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

P.I. - James Francfort
Idaho National Laboratory – Advanced Vehicle Testing Activity (AVTA)
May 11, 2011

Project ID # VSS_021
INL/CON-11-21375

Overview

Timeline

- **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

- **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

Budget

- **FY10 project funding**
  - $2,500k DOE share
  - $1,500k Partners' share
- **Funding for FY11**
  - $4,000k DOE share

Partners

- **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**

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

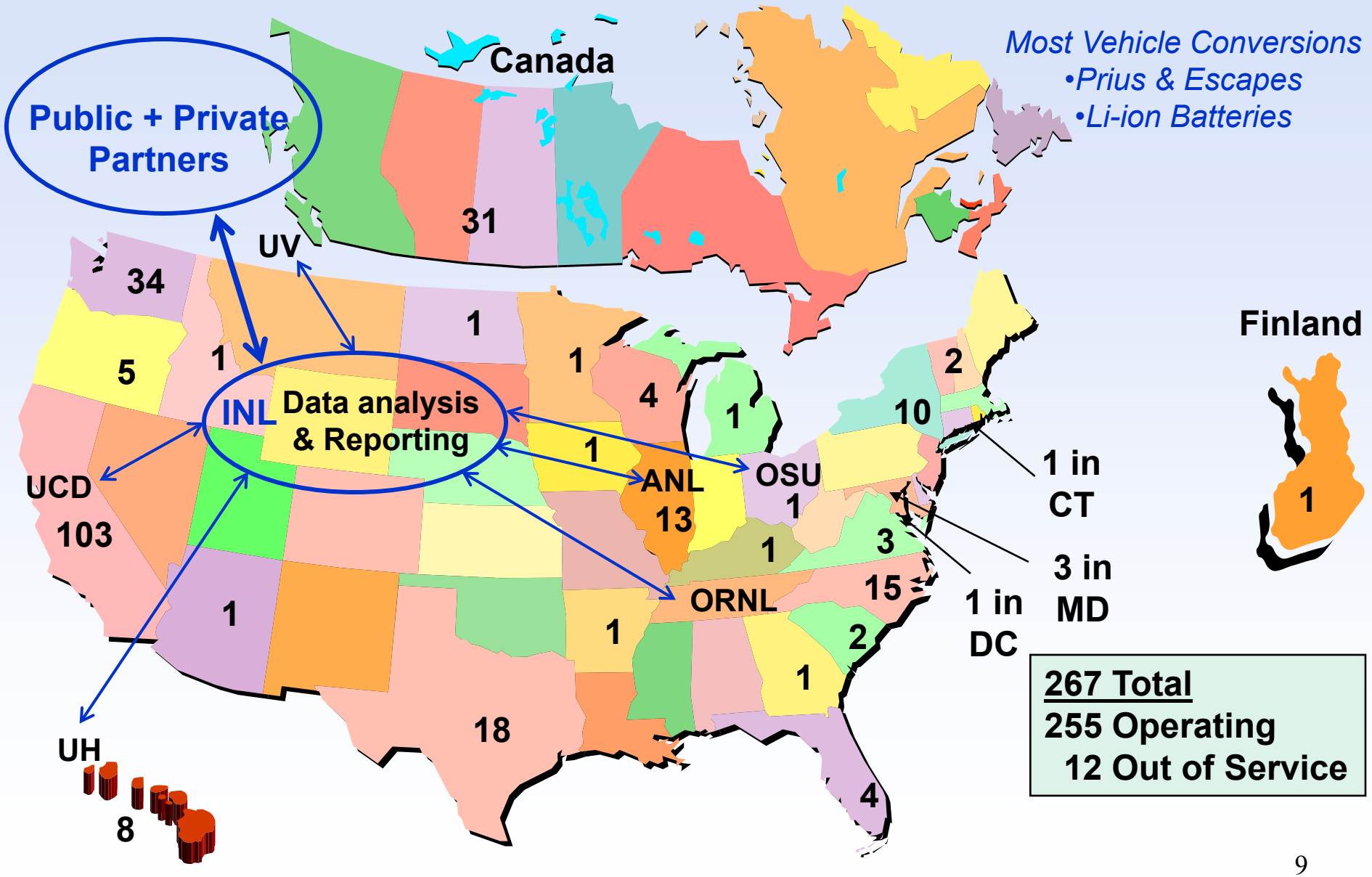
PHEV Accomplishments / Progress

- **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



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North American PHEV Demonstration

Vehicle Technologies Program

Fleet Summary Report: Hymotion Prius (V2Green data logger)

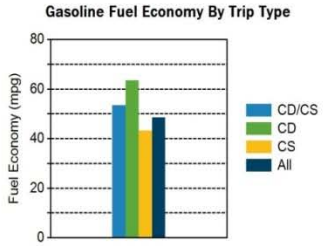
Number of vehicles: 184

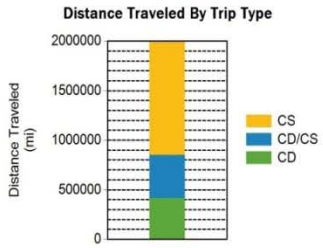
Reporting Period: Apr 08 - Sept 10

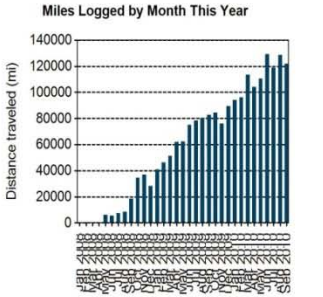
Date range of data received: 4/18/2008 to 9/30/2010

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) [1]	55
Overall DC electrical energy consumption (DC Wh/mi) [2]	40
Total number of trips	208,118
Total distance traveled (mi)	1,988,916
Trips in Charge Depleting (CD) mode [3]	
Gasoline fuel economy (mpg)	63
DC electrical energy consumption (DC Wh/mi) [4]	141
Number of trips	89,246
Percent of trips city / highway	87% / 13%
Distance traveled (mi)	415,267
Percent of total distance traveled	21%
Trips in both Charge Depleting and Charge Sustaining (CD/CS) modes [5]	
Gasoline fuel economy (mpg)	53
DC electrical energy consumption (DC Wh/mi) [6]	49
Number of trips	16,487
Percent of trips city / highway	47% / 53%
Distance traveled (mi)	436,508
Percent of total distance traveled	22%
Trips in Charge Sustaining (CS) mode [7]	
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%
Number of trips when the plug-in battery pack was turned off by the vehicle operator [8]	7155
Distance traveled with plug-in battery pack turned off by the vehicle operator (mi) [9]	187,800





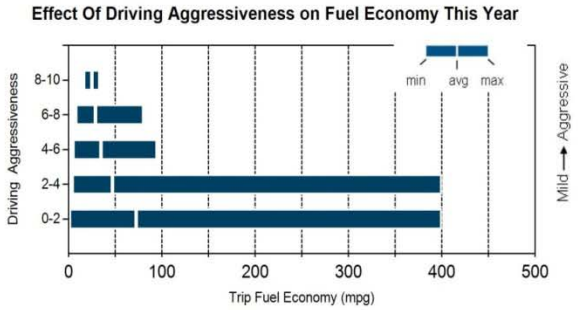


Notes: 1 - 9. Please see http://avt.inel.gov/phev/reportnotes for an explanation of all PHEV Fleet Testing Report notes.

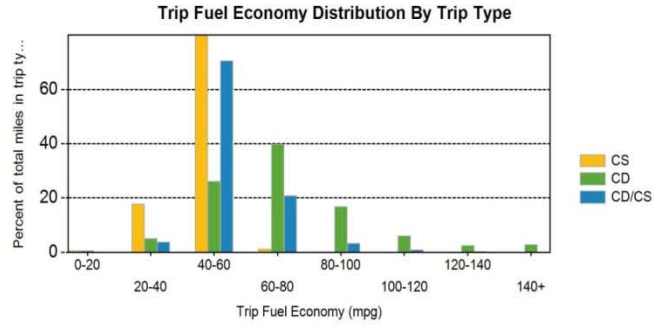
PHEV 3-Page Report

- 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

Trips in Charge Depleting (CD) mode	City	Highway
Gasoline fuel economy (mpg)	61	66
DC electrical energy consumption (DC Wh/mi)	165	109
Percent of miles with internal combustion engine off	32%	14%
Average trip aggressiveness (on scale 0 - 10)	1.8	1.8
Average trip distance (mi)	3.0	15.2
Trips in both Charge Depleting and Charge Sustaining (CD/CS) modes		
Gasoline fuel economy (mpg)	54	53
DC electrical energy consumption (DC Wh/mi)	79	44
Percent of miles with internal combustion engine off	26%	8%
Average trip aggressiveness (on scale 0 - 10)	1.9	1.6
Average trip distance (mi)	8.8	41.9
Trips in Charge Sustaining (CS) mode		
Gasoline fuel economy (mpg)	37	46
Percent of miles with internal combustion engine off	23%	7%
Average trip aggressiveness (on scale 0 - 10)	1.9	1.7
Average trip distance (mi)	3.5	35.1



Aggressiveness factor is based on accelerator pedal position. The more time spent during a trip at higher accelerator pedal position, the higher the trip aggressiveness.



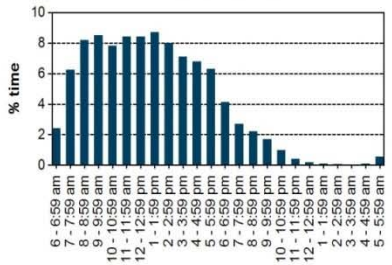
PHEV 3-Page Report

- Report fuel use by highway/city cycles and driver style
- CD city, 61 mpg, 165 DC Wh/mi
- CD highway, 66 mpg, 109 DC Wh/mi
- CS city, 37 mpg
- CS highway, 46 mpg
- Less aggressive driving (0 to 20%) averages ~70 mpg
  - (Aggressiveness = accelerator pedal position)

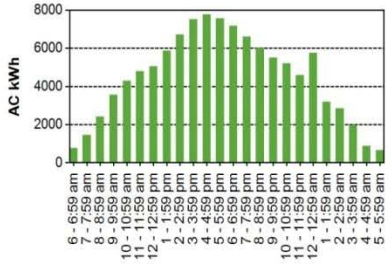
Plug-in charging

Average number of charging events per vehicle per month when driven	13
Average number of charging events per vehicle per day when vehicle driven	1.0
Average distance driven between charging events (mi)	49.3
Average number of trips between charging events	5.2
Average time plugged in per charging event (hr)	22.7
Average time charging per charging event (hr)	2.8
Average energy per charging event (AC kWh)	2.7
Average charging energy per vehicle per month (AC kWh)	36.5
Total number of charging events	40,363
Total charging energy (AC kWh)	109,302

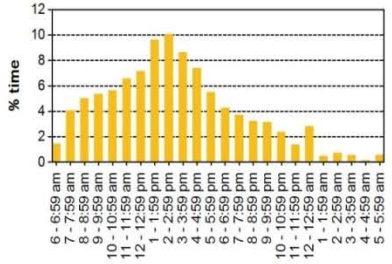
Time of Day When Driving



Time of Day When Charging



Time of Day When Plugging In

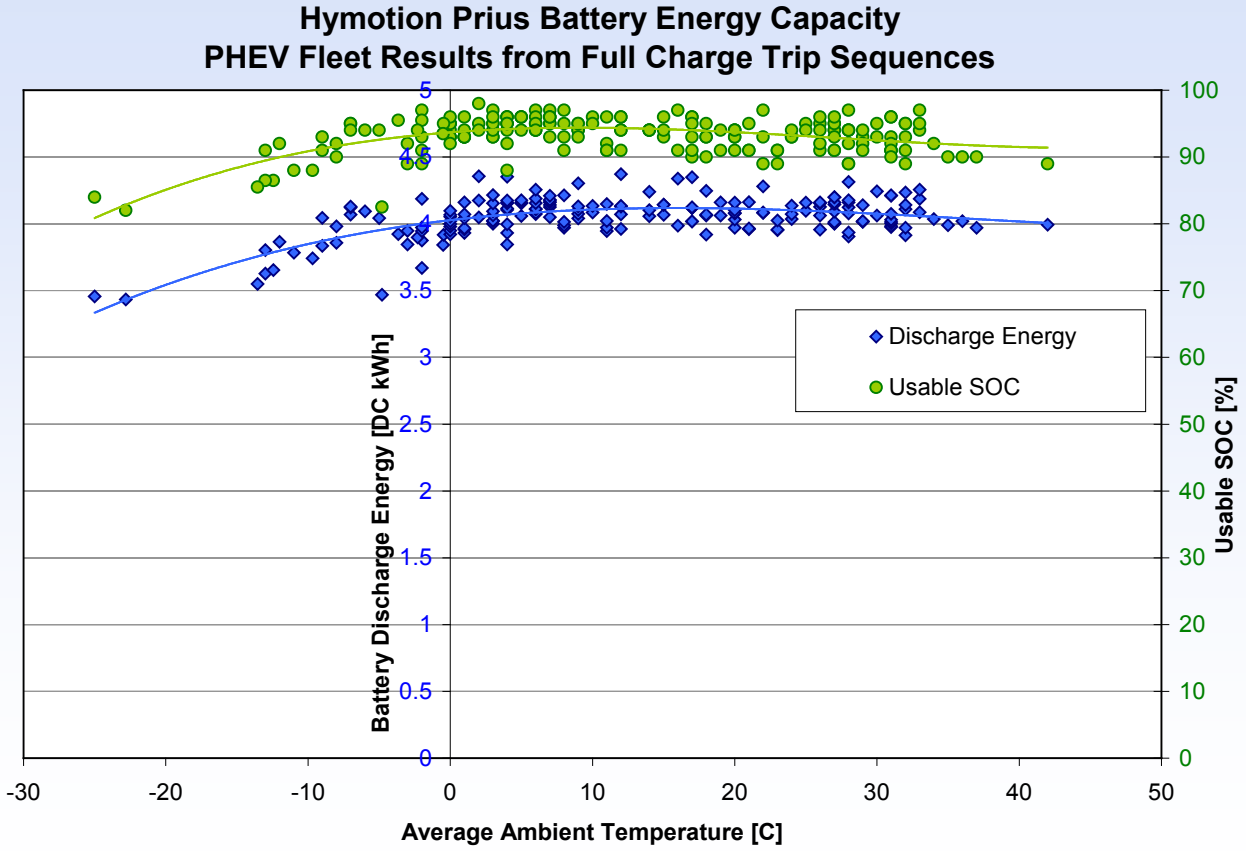


PHEV 3-Page Report

- 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

PHEV Accomplishments - Battery Capacity

Usable Battery Capacity is Slightly Effected by Temperature



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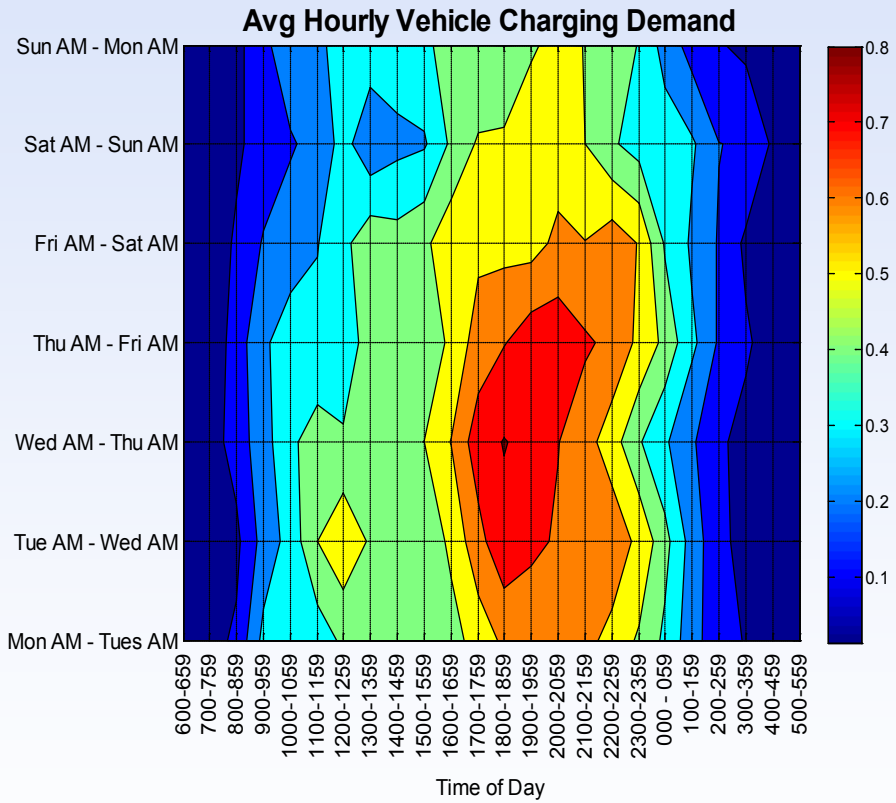
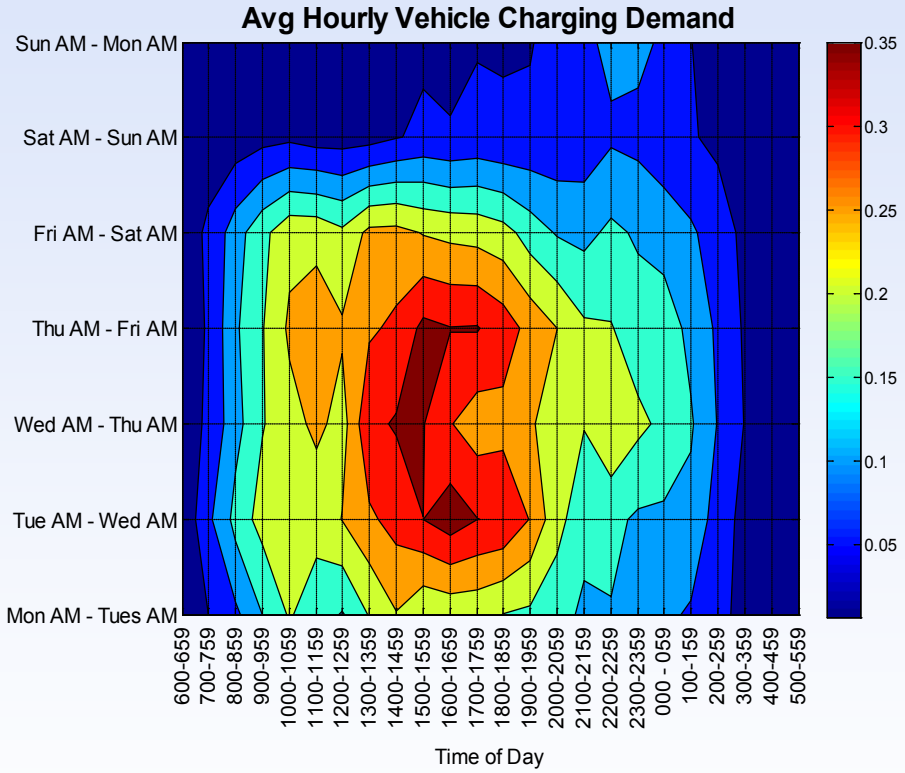
PHEV Accomplishments - Commercial / Private Fleet Charge Demand

Private Fleet



Commercial Fleet



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

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HEV Fleet Testing

2007 Toyota Camry Hybrid

Final Fleet Testing Results

Operating Statistics

Number of Vehicles Tested: 2

Distance Driven[1]: 320,189 mi

Average Trip Distance[2]: 25.3 mi

Stop Time with Engine Idling[2]: 19%

Trip Type City/Highway[2]: 52%/48%

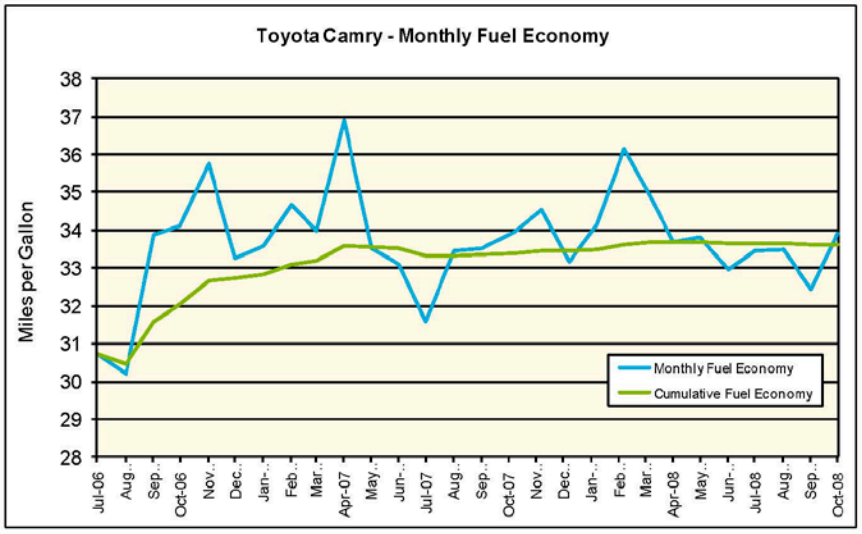
Operating Performance

Cumulative MPG[1]: 33.6

See HEV America Baseline Performance and Fleet Testing Fuel Economy fact sheets for more information on vehicle specifications and fuel usage reporting, available at http://avt.inl.gov/

Test Notes

1. Calculated over the life of the vehicle based on odometer reading and fuel logs. More information available in Fleet Testing Fuel Economy sheet.
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.



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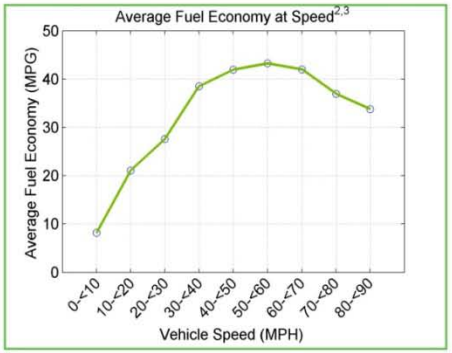
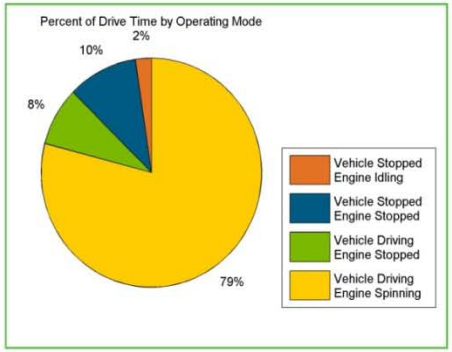
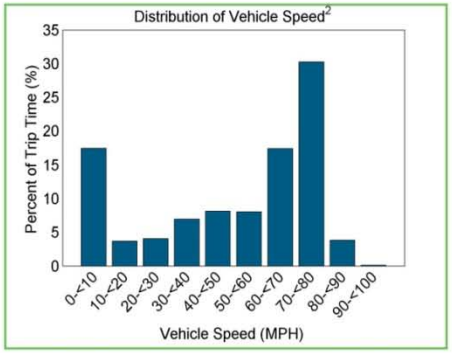
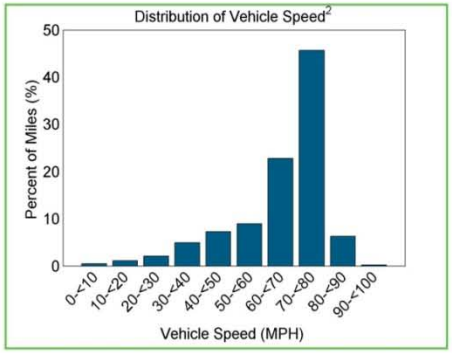
2-Page HEV Fleet Testing Fact Sheets

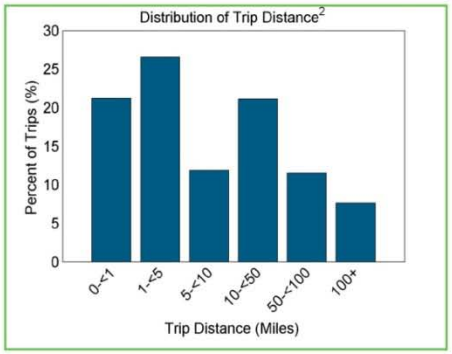
- Miles driven
- Fuel use
- Average trip distances
- Produced by HEV model

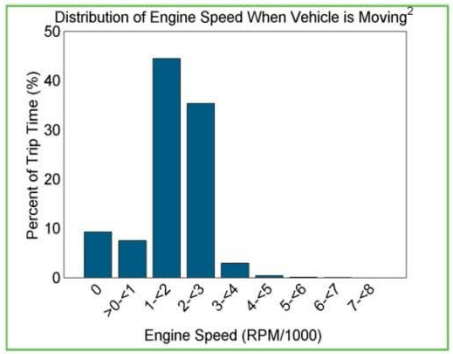












2-Page HEV Fleet Testing Fact Sheets – cont'd

- Engine on / off times
- MPG by vehicle speed
- Trip profiles
- Engine speed profiles

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VEHICLE TECHNOLOGIES PROGRAM

HEV Fleet Testing - Summary Fact Sheet

Advanced Vehicle Testing Activity

2007 Nissan Altima

VIN# 1N4CL21E87C172351

Fleet Performance

Operating Cost:

Purchase Cost: $25,536 (9/07)*

Sale Price: $5,500

Maintenance Cost: $0.03/mile

Operating Cost: $0.12/mile**

Total Ownership Cost: $0.28/mile

Operating Performance:

Total miles driven: 160,633

Cumulative MPG: 29.8

Major Operations & Maintenance Events:

None

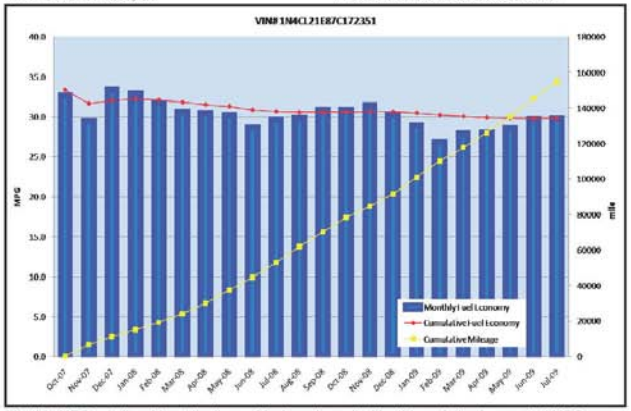
Description:

This vehicle is operated throughout the valley of Phoenix, Arizona by JP Morgan 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.

Vehicle Specifications

Engine: 2.5 L 4-cylinder
Electric Motor: 105 kW
Battery: NiMH
Seatbelt Positions: Five
Payload: 981 lbs
Features:
Regenerative braking
Traction control
CVT transmission

See HEVAmerica Baseline Performance Fact Sheet for more information



Monthly MPG = (miles driven)/(gallons of fuel purchased). Monthly variation in reported MPG may occur due to the difference in fuel tank level at the beginning and end of the month.

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

***Operating costs includes insurance, fuel, and registration costs*

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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

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 EREVs
- 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

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HICE Fleet Testing - Summary Fact Sheet

Advanced Vehicle Testing Activity

2005 Chevrolet Silverado 1500HD Hydrogen ICE[1] Conversion

Fleet Performance

Operating Statistics[2]:

Vehicles in Fleet: 12

Total Miles: 80,899

Total Number of Trips: 14,074

Average Trip Distance (miles): 5.7

Percent Idle Time: 16%[3]

Percent Air Conditioner On Time: 11%[3]

Operating Performance:

Cumulative MPGGE: 13.5[4]

Total Fuel Consumed (kg H_2): 6,072

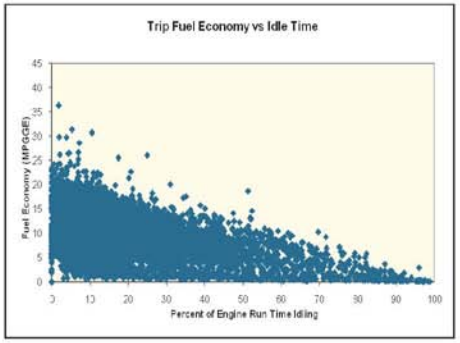
Total Engine Run Time (hours): 3,198

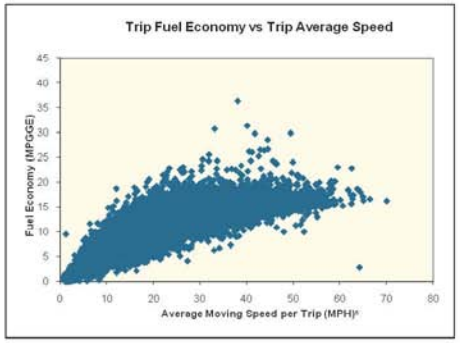
Total Engine Idle Time (hours): 514

Vehicle Specifications

Engine: 6.0 L V8
Fuel Capacity: 10.5 GGE
Nominal Tank Pressure: 5,000 psi
Seatbelt Positions: Five
Payload: 2,775 lbs
Features:
Four Speed Automatic Transmission

See HICEVAmerica Baseline Performance Fact Sheet for more information





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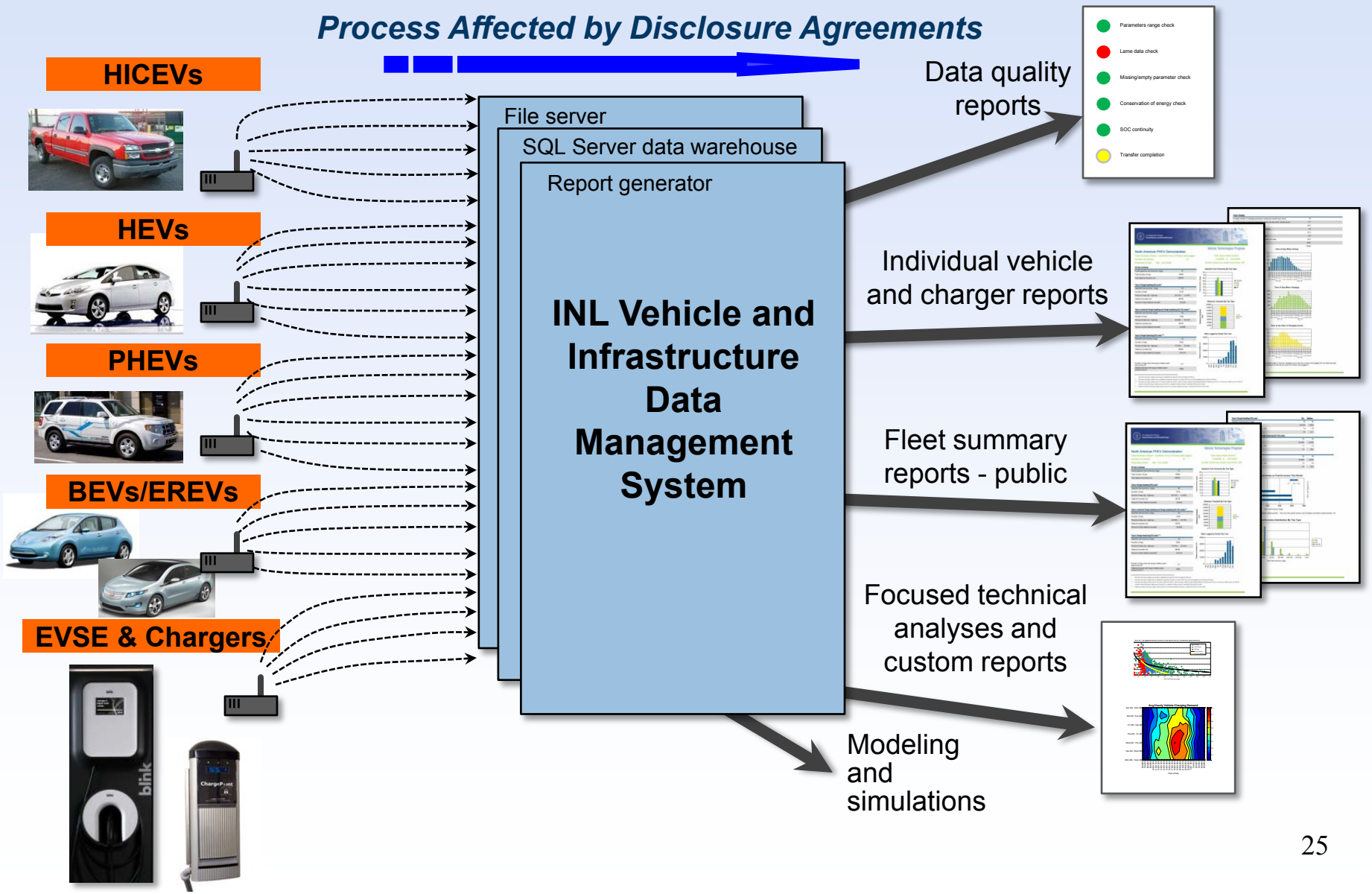
HICE Testing Accomplishments

- 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



Vehicle and Infrastructure Data Sources

Vehicle time-history data (1 second interval)	HEV and Start/Stop: 15 vehicle models, 1 data logger
	HICE: 1 vehicle model, 1 data logger
	Conversion PHEVs: 9 vehicle models, 3 data loggers
	USPS eLLV conversions: 5 models, Gridpoint wireless logger
	Ford Escape PHEV, Ford wireless logger
	Chrysler Ram PHEV, Chrysler wireless logger
Vehicle event data (key-on, key-off)	**Nissan** Leaf, Nissan/ATX telematics
	Chevrolet Volt, OnStar telematics
Charger event and time-history data (15 min interval)	**ECOtality** Blink networked level 2 EVSE and DC fast chargers
	Coulomb ChargePoint networked level 2 EVSE

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.”

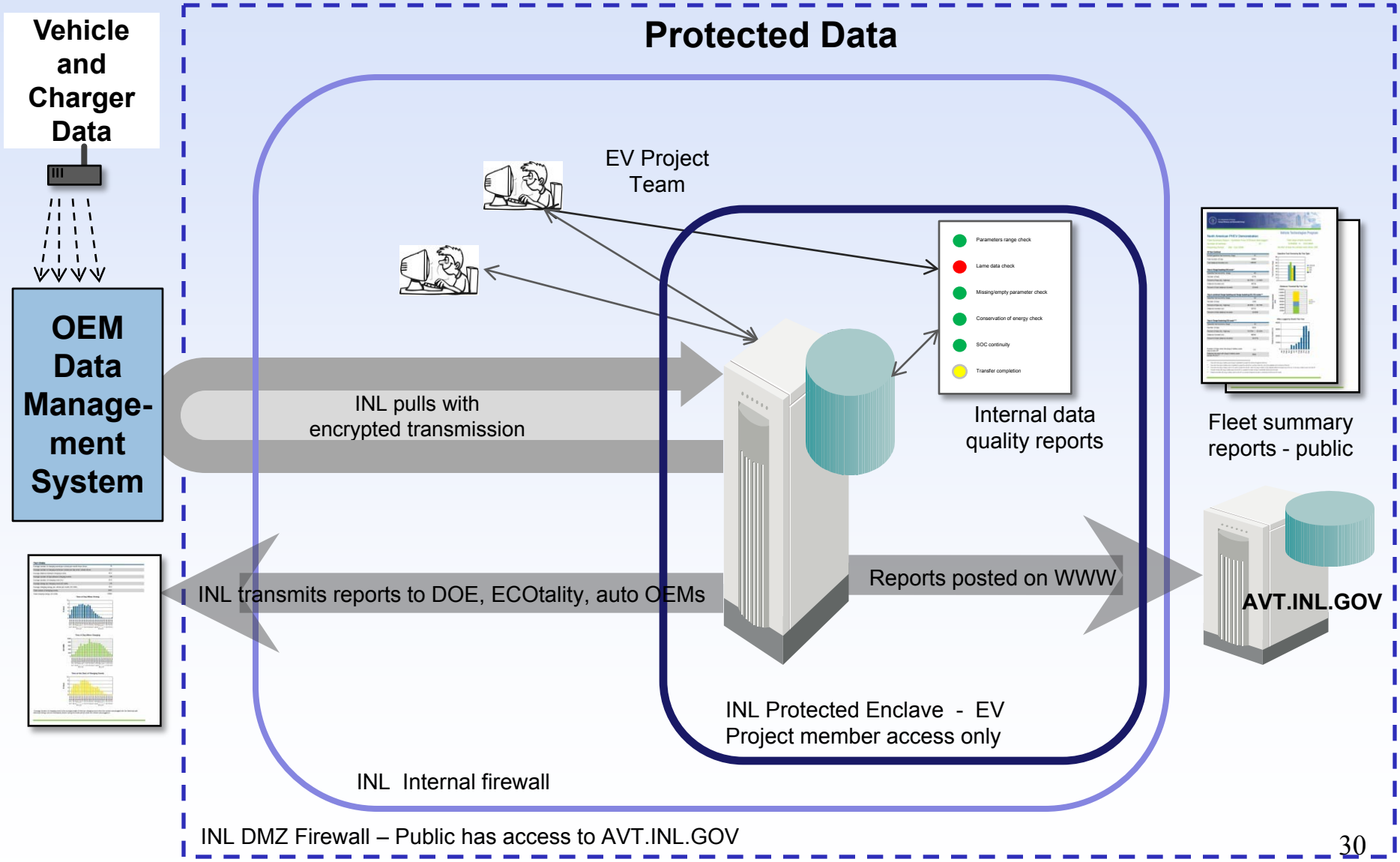
Quality Control Accomplishments

- **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**

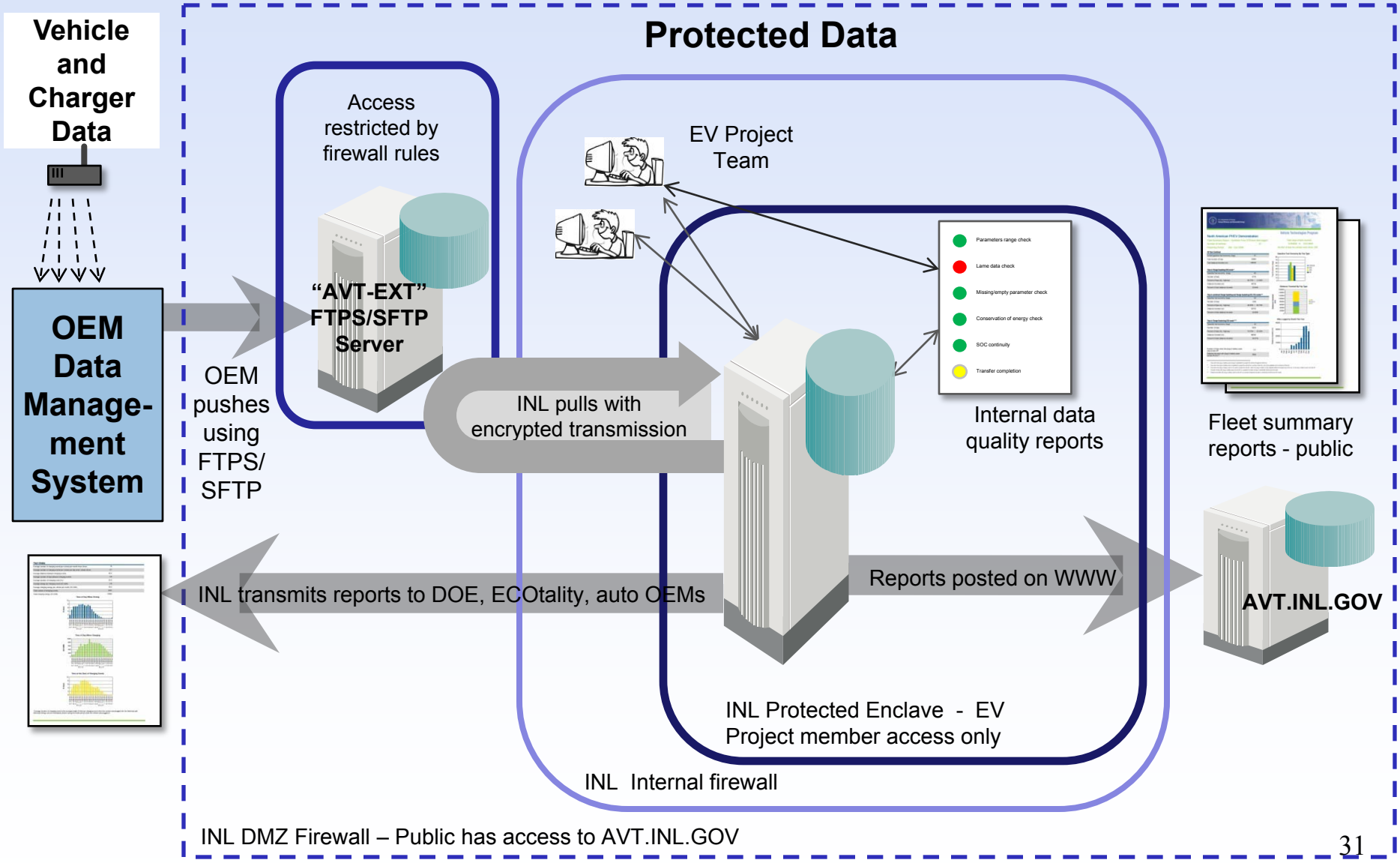
INL Data Security Accomplishments

- 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



INL Data Management System - Push



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
  - 9 City governments
  - 11 Universities
  - 2 Clean Air Agencies
  - 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)
  - Utilities include Southern California Edison®, Pacific Gas & Electric®, Puget Sound Energy, Southern Company, Arizona Public Service, Los Angeles Water & Light, City of Seattle, Tacoma Power, Sempra®

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

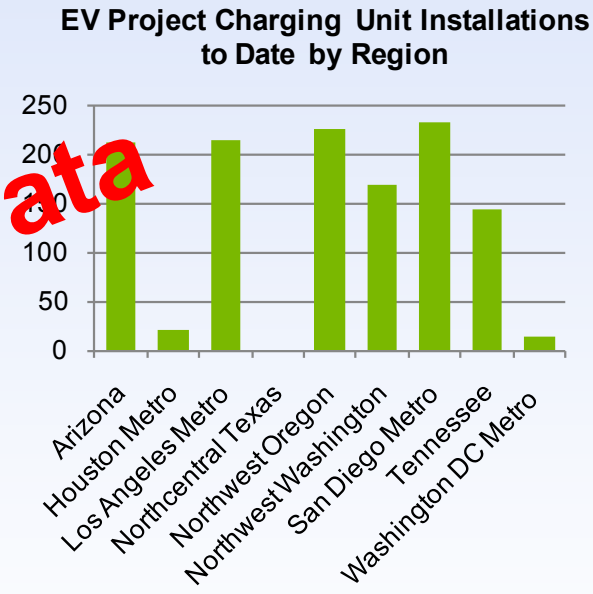
- Reporting targets include: DOE (first), other government agencies, OEMs, electric utilities, public, etc.
- Report on the charging infrastructure utilization (15,000 Level II EVSE units and fast chargers)
- INL will report on driver/vehicle charging patterns, and charging infrastructure utilization 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)

Charging infrastructure	Number of EV Project Charging Units			
Region	Installed to Date	Total Planned Installations[6]	Number of Charging Events Performed	Electricity Consumed (AC MWh)
Arizona[1]	213	2,100	697	8
Greater Houston Metropolitan Area	22	225	458	5
Greater Los Angeles Metropolitan Area	215	3,150	456	5
Northcentral Texas[2]	0	0	124	1
Northwest Oregon[3]	226	2,171	319	4
Northwest Washington[4]	169	2,169	185	2
Greater San Diego Metropolitan Area	233	2,185	258	3
Tennessee[5]	145	2,535	432	5
Greater Washington DC Metropolitan Area	14	150	165	2
Total	1,237	15,085	3,144	38

Fictitious Data



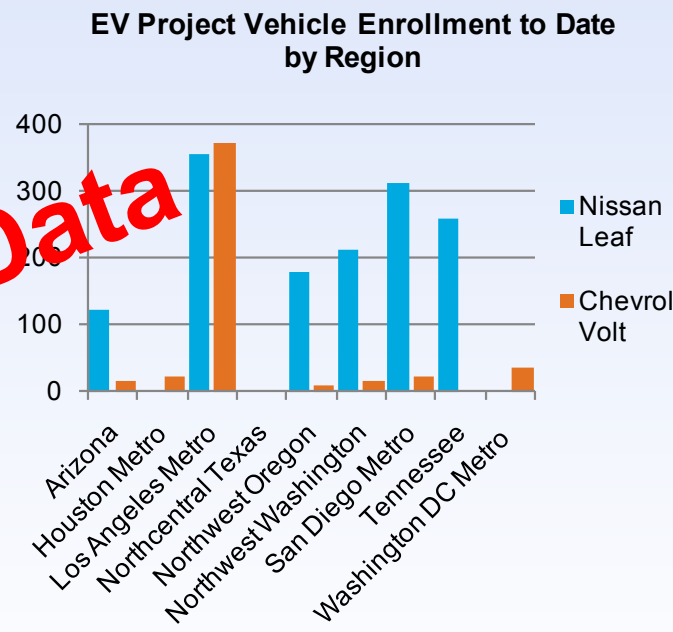
Future EV Project Activities Overview Fact Sheet

Example layout (bottom half pg 1)

Vehicles

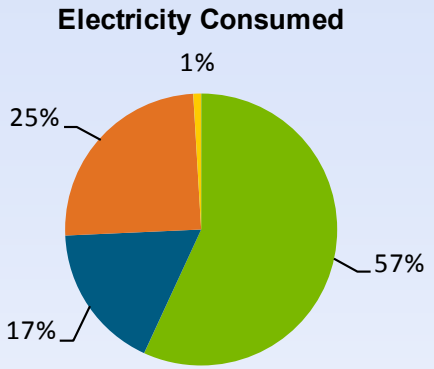
Region	EV Project Nissan Leafs Enrolled to Date[7]	EV Project Chevrolet Volts Enrolled to Date[7]	Number of Trips	Distance Driven (mi)
Arizona[1]	123	14	22,194	128,725
Greater Houston Metropolitan Area	n/a	22	3,564	20,671
Greater Los Angeles Metropolitan Area	356	371	117,774	683,089
Northcentral Texas[2]	0	0	0	0
Northwest Oregon[3]	178	9	31,294	175,705
Northwest Washington[4]	211	17	36,936	214,229
Greater San Diego Metropolitan Area	314	23	54,594	316,645
Tennessee[4]	259	n/a	41,958	243,356
Greater Washington DC Metropolitan Area	n/a	35	5,670	32,886
Total	1,441	491	312,984	1,815,307

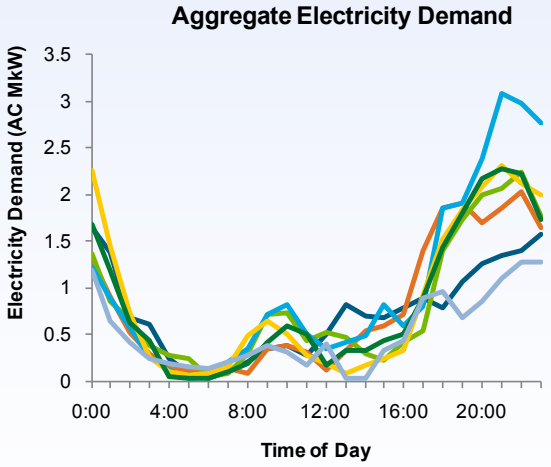
Fictitious Data



Future EV Project Activities - Infrastructure Usage Report

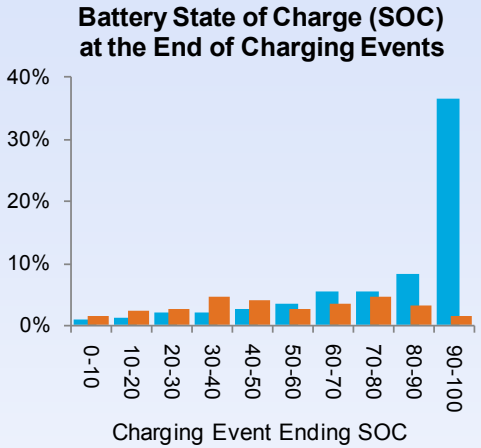
- 117 metrics and plots, including:
  - Electricity consumed
  - Charging unit utilization
  - Aggregate charging demand vs. time of day and day of the week
  - Individual charging event metrics
    - How often, how long, how empty, how full
  - Reporting by various subgroups

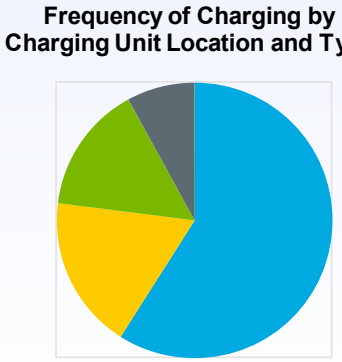




Future EV Project Activities - Vehicle Usage Reports

- 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)





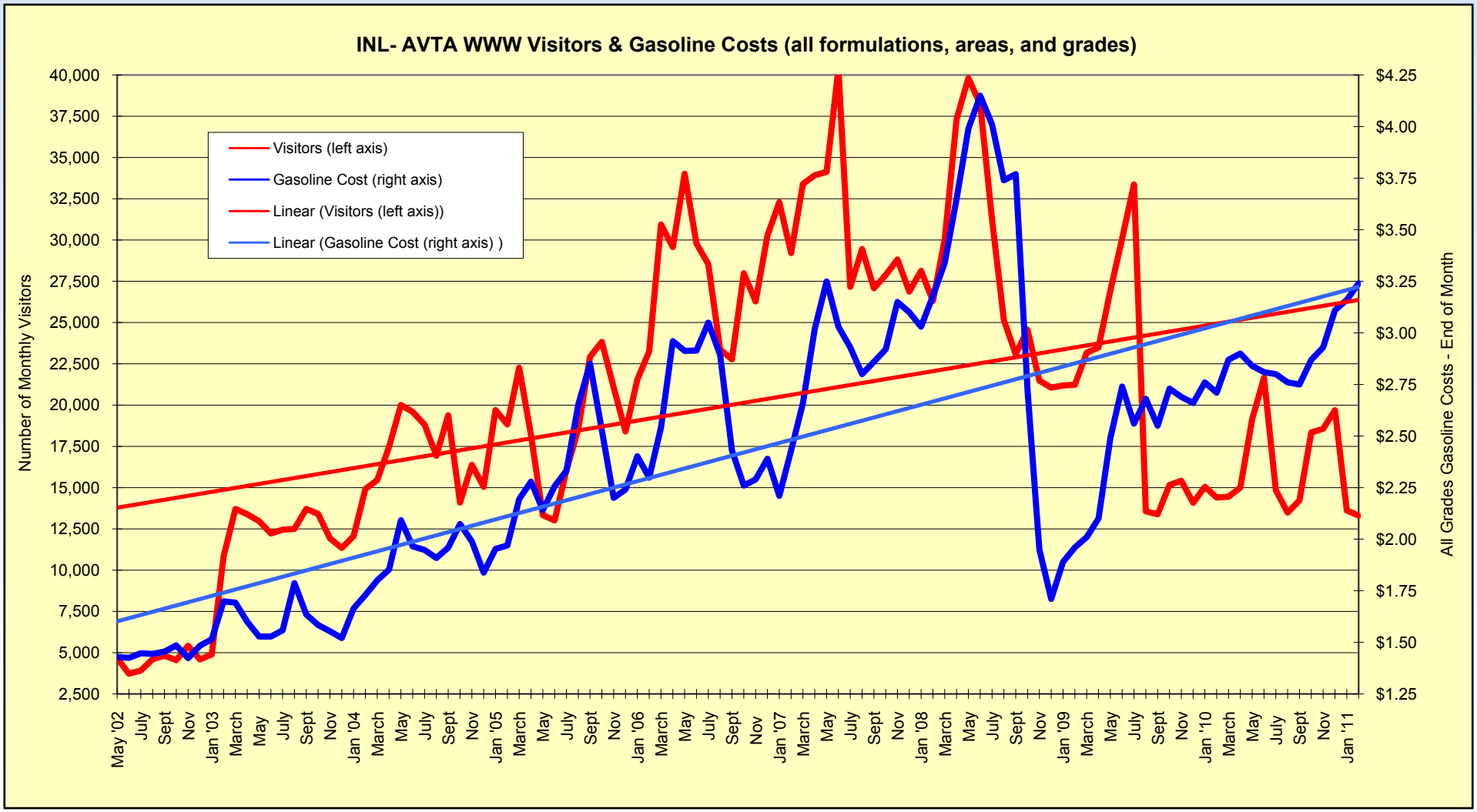
Summary

- **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



Acknowledgement

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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/

INL/CON-11-21375