



U.S. Department of Energy, Vehicle Technologies Program

PNWER – AVTA/INL PHEV Testing and Demonstration Activities in North America

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This presentation does not contain any proprietary, confidential, or otherwise restricted information

AVTA Background and Goals

- The Advanced Vehicle Testing Activity (AVTA) is part of DOE's Vehicle Technologies Program
- The Idaho National Laboratory (INL) conducts the AVTA for DOE, with Electric Transportation Engineering Corporation (ETEC) providing testing support
- The AVTA goals:
 - Provide benchmark data to technology modelers, research and development programs, vehicle manufacturers (via VSATT), and target and goal setters
 - Assist fleet managers in making informed early adaptor vehicle purchase, deployment and operating decisions

AVTA Testing by Technology

- Plug-in hybrid electric vehicles (PHEV)
 - 12 models, 187 vehicles, 800,000 fleet test miles
- Hybrid electric vehicles (HEV)
 - 17 models, 45 vehicles, 4.5 million test miles
- Neighborhood electric vehicles
 - 23 models, 200,000 test miles
- Hydrogen ICE (internal combustion engine) vehicles
 - 7 models, 400,000 test miles
- Full-size battery electric vehicles (BEVs)
 - 40 BEV models, 5+ million test miles
- Urban electric vehicles
 - 3 models, 1 million test miles



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PHEV Questions

- What are the petroleum savings and electricity demands?
- Will fleets and the public adapt to plugging in (charging) PHEVs to maximize mpg?
- What do PHEV charging profiles look like?
- Is a two-fuel scenario a difficult transition?
- What are the charging infrastructure needs, including 110V versus 220V? Fast charging?
- V2Grid – economic and technical benefit or liability to the vehicle operator?
- Are PHEVs technically and economically feasible as a transportation option?
- To answer these questions, the AVTA is testing and demonstrating 12 different PHEV models (by battery), their batteries, and the charging infrastructure



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12 PHEVs Models in Testing/Demonstrations

- Hymotion Prius (A123Systems)
- Hymotion Escape (A123Systems)
- Ford E85 Escape (Johnson Controls/Saft)
- EnergyCS Prius, 2 models (Valance and Altair Nano)
- Electrovaya Escape (Electrovaya)
- Hybrids Plus Escape, 2 models (Hybrids Plus and K2 Energy Solutions)
- Hybrids Plus Prius (Hybrids Plus)
- Manzanita Prius (lead acid)
- Manzanita Prius (Thunder Sky)
- Renault Kangoo (Saft NiCad)
- (All batteries are Lithium unless noted)



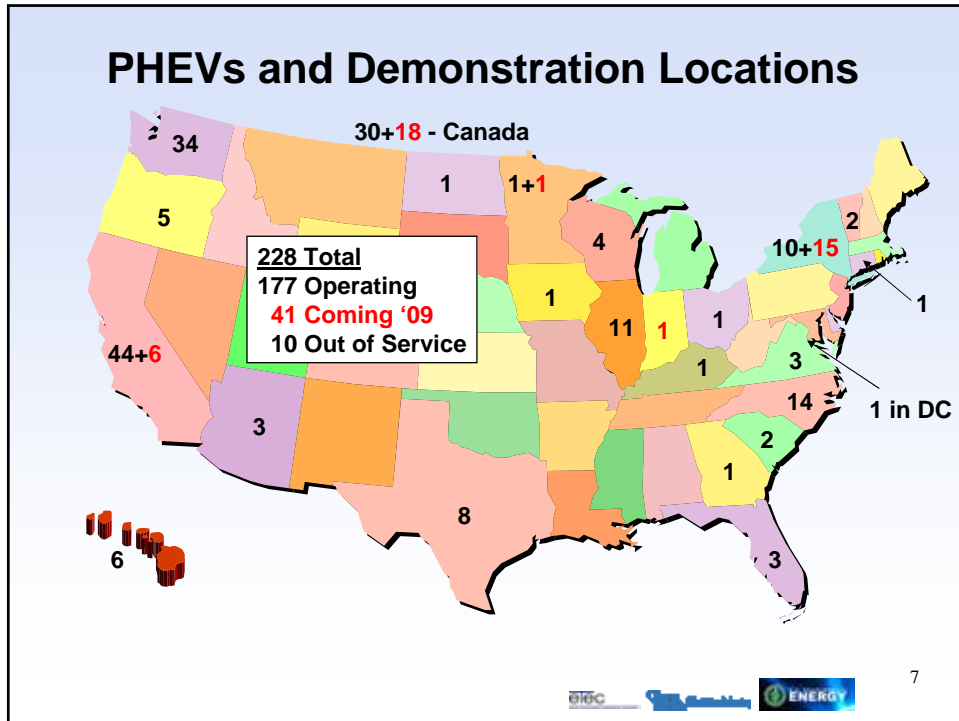
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Fleet Demonstration Partners

- 75+ Testing partners in the U.S. and Canada, including:
 - 40 Electric utilities and 2 clean air agencies
 - 10 City, county, state, and province governments
 - 7 Private companies and advocacy organizations
 - 8 Universities and colleges
 - 2 PHEV conversion companies
 - 1 sea port and 1 DOD facility
 - 22 U.S. states
 - 4 Canadian provinces



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- ## Washington State Demonstrations
- Washington state: 34 PHEVs, including:
 - Greater Seattle area: 13 Hymotion Prius
 - City of Seattle, King County, Port of Seattle and Puget Sound Clean Air Agency
 - Initial use of V2Green data loggers, GPS and cellular communications
 - Tacoma Power: 4 PHEVs
 - 2 Manzanita lead acid Prius
 - 2 Hymotion Prius
 - Port of Chelan lead: 14 Hymotion Prius
 - Benton, Chelan County, Douglas PUD, Wenatchee, Energy Northwest, Green IT Alliance, McKinstry, U of Washington, Snohomish County, Walla Walla and Wenatchee Valley Colleges
 - Puget Sound Energy: 2 Hymotion Prius
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Oregon and California Demonstrations

- Oregon: 5 PHEVs, including:
 - Oregon Departments of Energy and Transportation – 3 Hymotion Prius
 - A rural electric cooperative electric utility – 1 Hybrids Plus Escape
 - A large private electric utility – 1 Hymotion Prius
- California: 44 PHEVs, including:
 - University of California - Davis: 100 public drivers operate the 15 UC Davis Hymotion Prius. Only large PHEV study with public drivers in the United States
 - 22 Hymotion Prius and 7 Energy CS Prius operating in fleets that include: private and municipal electric utilities, private and large private companies, various other cities, counties, and an air quality district



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British Columbia \ Canadian Demonstrations

- Canada: 30 Hymotion Prius currently providing data
- British Columbia: 14 Hymotion Prius in operations and 18 Hymotion Prius on order
 - BC Ministries, BC Hydro, City of Vancouver and others
- Non-BC Canadian participants: 16 Hymotion Prius
 - Ministries, electric utilities, universities, share ride, and cities from Manitoba to Quebec
- Initiated PHEV testing with Toronto based Hymotion. INL and Hymotion defined data collection and reporting parameters and formats. Continue to jointly support PHEV data collection activities
- **The AVTA is collecting operating data from 97 PHEVs in the greater British Columbia, Washington, Oregon and California I-5 corridor**



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Other I-5 Corridor Testing

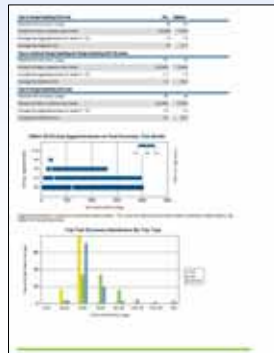
- Proposed 5,000 Nissan BEVs and 12,500 charging units to demonstrate BEV operations in five charging rich environments
 - Includes 1,000 BEVs and 2,500 chargers each in:
 - Greater Seattle
 - Greater Portland and south on I-5
 - Greater San Diego
 - Fast chargers installed on sections of the I-5 corridor
- INL has a 16 year history of vehicle and infrastructure testing and demonstration projects in the I-5 corridor from San Diego to British Columbia with SDG&E, SCE, SMUD, Pacific Gas & Electric, Portland General Electric, Orcas Power & Light, BC Hydro and others. Technologies include BEVs, PHEVs and hydrogen ICE vehicles



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PHEV Fleet Testing Reports

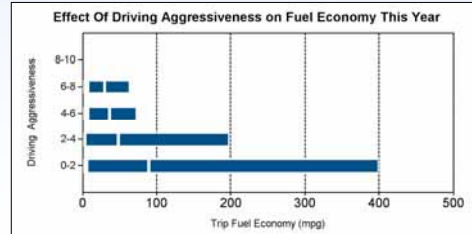
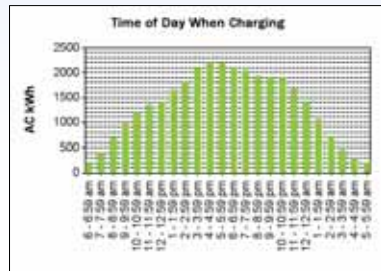
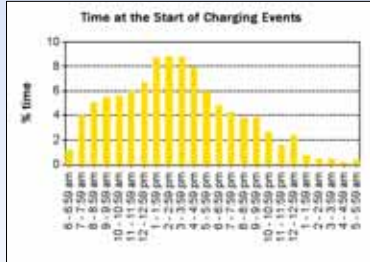
- Summary reports posted monthly on web
- Individual vehicle reports only go to the respective fleets each month, 950+ reports to date (July 1, 2009)
- 150 Hymotion Prius PHEVs, 710,000 miles, 76,000 trips, 18,000 charging events, 43,000 kWh used. V2Green and Kvaser data logger reports



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Hymotion Prius (V2Green Logger) Fleet Tests

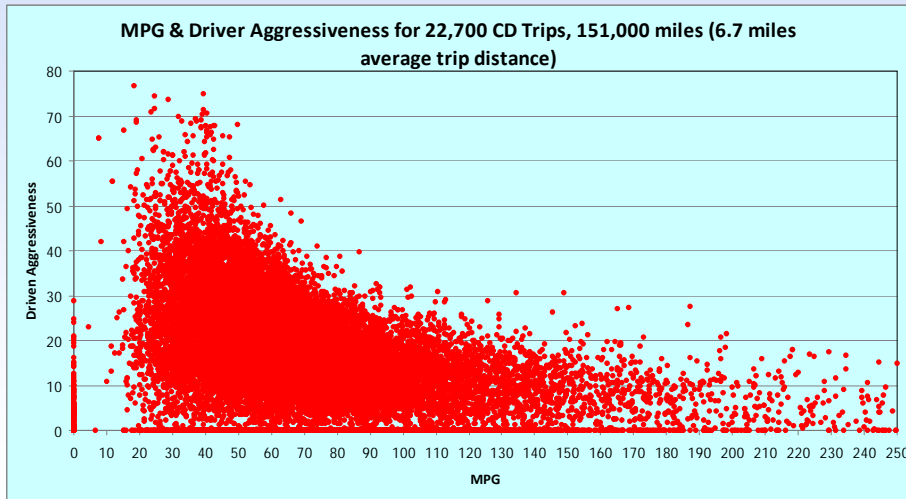
- March 01/08 to July 01/09. 110 PHEVs, 498,000 miles, 54,000 trips, 12,400 charging events and 31,000 kWh used



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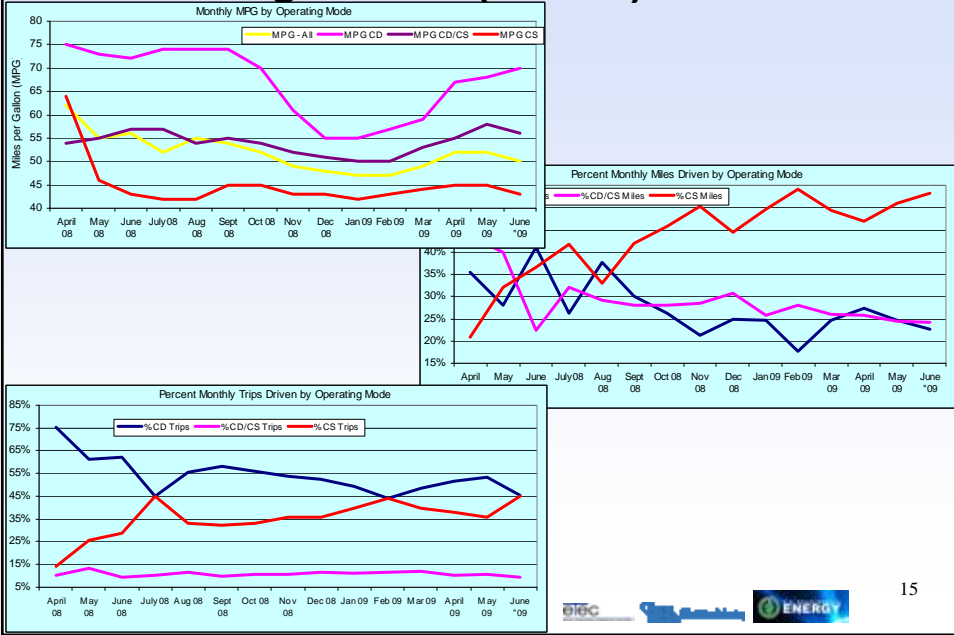
Hymotion Prius PHEVs – CD Trips

- MPG and aggressive driving impacts March '08 – May '09

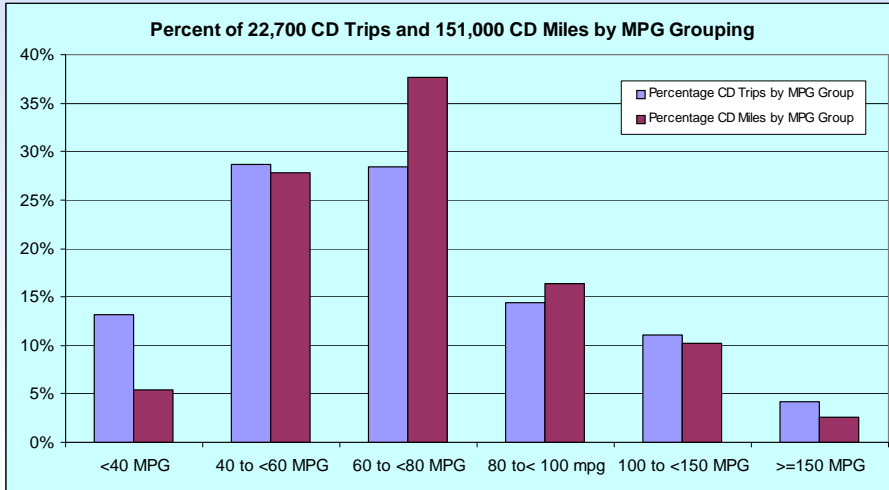


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Fleet Testing Results (Trends)



MPG Results - Charge Depleting (CD) Mode



Other PHEV Testing

- Bidirectional vehicle-to-grid (V2G) charging study
 - 6 kW and 20 kW levels, using lithium PHEV batteries, V2Green cellular charging control. Documents infrastructure requirements and costs
- City of Seattle \ V2Green lead time-of-day charging demonstration on 13 Seattle-area PHEVs. Includes INL battery impact analysis. Uses wireless charging control
- Developing vehicle-based battery test bed research project for testing PHEV and BEV batteries in various vehicle and charging operating scenarios
- Conduct vehicle \ battery testing on PHEVs when received via DOE's Technology Assistance and Demonstration Activity



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Other PHEV Testing – cont'd

- Tacoma Power charging infrastructure study
 - AVTA and Tacoma Power are collecting data on one section of administration building (800 amp, 480 volt, 3 phase load) and PHEV charging infrastructure
 - Document demand and energy profiles of PHEV charging as portion of facility profiles
 - WiFi local energy meter (LEM) data collection system



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PHEV Charging Infrastructure Cost Report

- Analyzes PHEV infrastructure requirements in single and multi-family residential, and commercial facilities as well as driving trends. No site specific costs
- Charging infrastructure equipment/administrative costs:
 - Levels 1 (120V, 15 or 20 amp) and 2 residential
 - Levels 1 and 2 (208/240V ~40 amp) apartment complex
 - Level 2 commercial facility
- Battery sizes & charge times for various PHEV platforms
- Power electronics & battery costs for PHEV platforms

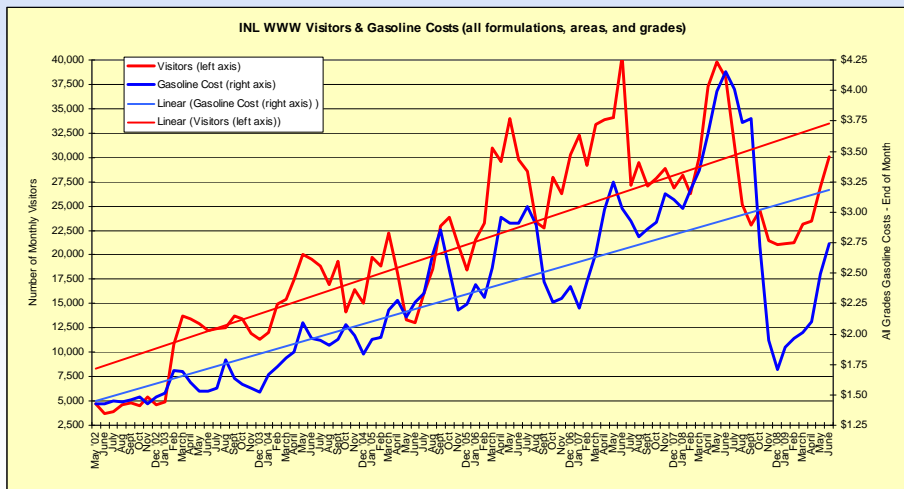
Level 1 Residential	Labor	Material	Permits	Total
EVSE (charge cord)	--	\$250	--	\$250
Residential circuit installation (20A branch circuit, 120 VAC/1-Phase)	\$300	\$131	\$85	\$516
Administration costs	\$60	\$43	\$9	\$112
Total Level 1 Cost	\$360	\$424	\$94	\$878

Report @ <http://avt.inl.gov/pdf/phev/pevhInfrastructureReport08.pdf>



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AVTA Webpage Use and Gasoline Costs



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Acknowledgement

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Additional Information

<http://avt.inel.gov>

or

<http://www1.eere.energy.gov/vehiclesandfuels/avta/>

This presentation can be found at:

<http://avt.inel.gov/pdf/phev/PNWERJuly2009.pdf>

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