

On Road Fuel Economy Performance of Hybrid Electric Vehicles

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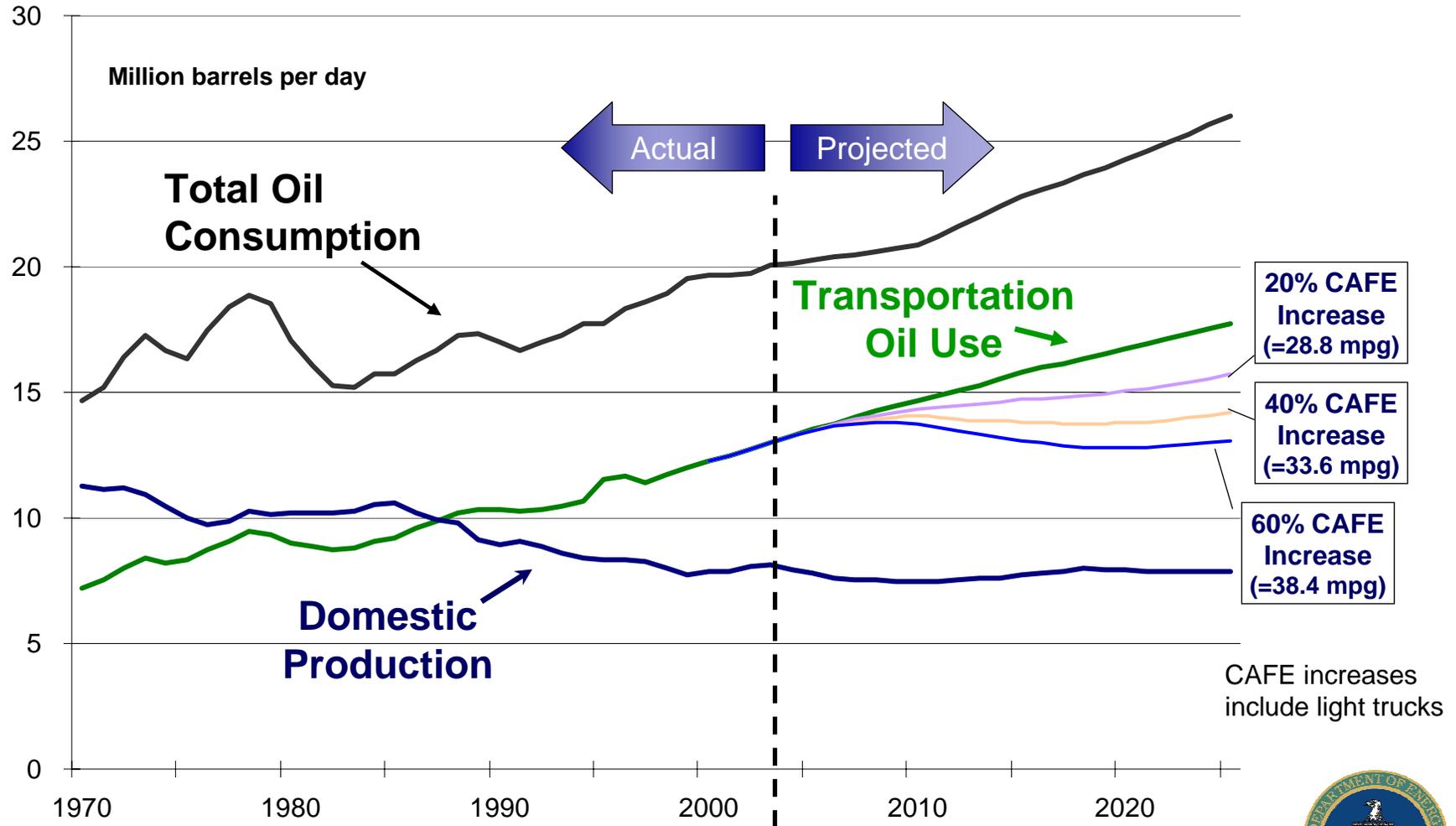


Outline

- Energy Drivers
- DOE FreedomCAR and 21st Century Truck Goals
- Vehicle systems analysis and testing
- Field testing and evaluation of light-duty hybrid electric vehicles
- Information resources



U.S. Oil Dependence is Driven by Transportation

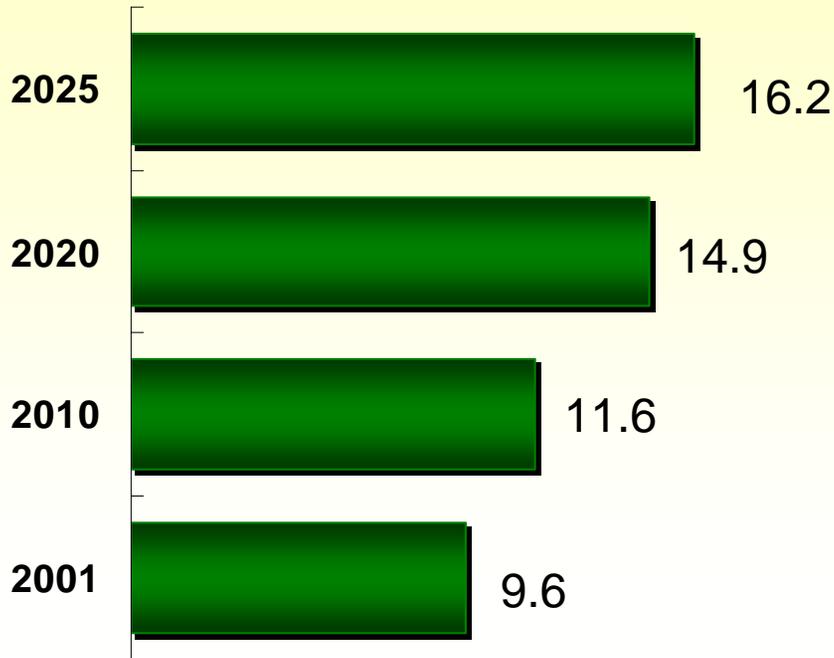


Increasing fuel economy dampens oil use for next 2 decades, but does not offset long-term growth in consumption

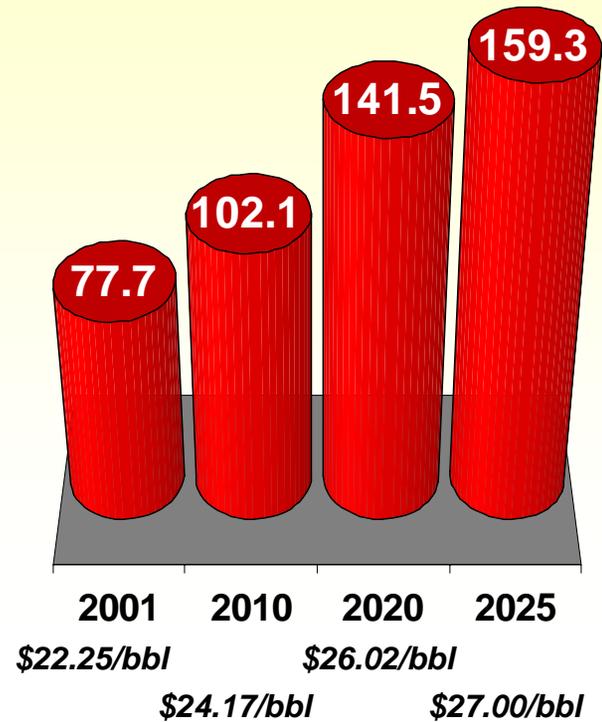


Economics of Oil

**U.S. Imported Crude Oil
(Million Barrels per Day)**



**Annual Cost of
U.S. Crude Oil Imports
(Billions 2002 \$)**

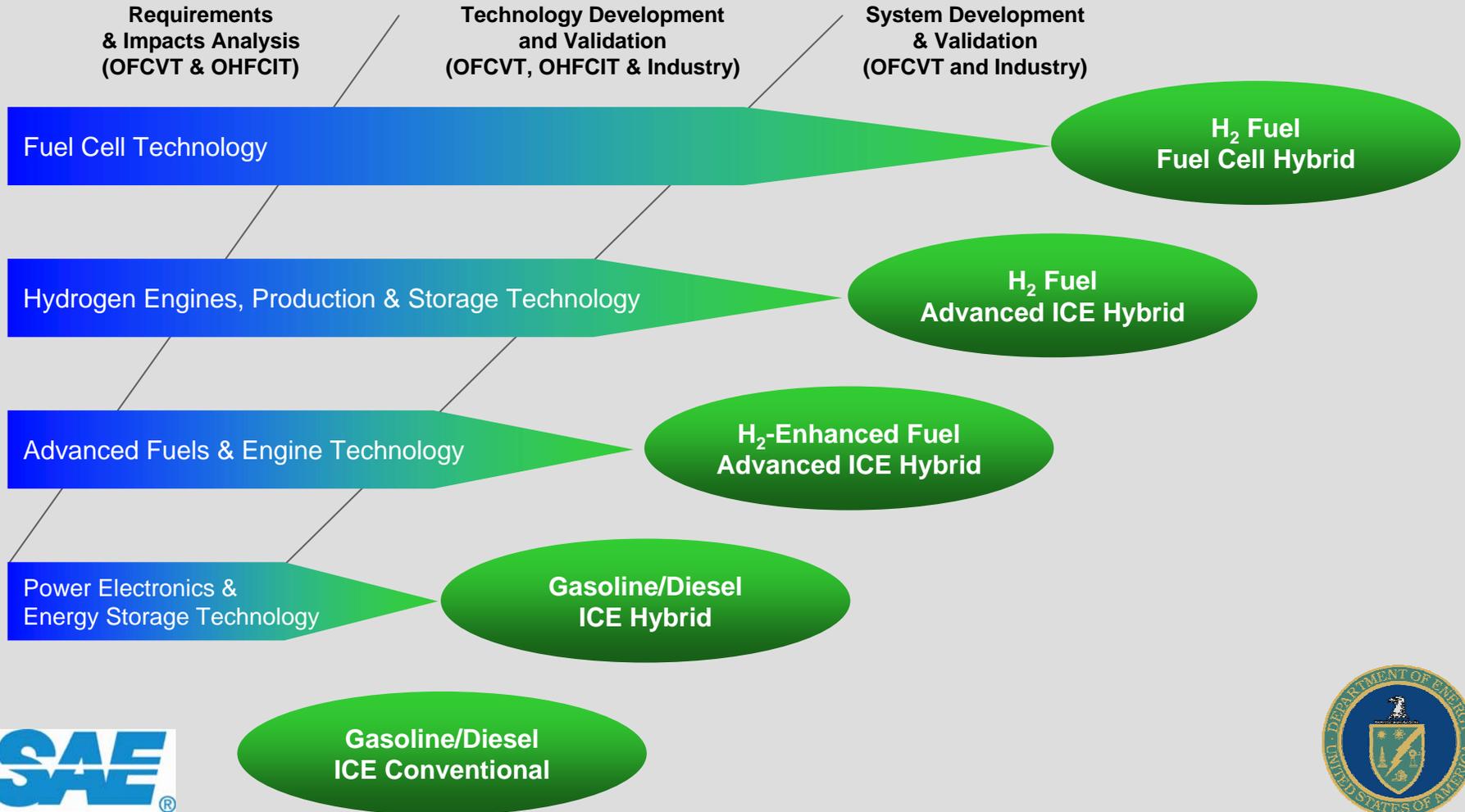


Source: DOE/EIA, Annual Energy Outlook 2004



DOE FreedomCAR and 21st Century Truck Goals

Transition to Hydrogen Vehicle Technology



Vehicle Systems Analysis & Testing

Technology Requirements & Targets

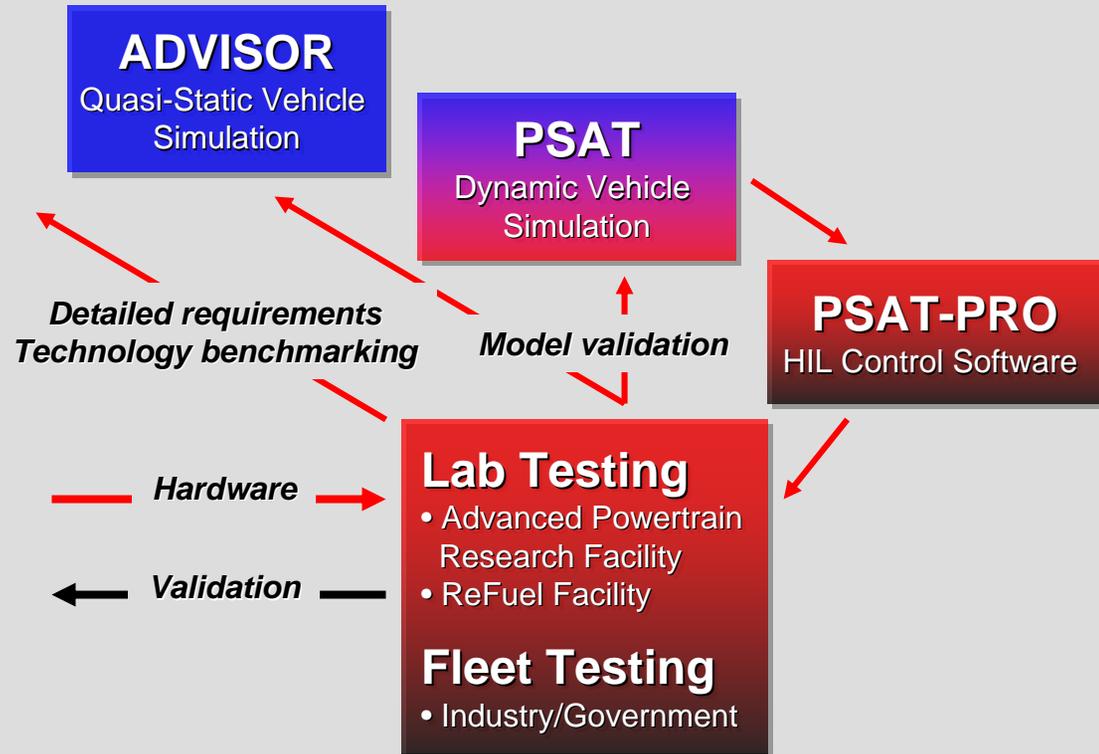
- Vehicle systems simulation & analysis
- Technical targets development
- Benchmarking

Technology Development

- Advanced propulsion & vehicle efficiency
- Electrochemical energy storage
- Power electronics & electric machines
- Advanced combustion engines
- Materials
- Fuels
- Fuel cells and H₂ storage (OHFCIT)

Validation & Introduction

- Laboratory testing & validation
- Field testing & evaluation
- Technology introduction



Field Testing and Evaluation of Light Duty Hybrid Electric Vehicles (HEV)

- Baseline performance, fleet & accelerated reliability testing
 - 6 MY 2001 Honda Insights
 - 4 MY 2003 Honda Civics
 - 6 MY 2002 Gen I Toyota Prius
 - 2 MY 2004 Gen II Toyota Prius
 - 2 MY 2004 Chevrolet Silverado (2 & 4WD)
 - 2 MY 2005 Honda Accord
 - 2 MY 2005 Ford Escape (2 & 4WD)

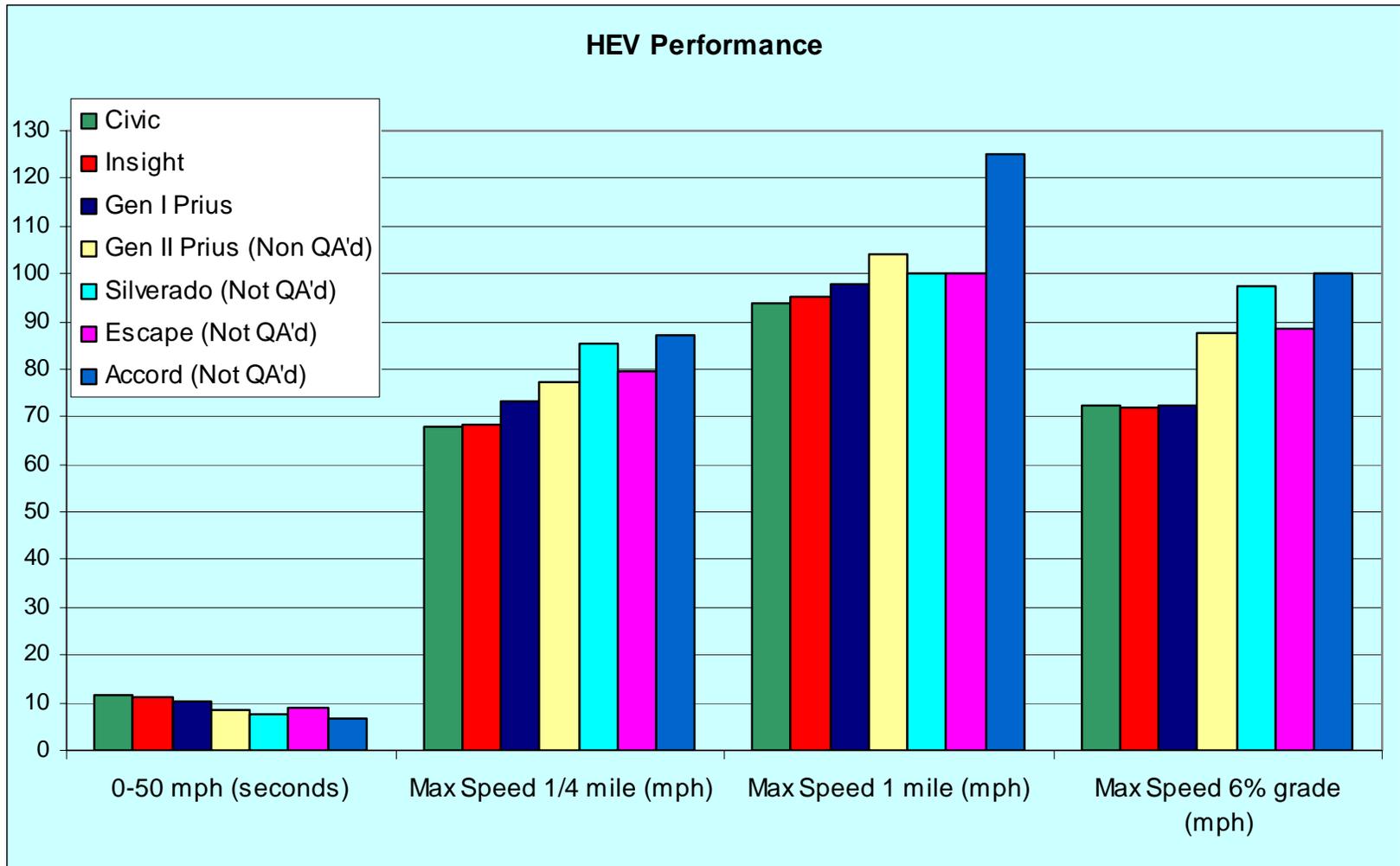


HEV Testing Methods

- Baseline Performance testing (dynamometers & closed tracks)
 - Acceleration, max speed, braking, handling & two fuel economy tests (SAE J1634 drive cycle - with & w/o air conditioning)
- Fleet & accelerated reliability (AR) testing
 - Bank One, Red Cross, Arizona Public Service, ETA
 - Collect fuel use, maintenance & operations (M&O), miles & costs
 - 2 of each HEV model accumulate 160,000 miles
- End of life (160,000 miles) SAE J1634 tests & battery capacity & power testing



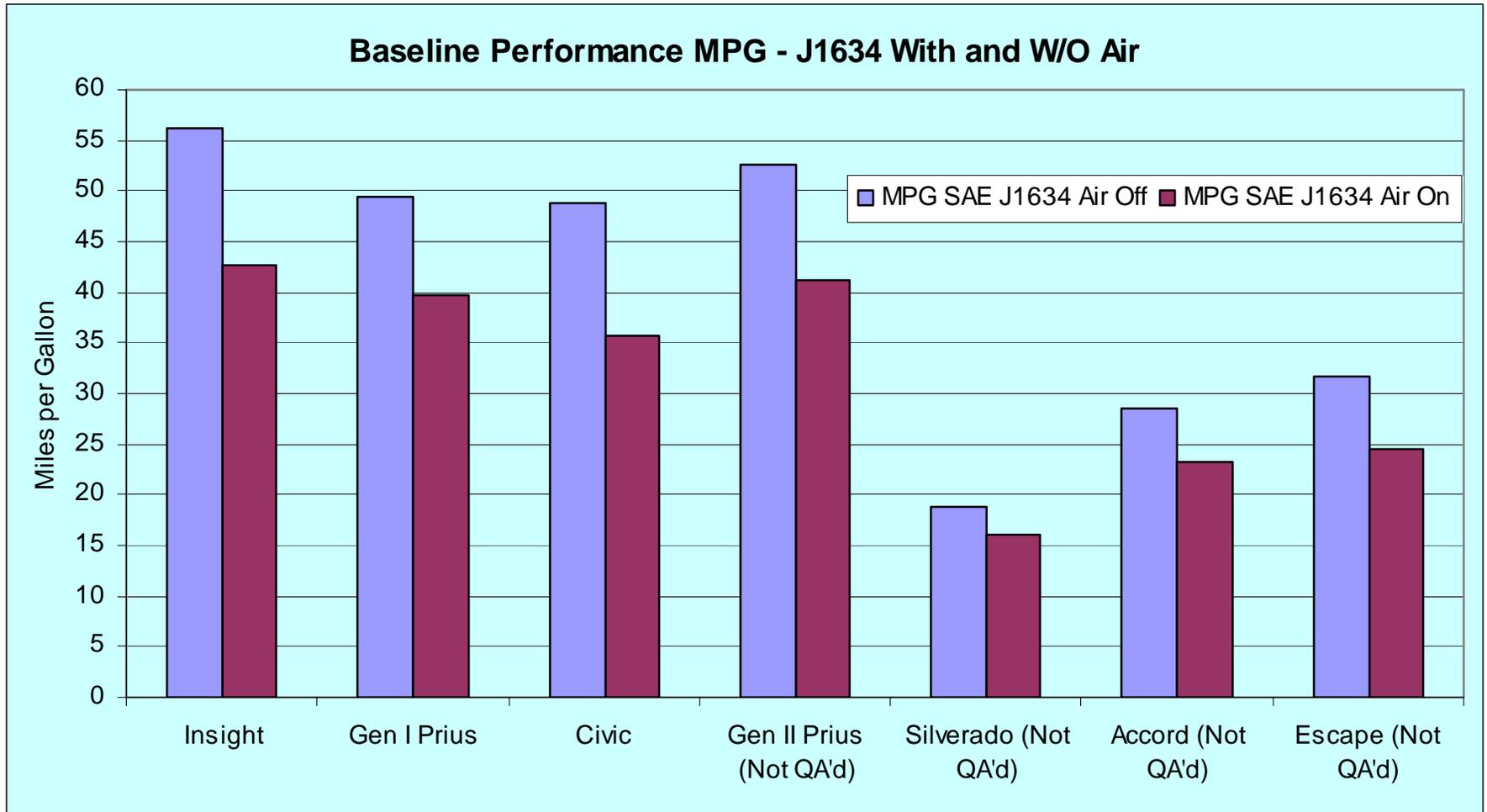
HEV Baseline Performance Testing



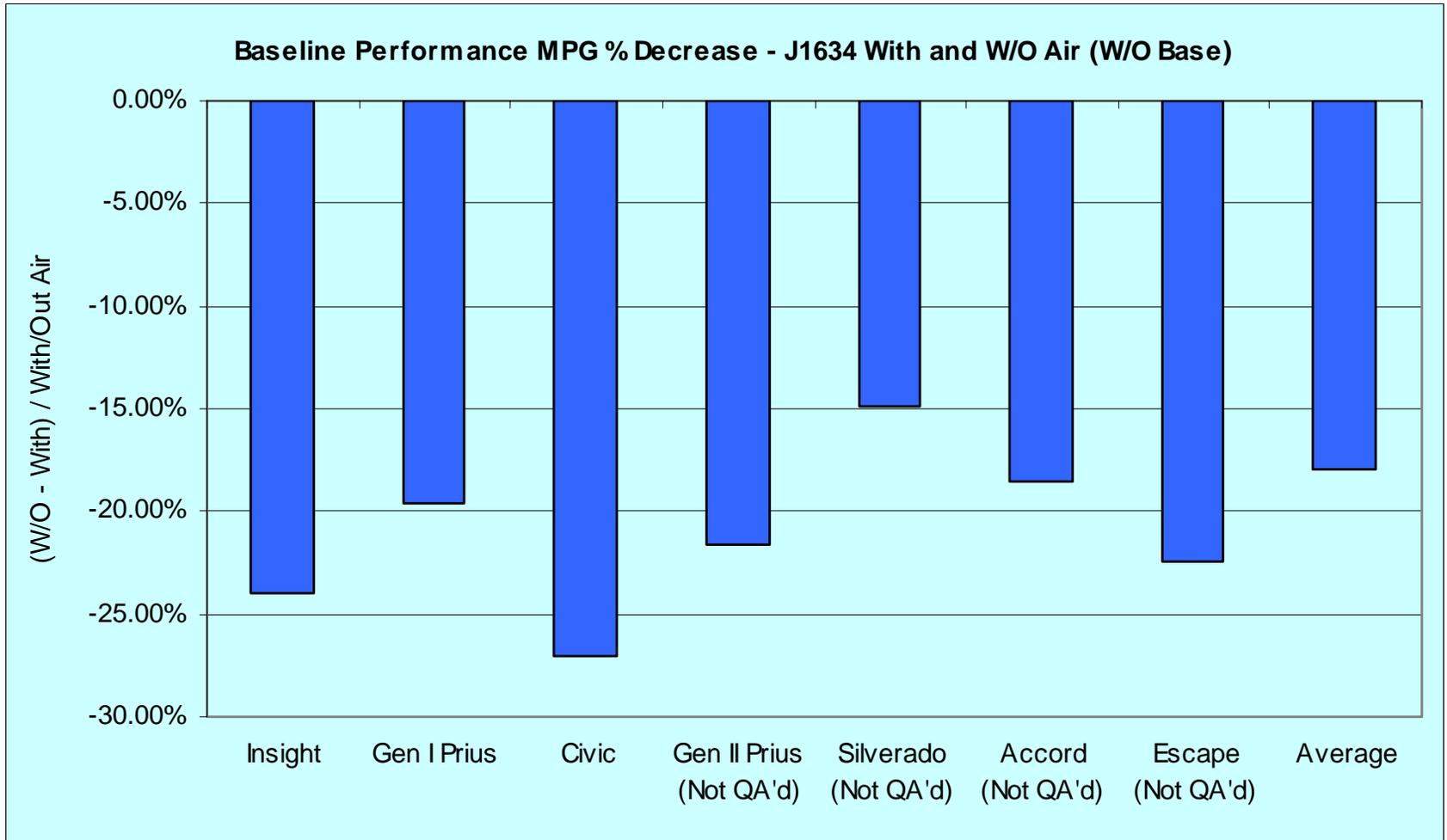
* The 1 mile Max Speed for the Silverado and Escape exceeded 100 mph



HEV Baseline Performance MPG



HEV J1634 MPG Difference (Air on/off)



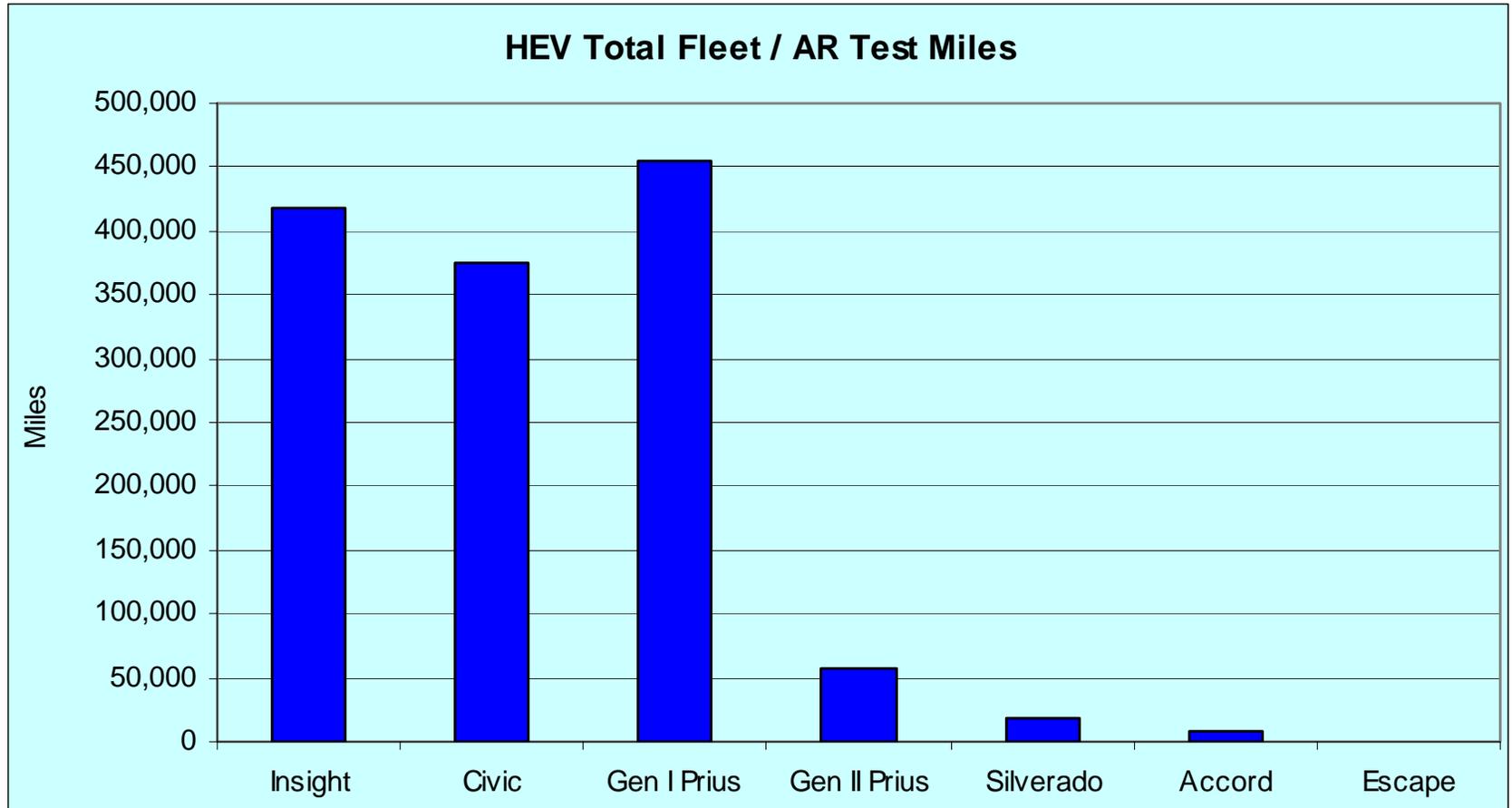
HEV Fleet & AR Testing Status

- 6 MY 2001 Honda Insights: Aug/01 - March/05
- 6 MY 2002 Gen I Toyota Prius: Nov/01 - March/05
- 4 MY 2003 Honda Civics: May/02 - March/05
- 2 MY 2004 Gen II Toyota Prius: Nov/03 - ongoing
- 2 MY 2004 Chevrolet Silverado: Sept/04 - ongoing
- 2 MY 2005 Honda Accord: Jan/05 - ongoing
- 2 MY 2005 Ford Escape: April/05 - ongoing

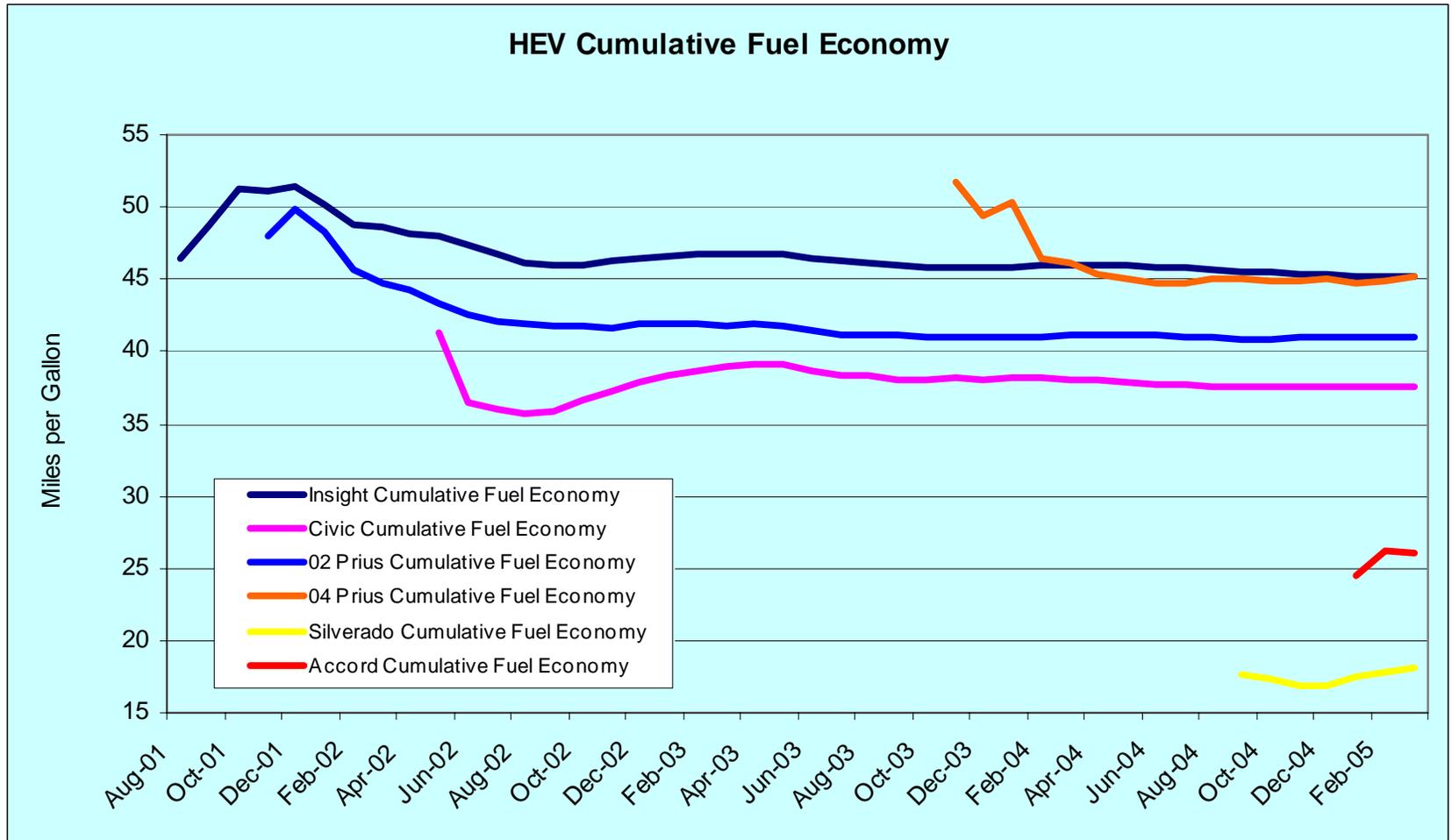


HEV Fleet & AR Testing

- 1.33 million total HEV test miles

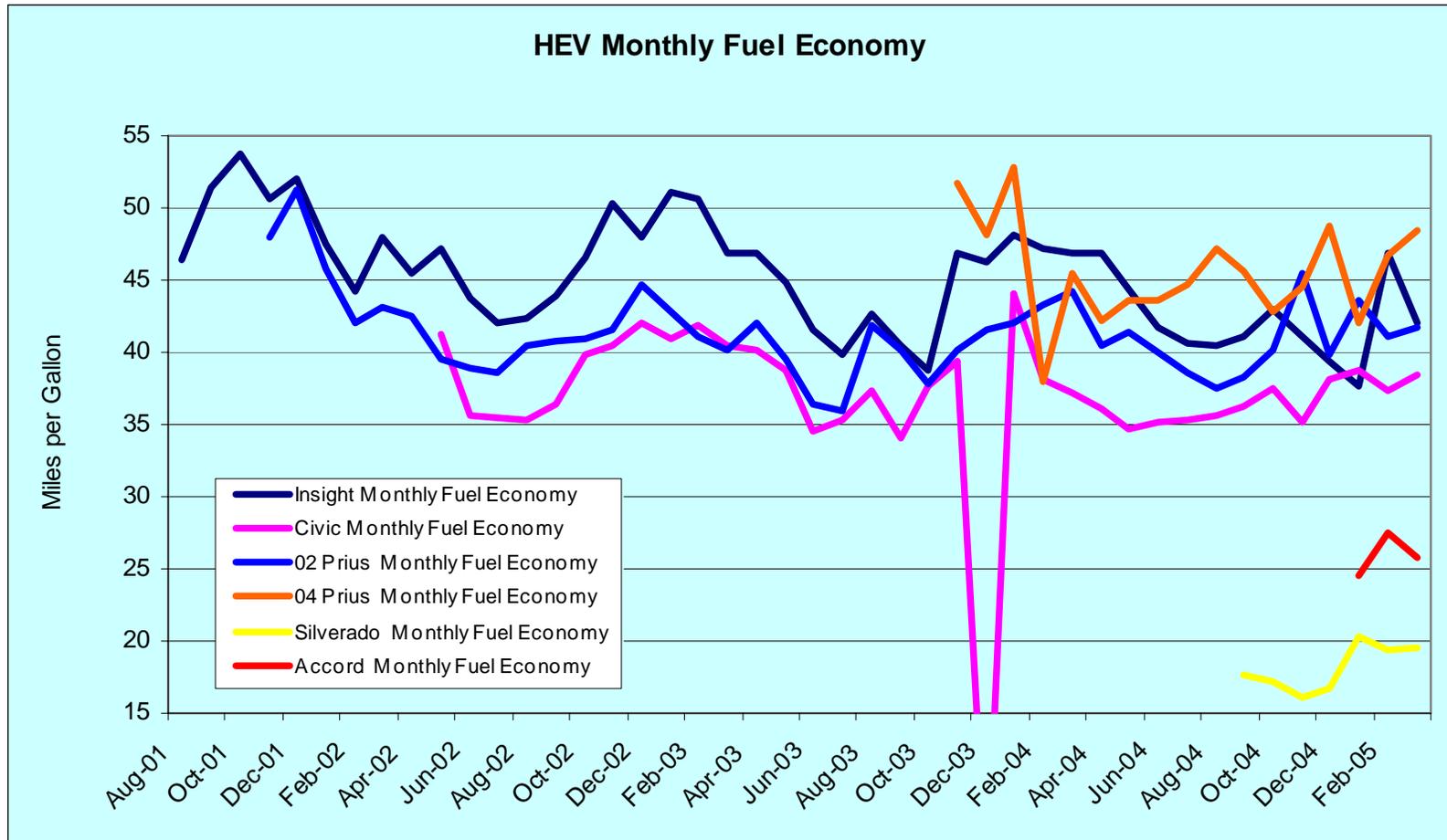


HEV Fleet & AR Cumulative MPG



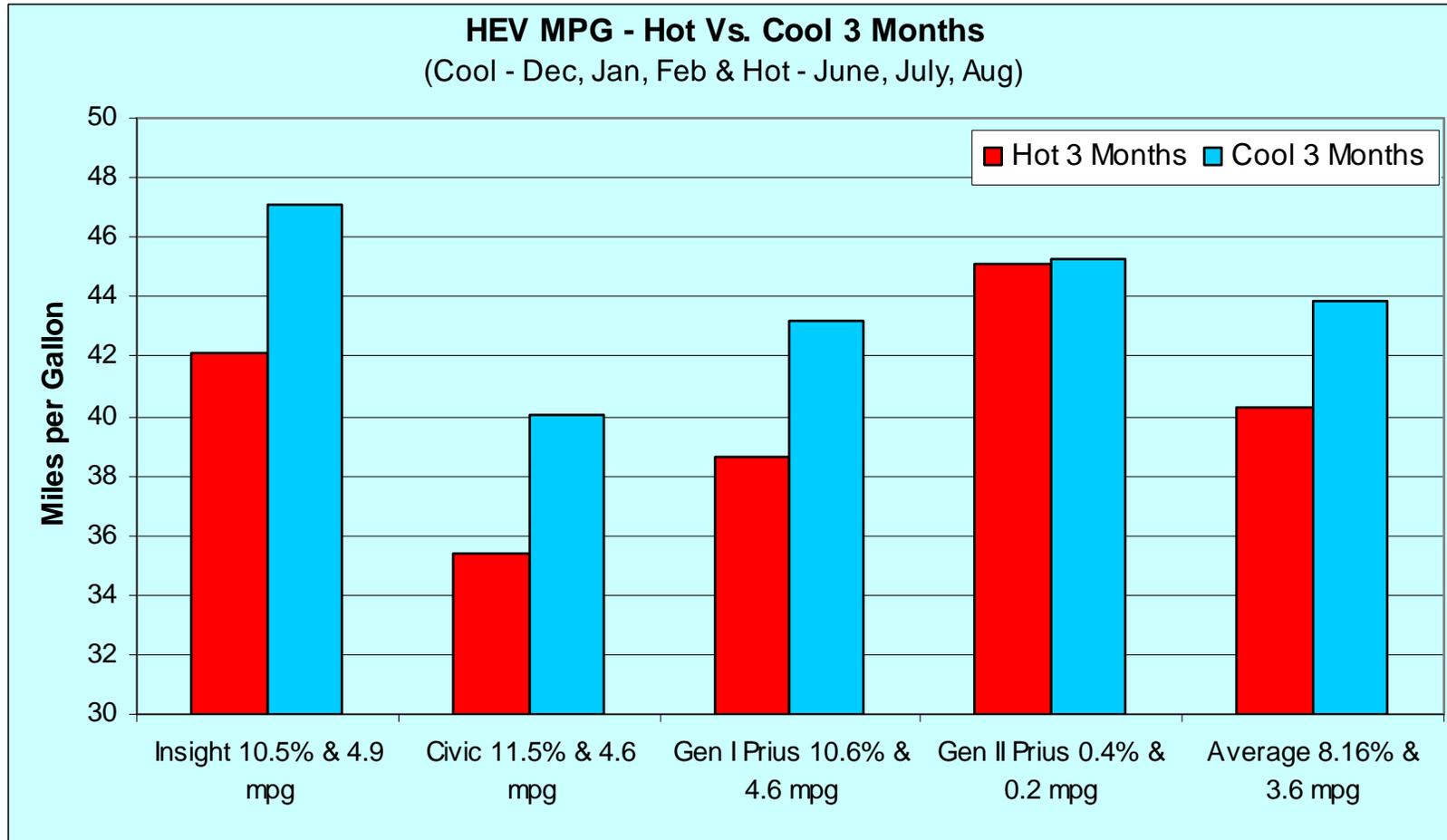
Hybrid Electric Vehicle Testing

- Fleet and accelerated reliability testing

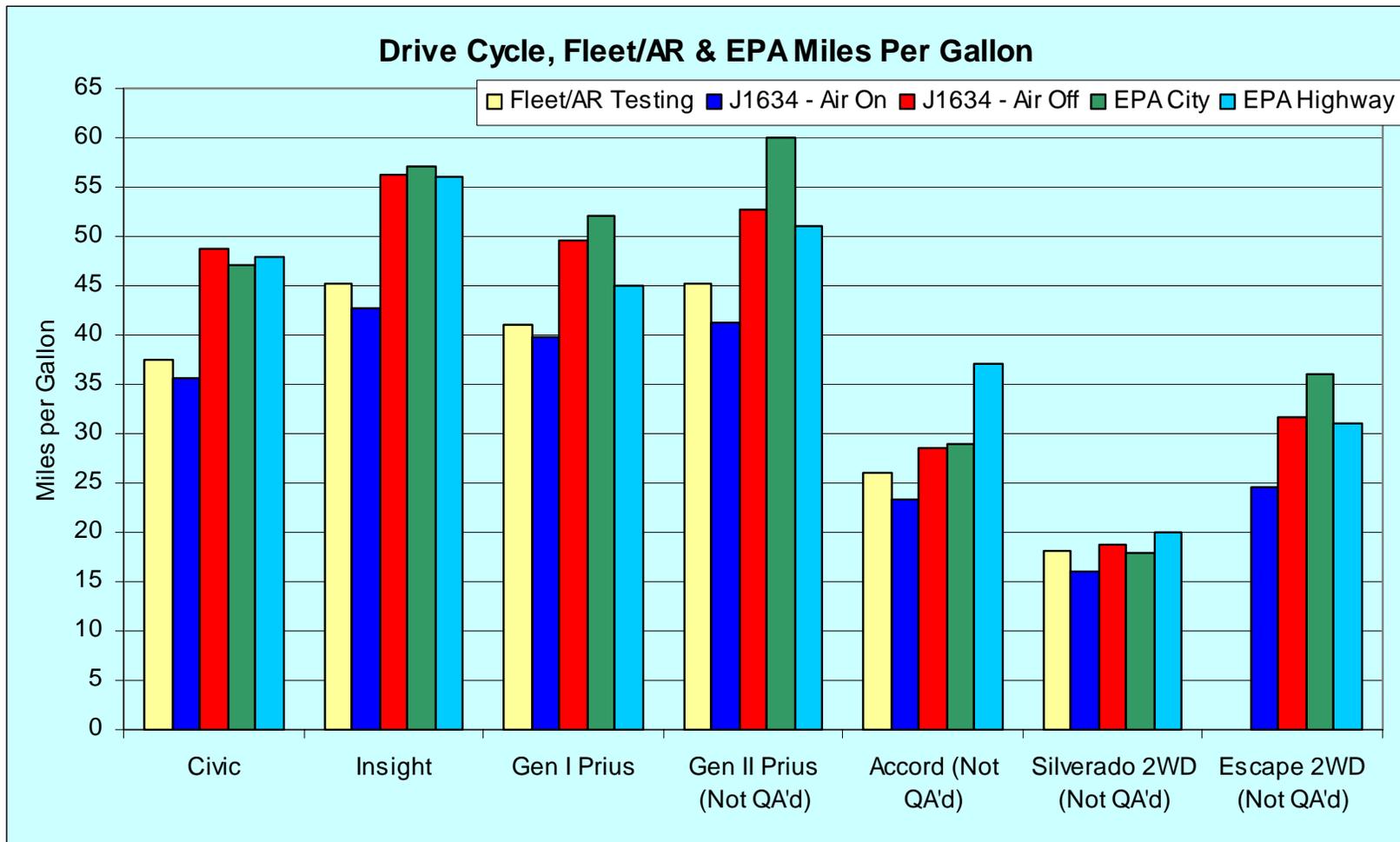


Hybrid Electric Vehicle Testing

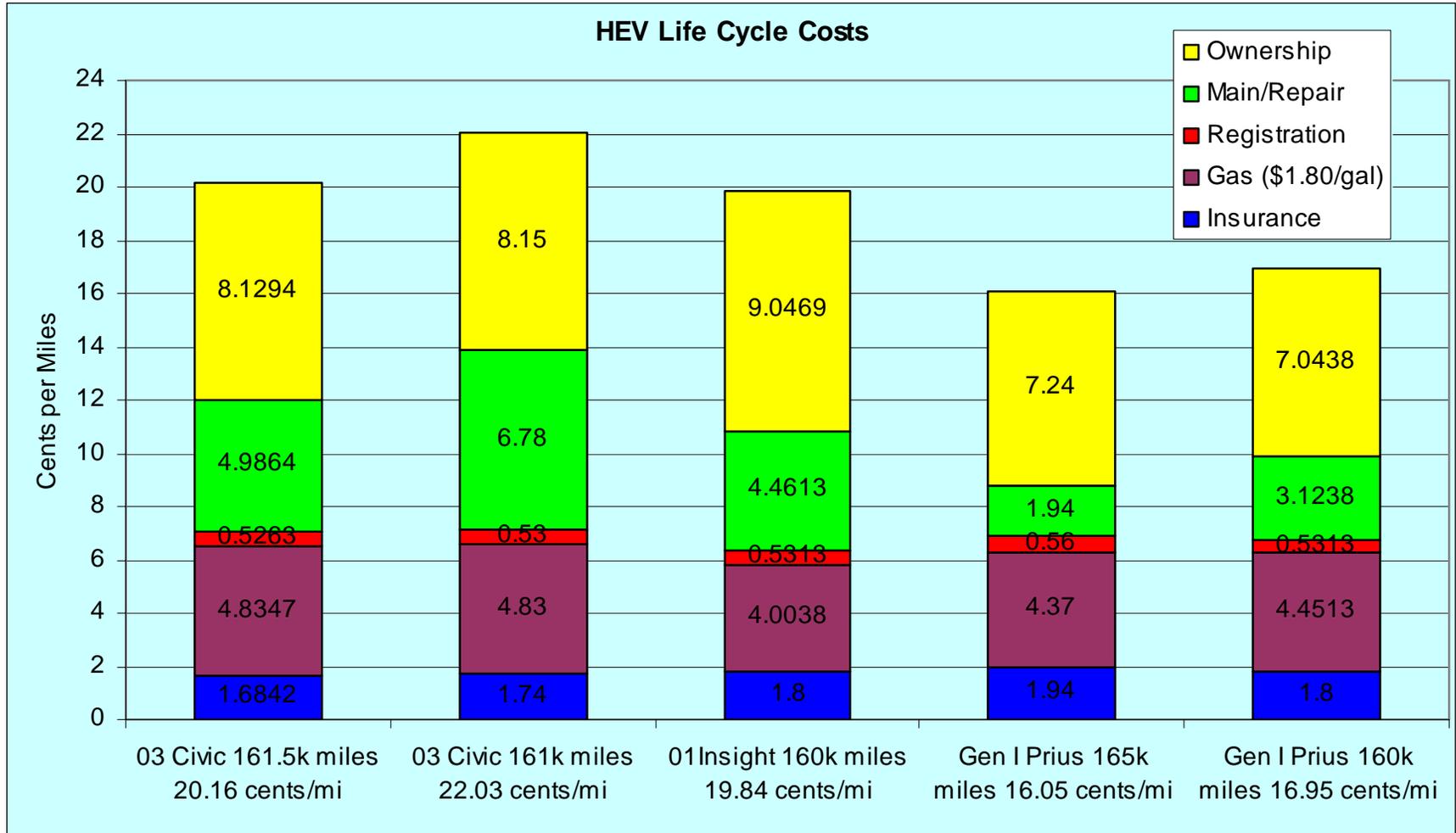
- Fleet and accelerated reliability testing



HEV Testing – All MPGs



HEV Life-Cycle Costs



Future HEV Testing

- 2005: end-of-life (160,000 miles) SAE J1634, & battery capacity & power tests (HPPC)
 - Two each – Insight (maybe), Civic & Gen I Prius
- 2005: HEV testing candidates
 - Toyota Highlander & Lexus RX400H SUVs
- 2006 and beyond HEV testing
 - HEV end-of-life (160,000 miles) testing
 - HEV Hydrogen Prius (Quantum)
 - Plug-in HEV Dodge Sprinter (lithium)
 - Plug-in HEV Escape conversion (lithium)
 - Plug-in ALABC small SUV (EcoSport)
 - Other OEM HEVs?



For More Information

- FreedomCAR and Vehicle Technologies

- www.eere.energy.gov/vehiclesandfuels

- Advanced Vehicle Testing Activity (AVTA)

Test reports, fact sheets, and maintenance logs available via-

- <http://avt.inl.gov> or

- <http://www.eere.energy.gov/vehiclesandfuels/avt/index.shtml>

