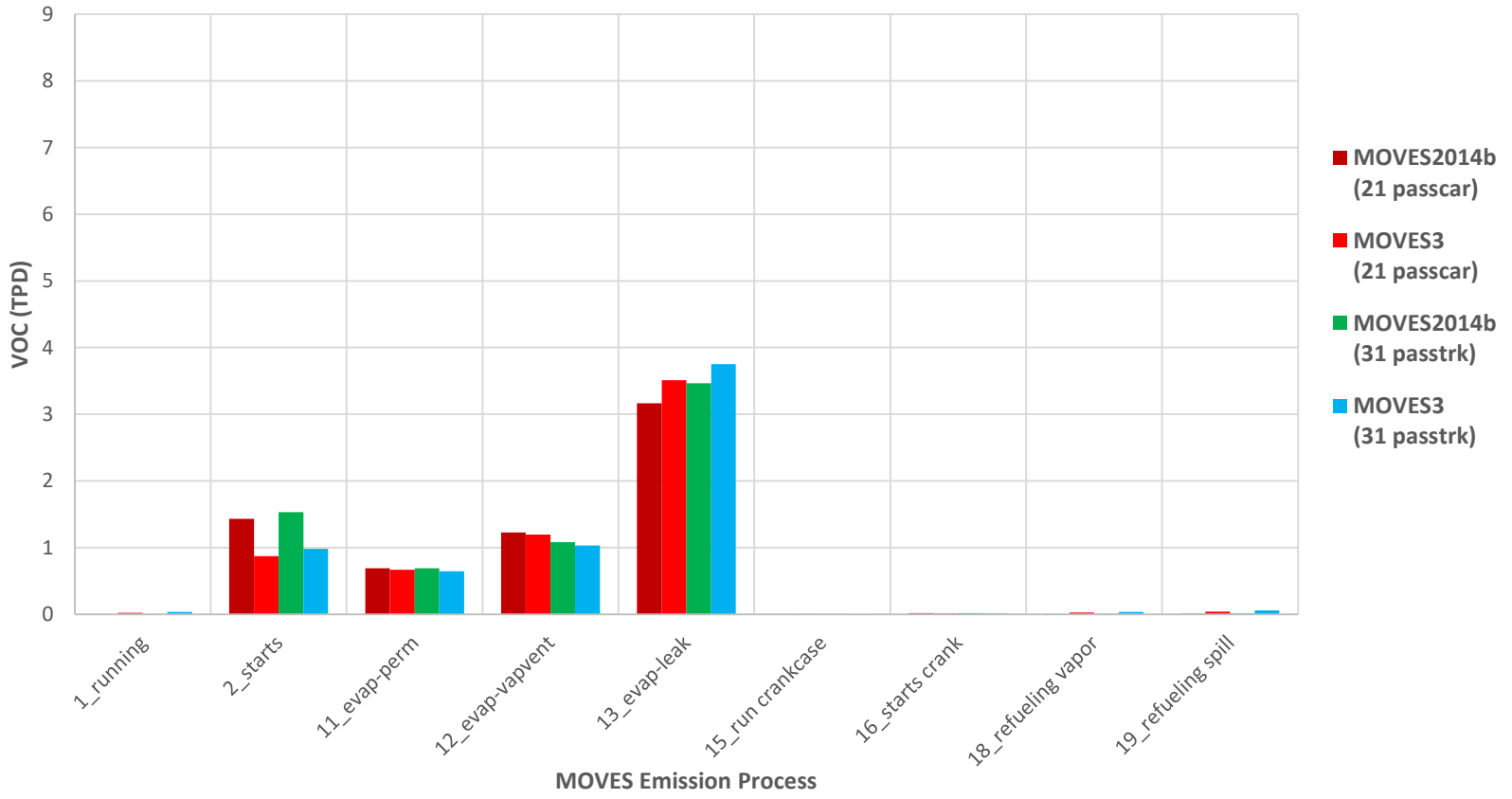

Results For Atlanta Region (NOx)

- MOVES3 (NOx) > MOVES2014b (NOx) by 7% in 2020, increasing steadily to 80-85% by 2050
- NOx difference is driven primarily from long haul combination truck running emissions on local urban roads
  - This emission source becomes more dominant with time
  - The contrasting decrease in emissions with light duty vehicles becomes negligible by 2050 as light duty emissions overall rapidly decrease over time
- When modifying VMT roadtype distribution for combination trucks emission changes are seen
  - Switch urban local road/interstate distribution: MOVES3 NOx ↓ 10%
  - Switch urban roads/rural interstate: MOVES2014b NOx ↑ > 40%
  - MOVES3 no additional significant change with move to rural
  - Increase rural interstate VMT fraction just from 1 to 30%: Big impact

Conclusions For Atlanta Region (NOx)

- Large NOx increase from MOVES2014b to MOVES3
  - MOVES3 decreases in extended idling are small
    - Atlanta area has very low rural interstate VMT so MOVES2014b NOx emissions not originally impacted by MOVES2014b high extended idling emissions unlike some more rural MPOs
  - MOVES3 increases in running emissions on urban local are large
    - Atlanta area has high fraction of local combination truck traffic
    - Emission factors for combination trucks on these roads increased with MOVES3 due to studies showing controls less effective at low speeds
- The NOx Emission Increase Get Bigger Over Time
  - Running emissions increase for heavy-duty initially countered by light-duty start emissions decrease in 2020
  - Decrease of overall light-duty vehicle emissions over time nearly eliminates the impact by 2050

The magnitude of extended idle versus running emissions from combination trucks determine fate of model emission changes.

Conclusions For Atlanta Region (VOC)

- MOVES3 (VOC) < MOVES2014b (VOC) by 10-15% 2020-2030 decreasing to ~zero difference by 2050
- VOC difference going from MOVES2014b to MOVES3 driven by light duty passenger vehicle emissions
  - 2020 decrease from start emissions (running emissions similar between models)
  - 2050 near zero difference since start emissions no longer significant and canceled out by slight increase between models from persistent fuel leak/evaporation emissions
  - Combination truck emissions are minor so extended idling and running emission variation have limited impact
    - Road type distribution less consequential, <10% effect

Recommendations

- Moving from MOVES2014b to MOVES3
  - Areas with high combination truck VMT and low % rural interstates (e.g., Atlanta) should consider the impacts of significantly higher NOx emissions in transportation conformity planning decisions, and model input development
- Future NOx emission reduction policies should focus on heavy-duty vehicles (especially, freight)
- MOVES3 model will need to be updated with any changes in standards related to running emissions for heavy-duty vehicles
- Investigate fuel leak/evaporation emissions further

CONTACT INFORMATION

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THANKS!
QUESTIONS?