Idaho National Laboratory Testing of Advanced Technology Vehicles
(DOE FY10 Merit Review)

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Idaho National Laboratory – Advanced Vehicle Testing Activity (AVTA)
May 11, 2011

Project ID # VSS_021
INL/CON-11-21375

This presentation does not contain any proprietary, confidential, or otherwise restricted information
The AVTA is a DOE annually funded activity that tests and validates petroleum reduction potentials of advanced electric drive technologies and their required fueling infrastructures.

Barriers addressed:
- Document HEV battery performance at end of life
- Document real-world HEV fuel use
- Document HEV life cycle costs
- Document HICE and NEV performances

Timeline
- Idaho National Laboratory - lead
- ECOtality™ conducts AVTA testing
- NETL, ORNL, ANL, NREL, EPA (Federal)
- OEMs via USABC’s VSATT and GITT Tech Teams
- U.S., Canadian and Finnish governments, and private fleets

Budget
- FY10 project funding
  - $2,500k DOE share
  - $1,500k Partners’ share
- Funding for FY11
  - $4,000k DOE share
Relevance - Objectives

- The Advanced Vehicle Testing Activity (AVTA) is DOE’s only field-based testing activity of light-duty advanced technology vehicles
- Supports DOE’s goal of petroleum reduction and energy security
  - Provide benchmarked real-world vehicle performance and sub-system data to DOE target / goal setters, modelers, and battery manufacturers
  - Partner with many OEMs to conduct technology assessments
  - Test DOE-funded technologies
  - Assist early adaptor fleet managers and the public in making informed vehicle purchase, deployment and operating decisions
  - Resource to industry and public groups, via many annual presentations at industry gathering such as USABC Tech Teams, DOE briefings and public events
Overall Approach/Strategy

• Test new technologies by first designing testing methods appropriate for each technology
• Incorporate fleet managers’, industry’s and other national laboratories’ comments, recommendations and relevant test procedures into the ATVA testing procedures
• Depending on vehicle technology and capabilities, vehicles are tested via:
  – Closed test tracks and dynamometers
  – Laboratory testing (batteries)
  – Accelerated testing, using dedicated drivers and other methods to accumulate miles and cycles
  – Fleet testing, uses unstructured vehicle utilization
  – Different testing methods are used to balance testing control / repeatability, sample size, and costs
• Document fuel (petroleum and electricity) use separately over various trip types, environments and distances
• Eliminate battery life and performance uncertainties
Overall Approach/Strategy – cont’d

• Document charger performance (profile and demand), infrastructure needs, and operator behavior impacts on charging times and frequencies

• Document environmental factors, such as temperature and terrain, that impact fuel consumption

• Publish and strictly follow testing procedures to reduce testing uncertainties

• Publish testing results in relevant ways to accurately
  – Document real-world petroleum reduction potentials
  – Document alternative fuel and infrastructure use
  – Document life-cycle risks and costs

• AVTA is conducted primarily by INL and ECOtality North America (ECOtality’s testing activities are covered in another presentation)

• Current INL staff have used onboard data loggers to document vehicle and charging operations since 1993
Vehicle Testing Accomplishments / Progress

• Plug-in hybrid electric vehicles (PHEVs)
  – 12 models, 267 vehicles, 3+ million test miles
• Hybrid electric vehicles (HEVs)
  – 22 models, 56 vehicles, 5+ million test miles
• Neighborhood electric vehicles (NEVs)
  – 23 models, 200,000 test miles
• Hydrogen internal combustion engine (HICE) vehicles
  – 7 models, 500,000 test miles
• Full-size battery electric vehicles (BEVs)
  – 41 EV models, 5+ million test miles
• Urban electric vehicles (UEVs)
  – 3 models, 1 million test miles
• 15 million test miles accumulated on 1,600 electric drive vehicles representing 107 different electric drive models
PHEV Accomplishments / Progress

- Initiated 12 city study of codes and standards requirements necessary to support the potential introduction of vehicle to grid charging. In cooperation with Ford Motor Company.
- Initiated the development of a workshop (April 2011) to evaluate for DOE the codes and standards required for large-scale vehicle recharging infrastructure. Conducted with the American National Standards Institute (ANSI).
- Reported real-time (not modeled) instrumentation and data collection of vehicle charging demand and energy costs at Tacoma Power, in Tacoma Washington.
- Tested PHEVs with lithium batteries from ten manufactures and non-lithium batteries (lead) from one manufacturer.
PHEV Accomplishments / Progress – cont’d

• Sent more than 3,000 individual PHEV testing results fact sheets to fleet testing partners
• Conducted geographically and mission-diverse PHEV testing and demonstration activities in 25 states, three Canadian provinces, and Finland
• Initiated data collection from Ford PHEV Escapes
• Completed and presented 26 formal reports and industry presentations on PHEV operations and petroleum reductions to outside groups
• Gave another 10 presentations on PHEV performance to Idaho National Laboratory (INL) site visitors and dignitaries
FY-10 PHEV Conversion Demonstrations

Most Vehicle Conversions
- Prius & Escapes
- Li-ion Batteries

Public + Private Partners

Data analysis & Reporting

267 Total
255 Operating
12 Out of Service
North American PHEV Demonstration

Vehicle Technologies Program

Date range of data received: 4/18/2008 to 9/30/2010
Number of days the vehicles were driven: 889

All Trips Combined

- Overall gasoline fuel economy (mpg): 48
- Overall AC electrical energy consumption (AC Wh/mi): 55
- Overall DC electrical energy consumption (DC Wh/mi): 40
- Total number of trips: 206,118
- Total distance traveled (mi): 1,968,916

Trips in Charge Depleting (CD) mode

- Gasoline fuel economy (mpg): 63
- DC electrical energy consumption (DC Wh/mi): 141
- Number of trips: 89,246
- Percent of trips city / highway: 97% / 13%
- Distance traveled (mi): 415,267
- Percent of total distance traveled: 21%

Trips in both Charge Depleting and Charge Sustaining (CD/CS) modes

- Gasoline fuel economy (mpg): 53
- DC electrical energy consumption (DC Wh/mi): 49
- Number of trips: 10,487
- Percent of trips city / highway: 47% / 53%
- Distance traveled (mi): 438,508
- Percent of total distance traveled: 22%

Trips in Charge Sustaining (CS) mode

- Gasoline fuel economy (mpg): 43
- Number of trips: 102,376
- Percent of trips city / highway: 76% / 24%
- Distance traveled (mi): 1,140,570
- Percent of total distance traveled: 57%


- Reports 2 million Hymotion Prius test miles and 208,000 trips
- Report by charge mode:
  - Charge depleting (CD)
  - Charge sustaining (CS)
  - Mixed (CD/CS)
- All trips, 48 mpg, 55 AC Wh/mi & 40 DC Wh/mi
- CD, 63 mpg & 141 DC Wh/mi
- CD/CS, 53 mpg & 49 DC Wh/mi
- CS, 43 mpg
Report fuel use by highway/city cycles and driver style

- Less aggressive driving (0 to 20%) averages ~70 mpg
- CD city, 37 mpg
- CS highway, 46 mpg
- CD highway, 66 mpg, 165 DC Wh/mi
- CD city, 61 mpg, 165 DC Wh/mi

\[
\text{Average Aggressiveness} = \frac{\text{Average Aggressiveness (on scale 0-10)}}{\text{Aggressiveness (accelerator pedal position)}}
\]

- More aggressive driving (20 to 100%) averages ~46 mpg
- CS city, 37 mpg
- CD highway, 66 mpg, 109 DC Wh/mi
PHEV 3-Page Report

- Report charging stats, time of day driving, and charging profiles
- Average 1 charging event per day when PHEV driven
- 49 miles between charge events
- 5.2 trips between charge events
- 2.8 hours per charge
- 22.7 hours time plugged in per charge
- 2.7 AC kWh per charge event
- Basis for development of future reporting methods
Usable Battery Capacity is Slightly Effected by Temperature

Hymotion Prius Battery Energy Capacity
PHEV Fleet Results from Full Charge Trip Sequences

Average Ambient Temperature [°C]

Usable SOC [%]

Battery Discharge Energy [DC kWh]

Discharge Energy
Usable SOC
HEV Accomplishments

• 5 million total HEV testing miles
• 22 HEV models and 56 HEVs tested to date:
  – 6, 2001 Honda Insight
  – 6, 2002 Gen I Toyota Prius
  – 4, 2003 Gen I Honda Civic
  – 2, 2004 Chevrolet Silverado
  – 2, 2004 Gen II Toyota Prius
  – 2, 2005 Ford Escape
  – 2, 2005 Honda Accord
  – 3, 2006 Lexus RX 400h
  – 2, 2006 Toyota Highlander
  – 2, 2006 Gen II Honda Civic
  – 2, 2007 Saturn Vue

  – 2, 2007 Toyota Camry
  – 2, 2008 Nissan Altima
  – 2, 2008 GM 2-mode Tahoe
  – 2, 2010 Ford Fusion
  – 2, 2010 Toyota Prius
  – 2, 2010 Honda Insight
  – 2, 2010 Mercedes Benz S400
  – 2, Honda CRZ
  – 3, 2010 Smart® Fortwo Pure Coupe
  – 2, 2010 Mazda 3 Hatchback
  – 2, 2010 Volkswagen Golf TDI.

• HEV testing includes beginning and high mileage HEV traction battery testing – HPPC, Static Capacity tests, as well as acceleration and fuel economy tests
HEV Accomplishments – cont’d

- Provided HEV testing results to the automotive industry, DOE, and other national laboratories via the Vehicle Simulation and Analysis Tech Team (VSATT) and the Electrochemical Energy Storage Tech Team (EESTT)
- Shared used HEV power electronics parts with the Oak Ridge National Laboratory (ORNL) for their power electronics testing, and made an HEV available to another DOE laboratory for cabin temperature testing
- Provided (sold) used HEVs to the Environmental Protection Agency for their HEV life cycle testing
- 5.2 million HEV test miles accumulated end of FY10, with 850,000 miles accumulated FY10
2-Page HEV Fleet Testing Fact Sheets

- Miles driven
- Fuel use
- Average trip distances
- Produced by HEV model

Operating Statistics
Number of Vehicles Tested: 2
Distance Driven: 300,189 mi
Average Trip Distance: 25.3 mi
Stop Time with Engine Idling: 19%
Trip Type City/Highway: 52%/48%

Operating Performance
Cumulative MPG: 33.6

Test Notes:
2. Calculated from electronic data logged over a subset of total miles traveled equal to 162,418 miles.
3. Fuel economy calculated for this figure using mass air flow over dynamic vehicle operation.
2-Page HEV Fleet Testing Fact Sheets – cont’d

- Engine on / off times
- MPG by vehicle speed
- Trip profiles
- Engine speed profiles
1-Page HEV Fleet Testing Summary Fact Sheets

- Life cycle costs:
  - Purchase and sale
  - Maintenance
  - Insurance
  - Fuel
  - Registration

- Total miles driven
- Cumulative MPG
- Produced for individual vehicles

**Vehicle Specifications**

- Engine: 2.5 L 4-cylinder
- Electric Motor: 105 kW
- Battery: NiMH
- Seatbelt Positions: Five
- Payload: 991 lbs
- Features:
  - Regenerative braking
  - Traction control
  - CVT transmission

**Description:**
This vehicle is operated throughout the valley of Phoenix, Arizona by JPMorgan Chase Bank of Arizona's courier fleet. It is operated six days a week, transferring documents between branches and a central processing center on city streets and urban freeways.

### Fleet Performance

- Operating Cost:
  - Purchase Cost: $25,558 (007)*
  - Sale Price: $5,500
  - Maintenance Cost: $0.03/mile
  - Operating Cost: $0.12/mile**
  - Total Ownership Cost: $0.26/mile

- Operating Performance:
  - Total miles driven: 160,633
  - Cumulative MPG: 29.8

- Major Operations & Maintenance Events:
  - None

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*Purchase includes dealer price with options plus taxes. It does not include title, license, registration, extended warranty or delivery fees costs.

**Operating costs include insurance, fuel, and registration costs.
HEV Lead Acid Battery Accomplishments

- Initiated baseline, accelerate and battery testing of the Ultra lead acid battery for 100,000 miles in a Honda Civic
  - Convert a Honda Civic HEV to operate using an Ultra Battery manufactured by East Penn
  - Maintain a minimum vehicle payload of 800 pounds (four passengers plus 200 pounds)
  - Provide packaging favorable to battery life, but not integral with existing vehicle dimensions
  - Provide a fuel economy equivalent to the unconverted, base HEV Civic with a NiMH stock battery
  - Maintain vehicle emissions performance equal to or better than the base vehicle
  - Obtain an "Experimental Vehicle" permit from CARB
  - Install conversion components without violating FMVSS certification
  - Vehicle being modified and cell strings tested
USPS Testing Support Accomplishments

• The AVTA has a twelve year history of cooperative testing with the USPS
  – Previously collected data and reported on the USPS 500 electric long live vehicle (eLLV) test fleet
• Developed test procedures for 5 new eLLV conversions funded by USPS
• Conducting baseline performance (dynamometer and track) testing and fleet testing with onboard data loggers
• Documenting performance, or lack thereof
• Conversion companies
  – Autoport/AC Propulsion/University of Delaware
  – Bright Automotive
  – EDAG
  – Quantum Technologies
  – Zap World
• More on this in another presentation
Electric Drive and Advanced Battery Testbed Vehicle Project Accomplishments

• Development of a testbed vehicle capable of testing a range of energy storage systems (ESS) via onroad testing and vehicle-based dynamometer testing
• Test ESS intended for EVs, PHEVs and EREV
• Onboard data acquisition system includes a data logger for recording CAN message parameters and ESS analog signals during drive and charging events
• The EDAB will test the new ESSs delivered to DOE starting in FY2011
• Subcontract in place and vehicle being converted
• More of this in another presentation
HICE Testing Accomplishments

- 12 H$_2$ internal combustion engine vehicles
- Averaged 13.5 miles per gasoline gallon equivalent (mpgge)
- 80,899 test miles
- 14,074 fleet trips
- Very low-cost data collection effort as no DOE funds were used to purchase, fuel, maintain or operate the HICE vehicles
- Task completed
ARRA and TADA Accomplishments

- Completed CRADA with Ford Motor Company to cover the data collection from 22 Ford Escape PHEVs
- Initiated NDA with General Motors and OnStar® for the data collection from 150 Volt extended range electric vehicles (EREVs)
- Initiated NDA with Chrysler for the data collection from 145 Ram Pickup PHEVs
- Initiated NDA with ECOtality™ North America for data collection from 15,350 Level 2 electric vehicle supply equipment and fast chargers, 5,700 Nissan Leaf electric vehicles (EVs), and 2,600 General Motors Volt EREVs. More on this in another presentation
- Initiated NDA with Coulomb for the development of data collection from 4,000+ Level 2 EVSE

ARRA – American Recovery and Reinvestment Act
TADA – Technology Acceleration and Demonstration Activity
Data Management Process Accomplishments

Process Affected by Disclosure Agreements

- HICEVs
- HEVs
- PHEVs
- BEVs/EREVs
- EVSE & Chargers

INL Vehicle and Infrastructure Data Management System

File server
SQL Server data warehouse
Report generator

Data quality reports
Individual vehicle and charger reports
Fleet summary reports - public
Focused technical analyses and custom reports
Modeling and simulations

Parameters range check
Lame data check
Misregistration parameter check
Conservation of energy check
SOC continuity
Transfer completion

Trip Fuel Economy (mpg)

MPG vs. Trip Aggressiveness (Percent of trip above the 40% accelerator pedal position)

CD trips
CD/CS trips
CS trips
Log. (CD trips)
Log. (CD/CS trips)

Avg Hourly Vehicle Charging Demand

Time of Day

Mon AM - Tues AM
Tue AM - Wed AM
Wed AM - Thu AM
Thu AM - Fri AM
Fri AM - Sat AM
Sat AM - Sun AM
Sun AM - Mon AM

0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8

Modeling and simulations

<table>
<thead>
<tr>
<th>Vehicle time-history data (1 second interval)</th>
<th>HEV and Start/Stop: 15 vehicle models, 1 data logger</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>HICE: 1 vehicle model, 1 data logger</td>
</tr>
<tr>
<td></td>
<td>Conversion PHEVs: 9 vehicle models, 3 data loggers</td>
</tr>
<tr>
<td></td>
<td><strong>USPS</strong> eLLV conversions: 5 models, Gridpoint wireless logger</td>
</tr>
<tr>
<td></td>
<td><strong>Ford</strong> Escape PHEV, Ford wireless logger</td>
</tr>
<tr>
<td></td>
<td><strong>Chrysler</strong> Ram PHEV, Chrysler wireless logger</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Vehicle event data (key-on, key-off)</th>
<th><strong>Nissan</strong> Leaf, Nissan/ATX telematics</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Chevrolet</strong> Volt, OnStar telematics</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Charger event and time-history data (15 min interval)</th>
<th><strong>ECOtality</strong> Blink networked level 2 EVSE and DC fast chargers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Coulomb</strong> ChargePoint networked level 2 EVSE</td>
</tr>
</tbody>
</table>

Managing 29 different data models
Data Collection Issues

• It is harder than you think....................
  – Data collection and processing is deceivingly complex
  – All companies having data collection launch issues, regardless of company size and expertise
  – Examples:
    • Data from conversion company in 2007: time stamps go backwards occasionally
    • Data from partner in 2010: time stamps go backwards occasionally
    • Start-up data provider in 2008: “I wish we had more QA resources”
    • Partner in 2010: “We allocated resources for sending the data, but not for looking at the data.”
Quality Control Accomplishments

• INL has identified and/or assisted with root cause analysis of numerous vehicle data issues, including:
  – Control software version differences cause unexpected differences in vehicle operation
  – Logger resets during driving or charging, resulting in missing data or split events
  – Split or missing driving and charging events due to bugs in logger trigger programming or post-processing algorithms
  – Missing records to indicate Key On, Key Off, Start of Charge, or End of Charge
  – Odometer and cumulative fuel consumed rolls backward or resets to zero
  – Number of parameters logged and other data formatting changes from month to month as vehicle software updates are made
INL Data Security Accomplishments

• Internal servers “Franc” and “Fort” in protected enclave are fully operational

• External server “AVT-EXT” is fully operational, loaded with software for multiple secure file transfer and encryption protocols

• Instituted security and export control policies per lab-wide procedures
  - Project data and information considered Official Use Only / Proprietary or CRADA-Protected
  - Guidelines documented specific to each project
INL Data Management System - Pull

Protected Data

INL pulls with encrypted transmission

INL Protected Enclave - EV Project member access only

INL pulls with encrypted transmission

INL transmits reports to DOE, ECOtality, auto OEMs

Reports posted on WWW

Fleet summary reports - public

AVT.INL.GOV

INL DMZ Firewall – Public has access to AVT.INL.GOV

Vehicle and Charger Data

INL DMZ Firewall – Public has access to AVT.INL.GOV

OEM Data Management System

INL Protected Enclave - EV Project member access only

Internal data quality reports

Parameters range check
Lame data check
Missing/empty parameter check
Conservation of energy check
SOC continuity
Transfer completion

INL Protected Enclave - EV Project member access only

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Reports posted on WWW

Fleet summary reports - public

AVT.INL.GOV

INL DMZ Firewall – Public has access to AVT.INL.GOV
INL Data Management System - Push

Vehicle and Charger Data

Protected Data

INL pulls with encrypted transmission

INL DMZ Firewall – Public has access to AVT.INL.GOV

INL Protected Enclave - EV
Project member access only

Internal data quality reports

Reports posted on WWW

AVT.INL.GOV

Fleet summary reports - public

OEM Data Management System

OEM pushes using FTPS/SFTP

“AVT-EXT” FTPS/SFTP Server

Access restricted by firewall rules

INL transmits reports to DOE, ECOtality, auto OEMs

INL Internal firewall

OEM

Pushes using FTPS/SFTP

INL Data Management System

Protected Data

INL Internal firewall

INL Protected Enclave - EV
Project member access only

Internal data quality reports

Reports posted on WWW

AVT.INL.GOV

Fleet summary reports - public

Vehicle and Charger Data

Protected Data

INL pulls with encrypted transmission

INL DMZ Firewall – Public has access to AVT.INL.GOV

INL Protected Enclave - EV
Project member access only

Internal data quality reports

Reports posted on WWW

AVT.INL.GOV

Fleet summary reports - public

Vehicle and Charger Data
INL Governmental Collaboration

- All vehicles requiring dynamometer testing are coordinated and shared with DOE’s ANL or ORNL
- High-mileage HEV components shared with ORNL
- High-mileage HEVs shared with EPA
- PHEV and HEV testing results shared with ANL, ORNL and NREL
- PHEV fleet testing includes 38 governmental fleets
- 94 PHEV testing partners include:
  - 38 Electric utilities
  - 10 County governments
  - 4 State governments
  - 10 Canadian government groups
  - 3 Sea ports and military bases
  - 2 PHEV conversion companies
  - 5 Private companies and advocacy organizations
INL Collaboration with other Institutions

• DOE - HQ
  – Program execution per DOE. INL focuses on meeting funder’s expectations
• National Energy Technology Laboratory (NETL)
  – Executes ARRA, TADA and ECOtality™ contracts
• ANL, NREL, ORNL and several other DOE laboratories as well as OEMs via USABC Tech Teams
  – Grid Integration Technical Team (GITT), VSATT and EESTT
• OEMs via individual ARRA and TADA projects
  – Nissan, General Motors, OnStar, Ford and Chrysler
• Electric Utilities via PHEV data collection, EV Project, and EPRI’s Infrastructure Working Council (IWC)
Future Testing Activities - Summary

• Continue to focus on testing electric drive vehicle technologies and energy storage systems that
  – Support DOE’s goal of petroleum reduction
  – Incorporate advanced electric drive and energy storage (primarily battery) technologies
  – Can be tested in a lower-cost manner that accurately portrays real world performance
  – Can be tested in a manner that leverages non-DOE cost share

• Continue to supply testing results to modelers at other DOE laboratories and OEMs
• Continue to build data analysis and dissemination tools
• Complete CRADA and NDA negotiations with OEMs and other organizations for additional data collection
• Continue role as DOE’s sole independent tester of light-duty whole-vehicle technologies in field applications
• End PHEV conversion data collection
Future EV Project Activities - Reporting

• Reporting targets include: DOE (first), other government agencies, OEMs, electric utilities, public, etc.
• Report on the charging infrastructure utilization (15,000 Level II EVSE units and fast chargers)
• INL will report on driver/vehicle charging patterns, and charging infrastructure utilization patterns
• Many of the 42+ EV Project partners are electric utilities with high interest in demand / smart charging controls, including multitier time-of-day pricing and micro grid analysis
• Specialty analyses will include micro grid, regional and sub regional variations, seasonal and aging influences
• Quarterly fact sheets to ECOtality, DOE, EV Project partners, AVTA website
• Charging infrastructure, not vehicle, focus
### Future EV Project Activities - Overview Fact Sheet

#### Layout (top half pg 1)

<table>
<thead>
<tr>
<th>Charging infrastructure</th>
<th>Number of EV Project Charging Units</th>
<th>Electricity Consumed (AC MWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Region</strong></td>
<td><strong>Installed to Date</strong></td>
<td><strong>Total Planned Installations</strong></td>
</tr>
<tr>
<td>Arizona¹</td>
<td>213</td>
<td>2,100</td>
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<tr>
<td>Greater Houston Metropolitan Area</td>
<td>22</td>
<td>225</td>
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<tr>
<td>Greater Los Angeles Metropolitan Area</td>
<td>215</td>
<td>3,150</td>
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<tr>
<td>Northcentral Texas²</td>
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<td>0</td>
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<tr>
<td>Northwest Oregon³</td>
<td>226</td>
<td>2,171</td>
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<td>Northwest Washington⁴</td>
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<td>Greater San Diego Metropolitan Area</td>
<td>233</td>
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<tr>
<td>Tennessee⁵</td>
<td>145</td>
<td>2,535</td>
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<tr>
<td>Greater Washington DC Metropolitan Area</td>
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<td>150</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>1,237</strong></td>
<td><strong>15,085</strong></td>
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</tbody>
</table>

**Fictitious Data**

![EV Project Charging Unit Installations to Date by Region](chart.png)
## Future EV Project Activities Overview

### Fact Sheet

Example layout (bottom half pg 1)

<table>
<thead>
<tr>
<th>Region</th>
<th>Nissan Leafs</th>
<th>Chevrolet Volts</th>
<th>Number of Trips</th>
<th>Distance Driven (mi)</th>
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</thead>
<tbody>
<tr>
<td>Arizona†</td>
<td>123</td>
<td>14</td>
<td>22,194</td>
<td>128,725</td>
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<tr>
<td>Greater Houston Metropolitan Area</td>
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<td>683,089</td>
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<td>Northwest Oregon³</td>
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<td>Northwest Washington⁴</td>
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<td><strong>1,815,307</strong></td>
</tr>
</tbody>
</table>
Future EV Project Activities - Infrastructure Usage Report

- 117 metrics and plots, including:
  - Electricity consumed
  - Charging unit utilization
  - Aggregate charging demand vs. time of day and day of the week
  - Individual charging event metrics
    - How often, how long, how empty, how full
  - Reporting by various subgroups
Future EV Project Activities - Vehicle Usage Reports

- Separate reports for Leafs and Volts
- 39 (Volt) and 47 (Leaf) metrics and plots, including:
  - Distance driven, trips statistics
  - Percent of distance driven in charge depleting vs. charge sustaining mode (Volt only)
  - Battery SOC at the start and end of charge events
  - Battery SOC at end and being of trips
  - Percent of charging events performed at home vs. away from home (Leaf includes line items for DC fast charging)
Summary

• The AVTA will continue to coordinate vehicle selection, testing and publishing activities with other DOE labs and OEMs, including:
  – ANL, NETL and ORNL
  – OEMs and battery manufacturers via VSATT and EESTT

• Continue to explore additional electric drive vehicle data collection and demonstration projects that:
  – Provide access to new vehicles and technologies
  – Provide operating environment diversity
  – Provide high value to DOE
  – Include unique infrastructure schemes such as battery swapping
Summary – cont’d

• Before a vehicle testing regime or demonstration is initiated, the AVTA identifies and determines the technical and economic values of testing partnerships to ensure that the maximum value to DOE and taxpayers are achieved

• AVTA is a very low-cost project for the number of test miles and data accumulated, and the number of reports published, as all funding is highly leveraged via testing partnerships to provide maximum benefits to DOE and taxpayers

• Every testing regime has at least 20% cost share, and most testing cost-share is typically 50% or higher

• Taxpayers receive independent information on emerging technologies and the associated amounts of petroleum used or avoided

• INL and the AVTA will continue to strive to confuse people with technology and energy facts
AVTA Summary – WWW Visitors

INL - AVTA WWW Visitors & Gasoline Costs (all formulations, areas, and grades)

- Visitors (left axis)
- Gasoline Cost (right axis)
- Linear (Visitors (left axis))
- Linear (Gasoline Cost (right axis))

Number of Monthly Visitors

All Grades Gasoline Costs - End of Month

May '02 - Jan '11
Acknowledgement

This work is supported by the U.S. Department of Energy’s Vehicle Technologies Program

My personal thanks to the great AVTA Staff at INL, ECOtality and NETL as well as our testing partners

Additional Information

http://avt.inl.gov
or
http://www1.eere.energy.gov/vehiclesandfuels/avta/