

U.S. Department of Energy FreedomCAR & Vehicle Technologies Program

Advanced Vehicle Testing Activity – *Hybrid Electric Vehicle and Idle Reduction Technology Activities*

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Presentation Outline

- **AVTA Goal**
- **AVTA Testing Partners**
- **Hybrid Electric Vehicle Testing (Performance)**
- **Hybrid Electric Vehicle Policy Support**
- **Hybrid Electric Vehicle Provisions in pending Energy Bill**
- **State and Local Idle Reduction Activities**
- **State and Local Idle Reduction Regulations**
- **DOE Idle Reduction Demonstration Project**

AVTA Goal

- **Benchmark and validate the performance of light-, medium-, and heavy-duty vehicles that feature one or more advanced technologies, including:**
 - ICE's burning advanced fuels, such as 100% hydrogen and hydrogen/CNG-blended fuels
 - Hybrid electric, pure electric, and hydraulic drive systems
 - Advanced batteries and engines
 - Advanced climate control, power electronic, and other ancillary systems

AVTA Testing Partners

- **Qualified Vehicle Testers (50 – 50 cost share)**
 - **Electric Transportation Applications (lead)**
 - **Arizona Public Service (APS)**
 - **Bank One**
 - **Ford Motor Company**
 - **Luke AFB**
 - **New York Power Authority**
 - **Red Cross**
 - **Southern California Edison**
 - **Salt River Project**
 - **Cities of Palm Springs, Palm Valley, Phoenix, Vacaville, and San Diego**

Hybrid Electric Vehicle Testing

- **Honda Insight**
- **Honda Civic**
- **MY '02 & '03 Toyota Prius**
- **MY '04 Toyota Prius**
- **Fleet and accelerated reliability testing (900,000+ miles)**
 - **Bank One, Red Cross, Arizona Public Service, ETA**
 - **Fuel use, maintenance, repairs, driver experience**
- **Baseline Performance testing (dynamometers and closed test tracks)**
 - **Fuel economy, acceleration, max speed, braking, & handling**

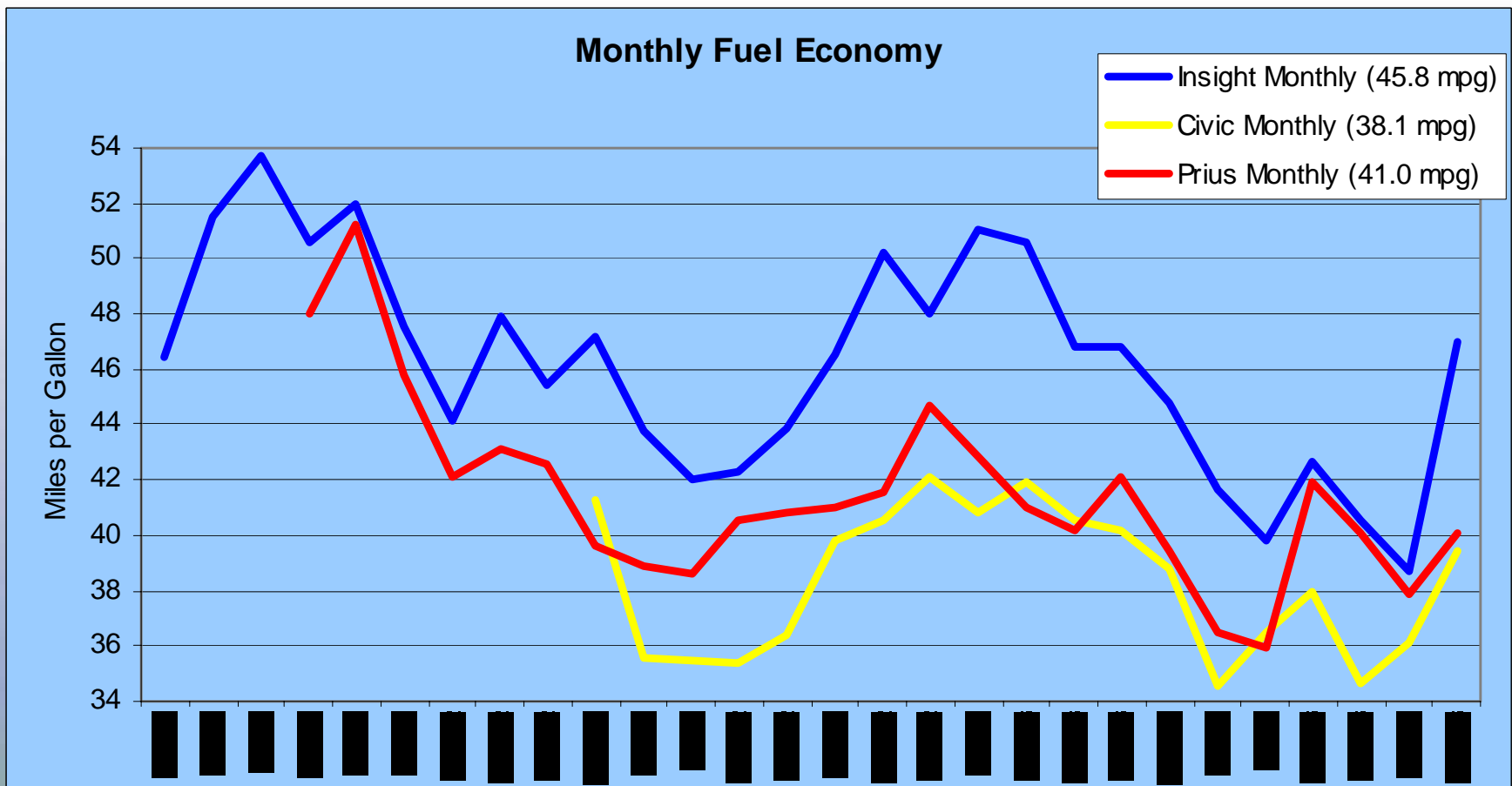
Hybrid Electric Vehicle Testing

- **Fleet and accelerated reliability testing**
 - **6 Honda Insights (302,000 miles) ~45.8 mpg**
 - **4 Honda Civics (248,000 miles) ~38.1 mpg**
 - **6 Model year 02 & 03 Toyota Prius (344,000 miles) ~41.0 mpg**



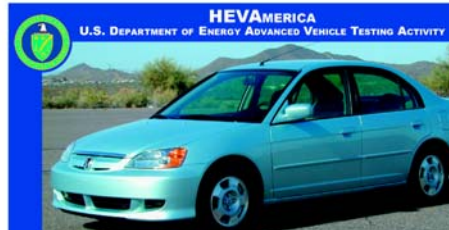
Hybrid Electric Vehicle Testing

- Fleet and accelerated reliability testing



Hybrid Electric Vehicle Testing

• Baseline Performance testing



2003 Honda Civic Hybrid Electric Vehicle

VEHICLE SPECIFICATIONS		PERFORMANCE STATISTICS
VEHICLE FEATURES Base Vehicle: 2003 Honda Civic VIN: JHMC566035000815 Seatbelt Positions: Five Standard Features: - CARB Certified as aULEV - AM/FM Stereo Cassette - Front Wheel Drive - CVT Transmission - Front Disc/Rear Drum Brakes - Regenerative Braking - Air Bags - Anti-Lock Brakes - Power Windows - Power Locks/Keyless Entry - Keyless Entry - Air Conditioning - Heater/Windshield Defroster - Rear Window Defroster - State-Of-Charge Meter - Low Rolling Resistance Tires		
WEIGHTS Design Curb Weight: 2732 lbs Delivered Curb Weight: 2717 lbs Distribution F/R: 58/42 % GVWR: 3620 lbs GAWR F/R: 1855/1845 lbs Payload: 882 lbs Performance Goal: 400 lbs		
DIMENSIONS Wheelbase: 103.1 inches Track F/R: 57.9/57.9 inches Length: 174.8 inches Width: 67.5 inches Height: 55.6 inches Ground Clearance: 4.7 inches Performance Goal: 5.0 inches		
TIRES Tire Mfg: Dunlop Tire Model: SP70 FE Tire Size: 185/70R14 Tire Pressure F/R: 30/30 psi Spare Installed: Yes		
BATTERY Manufacturer: Panasonic EV Energy Type: Nickel Metal Hydride (NiMH) Number of Cells: 120 Cylindrical Cell Weight: 0.183 kg Weight of Pack(s): 22 kg Pack(s) Location: Rear Nominal Cell Voltage: 1.2 VDC Nominal System Voltage: 144 VDC Normal Peak Capacity (C/2): 6.0 Ah Electric Motor: 10 kW		
TEST NOTES: 1. Energy transfer display 2. Vehicle not equipped with a battery only mode 3. Average battery discharge over 54.6 mile drive cycle 4. Value calculated based on fuel economy and fuel tank size 5. Air Conditioning on maximum with full battery 6. Air Conditioning on maximum with full battery		
PERFORMANCE STATISTICS Acceleration 0-50 mph At 100% SOC: 11.7 seconds At 50% SOC: N/A Performance Goal: 13.5 s Maximum Speed At 1/4 Mile: 68.0 mph In 1 Mile: 93.7 mph Performance Goal: 70 mph Driving Cycle Range w/o Accessories Average Electric Power: 6.0 kW Cycle Fuel Economy: 48.1 mpg Driving Range: 470 miles Driving Cycle Range w/Accessories Average Electric Power: 6.0 kW Cycle Fuel Economy: 48.1 mpg Driving Range: 470 miles Braking From 60 mph Controlled Dry: 158.4 feet Controlled Wet: 154.7 feet Panic Wet: 160.6 feet Handling Average Time: 56.7 seconds Average Dodge Neon Time: 54.6 seconds Gradeability (Calculated) Maximum Speed @ 3%: 72.4 mph Maximum Speed @ 6%: 88.4 mph Maximum Grade: 37.4%		



2001 Honda Insight Hybrid Electric Vehicle

VEHICLE SPECIFICATIONS		PERFORMANCE STATISTICS
VEHICLE FEATURES Design Vehicle: 2001 Honda Insight VIN: JHMCZE147211002465 Seatbelt Positions: Two Standard Features: - CARB Certified as aULEV - AM/FM Stereo Cassette - Front Wheel Drive - CVT Transmission - Front Disc/Rear Drum Brakes - Regenerative Braking - Air Bags - Anti-Lock Brakes - Power Windows - Power Locks/Keyless Entry - Air Conditioning - Heater/Windshield Defroster - Rear Window Defroster - State-Of-Charge Meter - Low Rolling Resistance Tires		
WEIGHTS Design Curb Weight: 1967 lbs Delivered Curb Weight: 1959 lbs Distribution F/R: 61/39 % GVWR: 2280 lbs GAWR F/R: 1355/1035 lbs Payload: 411 lbs Performance Goal: 400 lbs		
DIMENSIONS Wheelbase: 94.5 inches Track F/R: 56.5/52.2 inches Length: 155.1 inches Width: 66.7 inches Height: 51.5 inches Ground Clearance: 4.6 inches Performance Goal: 5.0 inches		
TIRES Tire Mfg: Bridgestone Tire Model: Potenza Tire Size: 165/65R14 Tire Pressure F/R: 38/35 psi Spare Installed: Yes		
ENGINE Model: VTEC-E Output: 48 kW @ 5700 rpm Configuration: In-Line 3-Cylinder Displacement: 1.0 L Fuel Tank Capacity: 10.5 Gallons Fuel Type: Unleaded Gasoline		
BATTERY Manufacturer: Panasonic EV Energy Type: Nickel Metal Hydride (NiMH) Number of Modules: 38 Prismatic Module Weight: 1.02 kg Weight of Pack(s): 39 kg Pack(s) Location: Behind Rear Seat Nominal Module Voltage: 7.2 VDC Nominal System Voltage: 274 VDC Normal Peak Capacity (C/2): 6.5 Ah Electric Motor: 33 kW		
TEST NOTES: 1. Energy transfer display 2. Vehicle not equipped with a battery only mode 3. Average battery discharge over 54.6 mile drive cycle 4. Value calculated based on fuel economy and fuel tank size 5. Air Conditioning on maximum with full battery 6. Air Conditioning on maximum with full battery		
PERFORMANCE STATISTICS Acceleration 0-50 mph At 100% SOC: 11.3 seconds At 50% SOC: N/A Performance Goal: 13.5 s Maximum Speed At 1/4 Mile: 68.4 mph In 1 Mile: 95.2 mph Performance Goal: 70 mph Driving Cycle Range w/o Accessories Average Electric Power: 0.7 kW Cycle Fuel Economy: 56.2 mpg Driving Range: 590 miles Driving Cycle Range w/Accessories Average Electric Power: 1.3 kW Cycle Fuel Economy: 42.7 mpg Driving Range: 448 miles Braking From 60 mph Controlled Dry: 169.3 feet Controlled Wet: 157.6 feet Panic Wet: 167.4 feet Handling Average Time: 61.2 seconds Average Dodge Neon Time: 54.6 seconds Gradeability (Calculate) Maximum Speed @ 3%: 81.9 mph Maximum Speed @ 6%: 72.4 mph Maximum Grade: 34.7 %		

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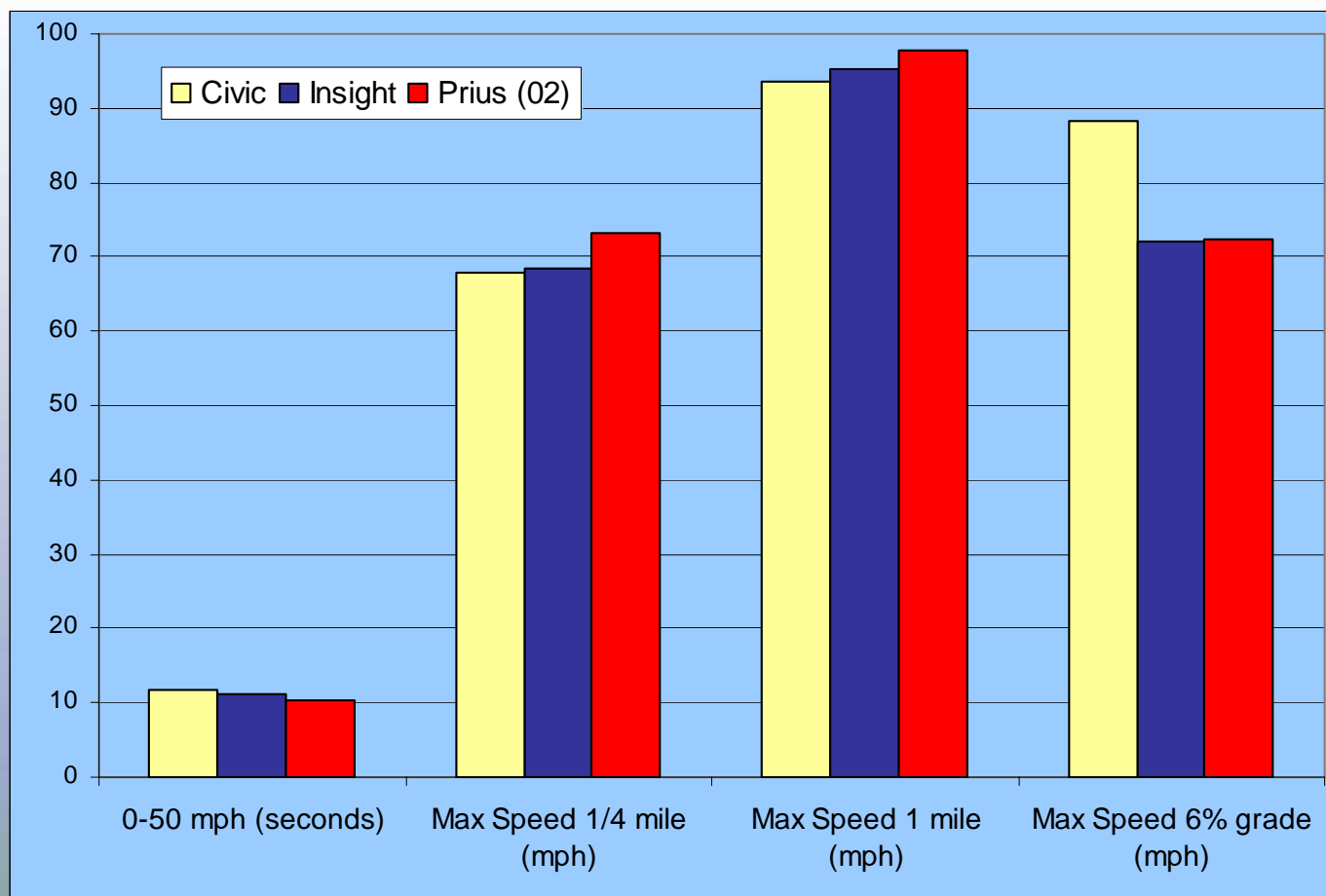
2002 Toyota Prius Hybrid Electric Vehicle

VEHICLE SPECIFICATIONS		PERFORMANCE STATISTICS
VEHICLE FEATURES Base Vehicle: 2002 Toyota Prius VIN: J3ZBK18U820042105 Distribution F/R: 60/40 % GVWR: 3615 lbs GAWR F/R: 1970/1685 lbs Payload: 865 lbs Performance Goal: 400 lbs Standard Features: - CARB Certified as aULEV - AM/FM Stereo Cassette - Front Wheel Drive - CVT Transmission - Front Disc/Rear Drum Brakes - Regenerative Braking - Air Bags - Anti-Lock Brakes - Power Windows - Power Locks/Keyless Entry - Air Conditioning - Heater/Windshield Defroster - Rear Window Defroster - State-Of-Charge Meter - Low Rolling Resistance Tires		
WEIGHTS Design Curb Weight: 2765 lbs Delivered Curb Weight: 2790 lbs Distribution F/R: 60/40 % GVWR: 3615 lbs GAWR F/R: 1970/1685 lbs Payload: 865 lbs Performance Goal: 400 lbs		
DIMENSIONS Wheelbase: 100.4 inches Track F/R: 58.1/58.3 inches Length: 169.6 inches Width: 66.7 inches Height: 57.2 inches Ground Clearance: 4.4 inches Performance Goal: 5.0 inches		
TIRES Tire Mfg: Bridgestone Tire Model: Potenza Tire Size: P175/65R14 Tire Pressure F/R: 35/33 psi Spare Installed: Yes		
BATTERY Manufacturer: Panasonic EV Energy Type: Nickel Metal Hydride (NiMH) Number of Modules: 38 Prismatic Module Weight: 1.02 kg Weight of Pack(s): 39 kg Pack(s) Location: Behind Rear Seat Nominal Module Voltage: 7.2 VDC Nominal System Voltage: 274 VDC Normal Peak Capacity (C/2): 6.5 Ah Electric Motor: 33 kW		
TEST NOTES: 1. Energy transfer and consumption display 2. Vehicle not equipped with a battery only mode 3. Average battery discharge over 54.6 mile drive cycle 4. Value calculated based on fuel economy and fuel tank size 5. Air Conditioning on maximum with full battery 6. Air Conditioning on maximum with full battery		
PERFORMANCE STATISTICS Acceleration 0-50 mph At 100% SOC: 10.4 seconds At 50% SOC: N/A Performance Goal: 13.5 seconds Maximum Speed At 1/4 Mile: 73.3 mph In 1 Mile: 97.9 mph Performance Goal: 70 mph in one mile Driving Cycle Range w/o Accessories Average Electric Power: 2.00 kW Cycle Fuel Economy: 49.5 mpg Driving Range: 588 miles Driving Cycle Range w/Accessories Average Electric Power: 1.84 kW Cycle Fuel Economy: 39.8 mpg Driving Range: 473 miles Braking From 60 mph Controlled Dry: 153.6 feet Controlled Wet: 172.7 feet Panic Wet: 182.2 feet Handling Average Time: 57.8 seconds Average Dodge Neon Time: 54.6 seconds Gradeability (Calculated) Maximum Speed @ 3%: 88.6 mph Maximum Speed @ 6%: 72.4 mph Maximum Grade: 36.1%		

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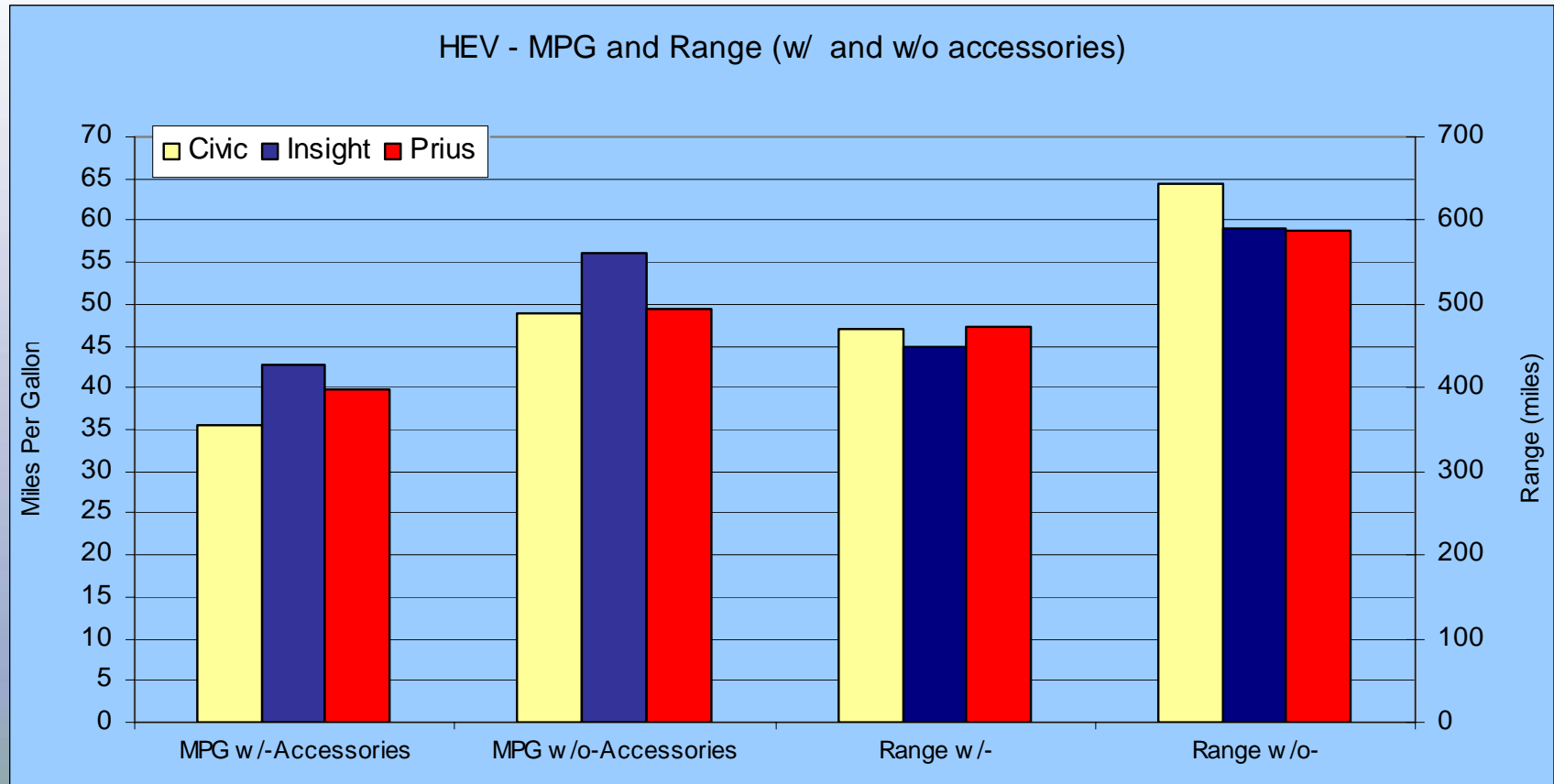
Hybrid Electric Vehicle Testing

- Baseline Performance testing results



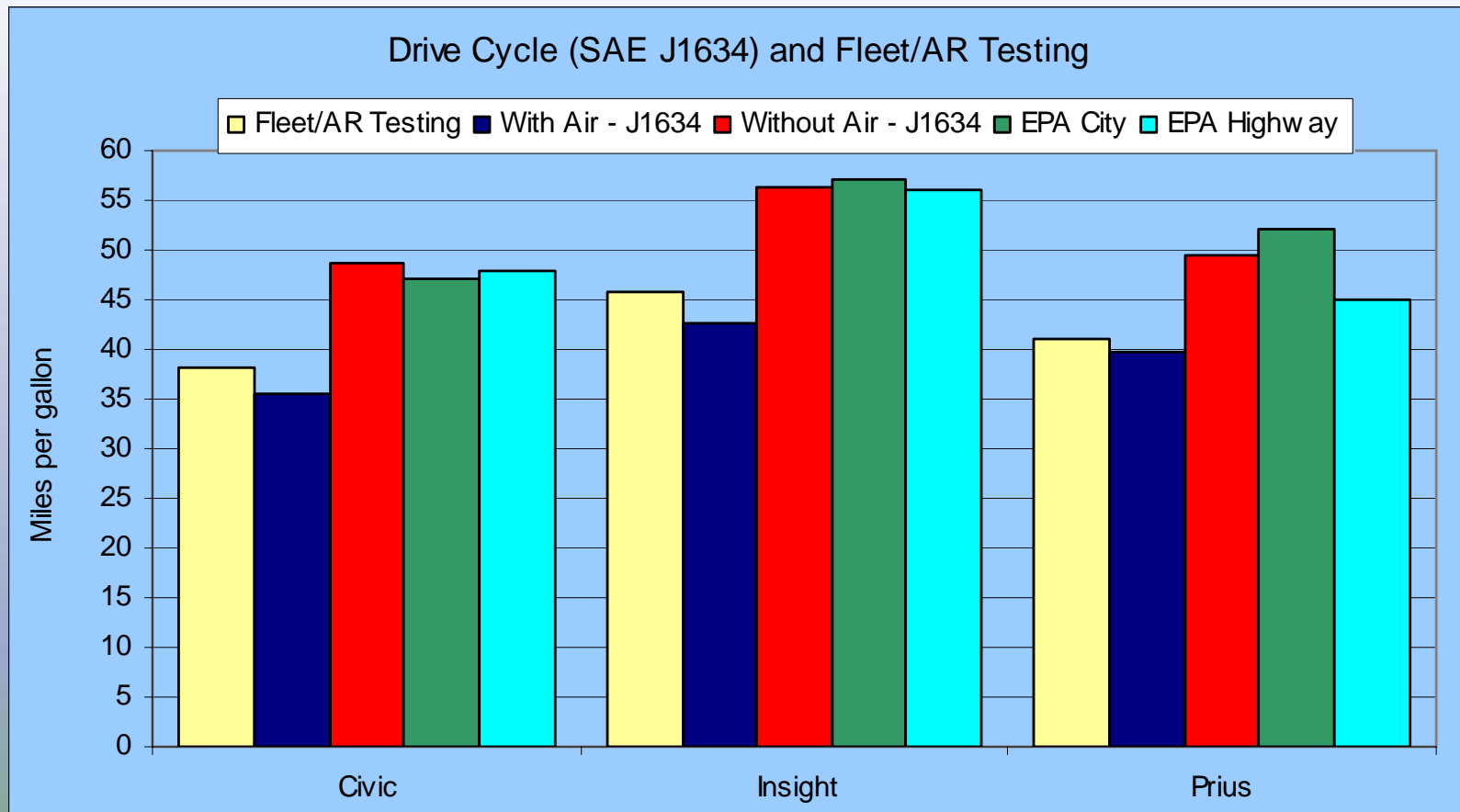
Hybrid Electric Vehicle Testing

- **Baseline Performance testing results (SAE J1634)**



Hybrid Electric Vehicle Testing

- **Baseline Performance, fleet and accelerated reliability, and EPA testing results**



Hybrid Electric Vehicle Testing

- **2004 HEV candidate test vehicles**
 - MY 04 Toyota Prius (started testing)
 - General Motors Sierra pickup
 - Toyota Highlander SUV
 - Lexus RX400 SUV
 - Honda Accord
 - Ford Escape SUV

Hybrid Electric Vehicle Policy Support

- **\$1,500 Federal income tax deduction**
- **HOV lane access (VA, CO, FL, AZ, GA)**
- **Exemption from emissions testing (MD)**
- **Government purchases (NY, CA)**
- **State tax incentives/rebates (CA, OK, OR)**
- **VA Legislature introduced Bill in Jan '04 exempting HEVs from emissions testing**
- **Maryland General Assembly introduced bill in Jan '04 allowing HEVs in HOV lanes with single occupants**

Source: Electric Drive Transportation Association

HEV Provisions in Pending Energy Bill

- **HEVs allowed as compliance option (except Federal Fleets) for EPA Act – up to 1 credit based on fuel efficiency and battery pack maximum power**
- **Allow HEVs (as defined by states) with single occupant in HOV lanes**
- **\$250 to \$1,000 tax credit for HEVs <8,500 lbs GVW based on rechargeable energy storage system maximum power**
- **\$500 to \$3,000 tax credit for HEVs meeting vehicle mileage performance (125-250% increase in MY '00 city fuel economy)**

Source: Electric Drive Transportation Association

State/Local Idle Reduction Activities - NY

- **NY State Energy Research and Development Authority (NYSERDA) working to accelerate development and commercialization of Truck Stop Electrification (TSE) equipment, systems design, and services**
- **NY State Thruway Authority, in partnership with NYSERDA and Niagra Mohawk Power Co., share financing of a two-year \$500,000 TSE program for the installation of up to 44 IdleAire multi-service consoles at 2 sites along rest stops in Syracuse**
- **Installation of 2 shorepower TSE facilities on the Adirondack Northway pending**

State/Local Idle Reduction Activities - CA

- **\$200k EPA grant awarded to EPRI, SMUD, and other partners for idle reduction project**
 - **Demonstrate use of onboard AC power**
 - **Reimburse fleets for 50% of purchase price for any one of 3 approved idle reduction packages**
 - **Installation of technology package and driver training provided by EPRI**
- **16 AC power receptacles installed by SMUD at Sacramento's 49er Travel Plaza - free power on a first-come basis. More units upon demand**

State/Local Idle Reduction Activities - CA

- **Carl Moyer Clean Engine Incentive Program - provide fleets with up to \$1,500 per vehicle for the installation of anti-idling technologies**
 - **Subsidy of \$2,500 per vehicle for advanced technology systems such as fuel cell auxiliary power units (APUs)**
 - **All devices must be certified and operated within California for at least 100 hours per year for five years**

State/Local Idle Reduction Regulations

State	Applicability	Idling Time Limit
AZ	Heavy duty diesel vehicles >14,000 lbs GVW	5 minutes*
CA	<ul style="list-style-type: none">•Marine terminals @ ports >100,000 containers per year•Pending: limit idling MY 2007 and later on-road heavy-duty vehicles. Sleepers can use automatic start-stop or other IR technologies	<ul style="list-style-type: none">•30 minutes*•Engine off if idling >5 minutes
CO	Any motor vehicle	10 minutes in any 1 hour*
CT	<ul style="list-style-type: none">•Mobile source engine•School buses	<ul style="list-style-type: none">•3 consecutive min*•off > 3 minutes*

Source: CARB and EPA

*with some exemptions

State/Local Idle Reduction Regulations

State	Applicability	Idling Time Limit
DC	Diesel/gasoline vehicles	3 minutes*
HI	All motor vehicles	No specified time*
MD & MA	All motor vehicles	5 minutes*
MN (St. Cloud)	All motor vehicles within 2 block area of city	5 minutes*
MO (St. Louis)	All motor vehicles	10 minutes*
NV / NY	Diesel truck or bus	15 / 5 minutes
NH	Diesel/gasoline vehicles	5 min* >32°F & 15 min* >-10°F & <32°F

Source: CARB and EPA

*with some exemptions

State/Local Idle Reduction Regulations

State	Applicability	Idling Time Limit
NJ	Diesel-powered motor vehicles	3 min* / 15 min* if stopped ≥ 3 hrs
NYC	All motor vehicles	3 minutes*
PA (Philly)	Diesel vehicles >8,500 lbs GVW or passenger carrying >12	2 min for layovers / 5 min <32°F / 20 min < 20°F / 20 min buses w/AC & no open windows & > 75°F

Source: CARB and EPA

**with some exemptions*

State/Local Idle Reduction Regulations

State	Applicability	Idling Time Limit
TX (Houston / Galveston)	Diesel/gasoline motor vehicles (> 14,000 lbs GVW)	5 min* April 1 – Oct 31 30 min* for heat/AC transit/school buses
UT (Salt Lake City)	Diesel vehicles	15 minutes*
VA	Buses when unattended, parked, or stopped	10 minutes*

Source: CARB and EPA

**with some exemptions*

DOE Idle Reduction Demonstration

- **Goal: To gather objective in-use information on the performance of available technologies by characterizing:**
 - **Specifications and Costs: system descriptions, capital and installation costs, payback periods**
 - **Vehicle Operations: fuel consumption (truck idling and IR systems), engine oil consumption and changes, maintenance (truck and IR systems)**
 - **Other Evaluation Information: engine and component wear, resale value, user impressions**

DOE Idle Reduction Demonstration

- **Reduce 800+ million gallons of annual fuel use during idling periods**
- **Reduce average of 2,000 hours of idling**
- **Fleet/component demonstration/data collection project partners:**
 - **Caterpillar, International Truck, Cox Trucking**
 - **Schneider National, Freightliner, Webasto Thermosystems**
 - **Espar, Wal-Mart Transportation, Truck manufacturer TBD**

DOE Idle Reduction Demonstration – Caterpillar Team

- Team: Caterpillar, International Truck, and Cox Transfer
- Five new idle reduction trucks, five control trucks
- Trucks idle about 1840 hours/year
- MorElectric™ Technology
- Electrically driven accessories
- Three main components
 - HVAC unit, generator, and APU
 - IR uses 0.2 gallons fuel/hour versus 0.9 gallons fuel/hour for C13 engine
- Duration - FY03 4 Quarter – FY05 4 Quarter



DOE Idle Reduction Demonstration – Schneider National Team

- **Team: Schneider National, Freightliner, Webasto Thermosystems**
- **100 trucks with heating and 20 trucks with cooling systems**
- **Trucks idle approximately 480 hours/year**

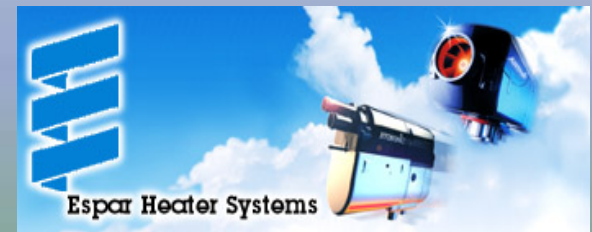


DOE Idle Reduction Demonstration – Schneider National Team (cont'd)

- **Webasto Air Top 2000 cab heater**
 - Self contained diesel fueled air heater
 - Offered as standard installation option from Freightliner
- **Webasto Cab Cooler**
 - New product that utilizes phase change cooling storage technology
 - Medium is charged during normal tractor operation using existing air conditioning system
- **Duration - FY03 4 Quarter – FY05 2 Quarter**

DOE Idle Reduction Demonstration – Espar Team

- Team: Espar, Wal-Mart Transportation, truck manufacturer TBD
- 20 trucks with combined heating / cooling systems
- At least two control trucks
- Espar Airtronic Bunk Heater
 - Diesel fueled coolant heater for engine pre heat
- D.C. Airco
 - Rooftop mounted electric air conditioning unit
 - Operates on starting or auxiliary batteries
- Duration - Award expected FY04



**All vehicle testing reports and fact sheets available
via:**

<http://avt.inel.gov>