

MOVES Progress Update

**Briefing for FACA Modeling Workgroup
June 13, 2002**

**U.S EPA Office of
Transportation and Air Quality**

Part I :

Design and Implementation

MOVES

- **M**ultiscale
- m**O**tor
- **V**ehicle & equipment
- **E**mission
- **S**ystem

Implementation Plan

- Interim Product: Fall 2002
 - Macroscale (county-level) inventory generation w/ MOBILE6.3 and NONROAD
- GHG On-Road Implementation: Fall 2003
 - CO₂, Air Conditioning HFCs, N₂O, CH₄
 - Macroscale only
- Full On-Road Implementation: Fall 2005
 - Adds HC, CO, NO_x SO_x, PM, NH₃, air toxics
 - Mesoscale/Microscale capability

Interim Product

- National Mobile Inventory Model (NMIM)
- Will produce national inventories at county level with MOBILE6.3 and NONROAD
 - We currently pay contractors to do this via OAQPS
 - Will provide flexibility and save time
- Ozone precursors, PM, Toxics, SO_x, NH₃, CO₂
- Primary uses:
 - Assisting in regulatory analyses (Nonroad final rule)
 - Policy evaluation
- Target completion: October 2002

Planning Documents

- MOVES Comprehensive Plan: Summer 2002
 - Top-level theory & design
 - Software framework
- GHG Emission Analysis Plan: Fall 2002
 - Data sources & emission analysis methodology
- GHG Science Document: Fall 2002
 - Will undergo Peer Review
 - Will establish Peer Review Panel
- Quality Assurance Project Plan: Fall 2002
 - Required per new OEI Guidance

Priority “Use Cases”

- 2003 (On-Road Greenhouse Gas)
 - Macroscale inventory
 - Policy evaluation
 - Estimating emission-based uncertainty
 - Model updates and expansion
- 2005 (On-Road All Pollutants)
 - Mesoscale inventory
 - Microscale analysis

MOVES Design Framework

- Core Model
 - Provides access to MOVES emission rates
 - Generic design provides flexibility
 - Concept applies across scale and emission source
- Add front-ends to “drive” core model in meeting specific use cases
 - Implementations
 - Utilities
 - Policy Evaluation
 - Uncertainty and Sensitivity Analysis

Core Model

- **Input (per time, location, process, vehicle class)**
 - Total Activity
 - Operating Mode distribution
 - Technology & Standard Distribution
 - Meteorology
 - Fuel Parameters
- **Emission calculation**
 - Accesses base emission rate database
 - Calculates appropriate correction factors
 - Aggregates emissions as desired
- **Output: Total Emissions and Emission Factors**

Proposed Implementations

- On-Road Macroscale: National Inventory
 - National inventories at county level
 - Could use all default data or user-supplied data
- On-Road Mesoscale: "Basic"
 - Domain-wide inventories at link/zone level
 - Would require volume/speed by link, starts by zone
 - Other data could be default of user-supplied
- On-Road Microscale: "CAL3QHC"
- TRANSIMS
- Off-Road

Macroscale Inputs

- Official guidance will be necessary
- Default mode would require no data
 - Purpose is to support EPA reports and rulemakings; would not likely be allowed for SIPs
- When modeling specific areas:
 - Required: VMT
 - Optional:
 - Fleet, activity, meteorology, fuel at level similar to MOBILE6

“Basic” Mesoscale Inputs

- Official guidance will be necessary
- Required input
 - Link-level volume and speed
 - Zone-level number of starts
 - Zone-level allocation factors for some processes
- Default or user-supplied for other input
 - Fleet, meteorology, fuel info for area being modeled

Software

- GUI provided to set up run specifications, provide necessary input files
 - Batch processing also available
- Software design very database-driven
 - Input data will need to follow MOVES database specs
 - “Importers” could convert data
- Database language: MySQL
 - Open-source database management tool
- Programming language: Java

Part II :

Emission Analysis

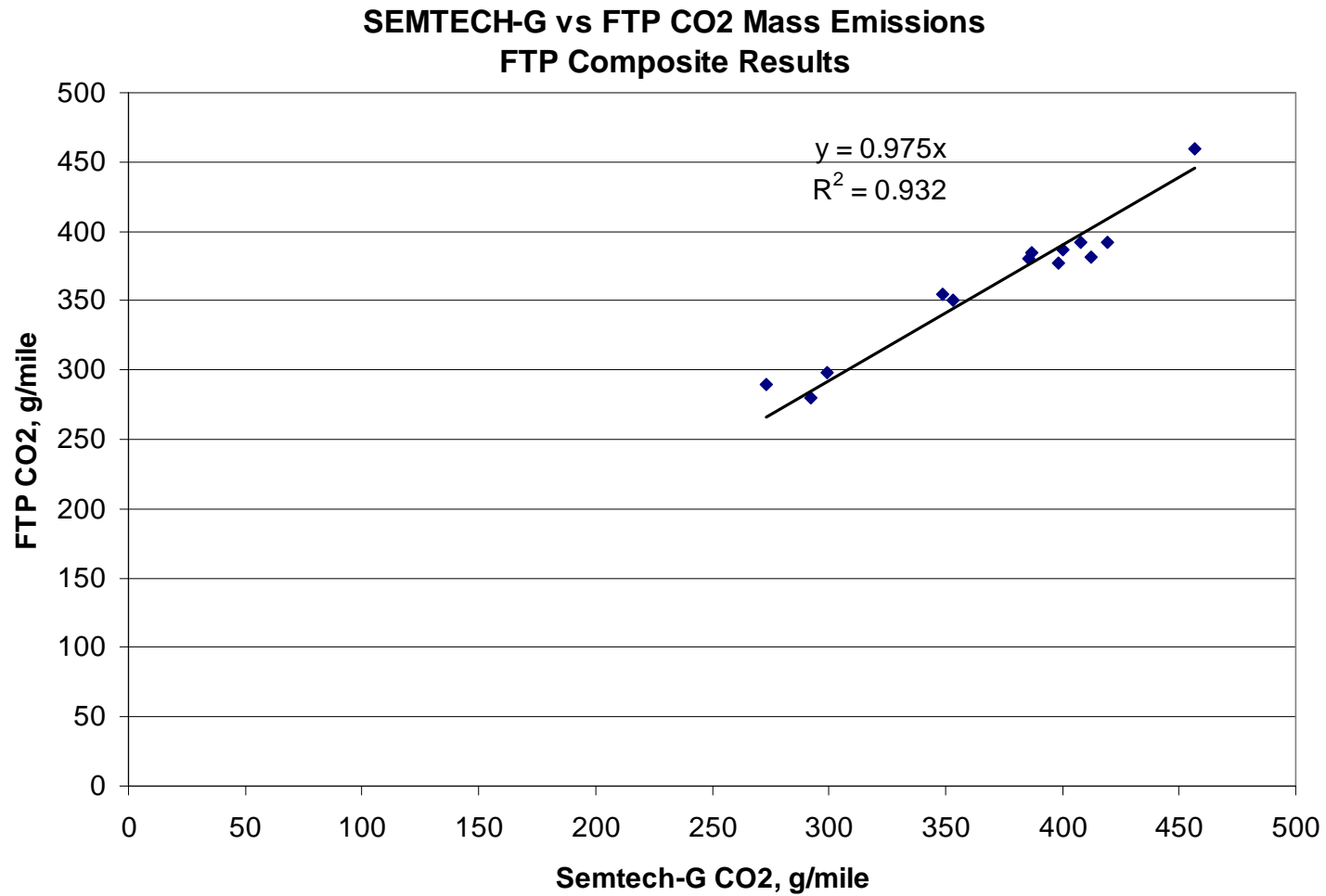
On-Board Data Analysis “Shootout”

- How can on-board data be used in MOVES?
- Analysis “shootout” contract:
 - Develop conceptual methodology
 - Demonstrate on pilot dataset
 - Recommend role of alternate data
 - Recommend sampling plan
- Competitive Process
- Participants
 - NC State, UC Riverside, Environ, EPA

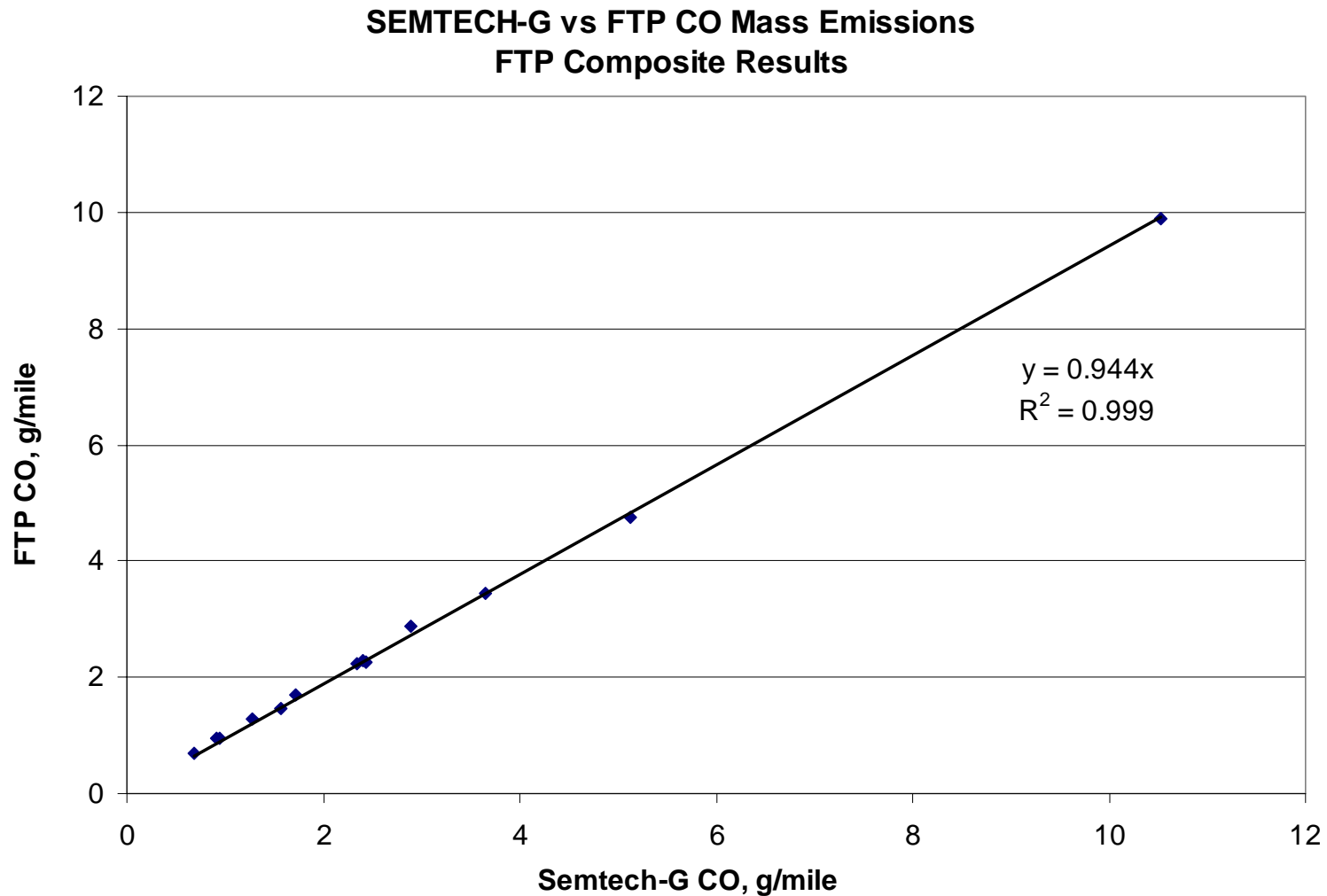
Shootout Parameters

- Participants developed model on “modeling” dataset
 - 12 Light-duty vehicles, multiple trips
 - 12 Buses, multiple trips
 - 3 Off-road pieces, 3 hrs of operation each
 - Bulldozer, Compactor, Scraper
- Blind prediction of operation on independent dataset
 - On-Road
 - 3 independent vehicles
 - 6 trips each for LD & HD
 - Off-Road
 - Same 3 pieces of equipment
 - 1 additional hour of operation

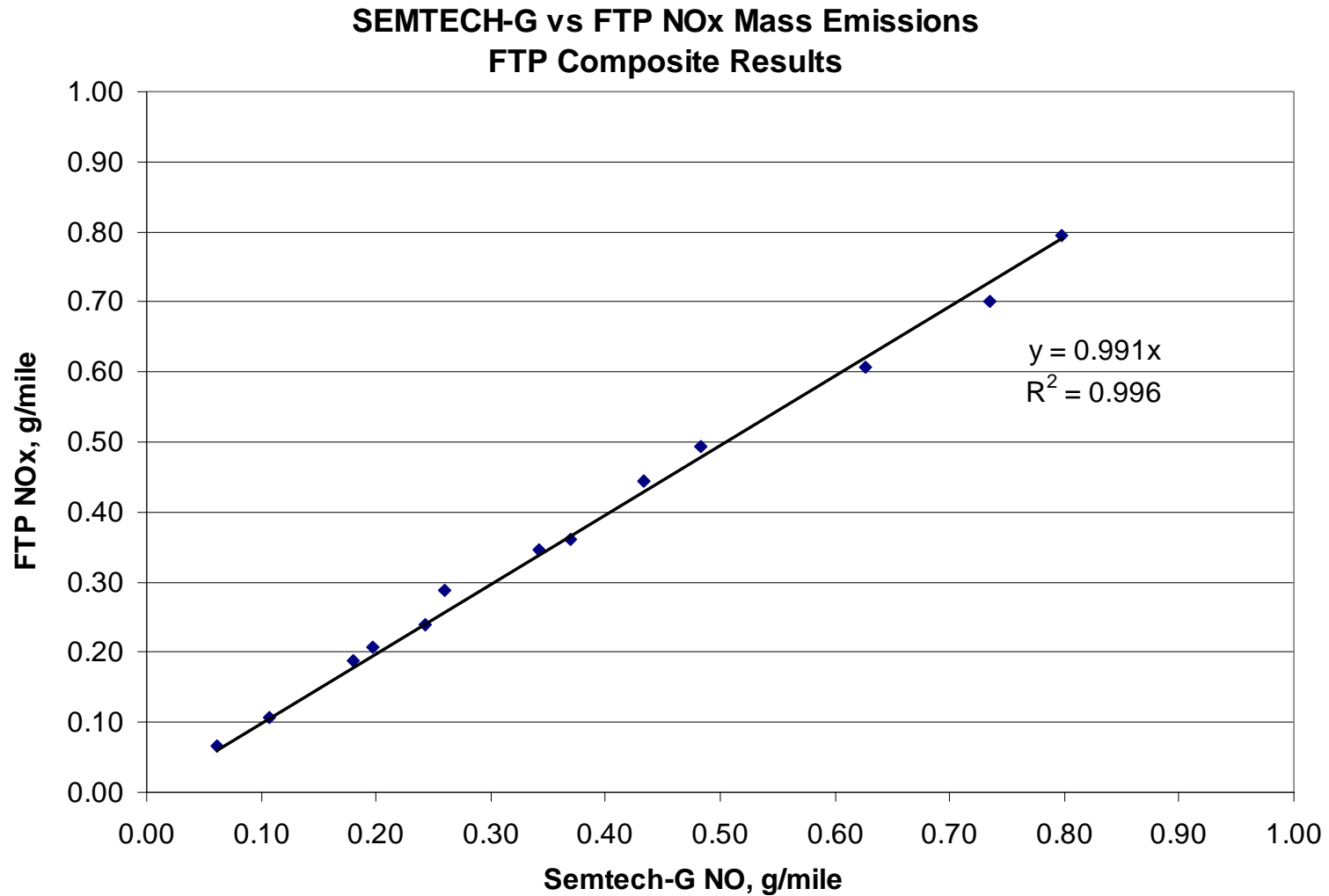
On-Board Data Reliability: CO₂ Correlation Results



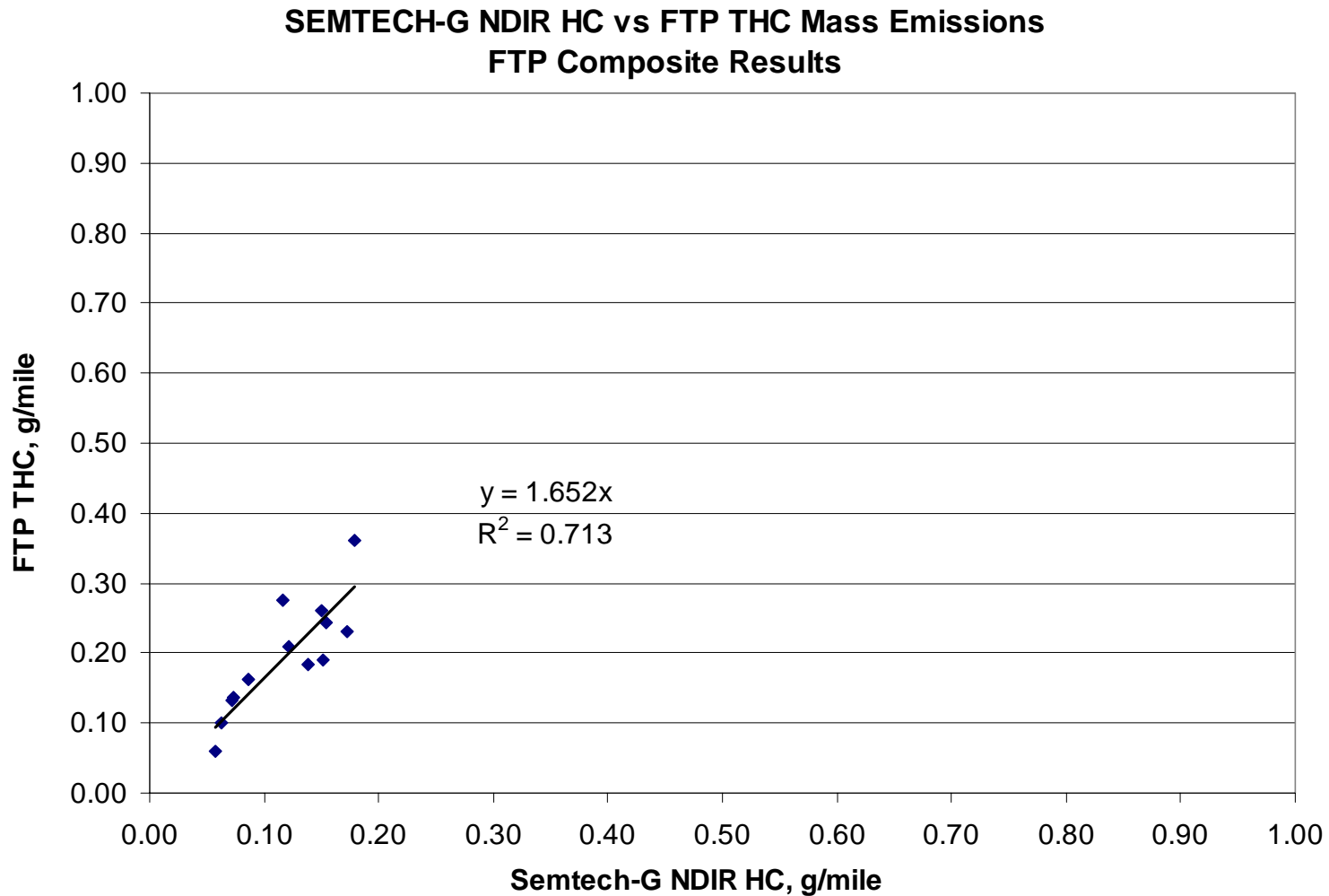
On-Board Data Reliability: CO Correlation Results



On-Board Data Reliability: NOx Correlation Results

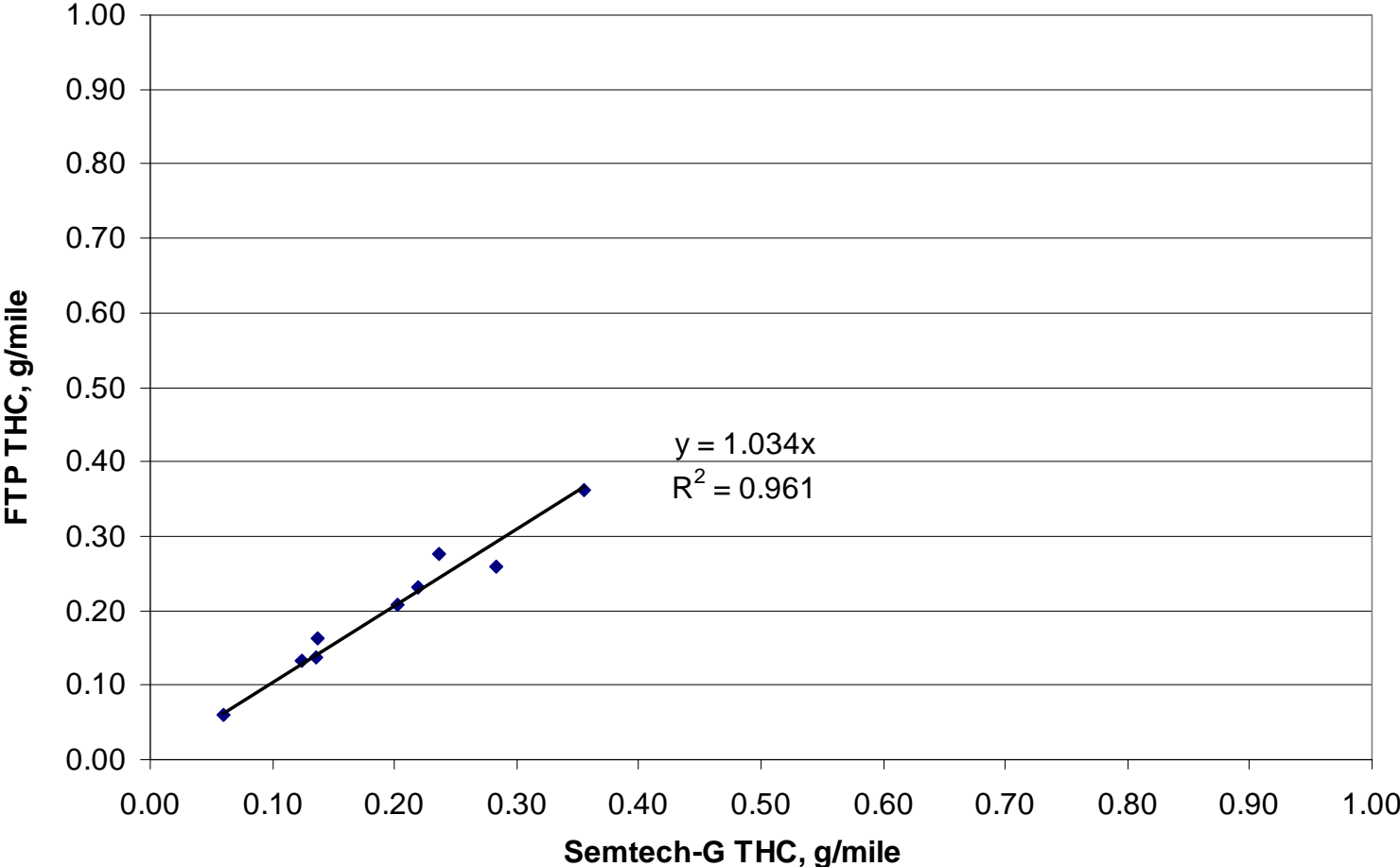


On-Board Data Reliability: HC Correlation Results (NDIR)



On-Board Data Reliability: HC Correlation Results (FID)

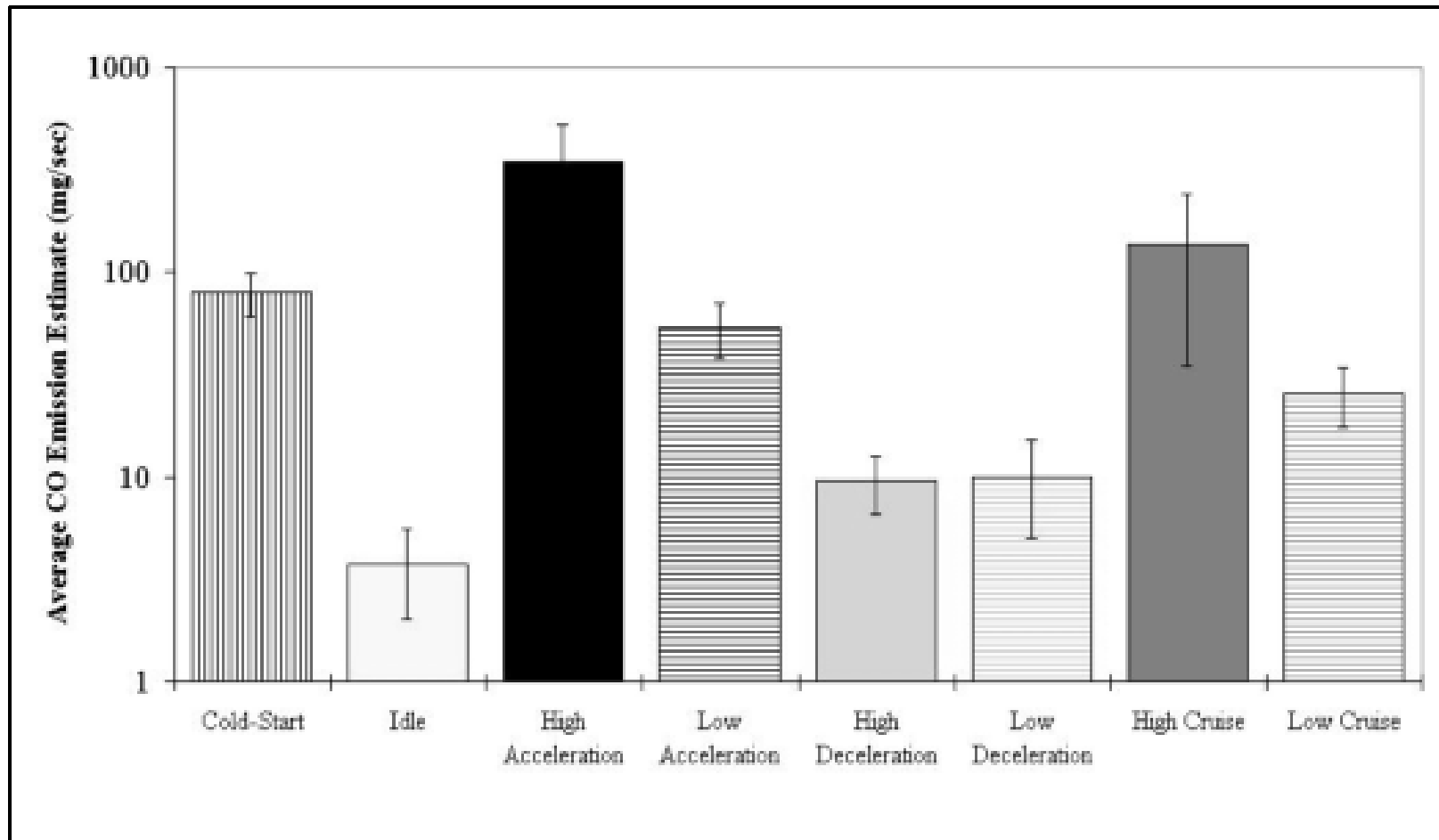
SEMTECH-G FID THC vs FTP THC Mass Emissions
FTP Composite Results



Shootout Approaches

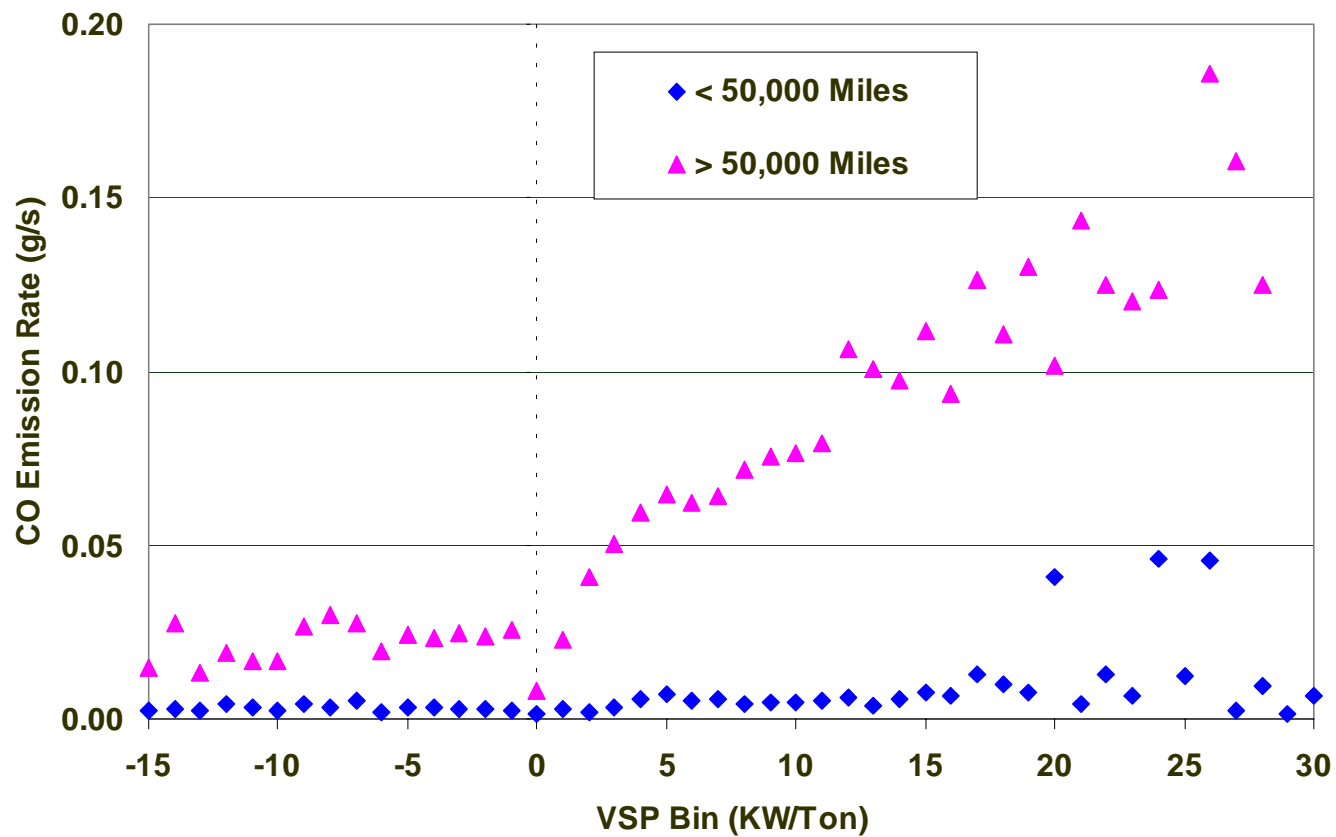
- **Modal Binning (NC State, EPA)**
 - Emissions defined by operating mode (accel/decel/cruise/idle or VSP)
 - Emissions are “binned” rather than regressed
- **Database (UC Riverside)**
 - Direct lookup of raw emission data
 - Unique approaches for each scale
- **Microtrip (Environ)**
 - Defined as 20+ second events between stable conditions
 - Regression with summary statistics on microtrips (e.g. VSP)
- **Aggregate (EPA)**
 - Regression with trip summary statistics (e.g. average speed, VSP)
 - Pursued to test “Status Quo” approach

Modal Bin Approach

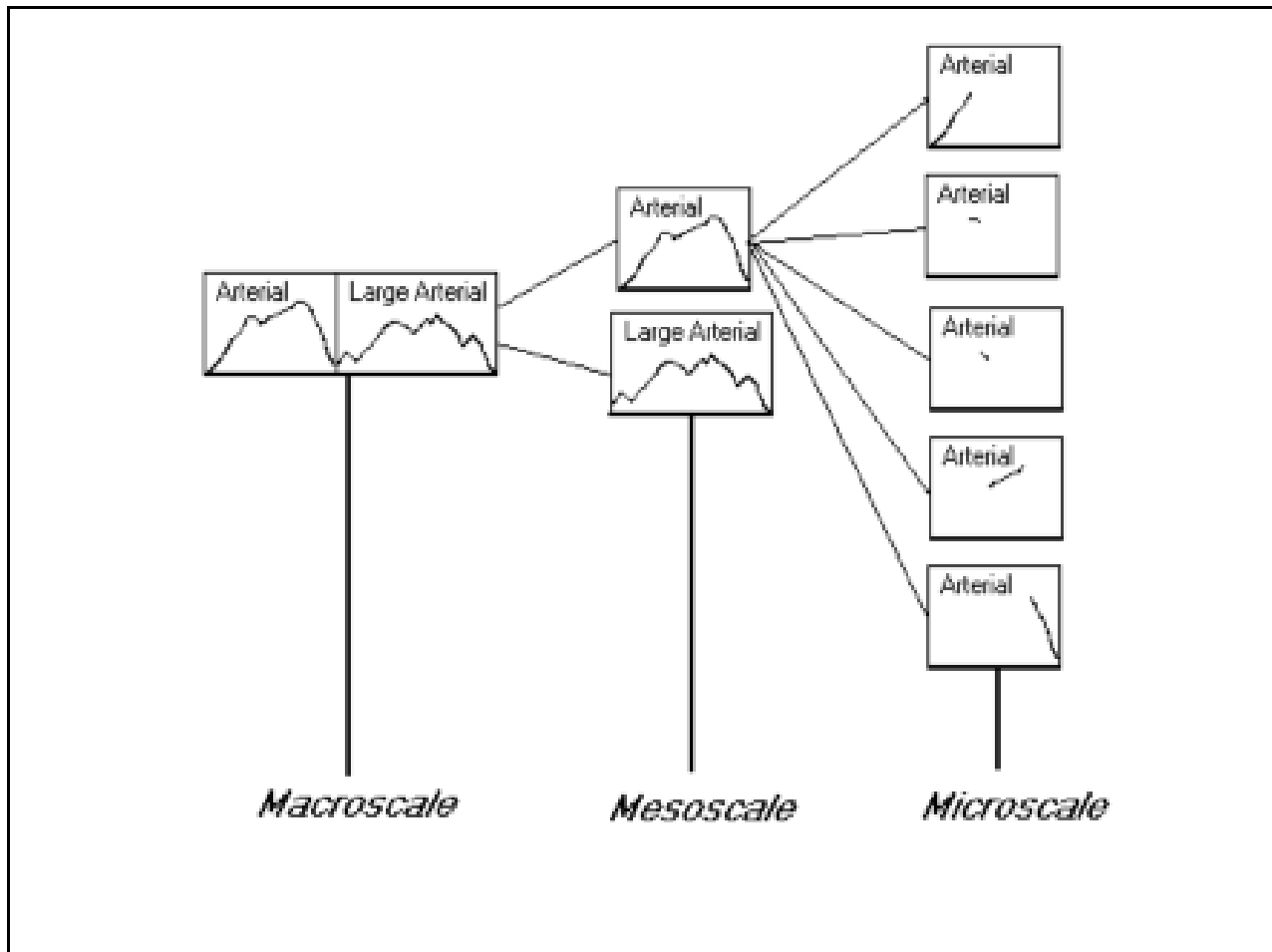


VSP Bin Approach

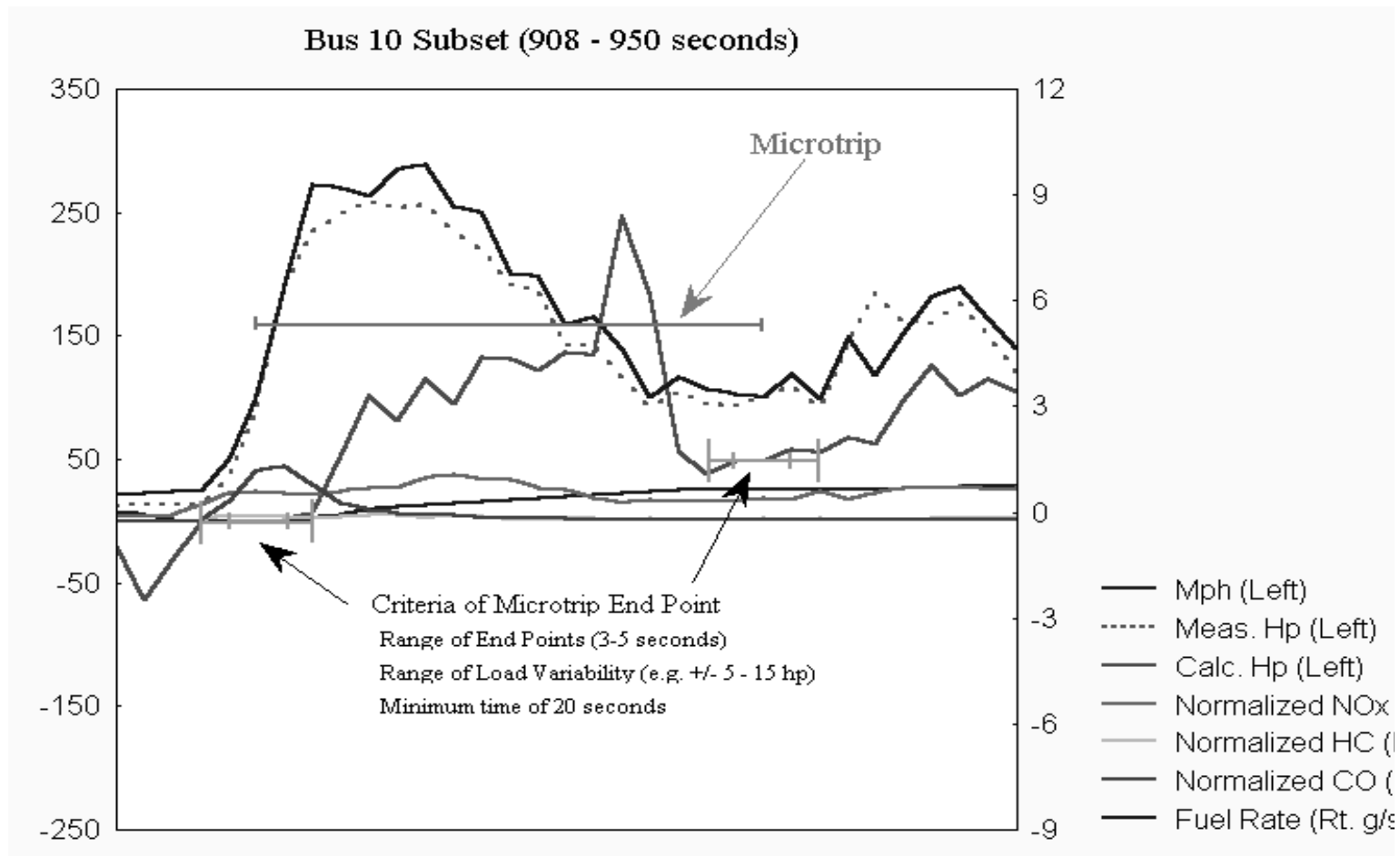
Running CO Emission Rate By VSP Bin
4 Cylinder LDVs



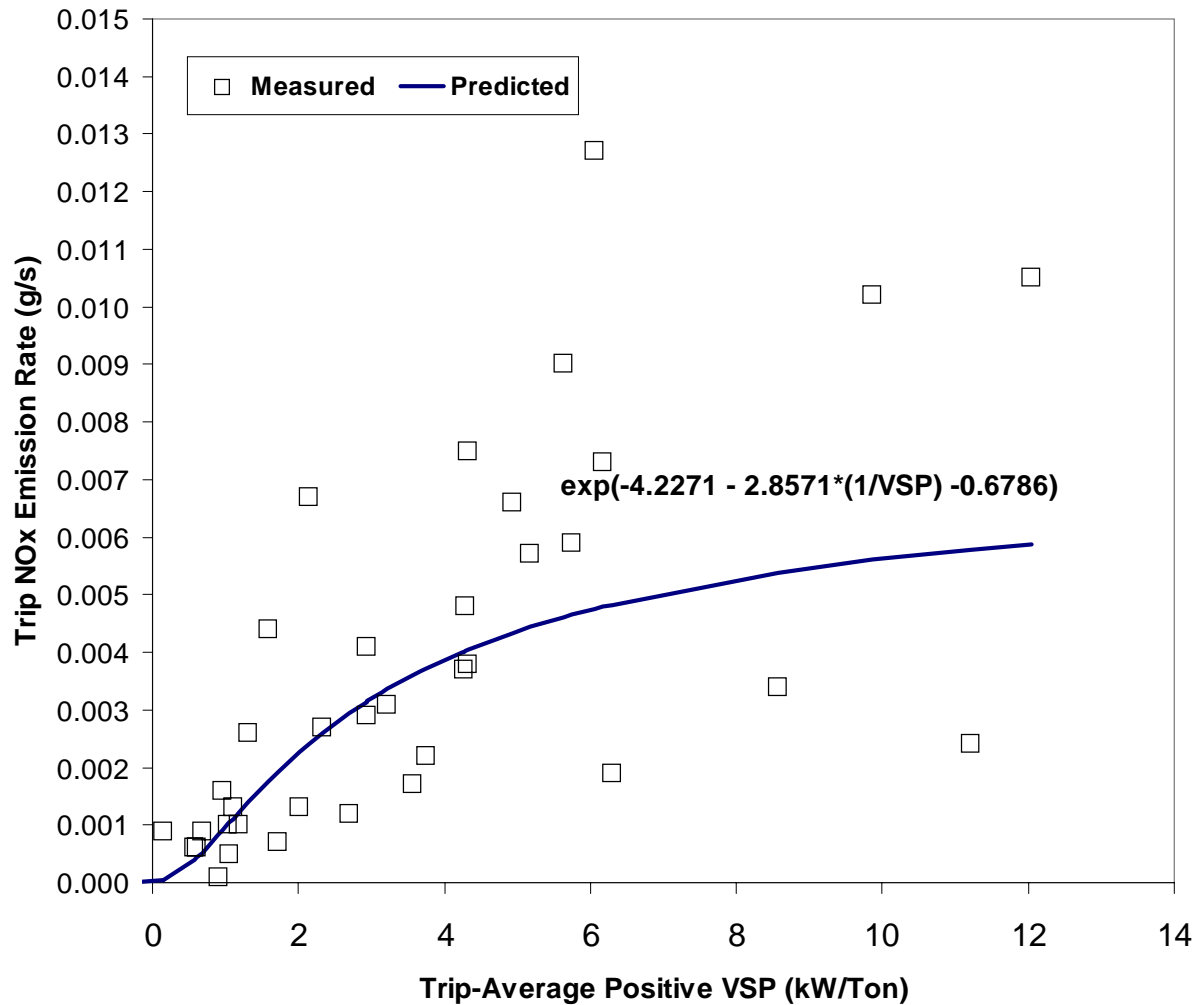
Database Approach



Microtrip Approach

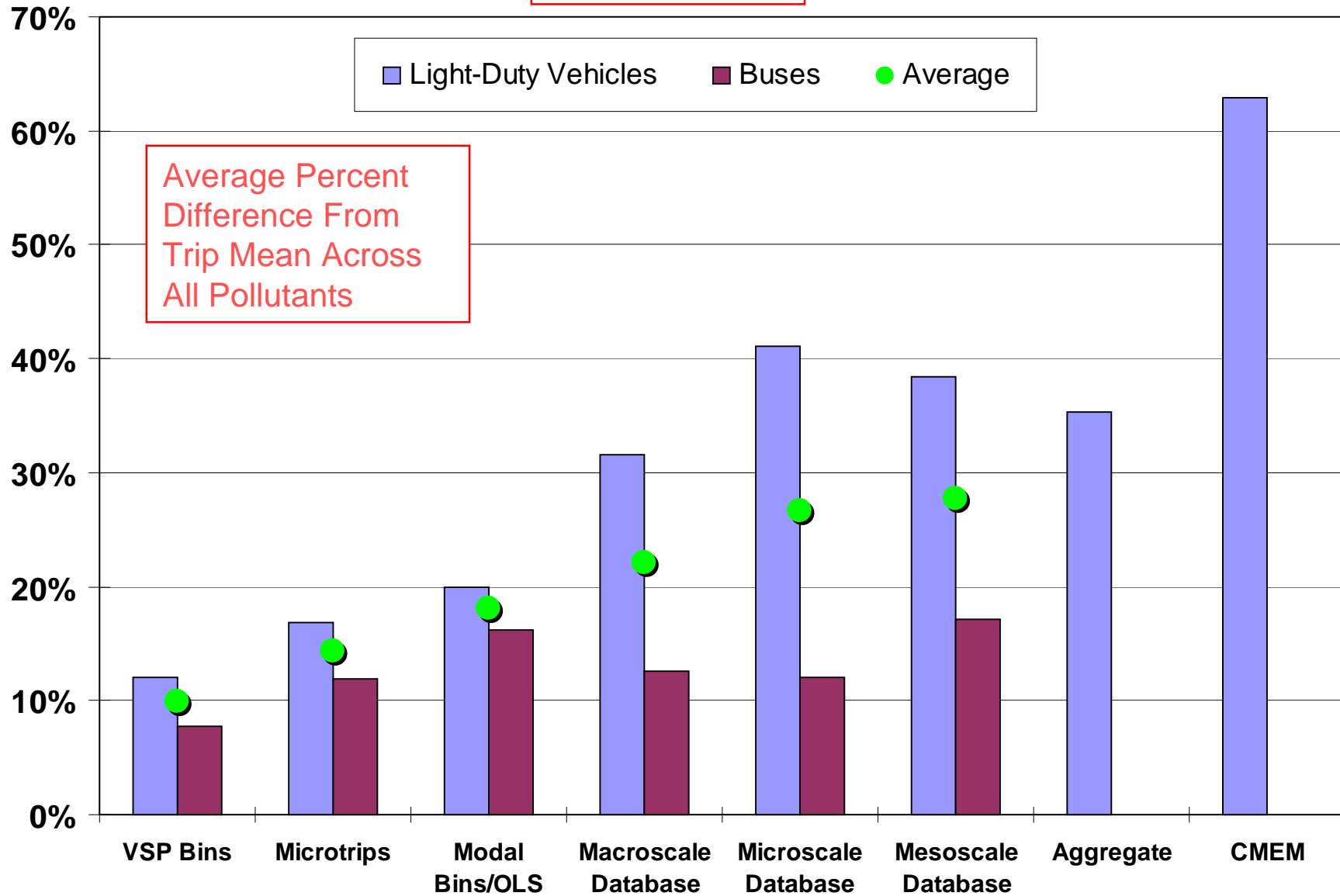


Aggregate Approach



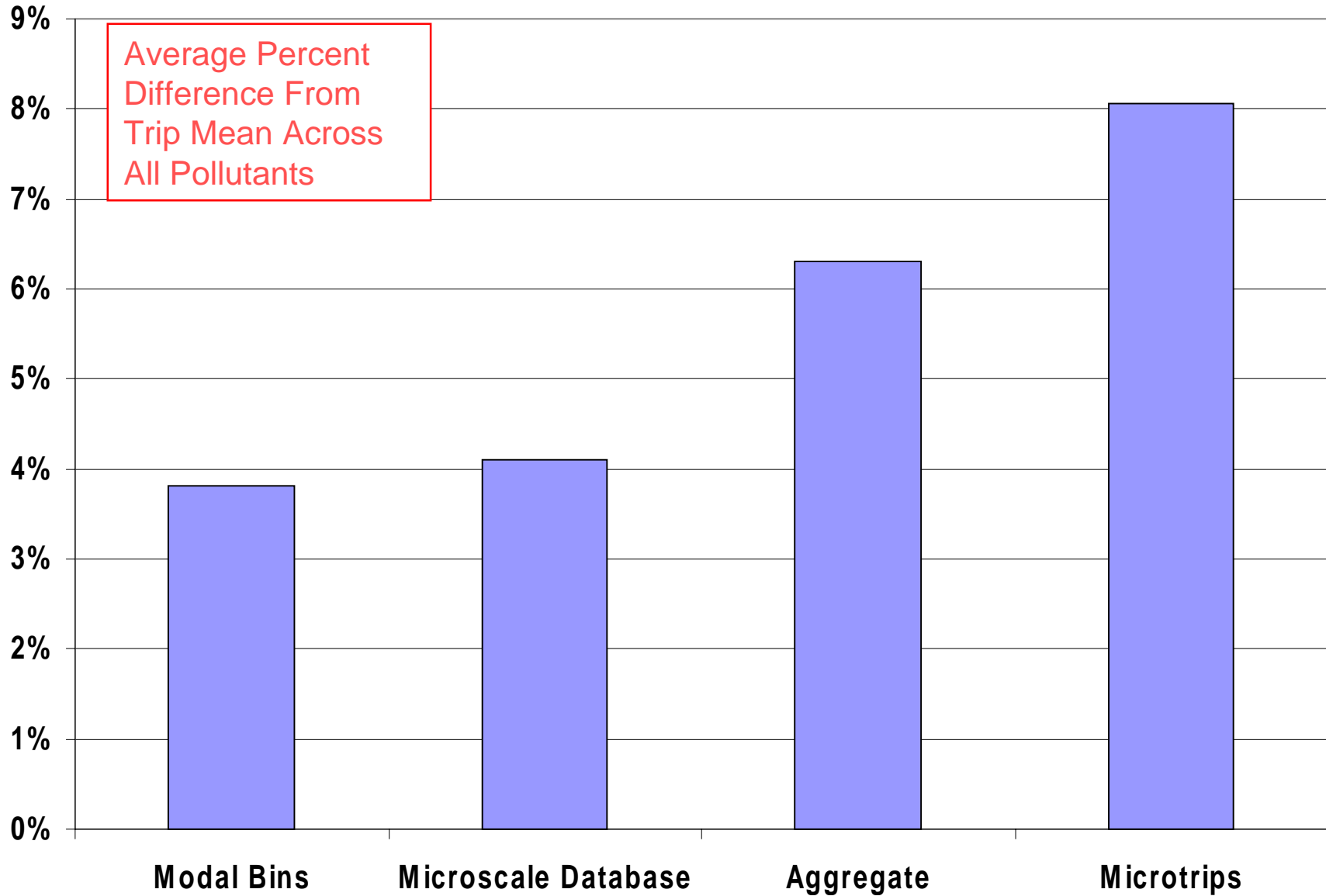
Shootout Results: On-Road

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Shootout Results: Off-Road

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Assessing Feasibility

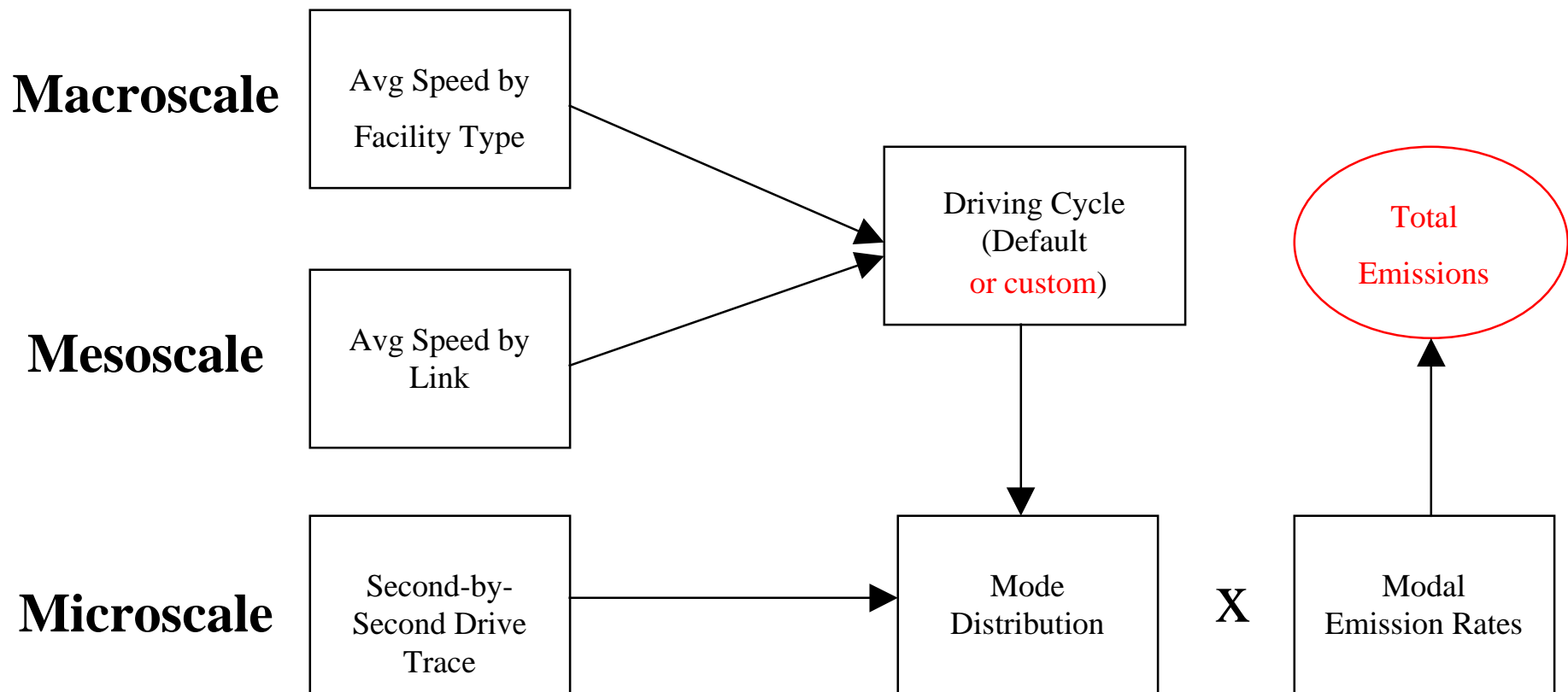
Feasibility Criteria	Physical Model	Modal	Database	Aggregate	Microtrip
Consistent Across Scales?	X	X			
Easily Updated?		X	X	X	X
Can Incorporate Many Data Sources?		X	X		
Software Efficiency?	X	X		X	X

Preliminary Conclusions

- Modal approach shows most overall promise for On-Road
- Aggregate approach likely sufficient for Off-Road

Applying Modal Emissions

Running Exhaust Process



Phase 2 Evaluation

- Competitive contract (one award)
- Evaluate modal approach on several data sources
 - Laboratory second-by-second (EPA MOBILE6 Cycles)
 - On-Board Data (Shootout)
 - IM240 Data (Denver)
 - RSD Data (Missouri: likely 500,000 - 1 Million vehicles)
 - Laboratory bag (NCHRP 25-21)
- Evaluate uncertainty methodologies
- Validate with independent test results

Data Gathering

- Initial focus on GHG exhaust emissions
- Evaluate several potential data sets
 - UC Riverside
 - West Virginia University
 - California ARB
 - Environment Canada
 - CRC (E-55)
 - NC State University
 - IM240 Programs
- Rank according to:
 - Data completeness (are necessary fields available)
 - Quality documentation (e.g instrumentation, sampling)
- Transfer to EPA's Mobile Source Observation Database (MSOD) if acceptable
- Will inform future data collection

Master Planning Process

- Two new OTAQ teams
 - Develop 5 year master plans for highway and nonroad data collection
 - Identify data gaps and needs
 - Develop sampling protocols, test plans, contract mechanisms
 - Pursue funding and execute plans
 - Market data plans to state and private sectors for partnership test programs
 - Work with OMB for Information Collection Request approval
- Draft highway plan this fall
- Kansas City pilot project initiated this fall