

New Generation Model Update



**Briefing for FACA Modeling Workgroup
February 12, 2002**

Progress

- Significant progress on software design
 - Would use EPA Multi-Media Integrated Modeling System (MIMS)
 - Allows for:
 - County-Level Inventory Development
 - Mesoscale/Microscale Analysis
 - Merging On-Road and Off-Road
 - Easier Policy Evaluation
 - Uncertainty Analysis
 - Improved Interface, Reporting, Visualization
- On-Board emission pilot study complete
- On-Board “Shootout” analyses nearly complete

Proposed Development Approach

- **Core Model**

- MOBILE6 replacement
- New software code
- Multi-scale emission estimation

- **Enhanced Modeling System**

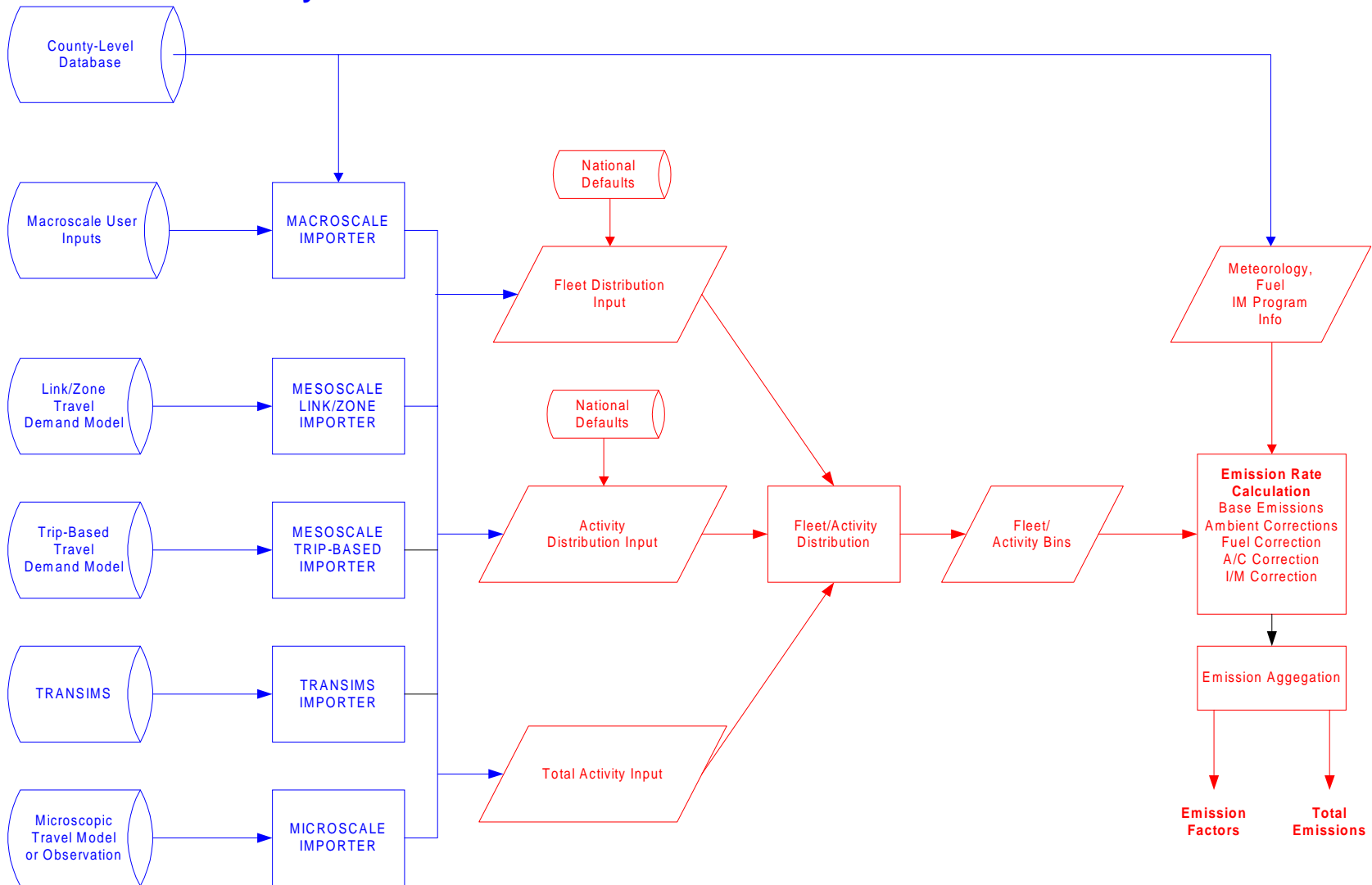
- National (county-level) inventory generation
- Linkage with transportation and AQ models
- Graphical interface
- Visualization, reporting, GIS capabilities

Core Model Framework

- **Several Emission “Processes”**
 - Running Exhaust, Start Exhaust, Diurnal, Running Loss, Resting Loss, Hot Soak, Brake Wear, Tire Wear, Refueling, Fuel Leak, Refrigerant Leak, Offgassing, Dust Re-entrainment
 - Rejected: Burning Cars (stationary source)
- **Input for Each Process**
 - Fleet Distribution
 - Activity Distribution
 - Total Activity
- **Output for Each Process**
 - Emission

Enhanced System

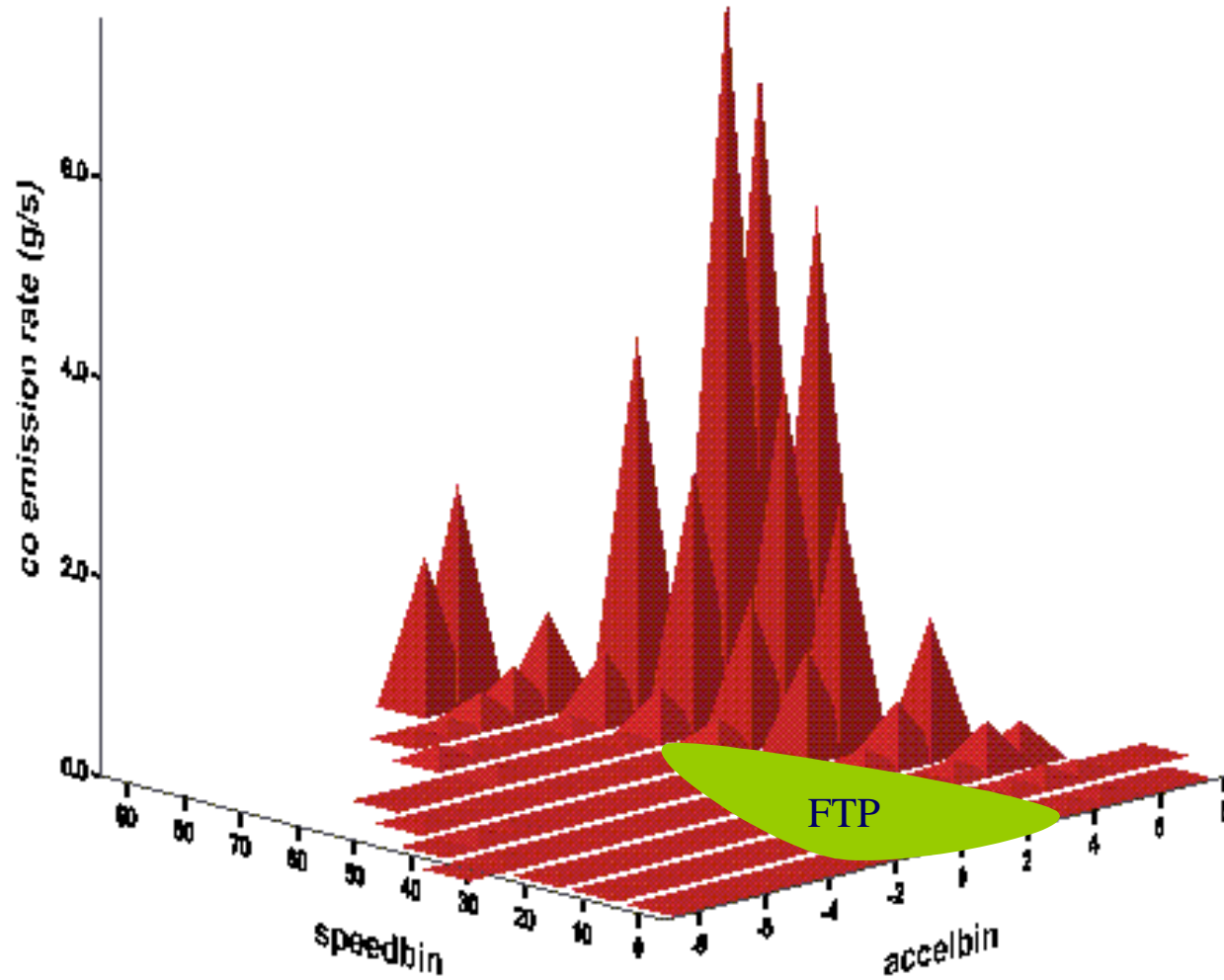
Core Model



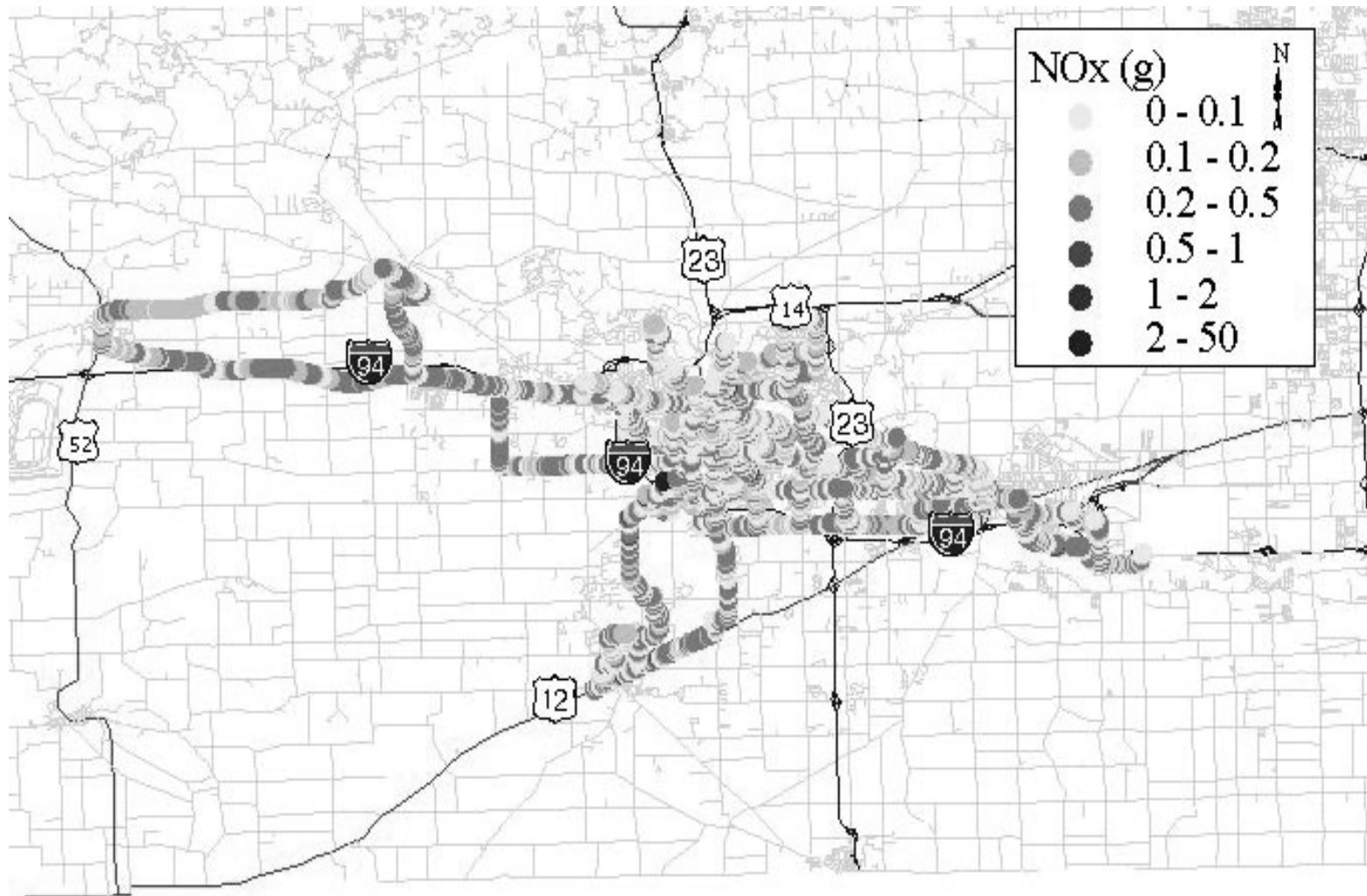
Emission Estimation

- **On-Board “Shootout”**
 - Analyze pilot data on 12 LDVs, 12 Buses, 3 NR
 - Predict emissions of independent dataset
 - Provide recommendations for:
 - On-board testing plan
 - Use of other data: lab, IM, RSD etc.
- **“Shootout” Approaches**
 - NC State: Modal Analysis
 - UC Riverside: Database Approach
 - Environ: “Event-Based” Analysis
 - EPA: Power-Based Modal Analysis
- **Most promising so far: NC State and EPA**

On-Board Data vs. FTP



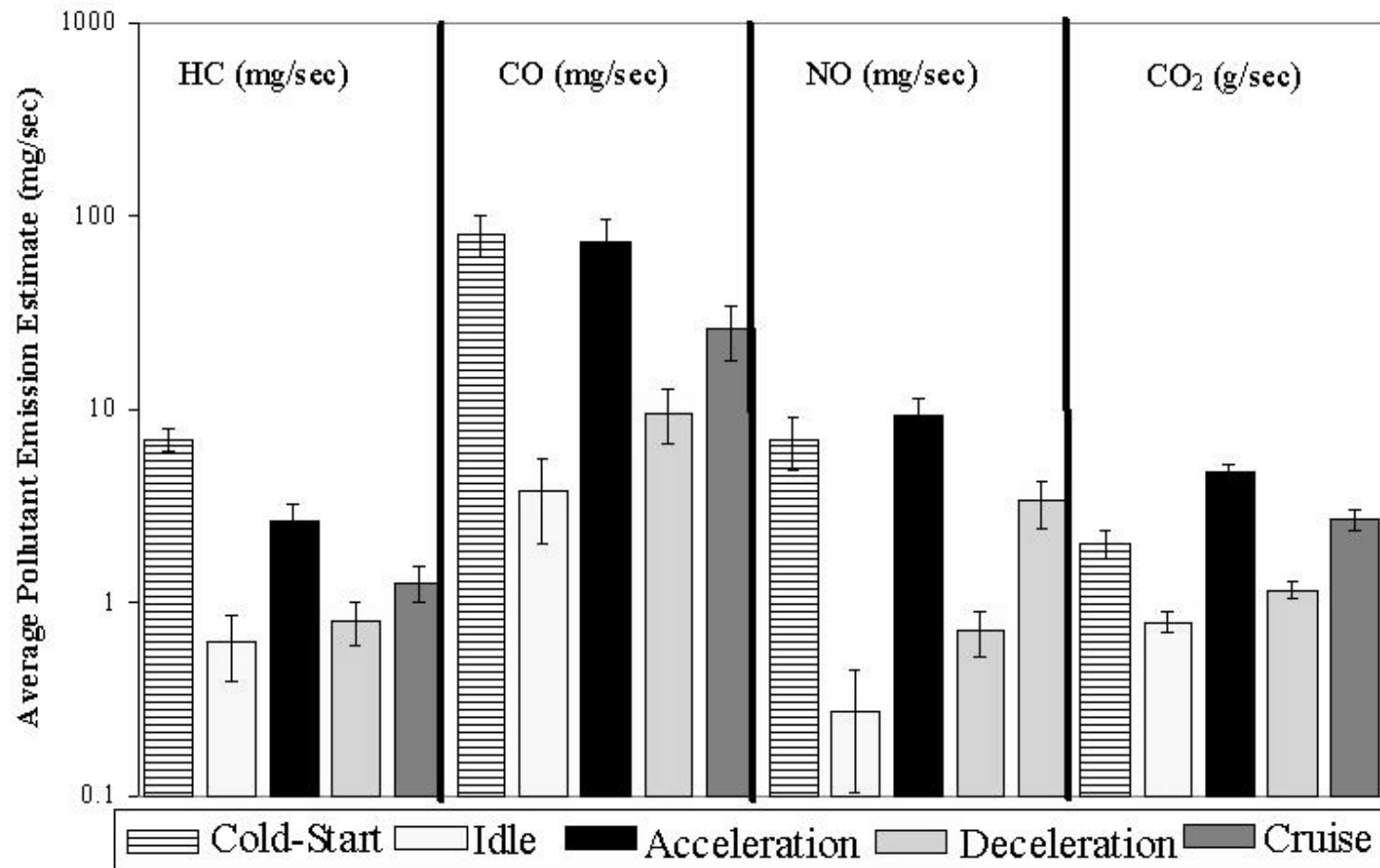
Spatial Analysis



Modal “Bin” Approach

- “Modes” can be specified several ways, e.g.
 - Idle, Accel, Cruise, Decel
 - Vehicle Specific Power Bins
- Second-by-second data grouped into appropriate bin based on speed, accel, grade
- Emission rate = average emissions by mode
- Aggregate emission calculation:
$$\left(\sum \text{Emission Rate (g/s)}_{\text{MODE}} * \text{Fraction of Time}_{\text{MODE}} \right) * \text{Total Time}$$

Modal Emission Analysis



Does It All Add Up?

Aggregate Emission Calculation

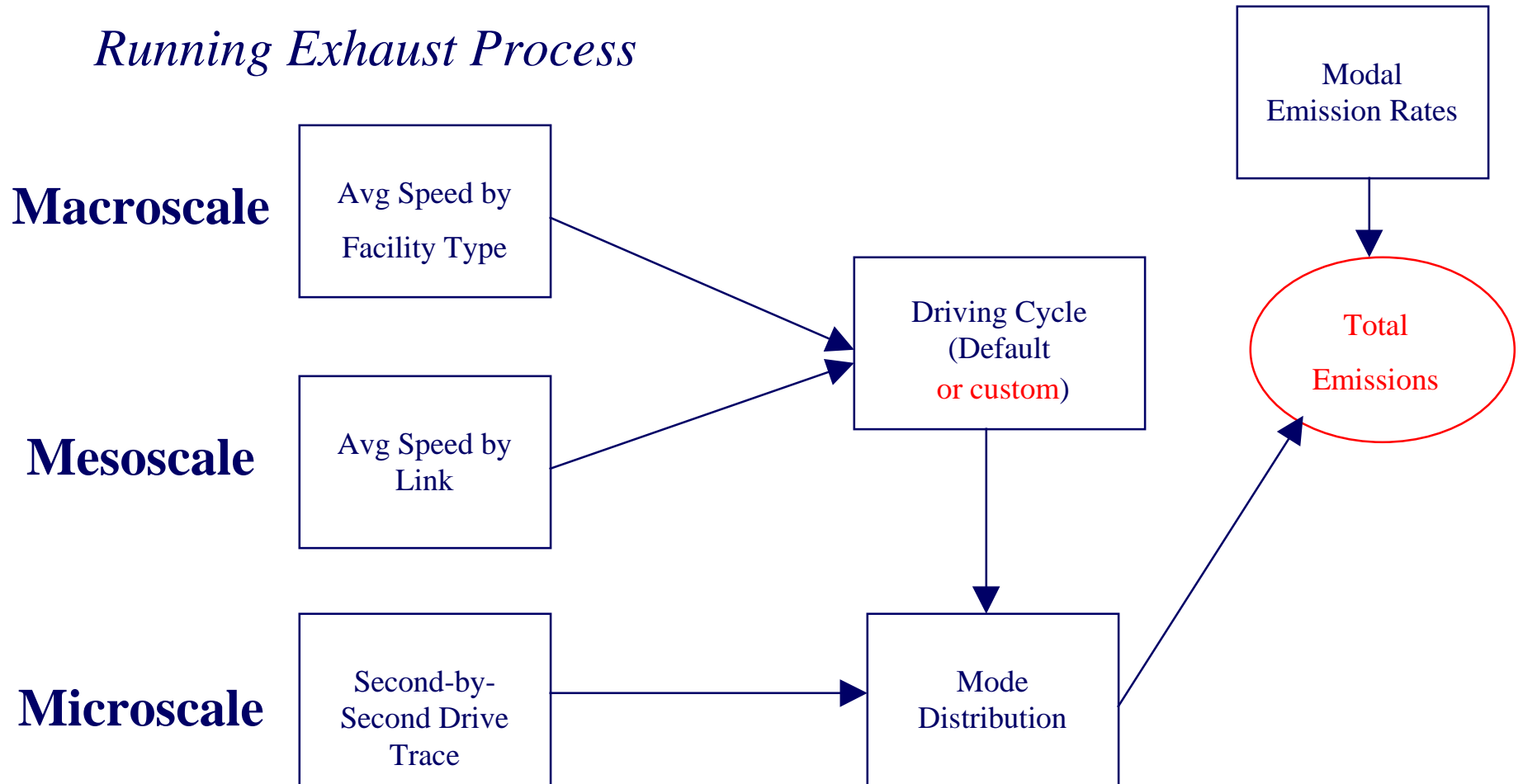
	total time (s)	total grams	emission rate g/s
HC	72,551	125	0.0017
CO	72,551	2884	0.0398
CO2	72,551	204417	2.82
NO	68,325	319	0.0047

Modal Emission Calculation

	accel	cruise	decel	idle	start	emission rate (g/s)
HC	0.00275	0.0011	0.00054	0.00041	0.00538	0.0017
CO	0.12582	0.03281	0.00912	0.00224	0.07448	0.0397
CO2	5.94	3.34	1.04	0.83	2.08	2.82
NO	0.01104	0.00502	0.0006	0.00013	0.0066	0.0047
Mode Distribution	0.072	0.564	0.079	0.135	0.149	

Applying Modal Emissions

Running Exhaust Process



Benefits of Modal Approach

- Common emission rates for all analysis scales: macro, meso, micro
- Can be used for LD, HD, NR
- Can use significantly more data than traditional cycle-based methods
 - MOBILE6 approach:
 - Requires lab testing over specific driving cycles = \$, time
 - Modal approach:
 - Uses testing over any driving cycle (EPA, ARB, CRC, etc)
 - Can use on-board data, I/M, RSD
- Can predict emissions for wide range of vehicle operation

Example Calculation - Running Exhaust Process

- Estimate LDGT2 NO_x Emissions for:
 - March 2007 weekday, 9-10 am
 - Washtenaw County, MI
 - Urban Interstates
- County Database Inputs
 - Annual LDT VMT on Washtenaw Urban Interstates in 2007: 373,000,000 (NEI via HPMS)
 - Default Average Speed on Urban Interstates: 46.3 mph (NEI)

Example Calculation - Running Exhaust Process

- Convert Annual VMT to Annual Vehicle Hours Traveled (VHO)
 - $373,000,000 \text{ miles} / 46.3 \text{ mph} = 8,056,156 \text{ AVHO}$
- Allocate to hourly VHO
 - AVHO * Monthly Allocation * Daily Allocation * Hourly Allocation

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