Module 5
Emission Rates for County Scale Analyses
Module Overview

• Introduction to rates
• Building a rates lookup table
• Creating a RunSpec for a rates run
• Creating an input database for a rates run
• Class exercise
Introduction to Rates

• Rates can be generated at the National, County (including custom domains), and Project Scales

• Output from an Emission Rates run is a set of emission rates: e.g., rate per mile, per vehicle, per hour, per start

• User must post-process results by multiplying rates by appropriate activity (e.g., miles, vehicles)
  • MOVES does for you when using Inventory mode
  • Because of the post-processing needed, with Emission Rates mode there is greater potential to introduce error

• But, there are some applications where rates are useful...
Why use rates?

• More flexibility when you need to estimate emissions over a wide range of conditions, e.g., many counties, or a wide range of temperatures
  • for creating SIP or other inventories
  • for modeling specific episodes in a SIP for photochemical modeling

• To generate rates for a smaller temperature range for transportation conformity purposes (e.g., a typical summer day)

• To create a link-based inventory (e.g., in a travel model post-processor) by applying the specific rates needed on each link
In Emission Rates mode, MOVES output database includes rate tables that cover all the emissions processes:

- **Rateperdistance**: Running processes
- **Ratepervehicle**: Start, Hotelling, Evap, Refueling processes
  - **Rateperstart**: Start processes
  - **Rateperhour**: Hotelling processes
- **Rateperprofile**: Evap fuel vapor venting

To calculate an inventory that captures all vehicle activity, you will need to use rates from several rate tables.
# Processes Included in Each Rate Table

<table>
<thead>
<tr>
<th>MOVES Output Table</th>
<th>Process ID and Process:</th>
</tr>
</thead>
</table>
| **Rateperdistance** | 1: Running exhaust  
  9: Brakewear  
  10: Tirewear  
  11: Evap permeation  
  12: Evap fuel vapor venting  
  13: Evap fuel leaks  
  15: Crankcase running exhaust  
  18: Refueling displacement vapor loss  
  19: Refueling spillage loss |
| when running       |                        |
| **Ratepervehicle** | 2: Start  
  11: Evap permeation  
  13: Evap fuel leaks  
  16: Crankcase start  
  17: Crankcase extended Idle  
  18: Refueling displacement  
  19: Refueling spillage  
  90: Extended idle  
  91: Aux power exhaust |
| when resting       | alternative: use rate from **Rateperstart**  
  alternative: use rate from **Rateperhour** |
| **Rateperprofile** | 12: Evap fuel vapor venting |
|                   | alternative: use rate from **Rateperhour** |
When would I use alternative rates?

- Depends on the “activity” information you have

<table>
<thead>
<tr>
<th>Use rates from:</th>
<th>If you have:</th>
<th>To get emissions for:</th>
<th>Notes:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rateperstart</td>
<td>Number of vehicle starts</td>
<td>Start (2, 16)</td>
<td>Use these rates instead of rates from “ratepervehicle”</td>
</tr>
<tr>
<td>Rateperhour</td>
<td>Number of hours that trucks are hoteling</td>
<td>APU (90) Extended idle (17, 91)</td>
<td>Use these rates instead of rates from “ratepervehicle”</td>
</tr>
<tr>
<td>Ratepervehicle</td>
<td>Only number of vehicles, and no other info</td>
<td>Start (2, 16)</td>
<td>Use these rates if you don’t have number of starts</td>
</tr>
<tr>
<td></td>
<td></td>
<td>APU (90) Extended idle (17, 91)</td>
<td>Use these rates if you don’t have hours hoteling</td>
</tr>
</tbody>
</table>

- Regardless, to capture all processes, you will also need to use rates from rateperdistance, ratepervehicle, and rateperprofile
How Rates Vary: General

• You can obtain rates that vary by:
  - source use type (vehicle type)
  - model year
  - fuel type

• By checking the box on the “Output Emissions Detail” panel in the RunSpec
  • If you don’t make these selections, MOVES produces composite emissions rates over that category

• When should you select:
  - Source use type? Likely always (13 source types)
    • You need activity (VMT, population) by source type, to calculate emissions
    • Remainder of module assumes this box is checked
  - Model year? ONLY IF you have different age distributions by county (31 model years)
  - Fuel type? ONLY IF you have activity by fuel type (4 fuel types)
How Rates Vary

• Running rates vary with:
  • Temperature: you input the range
  • Road type: rates for each of 4 different road types, ids 2 - 5
  • Speed bin: rates for 16 speed bins

• How many rates does the rateperdistance table produce?
  = [up to 9 processes] x [13 source types] x [4 road types] x [16 speed bins] x [# of temps]
  = Up to 7488 rates per temperature, for each pollutant
## MOVES Speed Bins

<table>
<thead>
<tr>
<th>avgSpeedBinID</th>
<th>avgSpeedBinDesc</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Speed &lt; 2.5mph</td>
</tr>
<tr>
<td>2</td>
<td>2.5mph &lt;= speed &lt; 7.5mph</td>
</tr>
<tr>
<td>3</td>
<td>7.5mph &lt;= speed &lt; 12.5mph</td>
</tr>
<tr>
<td>4</td>
<td>12.5mph &lt;= speed &lt; 17.5mph</td>
</tr>
<tr>
<td>5</td>
<td>17.5mph &lt;= speed &lt; 22.5mph</td>
</tr>
<tr>
<td>6</td>
<td>22.5mph &lt;= speed &lt; 27.5mph</td>
</tr>
<tr>
<td>7</td>
<td>27.5mph &lt;= speed &lt; 32.5mph</td>
</tr>
<tr>
<td>8</td>
<td>32.5mph &lt;= speed &lt; 37.5mph</td>
</tr>
<tr>
<td>9</td>
<td>37.5mph &lt;= speed &lt; 42.5mph</td>
</tr>
<tr>
<td>10</td>
<td>42.5mph &lt;= speed &lt; 47.5mph</td>
</tr>
<tr>
<td>11</td>
<td>47.5mph &lt;= speed &lt; 52.5mph</td>
</tr>
<tr>
<td>12</td>
<td>52.5mph &lt;= speed &lt; 57.5mph</td>
</tr>
<tr>
<td>13</td>
<td>57.5mph &lt;= speed &lt; 62.5mph</td>
</tr>
<tr>
<td>14</td>
<td>62.5mph &lt;= speed &lt; 67.5mph</td>
</tr>
<tr>
<td>15</td>
<td>67.5mph &lt;= speed &lt; 72.5mph</td>
</tr>
<tr>
<td>16</td>
<td>72.5 &lt;= speed</td>
</tr>
</tbody>
</table>
Why would running emission rates for the same speed bin differ by road type?

- For example, suppose traffic on each of these road types is averaging 35 mph.
How Rates Vary

• Ratepervehicle rates (9 processes), rateperstart rates (2 processes), and rateperhour rates (3 processes) vary with:
  • Temperature (based on what you enter for a daily “temperature profile” – the temperature over the course of a day)
  • Type of day (weekday vs. weekend day)
  • Hour of day

• How many rates does the ratepervehicle table produce?
  = [up to 9 processes] x [13 source types] x [2 day types] x [24 hours] x [# of temperature profiles]
  = up to 5616 rates for each temperature profile, for each pollutant

• Similarly, up to 1248 rates per temperature in the rateperstart table
• And up to 1872 rates per temperature in the rateperhour table
How two temperature profiles affect rates...
Effect of temperature/hour on running emissions

The rates for hour 10 and hour 20 will be identical since the temperatures are the same.
Effect of temperature/hour on start emissions

The rates for hour 10 and hour 20 will be different since the number of starts and soak-time distributions differ by hour.
The rates at hour 15 will be different because the rate of temperature change in the previous hours is different.
How Rates Vary

• Why would ratepervehicle, rateperstart, and rateperhour rates differ by both temperature and hour of day?

• Why would they differ by type of day?
How Rates Vary

- **Rateperprofile rate** (1 process) varies with
  - Temperature (based on what you enter for a daily temperature profile),
  - Temperature in the previous hour
  - Type of day (weekday vs. weekend day)
  - Hour of day

- How many rates does the **rateperprofile** table produce?
  - \[ \text{Process} \times \text{Source Types} \times \text{Day Types} \times \text{Hours} \times \text{Temperature Profiles} \]
  - \[1 \times 13 \times 2 \times 24 \times \text{# of temperature profiles}\]
  - 624 rates for each temperature profile, for each pollutant

- Why would these rates differ by both temperature and hour of day?
- Why would they differ by type of day?
## How Rates Vary: Summary

<table>
<thead>
<tr>
<th>Rates vary with:</th>
<th>Rateperdistance</th>
<th>Ratepervehicle</th>
<th>Rateperprofile</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Only if selected</td>
<td>Only if selected</td>
<td>Only if selected</td>
</tr>
<tr>
<td>Vehicle type (x 13)</td>
<td>Yes</td>
<td>Yes – temperature profile</td>
<td>Yes – temperature profile</td>
</tr>
<tr>
<td>Temperature (x ?)</td>
<td>Yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Road type (x 4)</td>
<td>Yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Speed bin (x 16)</td>
<td>Yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type of day (x 2)</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>(Weekday/Wkend)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hour of Day (x 24)</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Model year (x 31)</td>
<td>Only if selected</td>
<td>Only if selected</td>
<td>Only if selected</td>
</tr>
<tr>
<td>Fuel type (x 4)</td>
<td>Only if selected</td>
<td>Only if selected</td>
<td>Only if selected</td>
</tr>
</tbody>
</table>
Running Emissions (Rate per distance Table)

- Total running emissions = 
  \[ (\text{Running emissions rate}) \times (\text{VMT}) \]

- Rates given in grams per vehicle-mile
- To get a total running inventory, repeat calculation for each process, vehicle type, road type, and speed bin at the relevant temperature; sum results
Start Emissions

• Start rates are produced in both:
  • grams per vehicle from the ratepervehicle table, for each hour of day, for each daily temperature profile
    • Calculate inventory by multiplying by vehicle population
  • grams per start from the rateperstart table, for each hour of day, for each daily temperature profile
    • Calculate inventory by multiplying by number of starts

• WARNING: Use one or the other – not both
Start Emissions

• Calculate total start emissions by multiplying:
  \[
  \text{Start emissions rate} \times (\text{vehicle population})
  \]
  from \text{ratepervehicle}

  OR

• Calculate total start emissions by multiplying:
  \[
  \text{Start emissions rate} \times (\text{number of starts})
  \]
  from \text{rateperstart}

• To get total daily start emissions, repeat calculation for each vehicle type, start process (2, 16), hour of the day at the relevant temperature; sum results
Hotelling Emissions: APU, Extended Idle

- Hotelling rates given in both:
  - *grams per vehicle* from the *ratepervEHICLE* table, for each temperature and hour of day
    - Calculate inventory by multiplying by vehicle population (i.e., of 62’s)
  - *grams per hour* from the *rateperHOUR* table, for each temperature and hour of day
    - Calculate inventory by multiplying by number of hoteling hours

- **WARNING:** Use one or the other – not both

- Be sure to check “Source Use Type” on Output Emissions Detail panel -- if not selected, MOVES will give you a composite rate that applies to all vehicles
Hotelling Emissions: APU, Extended Idle

• Calculate total extended idle emissions, and total APU emissions by multiplying:

\[(\text{rate from ratepervehicle}) \times (\text{number of source type 62s})\]

OR

\[(\text{rate from rateperhour}) \times (\text{number of hoteling hours})\]

• To get total daily hotelling emissions, repeat calculation for 62’s, for each hotelling process (17, 90, 91), hour of the day at the relevant temperature; sum results
Evaporative Fuel Vapor Venting (Rate per profile table)

- Rate given in grams per vehicle, for each temperature and hour of day
- Rates are affected by the temperature, and hour of day, as well as the temperature of the previous hour
- Inventory is calculated by multiplying the rate by the vehicle population – not the number of parked hours
Evaporative Fuel Vapor Venting (Rate per profile table)

• Calculate total evaporative emissions by multiplying:

\[(\text{evaporative Fuel Vapor Venting rate}) \times (\text{number of vehicles})\]

• For total daily evaporative fuel vapor venting emissions, repeat calculation for each vehicle type and hour, for the relevant temperature profile; sum results
Building a Rates Lookup Table
Building a Rates Lookup Table

• An advanced approach; particularly useful for modeling large geographic areas

• Allows you to generate rates for a wide range of temperatures with a minimal number of runs

• Involves making certain selections in the RunSpec, and using the meteorology tab of the CDM to define temperatures:
  • Each month selected in the RunSpec provides you 24 temperature “slots” (one for each hour of the day)
  • These slots can hold temperatures in 1 degree increments, to get running rates at each specific temperature
  • Or, a month’s slots can hold a daily temperature profile, needed for start, hotelling, and evaporative fuel vapor venting rates
  • Determine how many months to select in the RunSpec based on the number of temperature slots needed to represent all the rates you need
Building a Rates Lookup Table

For running rates (rateperdistance table):

• Determine the temperature range for which you want rates, and how many months are needed in the RunSpec (each month = 24 temperatures)
  • For example, if the temperature range of interest is 50 to 97°F, 48 temperature slots are needed; 2 months can accommodate all of them
  • July Hour 1: 50 degrees
  • July Hour 2: 51 degrees ... (and so on, one degree per slot until...)
  • August Hour 24: 97 degrees

• A rate will be produced for each temperature – in this case, the hourID does not impact the results

• MonthID (the month(s) chosen in the RunSpec) affects the fuels MOVES assumes, but otherwise does not affect the rates
  • because you are defining the temperatures
Building a Rates Lookup Table

- For start and hotelling rates (ratepervehicle table) and evaporative fuel vapor venting (rateperprofile table):
  - Determine the number of diurnal profiles you need; each month selected can accommodate one diurnal profile
  - Input a realistic diurnal profile for the 24 hours, since both temperature and hour of day impact these emission rates, e.g.:
    September Hour 1 – 50.1 degrees
    September Hour 2 – 51.6 degrees
    September Hour 3 – 54.4 degrees, etc.
  - A rate will be produced for each temperature/hourID
  - MonthID (the month(s) chosen in the RunSpec) affect the fuels MOVES assumes, but otherwise does not affect the rates
    - because you are defining the temperatures
Building a Rates Lookup Table

• You can get running rates (rateperdistance table), start and hotelling rates (ratepervehicle table) and resting evaporative rates (rateperprofile table) all in one run:
  • Use some months to define one degree temperature intervals, for running rates
  • Use other months to define daily temperature profiles, for start, extended idle, and resting evaporative rates
  • Use specific months to have MOVES assume the right fuels
Building a Rates Lookup Table

Example of an annual inventory – Six months selected in RunSpec

Winter rates:
• Use months 12 and 1 to cover the winter temperature range for \textit{rateperdistance} rates
  • E.g., 10 degrees through 57 degrees in 1 degree intervals
• Use month 2 to define a typical winter daily temperature profile for \textit{ratepervehicle} and \textit{rateperprofile} rates

Summer rates:
• Use month 6 and 7 to cover the summer temperature range for \textit{rateperdistance} rates
  • E.g., 40 degrees through 87 degrees in 1 degree intervals
• Use month 8 to define a typical summer daily temperature profile for \textit{ratepervehicle} and \textit{rateperprofile} rates
Building a Rates Lookup Table

For discussion:

What if you need more temperature slots for summer, but you run out of summer months in the RunSpec?

What if you need more temperature slots, period?
Building a Rates Lookup Table

For discussion:

What if you need more temperature slots for summer, but you run out of summer months in the RunSpec?

- You can use any of the 12 months – just be sure to apply the summertime fuel formulation to any months where summertime temps are defined (in the fuel tab of the CDM)

What if you need more temperature slots, period?

- You could do multiple runs
- You could choose Custom Domain in the RunSpec, and each Zoneid can then be used to define more temperatures
Creating a RunSpec for a Rates Run
Rates RunSpec Guidance – Scale

- Select *County* in the Domain/Scale
- Select Emission Rates
- MOVESScenarioID is required but will not affect results
  - Used for SMOKE-MOVES
  - If not using SMOKE-MOVES, enter something descriptive
Rates RunSpec Guidance – Scale

- **Scale**
  - Time Spans
  - Geographic Bounds
  - Vehicles/Equipment
  - Road Type
  - Pollutants And Processes
  - Manage Input Data Sets
- **Strategies**
- **Output**
  - Advanced Performance Features

**Model**
- Onroad
- Nonroad

**Domain/Scale**
- National: Use the default national database with default state and local allocation factors.
  - Caution: Do not use this scale setting for SIP or conformity analyses. The allocation factors and other defaults applied at the state or county level have not been verified against specific state or county data and do not meet regulatory requirements for SIPs and conformity determinations.
- County: Select or define a single county that is the entire domain.
  - Note: Use this scale setting for SIP and regional conformity analysis. Use of this scale setting requires user-supplied local data for most activity and fleet inputs.
- Project: Use project domain inputs.
  - Note: Use this scale setting for project-level analysis for conformity, NEPA, or any other regulatory purpose. Use of this scale setting requires user-supplied data at the link level for activity and fleet inputs that describe a particular transportation project.

**Calculation Type**
- Inventory: Mass and/or Energy within a region and time span.
- Emission Rates: Mass and/or Energy per unit of activity.

**Moving Scenario ID:**
- Washtenaw Rates Run

**Caution:** Changing these selections changes the contents of other input panels. These changes may include losing previous data contents.
Rates RunSpec Guidance – Time Spans

• Select one or more months
  • Each month allows rates for 24 temperatures

• Select all hours

• Select one or more day types
  • Start/evap rates will vary by day type
  • An annual inventory should use rates for weekend and weekdays
  • Daily inventory may just use weekday
Rates RunSpec Guidance – Time Spans
Rates RunSpec Guidance – Geographic Bounds

• Select a single county or custom domain

• Custom domain can add additional flexibility using the zone input
  • Possible to model many temperature ranges and diurnal profiles with separate zoneIDs
Rates RunSpec Guidance – Geographic Bounds
Rates RunSpec Guidance – Vehicle/Equipment

• Select all vehicle/fuel types present in modeling domain

• A rate will be produced for each ☑ source type and ☑ fuel type
  • IF checked on the Output panel
Rates RunSpec Guidance – Vehicle/Equipment
Rates RunSpec Guidance – Road Type

- Select all road types present in modeling domain
  - Usually all road types
- A running emissions rate will be produced for each road type other than “off network”
- Start, hotelling, and evaporative rates are for activity occurring on the “off network” road type
Rates RunSpec Guidance – Road Type
Rates RunSpec Guidance – Pollutants And Processes

• Select all pollutants of interest

• For a complete inventory, it is necessary to select all processes

• A rate will be produced for each pollutant and process
  • Either expressed as rateperdistance, ratepervehicle, or rateperprofile
Rates RunSpec Guidance – Pollutants And Processes
Rates RunSpec Guidance – General Output

• Create an output database

• Select grams, joules, and miles

• Activity output will automatically be generated for distance traveled and population
Rates RunSpec Guidance – General Output
Rates RunSpec Guidance – Output Emissions Detail

• Road type and emission process are auto-selected
  • Rates will be produced for each road type and emissions process

• Additional selections depend on available activity data (VMT or vehicle population)
  • VMT by source type?
    • Usually
  • VMT by fuel type or model year?
    • Less likely
Rates RunSpec Guidance – Output Emissions Detail
Creating an Input Database for a Rates Run
Meteorology

• Recall: meteorology tab can be used to define the range of rates produced
  • A rate is generated for every temperature defined
• Each month selected in the RunSpec allows 24 temperatures to be defined (hours 1-24)
• Select multiple months to allow a complete range of temperatures for rateperdistance as well as several diurnal profiles for ratepervehicles/rateperprofile rates
• MonthID affects fuels, but otherwise does not affect the rates produced
Source Type Population

- After the run, you multiply rate per vehicle and rate per profile rates by vehicle population
- However, population is still necessary as an input
- A population should be entered that is reasonable, and consistent with VMT
  - One option is to enter the total vehicle population of the modeling domain
  - Alternatively, a representative county’s vehicle population can be used
- Most important, the ratio of vehicle population to VMT must reflect actual conditions
Age Distribution

• Users should enter the Age Distribution of the modeling domain
• This must be uniform across all counties in order to use the output rates for all areas
• If age distribution is not uniform across all counties you need to model, either
  • Do multiple runs, or
  • Select Model Year on the output emissions detail to produce rates for each model year
    • Then rates can be post-processed to account for varying age distribution across a multi-county domain
VMT (HPMSVTypeYear)

• After the run, you multiply rateperdistance rates by VMT
• However, VMT is still necessary as an input
• A VMT should be entered that is reasonable, and consistent with vehicle population
  • One option is to enter the total VMT of the modeling domain
  • Alternatively, a representative county’s VMT can be used
• Most important, the ratio to vehicle population must reflect actual conditions
VMT (month, day, hour fractions)

- MonthVMTfraction, dayVMTfraction, and hourVMTfraction are also required by MOVES

- These fractions impact emission rate calculations

- Reasonable values should be entered
  - Either local fractions or MOVES defaults
Speed Distribution

• Emission rates for rateperdistance will be produced for each of 16 speed bins

• MOVES still requires an average speed distribution input

• This should be a reasonable distribution
  • Either local distribution or MOVES defaults
Road Type Distribution

• Emission rates for rateperdistance will be produced for each road type

• MOVES still requires a road type distribution input

• This should be a reasonable distribution
  • Either local distribution or MOVES defaults
Ramp Fraction

• Users should input the local ramp fraction
  • or use the MOVES default (0.08) if none is available

• Emission rates for rateperdistance will include ramp activity within each of the 16 speed bins
  • The table does not have separate rates for ramps

• Ramp VMT should be added to Restricted Access roadway VMT since the rates are a combination of freeway and ramp emissions
Fuel

• If local data suggests that ethanol/diesel/gasoline/CNG mix for a given source type or model year differ from the defaults, these fractions should be changed

• If no local data exists, users may use the default Fuel data
  • Automatically selected in the CDM

• If user selects output by fuel type, these fractions do not need to be changed
Fuel

• Users should input the fuel information used in the modeling domain
  • Rates cannot be applied to areas that use different fuels

• Also, fuels should correspond to the temperature profile for a given month
  • For instance, a **summertime** diurnal temperature profile using the MonthID = 1 should not use January fuels (see meteorology)
I/M Programs

• Users should input the Inspection and Maintenance program used in the modeling domain
  • Rates cannot be applied to areas that have a different I/M program, or different compliance rates
Class Exercise
Class Exercise

• We will use MOVES to develop a HC inventory for gasoline passenger cars in Lake County, IN operating on off-network and urban unrestricted roads at 12-1am in a typical summer day
  • Same analysis as Day 1’s County-level inventory run
  • Temperature is 66 degrees F
  • All processes will be modeled to produce rateperdistance, ratepervehicle, and rateperprofile tables

• The output tables will be queried for relevant information and applied to known vehicle activity
Class Exercise

Step 1: Load the RunSpec

- Open Rates.mrs (in “Course Files\Rates Exercise” folder)
- This runspec is identical to Day 1’s County Inventory Run, except:
  - Emission Rates are selected in the Scale panel
  - Both July and August are selected in Time Spans panel
    - This enables us to enter a temperature range for one month, and a diurnal temperature profile for the other month – all in one MOVES run
  - A new output database is created (lake_rates_HC_out)
Class Exercise

Step 2: Use an existing input database

- In your mysql data folder on your C:\, copy the Lake_2015_training_in folder (created on Day 1)
- Paste folder and re-name as Lake_Rates_HC_in
- In the MOVES Geographic Bounds panel, select Lake_Rates_HC_in from the drop-down menu

Step 3: Open the CDM and “Clear Imported Data” for the meteorology tab

Step 4: Import a meteorology table that produces the desired lookup table (met.xls, from “Course Files\Rates Exercise” folder)
Class Exercise – Met.xls input file

- MonthID 7 will be used to define a summertime diurnal temperature profile
Class Exercise – Met.xls input file

• MonthID 8 will be used to create a lookup table for a summertime temperature range
  • 61 degrees through 84 degrees in 1 degree increments
Class Exercise

Step 5: “Clear Imported Data” for the fuels tab

Step 6: Import Fuels tables (fuels.xls), from “Course Files\Rates Exercise” folder)
Class Exercise

Step 7: Close the CDM

Step 8: Execute MOVES

This run should take approximately 30 minutes

We will now process the resulting data.
Querying the output

Running Rates Query:

```
SELECT * FROM `lake_rates_hc_out`.rateperdistance where monthid = 8
and temperature = 66 and roadtypeid = 5 and processid = 1 and
pollutantid=1;
```

*Export the result set to excel and save as rateperdistance.csv*

Start Rates Query:

```
SELECT * FROM `lake_rates_hc_out`.ratepervehicle where monthid = 7
and processid = 2 and hourid = 1;
```

*Export the result set to excel and save as ratepervehicle.csv*

Resting Evap Rates Query:

```
SELECT * FROM `lake_rates_hc_out`.rateperprofile where hourid = 1 and
temperatureprofileID = 1808900700;
```

*Export the result set to excel and save as rateperprofile.csv*
Post-process – rateperdistance.xls (running emissions)

• Multiply the VMT shown here with the running emission rate (rateperdistance)

• Sum the result of each speed bin to calculate the total running inventory

<table>
<thead>
<tr>
<th>Speedbin</th>
<th>VMT for sourcetype 21, roadtype 5, and hourID 1 by speed bin</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>58.25896534</td>
</tr>
<tr>
<td>2</td>
<td>173.89147</td>
</tr>
<tr>
<td>3</td>
<td>237.2757864</td>
</tr>
<tr>
<td>4</td>
<td>361.0571845</td>
</tr>
<tr>
<td>5</td>
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Post-process – Ratepervehicle.xls (Start Emissions)

- Multiply the total vehicle population by the appropriate ratepervehicle (queried earlier)

- Total vehicle population for sourcetype 21 (passenger cars) is 47,292
Post-process – *Rateperprofile.xls* (Evap Vapor Venting)

- Multiply the total vehicle population by the appropriate *rateperprofile* (queried earlier)

- Total vehicle population for *sourcetype 21* (passenger cars) is 47,292
Sum totals

Sum the emissions that were post-processed in

- rateperdistance.xls,
- ratepervehicle.xls, and
- rateperprofile.xls tables

to calculate an inventory
Conclusions

• The total should equal 1179.21 grams

• Note that this total is only for a very small part of the overall HC inventory:
  • Gasoline passenger cars on road types 1 and 5 at 12-1am on a typical summer weekday (exhaust and vapor venting only)

• To get a complete inventory using the Rates approach, this process would be repeated for all source types, all road types, all processes, and all hours

• An annual inventory would involve even more post-processing
Module Summary

• A rates run allows you to generate rates for a variety of applications, especially useful for wide geographic areas

• A rates run generates potentially thousands of rates, found in several tables
  • Multiply the rates by the appropriate activity after the run
  • Be careful in post-processing to avoid introducing errors

• MOVES does the multiplying for you in Inventory mode
  • Consider whether Inventory would be simpler, e.g., for modeling a small number of counties

• Either mode is acceptable for SIP and conformity purposes and will produce the same results
Questions?