Alt Fuels & Heavy-Duty Vehicles

Fuel and Emissions Calculator

Georgia Institute of Technology

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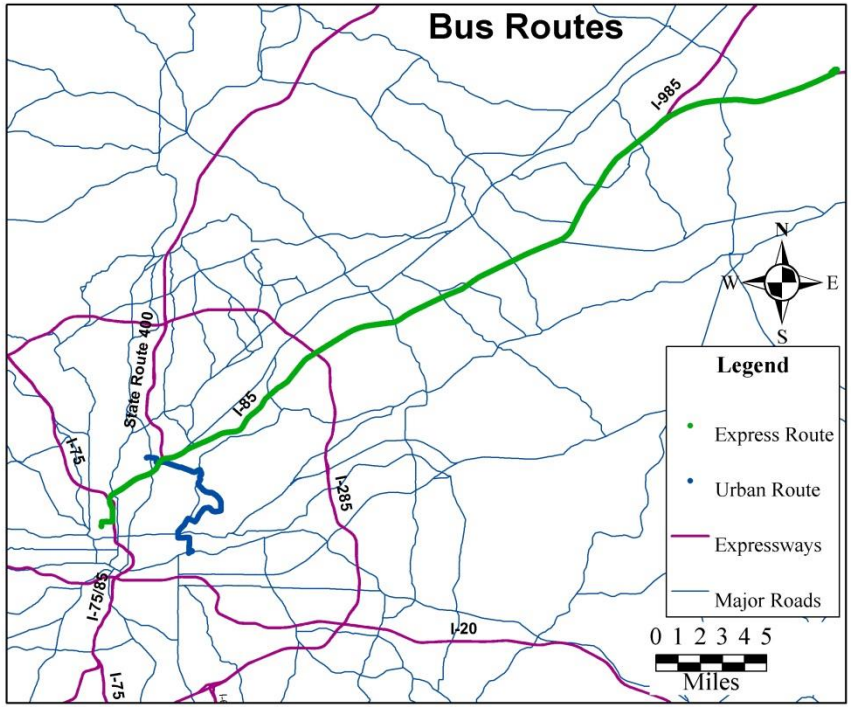
Northern Transportation & Air Quality Summit 2016

Mirror, Mirror, on the Wall…

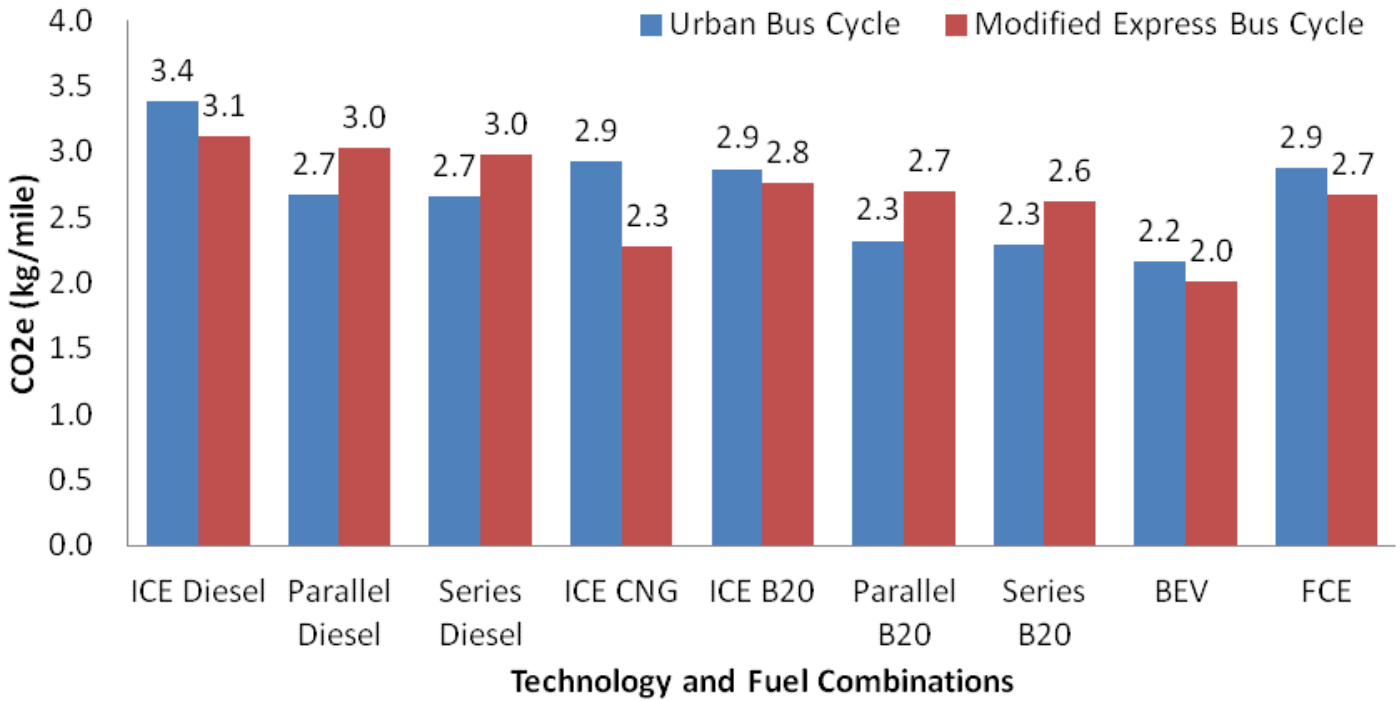
- Duty cycle matters
- Location matters
- FEC – a practical tool

Duty Cycle Matters



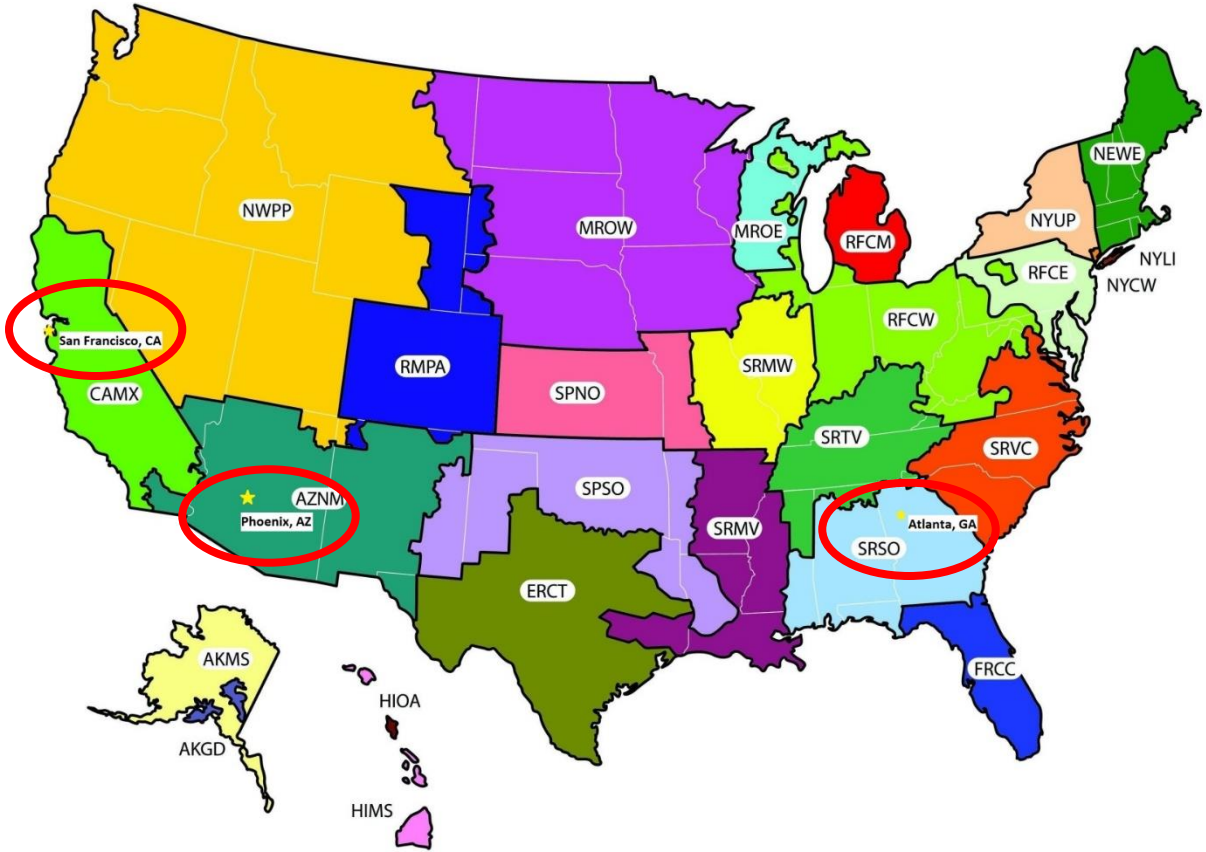
- Urban transit bus route
  - Avg. speed: 15.8 mph
  - Max. speed: 36.8 mph
- Express bus route
  - Avg. speed: 60.6 mph
  - Max. speed: 88.0 mph
- Modified express bus route
  - Avg. speed: 51.63 mph
  - Max. speed: 60.0 mph

Duty Cycle Comparison



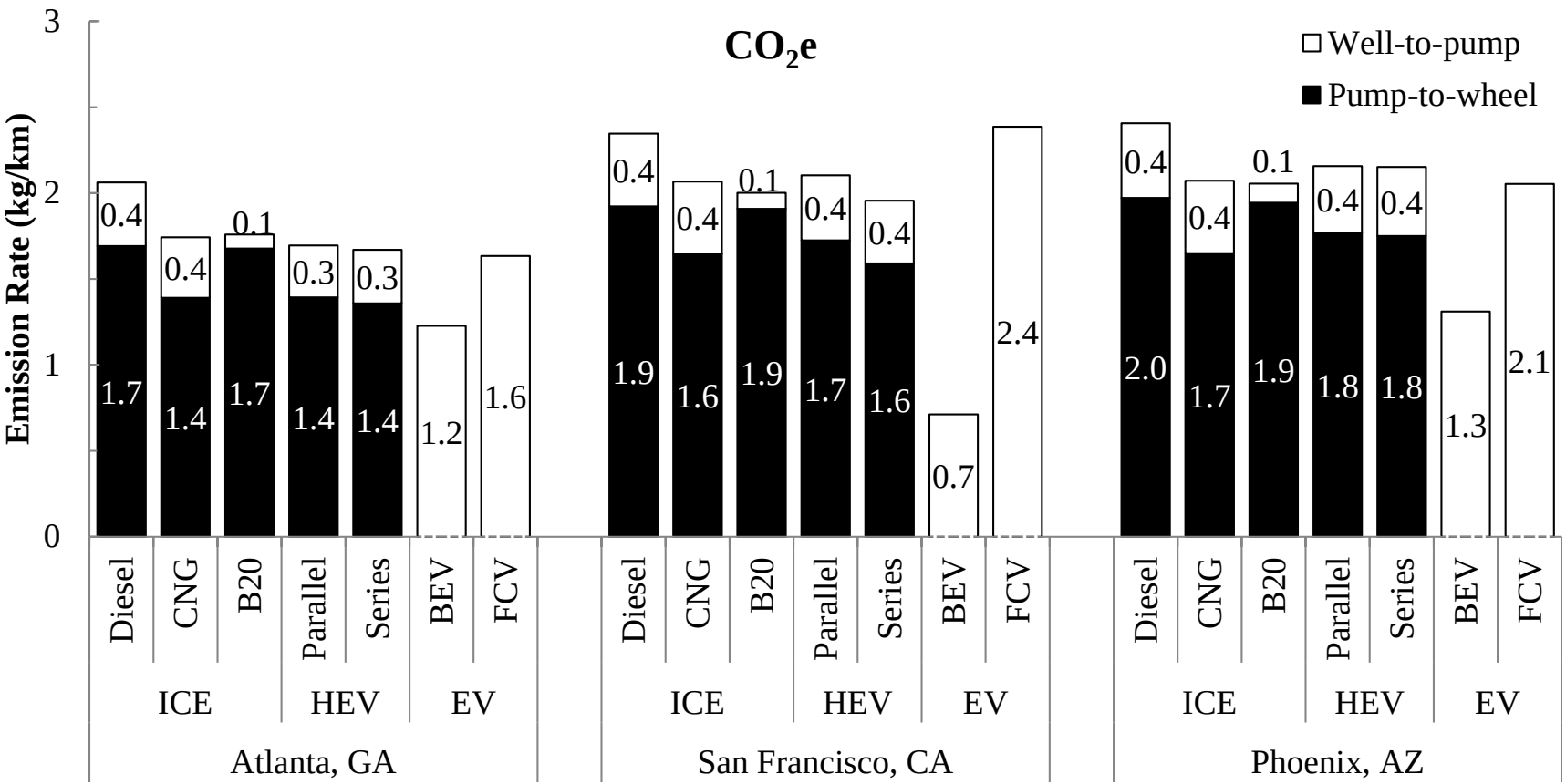
Xu, Y., D. Lee, F. Gbologah, G. Cernjul, V. Elango, M. Rodgers, R. Guensler (2013). "Load-Based Life-Cycle Greenhouse Gas Emissions Calculator for Transit Buses; An Atlanta, GA Case Study." Proceedings of the 2nd T&DI Green Streets, Highways and Development Conference, pp. 284-294. Austin, TX. November 3-6, 2013.

Location Matters

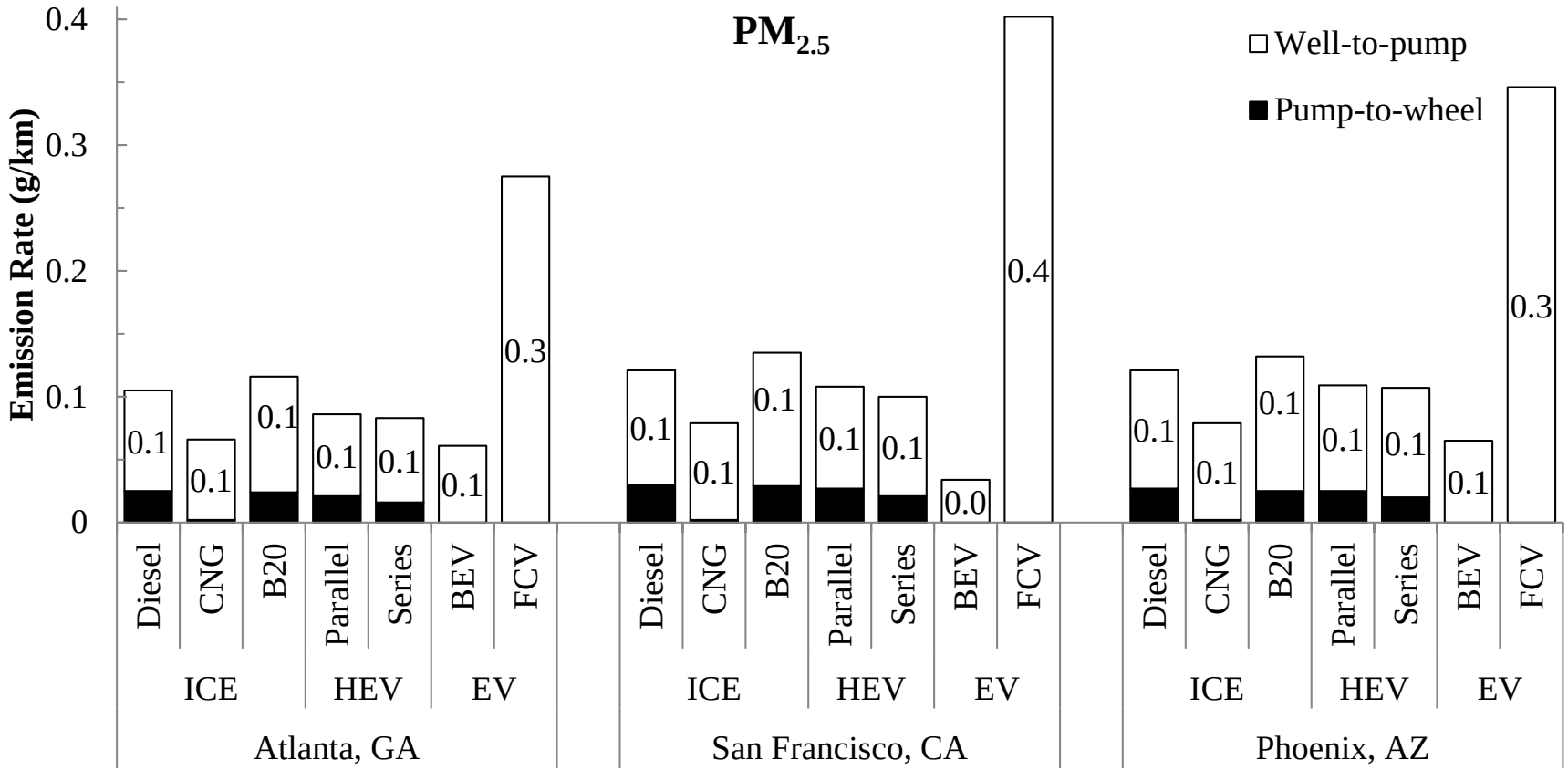


This Is a representational map; many of the boundaries shown on this map are approximate because they are based on companies, not on strictly geographical boundaries.
USEPA eGRID2010 Version 1.0 December 2010

Geographic Comparison

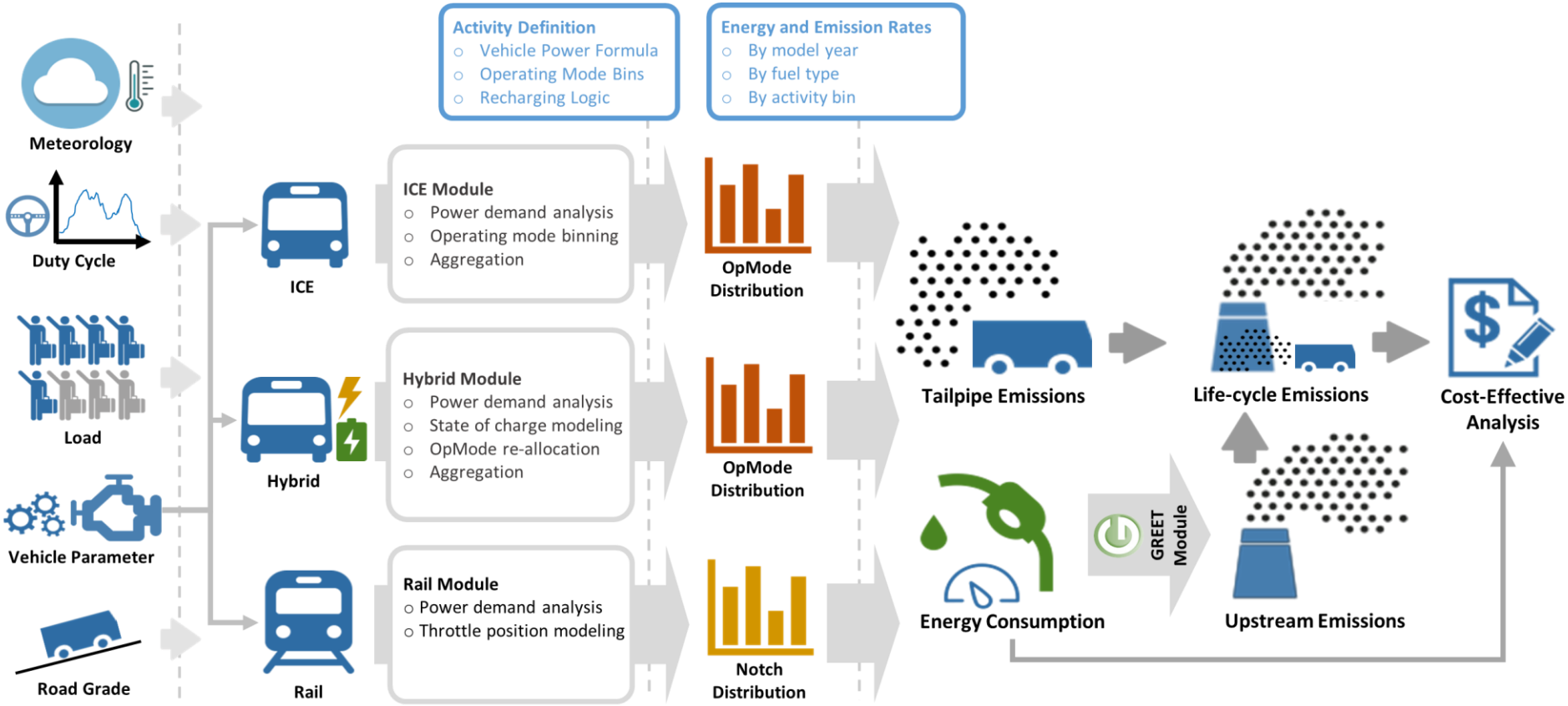


Geographic Comparison



Xu, Y., F. Gbologah, H. Liu, M.O. Rodgers, and R. Guensler (2015). "Assessment of Alternative Fuel and Powertrain Transit Bus Options using Real-world Operations Data: Life-cycle Fuel and Emissions Modeling." Applied Energy, 154, 143-159.

FEC (Fuel & Emissions Calculator)



Modeling Approach

Georgia Tech

❑ Fuel-based top-down approach

- Based on fuel use or average fuel economy
- GREET Fleet Footprint Calculator
- Travel Matters Emission Calculator, Center for Neighborhood Technology

☑ Activity-based bottom-up approach

- Capable of analyzing the effects of different operating scenarios in a specific area
- Better estimates of air pollutants and other GHGs

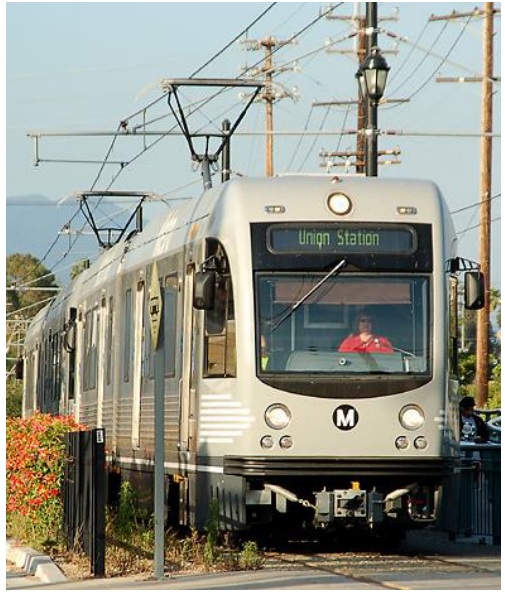
Vehicle and Propulsion Systems

Buses/Vans/Trucks

- Conventional ICE
- All-electric
- Hybrid-electric
- Plug-in hybrids
- Fuel-cell
- Fuels: gasoline, diesel, CNG, biodiesel (2, 5, 10, 20%), electricity, hydrogen

Rail

- All-electric
- Diesel-electric



Source: wikipedia

Applications

- Policy evaluations
  - Eco-driving evaluation and training
  - Anti-idle programs
- Environmental justice
  - Trade-offs between well-to-pump and pump-to-wheel emissions
  - GHGs and air pollutants
- Cost-effectiveness analysis
- Multi-criteria evaluations

Thank you!

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