



Application of MOVES to Travel Demand Models

Balaji Yelchuru
AECOM Consult, Inc.
June 22, 2008



Study Objectives

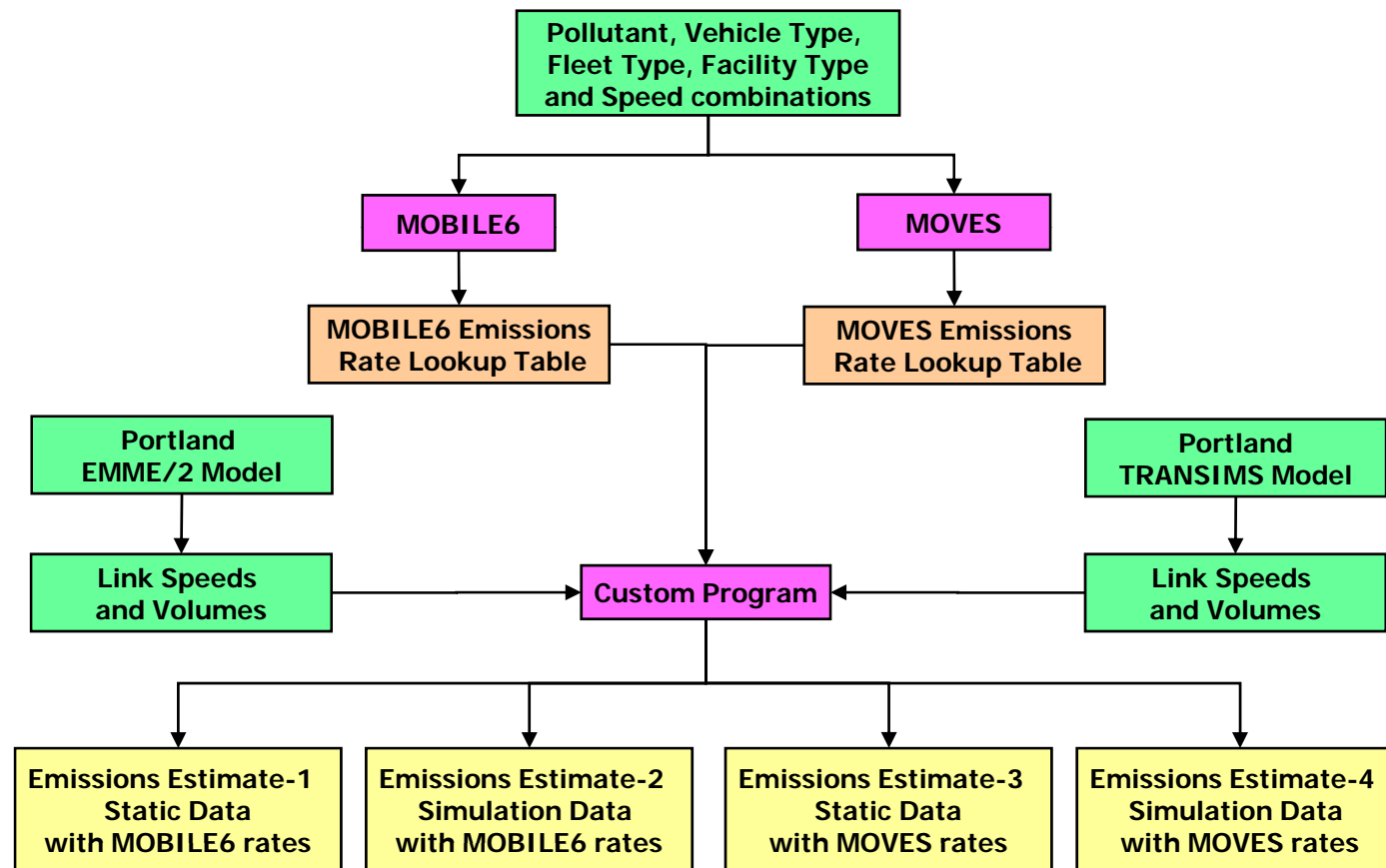
- Options for interfacing MOVES with transportation models
 - Level of Effort to transition from MOBILE6
 - Macro vs. Meso vs. Micro analysis differences
 - Lookup tables vs. Direct applications
- Options for customizing MOVES to suit local conditions
 - Using MYSQL or other tools
 - Implementing IM programs
 - Changing Fleet or Vehicle Mix



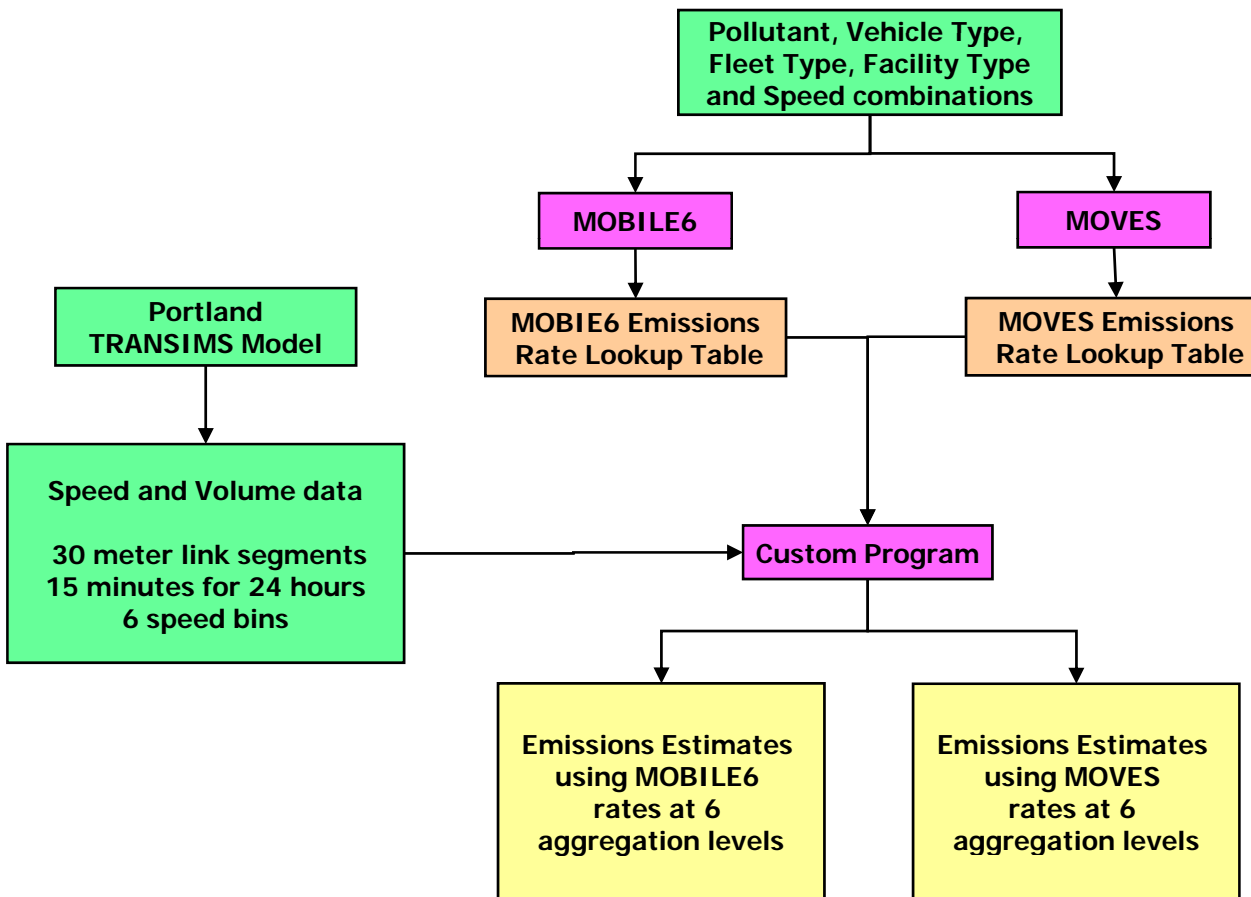
Study Objectives - Continued

- Impacts of simulation speeds on emissions estimate
 - Traditional Vs Simulation model data
 - MOBILE6 Vs MOVES Emissions Rates
- Impacts of aggregating speeds to estimate emissions
 - MOBILE6 Vs MOVES Emissions Rates
- Using simulation outputs with MOVES for NEPA analyses
 - TRANSIMS, VISSIM & CORSIM

Overview of the Study



Impacts of Aggregation





Presentation Focus

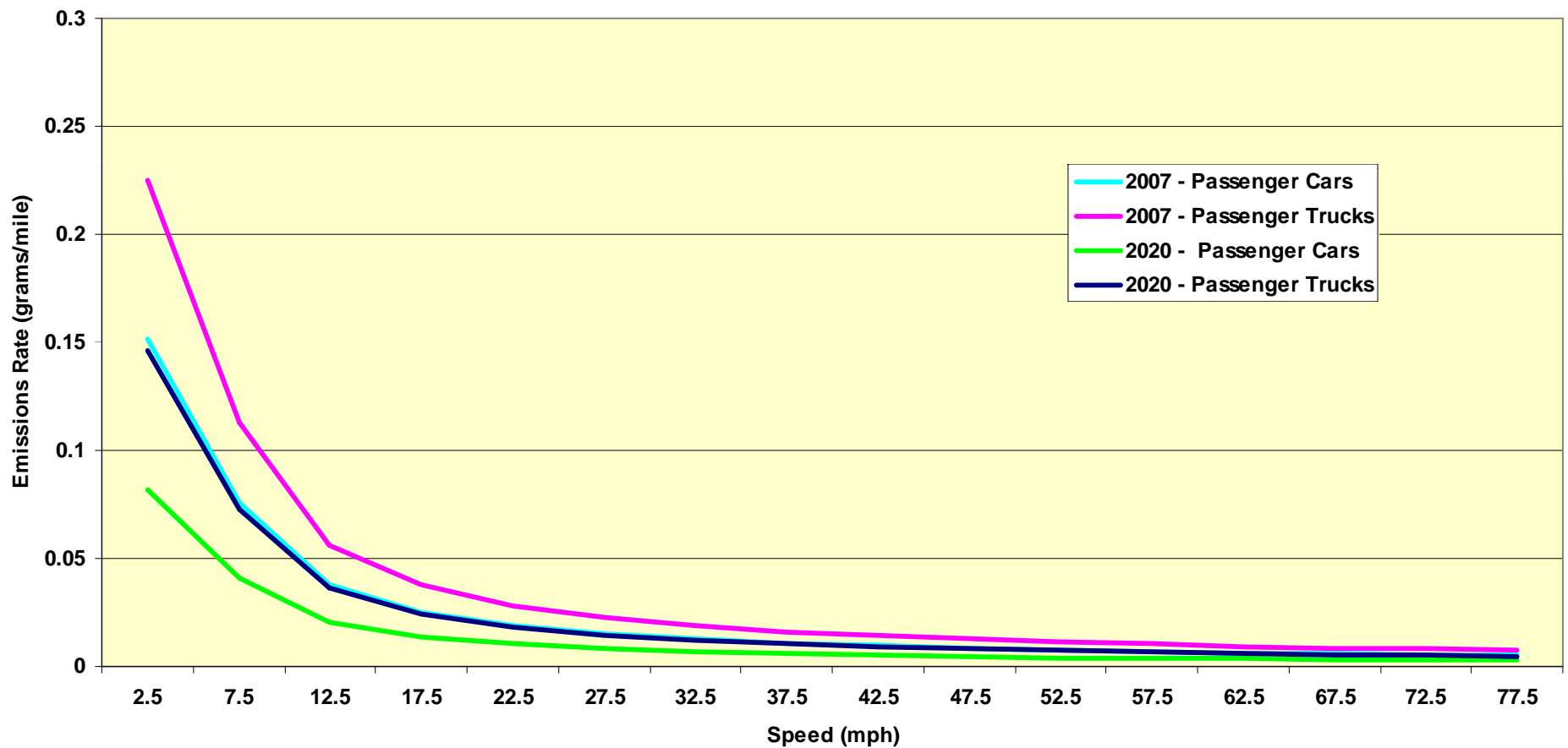
- Initial Experience with “MOVES – Demo”
- MOVES Emissions Rates for Greenhouse Gases
 - Methane, Nitrous Oxide, Carbon Dioxide
- Impact of Aggregating Speed data
 - Preliminary Results
- CAUTION: All Emissions Rates and results presented are very preliminary



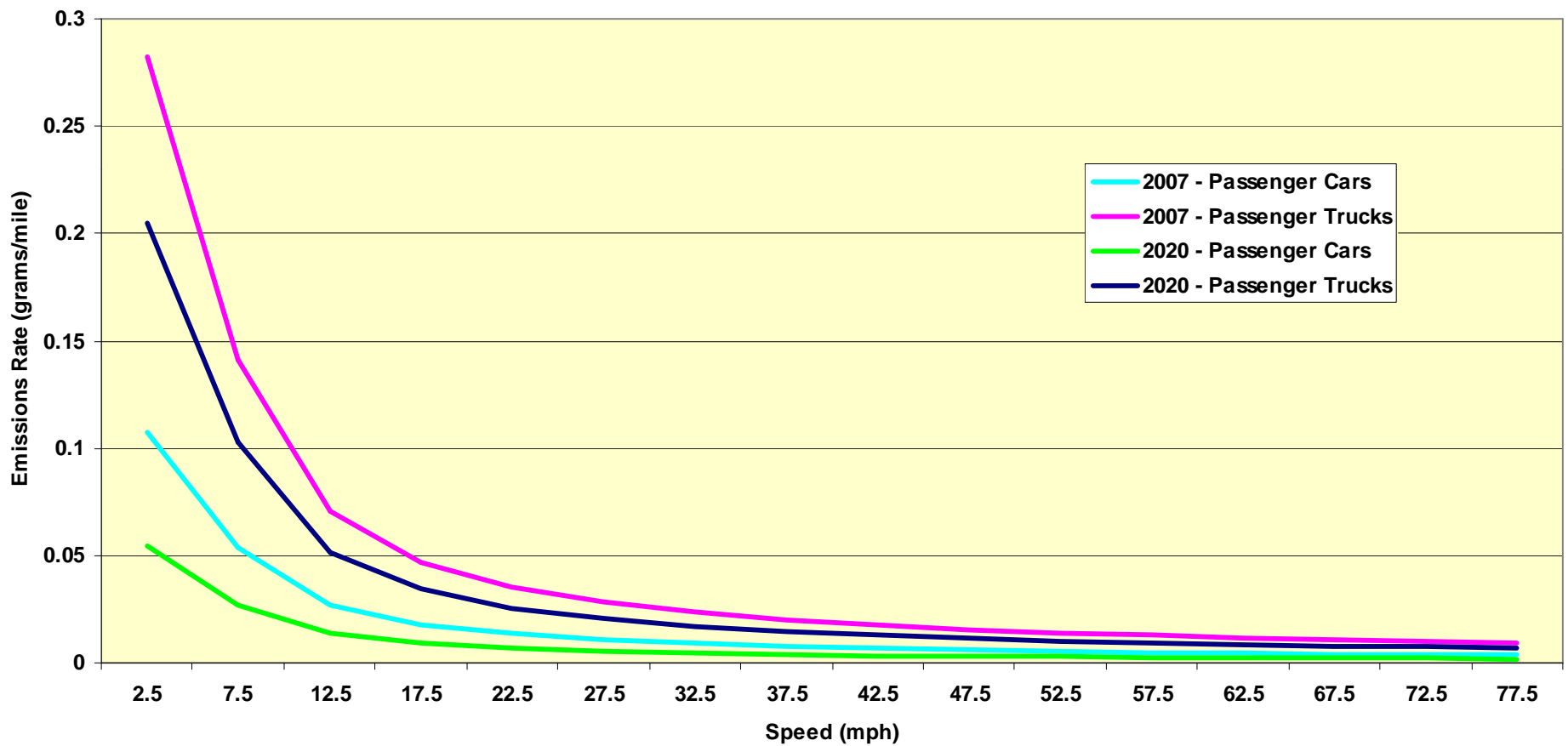
Initial Experience with MOVES

- Performed several runs using MOVES-Demo
- Runs using stand alone Dual-Core computer
- Emissions Rates for Greenhouse Gases
 - Using “Mesoscale lookup” option and default MOVES input database
- Sample rates have been generated for single or multiple counties in the Portland region

Emissions Rates – Methane

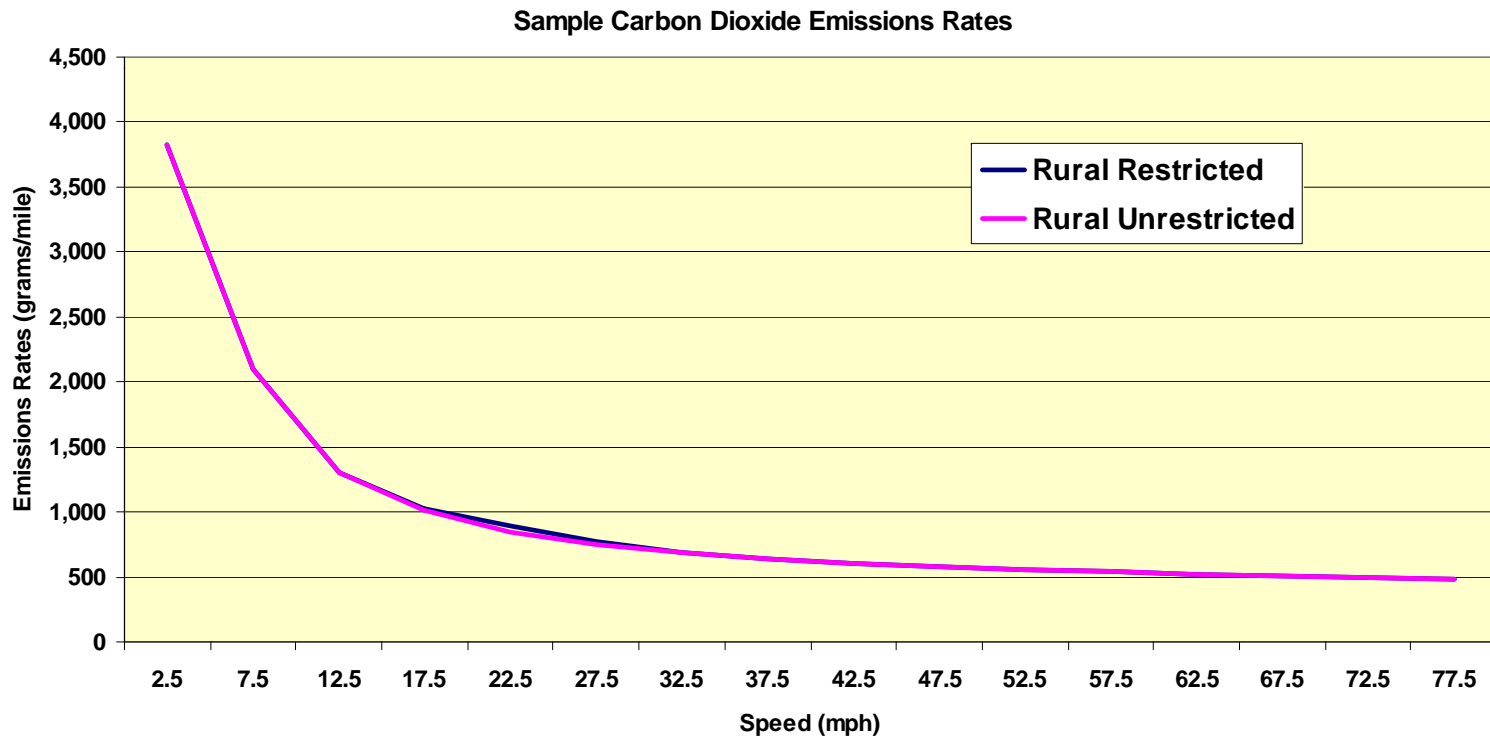


Emissions Rates – Nitrous Oxide



Greenhouse Gas Emissions

- Same for Rural and Urban facility types
- Marginally different for Restricted and Unrestricted facilities



MOVES Parameter Testing

- MOVES provides options to select:
 - Time Aggregation Levels
 - Year, Month, Day and Hour
 - Months
 - January thru December
 - Days
 - Weekend and Weekdays
 - Hours (0 to 24)

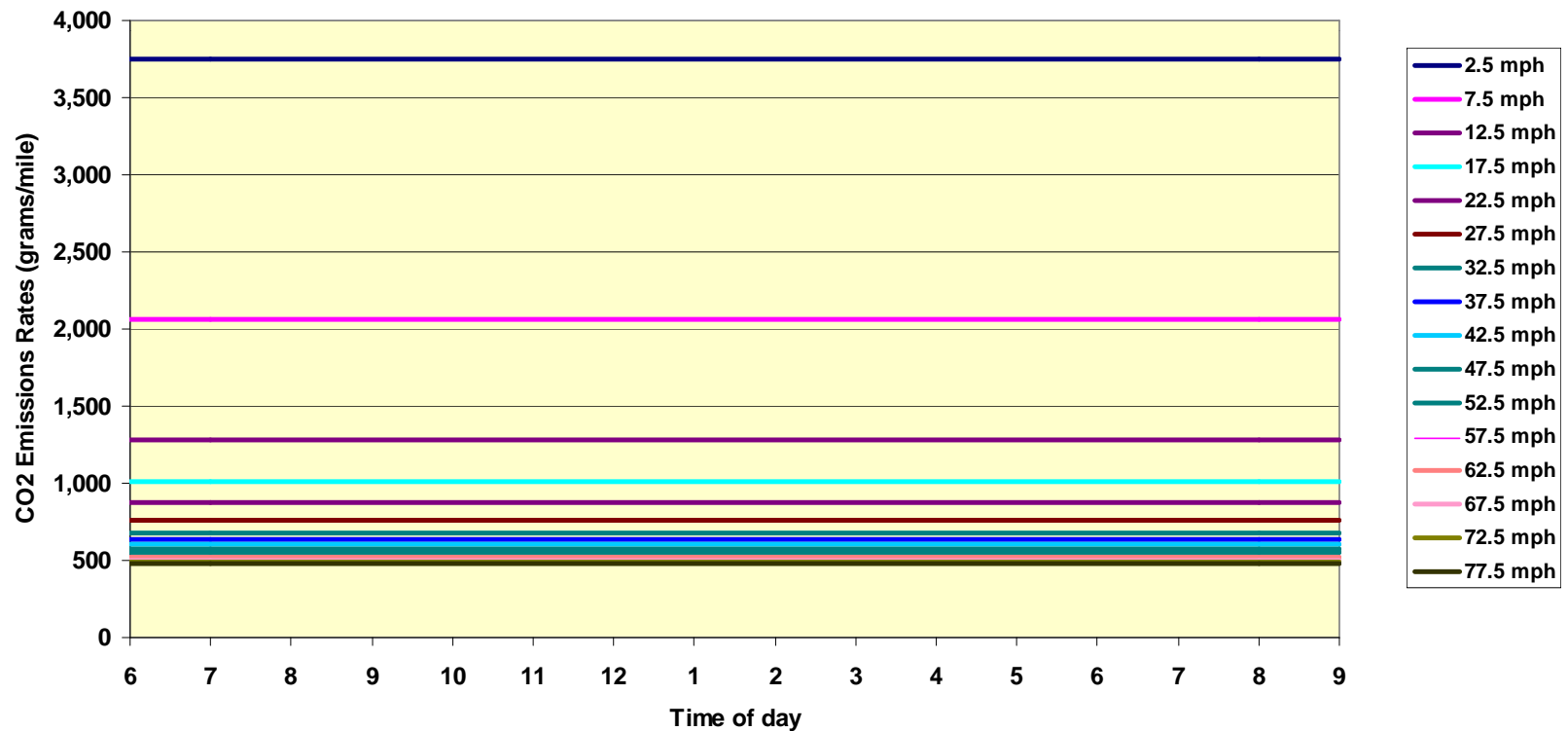
The screenshot shows a web-based interface for testing MOVES parameters. It is organized into four main sections:

- Time Aggregation Level:** A horizontal row of radio buttons for selecting the aggregation level: Year, Month, Day, and Hour. The 'Hour' option is currently selected.
- Years:** A section with a 'Select Year:' dropdown menu, an 'Add' button, a text area labeled 'Years:', and a 'Remove' button.
- Months:** A grid of checkboxes for each month from January to December, with 'Select All' and 'Clear All' buttons at the bottom.
- Days:** A section with checkboxes for 'Weekend' and 'Weekdays', and 'Select All' and 'Clear All' buttons at the bottom.
- Hours:** A section with 'Start Hour:' and 'End Hour:' dropdown menus, and 'Select All' and 'Clear All' buttons at the bottom.

Greenhouse Gas Emissions

- Does not change by time-of-day
- Are higher at lower travel speeds

Variation in CO2 Emissions Rates - By Time-of-Day and Speed





Process Time

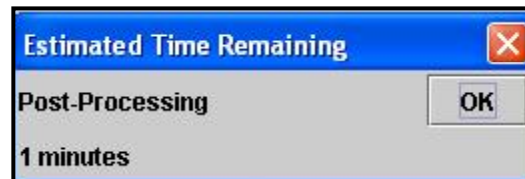
- Monthly or hourly options impact process time

RUN	Number of Counties	Time Aggregation Levels	Process Time	# of Emissions Records
1	1	Monthly	15 mins	2,560
2	1	Hourly	2 Hours 33 mins	122,880
3	4	Monthly	1 Hour	16,384
4	4	Hourly	72 Hours	786,432

- Do separate MOVES runs for individual counties, instead of one run for all counties?
- “Model Year” and “Source Type” outputs increase the process time significantly
 - Runs take Several days or weeks to complete

Process Time

- MOVES displays “Estimated Time Remaining” inaccurately
 - Remaining Time displayed as “1-minute” for 2 or more days



- Better run-time logs/descriptions are desirable



Differences – MOVES Vs MOBILE6

- In MOBILE6, Facility Types are classified as
 - Freeways, Arterials, Locals and Ramps
 - Use 14 Speed Bins for Freeways and Arterials
 - Average Speed Bin for Locals and Ramps
- In MOVES, Facility Types are classified as
 - Rural – Restricted or Unrestricted
 - Urban – Restricted or Unrestricted
 - Ramps Modeled using a Ramp Percentage Factor
- Map 4 link types in MOBILE6 to 2 link types in MOVES



MOVES Application - Issues

- Different emissions rates for each county selected
 - Average rates for a group of counties (i.e., region) is desirable
- MOVES has two options
 - A single set of emission rates for all Source Types (e.g., autos, trucks, transit bus, school bus, etc.)
 - Separate emission rates for 13 Source type
- Useful if MOVES combines emission rates for selected Source Types
 - Example: Combine light commercial, single unit short-haul, single unit long-haul , combination short-haul and combination long-haul truck emissions rates



MOVES Application - Issues

- Major changes to default tables using MYSQL Query Browser
 - Tedious and time consuming
 - SQL scripts may be needed to automate the process
- Post Processing necessary using MYSQL or MS-Access
 - Number of records in output database may not fit in Excel
- Familiarity with MYSQL will help a smooth transition from MOBILE6 to MOVES
- Users can modify or update any default MOVES input table
 - Quality Control?



Preliminary Application of MOVES Emissions Rates

- MOVES Greenhouse Gas Emissions Rates applied to Simulation Speeds
 - Methane, Nitrous Oxide and Carbon Dioxide emissions rates generated for
 - Year – 2007
 - Season – Winter
 - Vehicle Type – Passenger Car
 - Speed Categories – 16 speed bins (default)
 - County – Clark County
 - State – Washington
 - Time Aggregation Level – Monthly



Preliminary Application of MOVES Emissions Rates

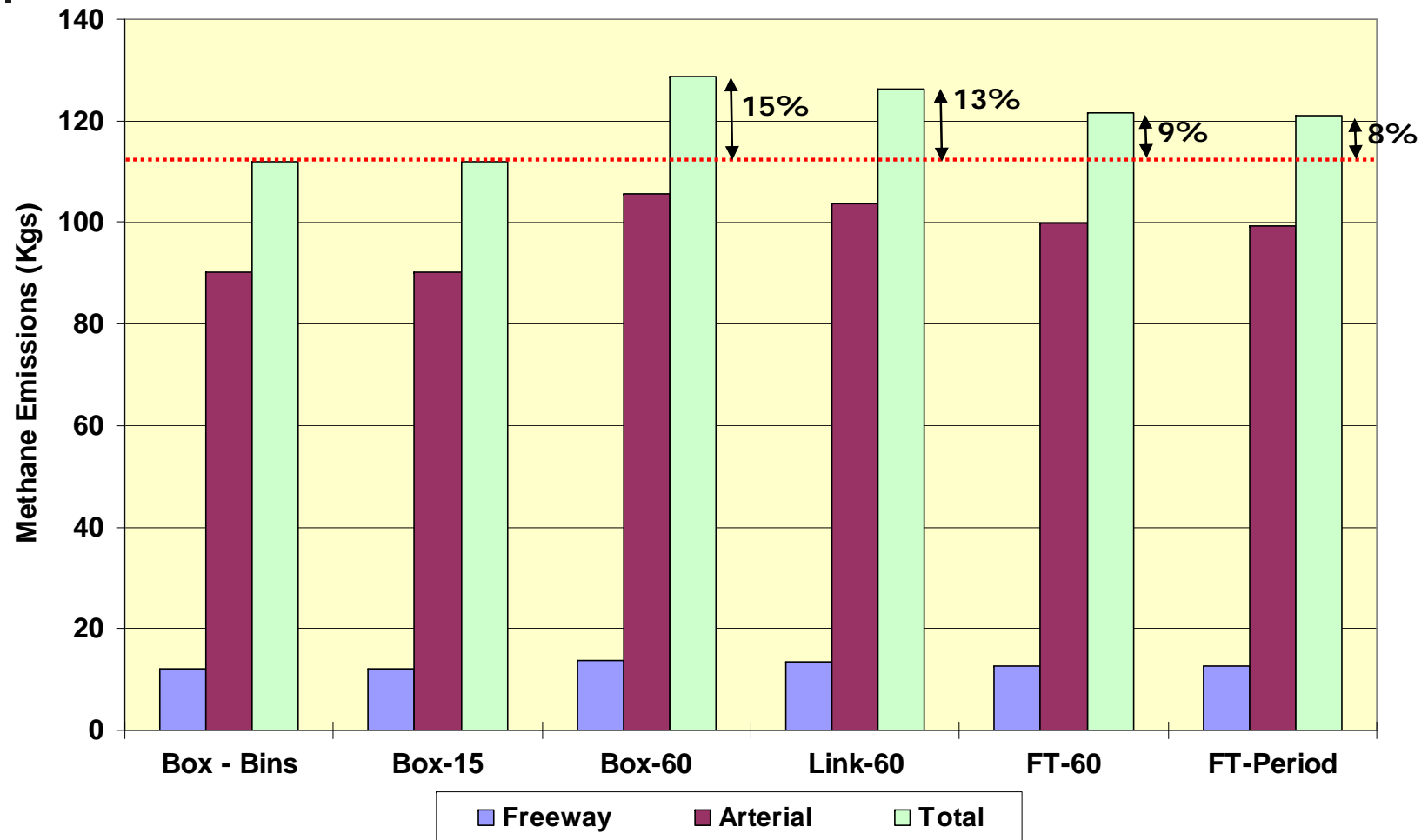
- The TRANSIMS Simulation data aggregated at 6 different levels (space, time and speed levels)

Level	Segment Type	Time Steps	Speed
1	30m Link Segment	15 mins.	6 speed Bins
2	30m Link Segment	15 mins.	Average
3	30m Link Segment	60 mins.	Average
4	Entire Link Length	60 mins.	Average
5	Facility Type	60 mins.	Average
6	Facility Type	3 periods	Average

- The MOVES Emissions rates applied to the simulation speeds using a custom program

Preliminary Results – Impact of Aggregation

Methane Emissions Estimate

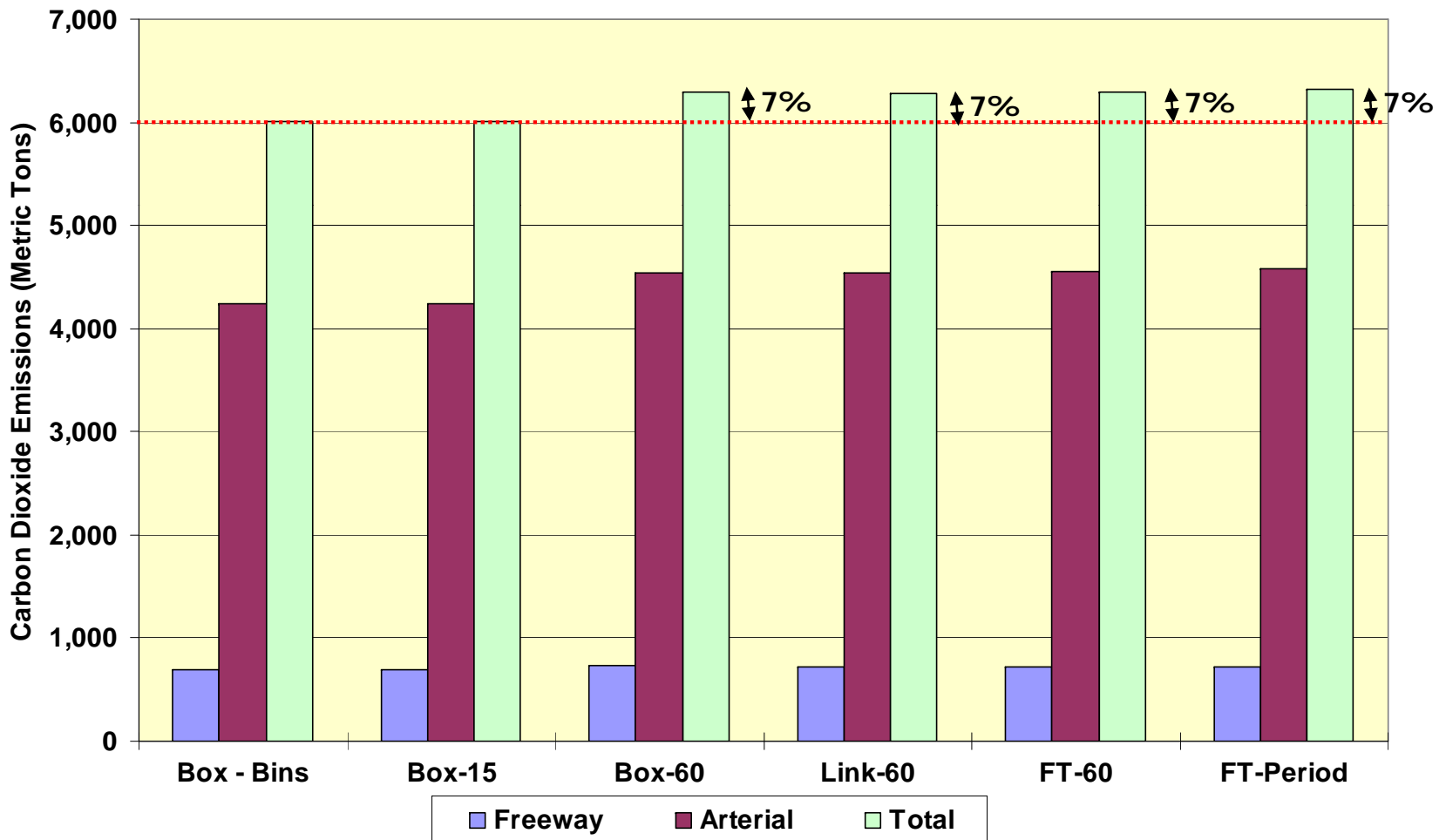


6/22/2008

MOVES Application

20

Preliminary Results – Impact of Aggregation Carbon Dioxide Emissions Estimate



6/22/2008

MOVES Application

21



Conclusions

- Running MOVES is reasonably straight forward for small applications
 - Run time performance needs to be significantly improved
 - Better run-monitoring features needed
- Reproducing a MOBILE6 application can be difficult
 - The learning curve / re-tooling effort is significant
 - Differences in the facility types, speeds, fleet mix, I/M programs etc
- Guidance should be provided on
 - Default tables that needs to be changed
 - Additional data required or desirable
- Preliminary application indicates speed aggregation impacts emissions estimate



Next Steps

- Continue testing the MOVES software
 - Share lessons learned and questions with EPA
- Generate “real” emission rates using MOVES2008
 - “Carefully Compare” MOVES emission rates with MOBILE6
- Apply MOVES to static and simulated travel data
 - Compare the results with MOBILE6