RIT-CIMS/USDOT
E-85 Fuel Economy Study
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E85 Fuel Economy Study

- Program Background
- Study Objectives
- E85 Study Fleet Vehicles
- Fuel Mileage Data Collection
- Fuel Mileage Results
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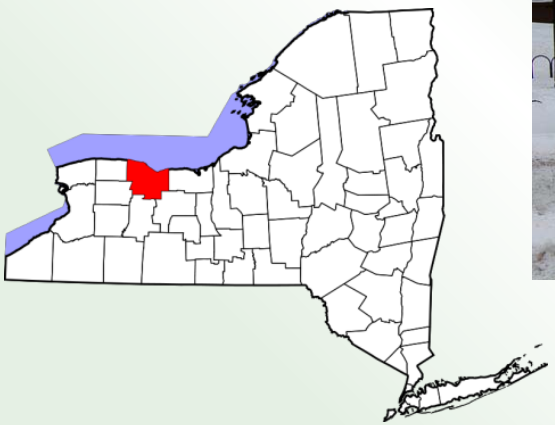
- Q and A

RIT CIMS Alt Fuel Program Background

- The E85 project is part of a larger program to study the application and impact of alternative fuels on the US transportation enterprise.
- Work is sponsored by a grant from US DOT in November 2007, finishing in 2011.
- The wider DOT study encompasses ethanol (both E20 and E85), biodiesel blends and hydrogen; along with the technology readiness and life cycle analysis of alternative fuels.
- Includes both fleet studies and laboratory/dynamometer testing.
- Crucial to implementation was partnership with the local county government – Monroe County, NY

Monroe County / Rochester, NY

- Testing in Monroe County offered unique opportunities and conditions
  - 1300 sq. mile region
  - Four season testing
    - Cold weather starts
    - Hot weather soak
  - Diverse vehicle set
  - Multiple drivers
  - Urban and Rural
  - City and Highway



Monroe County Green Fleet

Vehicles running on Ethanol

- 300 Conventional Light Duty Vehicles – E20 fueled
- **124 Flex Fuel Vehicles (Impalas, Uplanders) (E20 and E85)**
- **100 Sheriff vehicles (FFV, Ford Crown Victoria) (E20 and E85)**

Other Alternative Energy Vehicles

- 300+ Diesel vehicles (B5 / B20)
- 25 hybrids (Silverados, Malibus, Escapes)
- 6 CNG Airport shuttles
- Airport ground service equipment, parks equipment
- Hydrogen Fuel Cell Vehicle (GM Project Driveway)
- Propane Pickup Trucks
- Green Fueling Station (B20/E85/E20/Hydrogen/CNG/Propane)

RIT CIMS E85 Study Objectives

- Exhaust emission deltas between E0 and E85 in FFV.
- Impact to vehicle fleets – durability, drivability, maintainability, service life.
- Impact to fuel economy vs. E0 operation.
- Life cycle cost of E85 fuel operations. 
- Document supply chain issues with ethanol fuel.

RIT/MC E85 Flex Fuel Vehicle Study Fleet

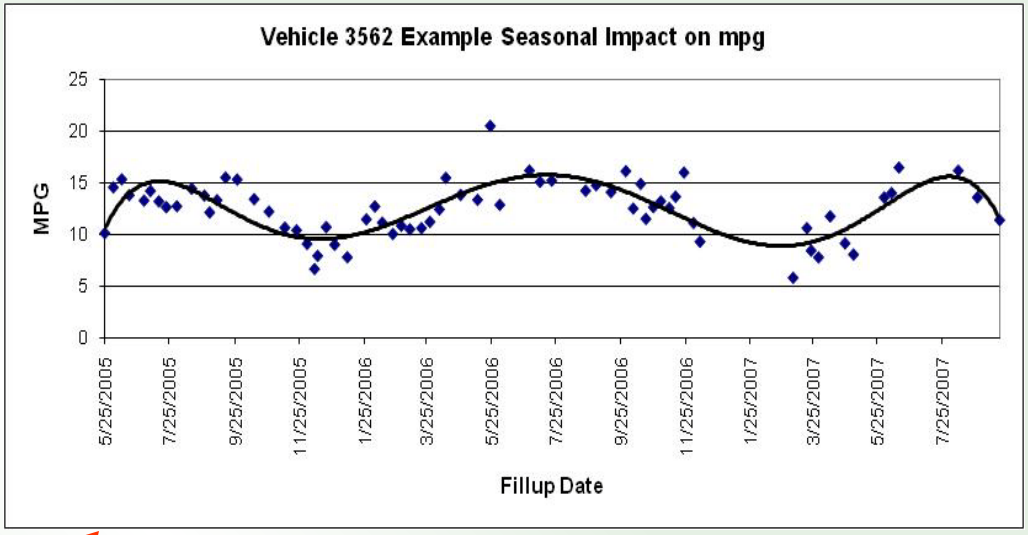
- MC has a diverse FFV fleet representing a broad sample of FFV:

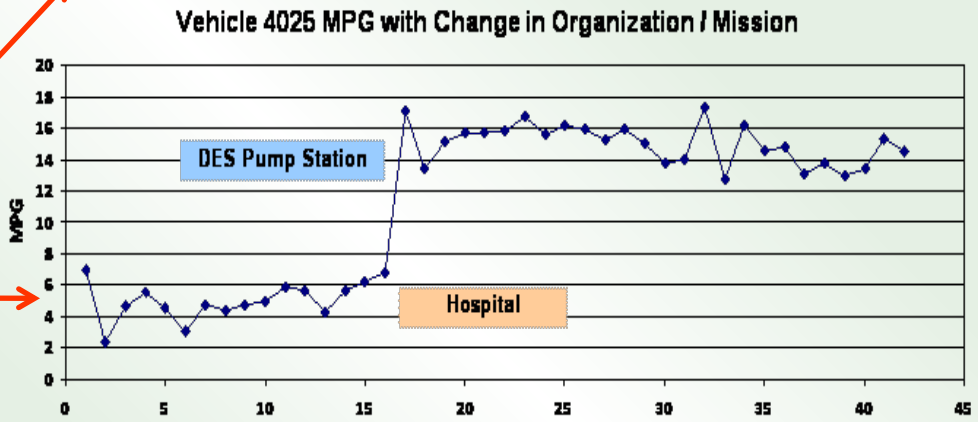
  15 different FFV models, totaling 124 vehicles.

- 53 sedans, 28 minivans, 43 work trucks/full size vans.
- Most numerous are Chevy Impalas, Uplanders, and Tahoes
- Ford Crown Victoria – sedans and Police models
- These vehicles handle diverse missions and operate in both city and highway driving conditions.
- The county has been using E85 in bulk for over two years.
- County consumes an average of 55K gallons per year of E85 and 230K gallons of E20.

E85 Fuel Mileage Data Collection

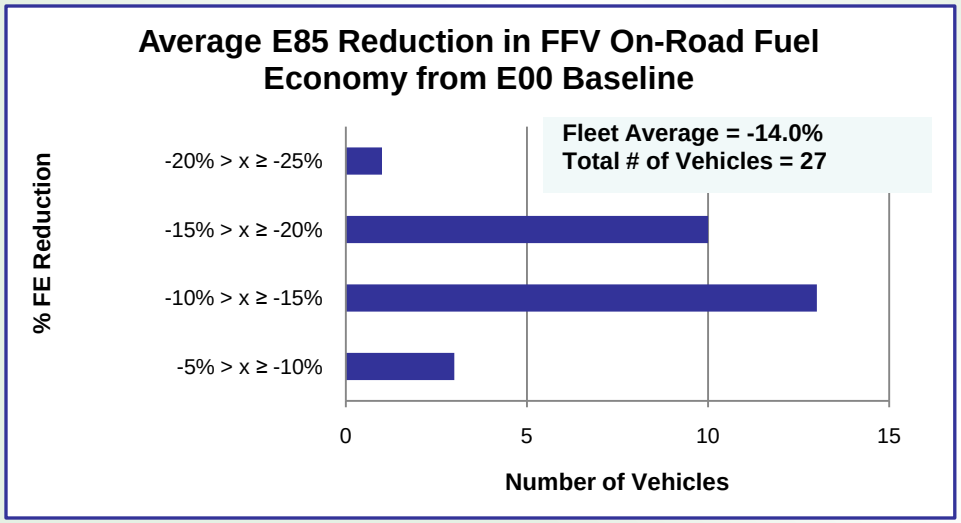
- Fuel mileage was determined through on-road data and experimentally.
- On-road MC vehicle data was sorted for dedicated fuel use: 1 calendar year of data on E0, an additional year on E85, minimum of 20 data points per fuel, and same assigned organization for both years/fuels.
- Odometer and fuel volume collected through MC PetroVend fuel control and inventory system.
- Data ported to RIT database for analysis.
- General observations: on-road fuel economy can be greatly impacted by:
  - Seasonal variation
  - Usage: organization / mission / driver





E0 vs. E85 Fuel Mileage Results

- Practical (On-road) Fleet Data
  - 14% average measured reduction in 27 fleet vehicles (Impalas, Silverados, Uplanders, Taurus, Crown Vic- mostly 2007 veh.)
- Theoretical (Fuel Energy)
  - 26% calculated reduction based on fuel energy.
- Experimental (EPA Fuel Economy-Sticker Value)
  - Roughly 26% reduction based on measured carbon emissions during chassis dynamometer FTP testing.

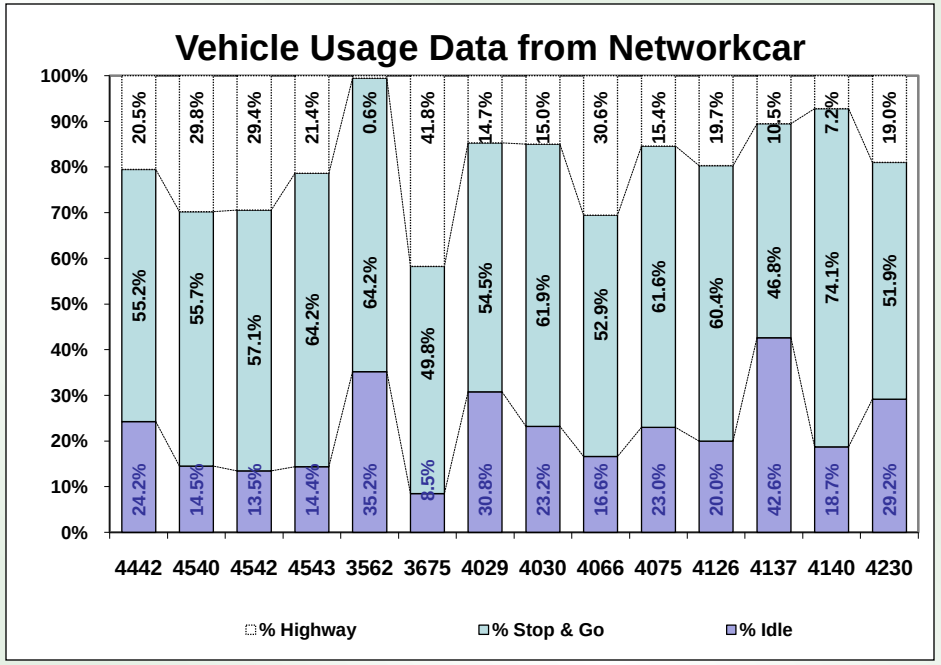


Analysis of Fuel Mileage Results

- Why is on-road data better than theoretical or predicted?
- Theory: Knock limit on compression ratio restricts engine performance on gasoline - makes gasoline performance worse, not ethanol "better"
- Supporting data is from Networkcar low speed travel history.
- Vehicles spend significant time in low speed, high load, knock-limited range.

Use of Networkcar Vehicle Monitoring System

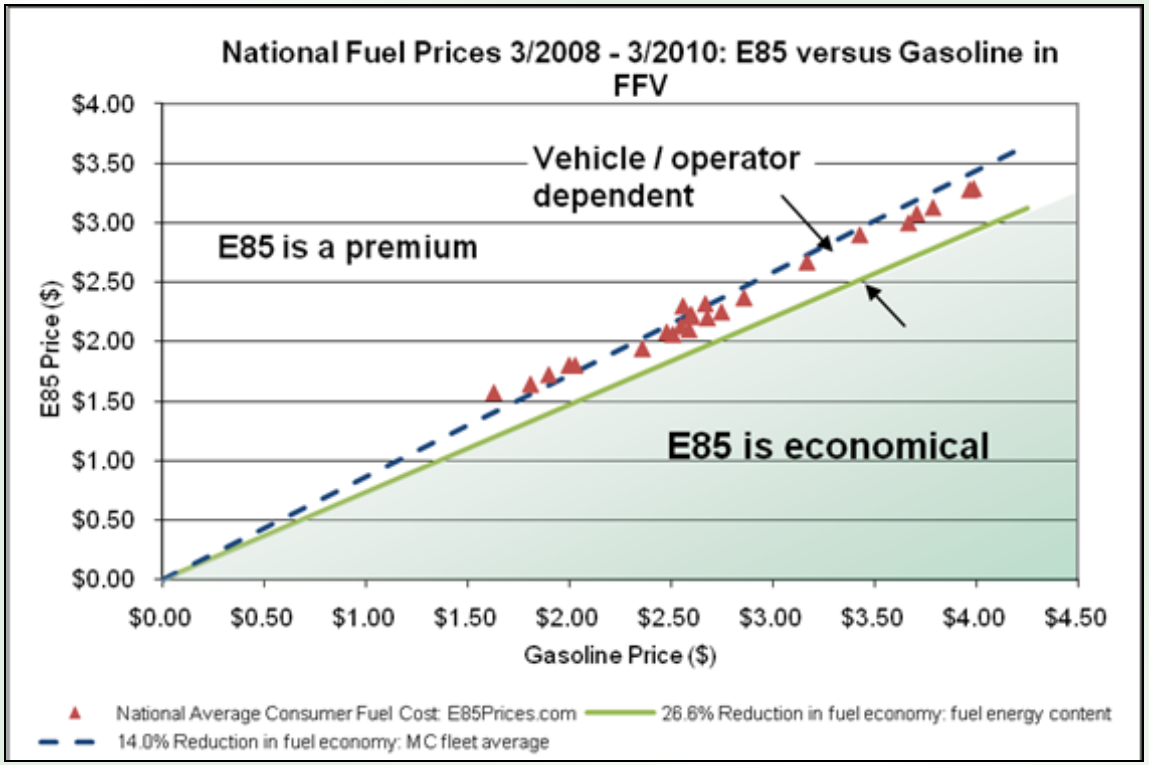
- Some of the study vehicles and a number of other E20/E85 vehicles are equipped with the commercial Networkcar monitoring system linked into the OBD network.
- System provides GPS location, speed ranges, idle time and alerts when vehicle detects a fault or failure.



Analysis of Fuel Mileage Results

- Other theories:
  - Injector timing? We measured pulse width with MODIS but fuel flow rate consistent with energy content difference – not the likely cause.
  - Dyno Test? Drive cycle of the EPA FTP dyno test not optimum for E85 fuel performance. It's a legacy test for gasoline, not flex fuel vehicles.
  - Fuel used in dyno tests? Premium or regular E0?
  - Charge cooling effect of ethanol in fuel?
  - Higher octane/power level provided by E85 reduces number of situations that require WOT/open loop conditions?

Impact of Fuel Economy Results



- Two possible cost relationships – based on theoretical or measured data.
- The difference can influence what drivers will want to buy.
  - DOE/EIA estimates that only 450,000 of the 7,100,000 flex fuel vehicles on the road in 2008 were used as alternative-fuel vehicles filling up on E85. (DOE/EIA-0384 (2009), Table 10.5)
- Consumer wants to know "Best Value" for fuel dollar.

Issues

- To implement RFS, US must get more ethanol in the market. Blend wall of E10 has just about been reached.
- E15 waiver goes further, but wider availability of E85 would help – and when will E15 be available?
- How to get all those 7 Million FFV using E85?
- E85 must be cost competitive with E10-E15 for FFV drivers, considering mileage penalty.
- Further work must be done to help drivers optimize performance on E85, and analyze the "break even point."
- US must also consider limited subsidies only for higher blends/E85 if oxygenate mandate leads to widespread E10 anyway.
- Expansion of "blender pump" infrastructure will be a benefit to FFV drivers – consumer gets the blender's credit.

Questions?

Thank you for your participation!

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