

E-drive Vehicle Sales Analyses

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Argonne National Laboratory**

2014 Vehicle Technologies Annual Merit Review

June 18, 2014

Project VAN011

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Overview

Timeline

Start Date: October 2013
End Date: Project continuation and direction determined annually by DOE

Barriers

- Lack of readily available historical sales in the U.S. and other markets
- Lack of data on advanced vehicle usage and survival pattern
- Lack of data on cost components for levelized cost analyses
- Poor understanding of uncertainty in vehicle choice models and projections

Budget

Total Project Funding (DOE)

- FY14: \$84k
- FY14: \$56k for Navigant research reports

Partners

Interaction/Collaborations

- Hybridcars.com
- European Automotive Industry Newsletter
- Kelley Blue Book, NADA
- Navigant Research
- Tsinghua University, Beijing, China
- ORNL, NREL, SNL, TA Engineering

Objectives and Relevance

Data acquisition and analysis of sales, usage, cost to improve market modeling of electric-drive vehicle ecosystem and support DOE programs

Task 1: Track global E-drive vehicle sales

Objective: Provide reference data for vehicle choice modeling and DOE/EERE policy impacts analysis



Task 2: Examine HEV usage trends and survival rates

Objective: More realistic projections of utilization and resulting energy and emission reductions



Task 3: Extend levelized cost to include more components

Objective: More comprehensive levelized cost for advanced vehicle technologies



Task 4: Improve vehicle choice modeling using standardized inputs

Objective: More robust projections of vehicle market penetration and energy savings



Approach and Accomplishments

Task	Approach	Accomplishments
Task 1: Track global E-drive vehicle sales	<p>Document historical sales by make and model for each country/region</p> <p>Summarize both financial and non-financial policies matrix in each country/region</p>	<ul style="list-style-type: none"> • Extensive Use by DOE Programs Such as eGallon • E-drive vehicle policy matrix for each country/region summarizing: numerical targets, regulation and fiscal incentives • Factors could impacting early E-drive sales
Task 2: Examine HEV usage trends and survival rates	<p>Compare HEV daily travel usage with conventional vehicles using 2009 National Household Survey</p> <p>Examine HEV survival rate using Polk registration data</p>	<ul style="list-style-type: none"> • Daily distance distribution, average speed, travel time, trips per vehicle of HEVs and conventional cars and SUVs
Task 3: Extend levelized cost to include more components	<p>Collect data on key cost components for advanced vehicle technologies</p>	<ul style="list-style-type: none"> • Total cost of ownership data for PEVs and conventional vehicles
Task 4: Improve vehicle choice modeling using standardized inputs	<p>Comparing market penetration forecast of several vehicle choice models (VCMs)</p> <p>Analyze sensitivity to different vehicle attributes</p>	<ul style="list-style-type: none"> • Difference in projections of market penetration



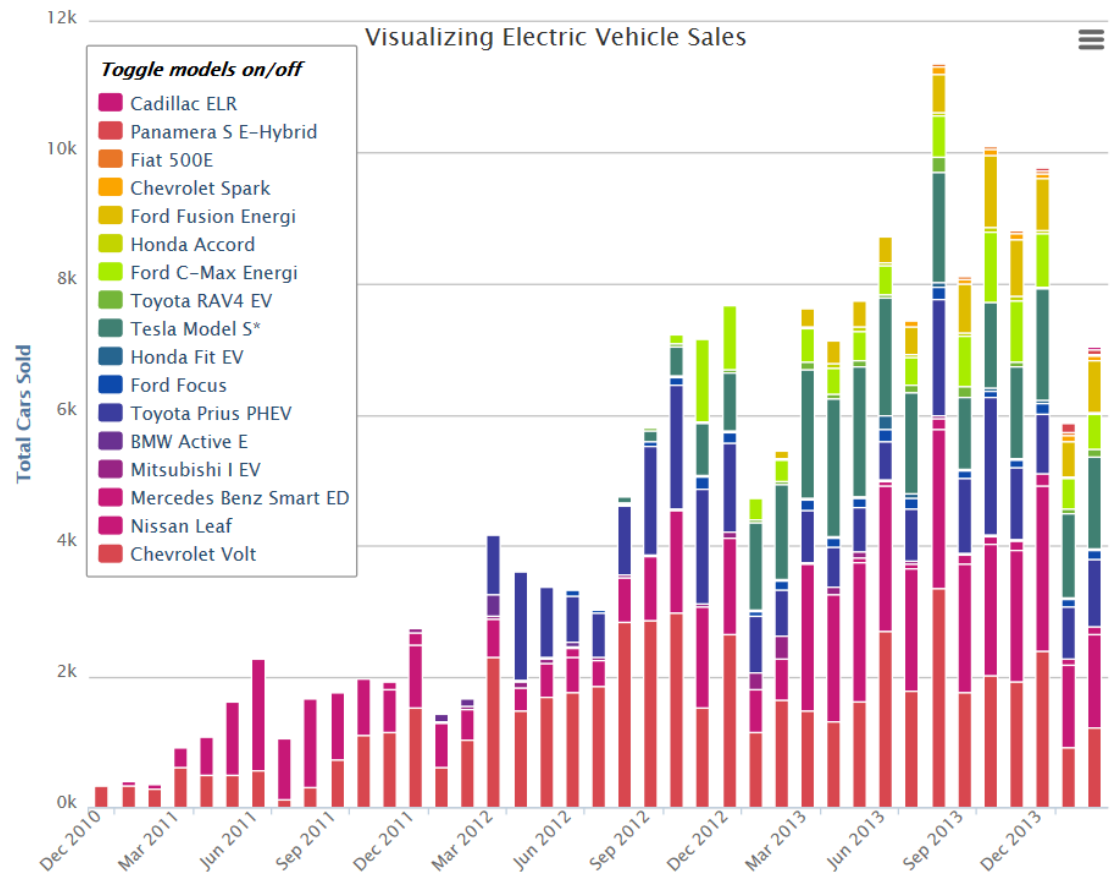
Milestones

Due Date	Milestones	Status
1/31/2014	1. Publish collected electric-drive vehicle sales for selected regions	Completed
6/30/2014	2. Report on usage trends by technology and HEV survival rates	On schedule
6/30/2014	3. Report on levelized costs components for PEVs	On schedule
9/30/2014	4. Report on comparison of vehicle choice models and their market projections	On schedule



Accomplishment 1: Extensive Use by DOE Programs Such as eGallon

- Publish monthly sales and market trend on both Argonne and DOE websites
- Support DOE/EERE programs and activities such as eGallon
- Develop extra charts and provide interpretation as needed for DOE project managers (market share, comparison of sales by model since market introduction, etc.)



DOE Website:

<http://energy.gov/articles/visualizing-electric-vehicle-sales>

ANL Website:

http://www.transportation.anl.gov/technology_analysis/edrive_vehicle_monthly_sales.html

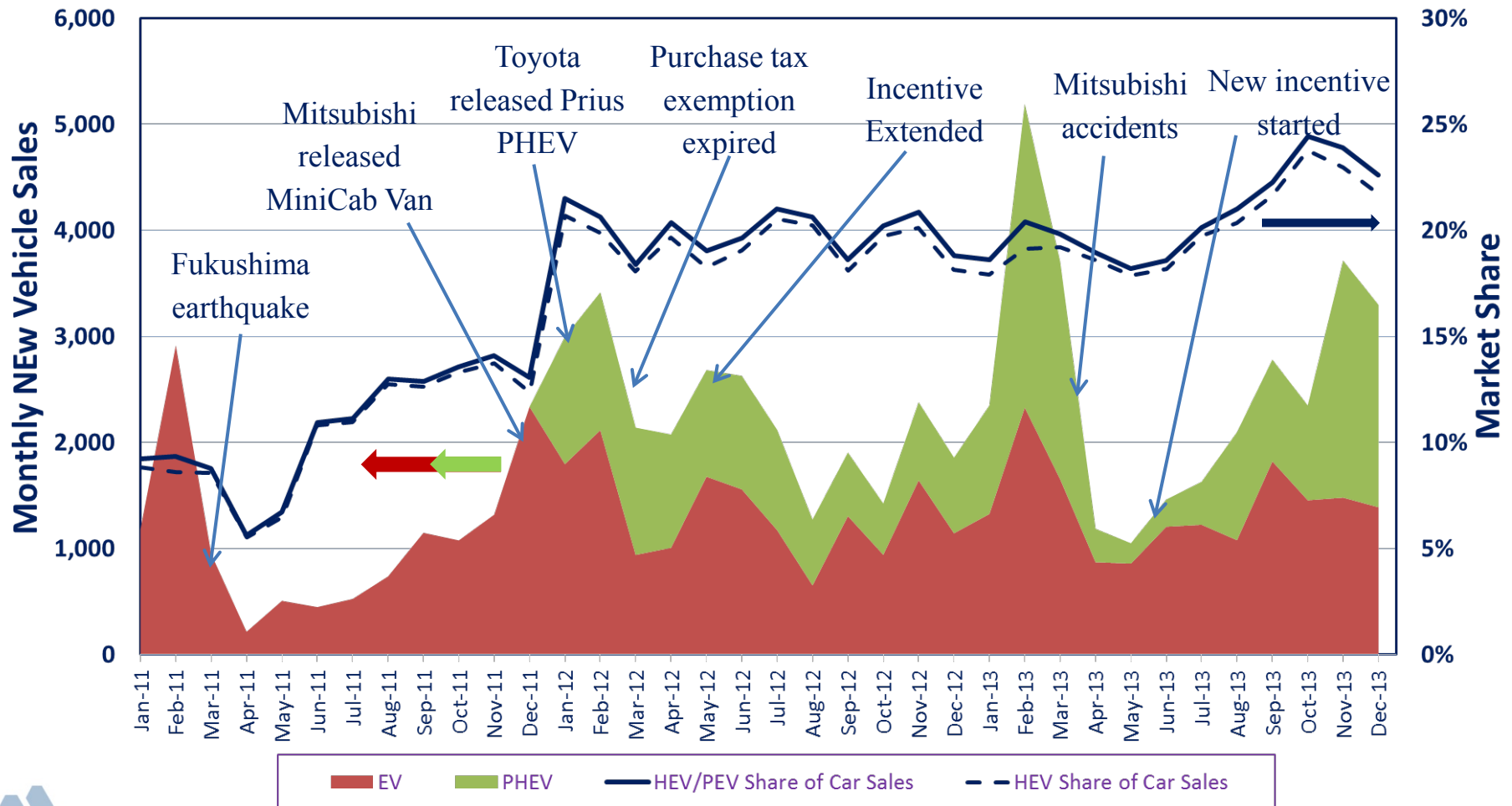


Accomplishment 1(Cont'd): E-drive Vehicle Policy Matrix for Each Country/Region (For Example: in China)

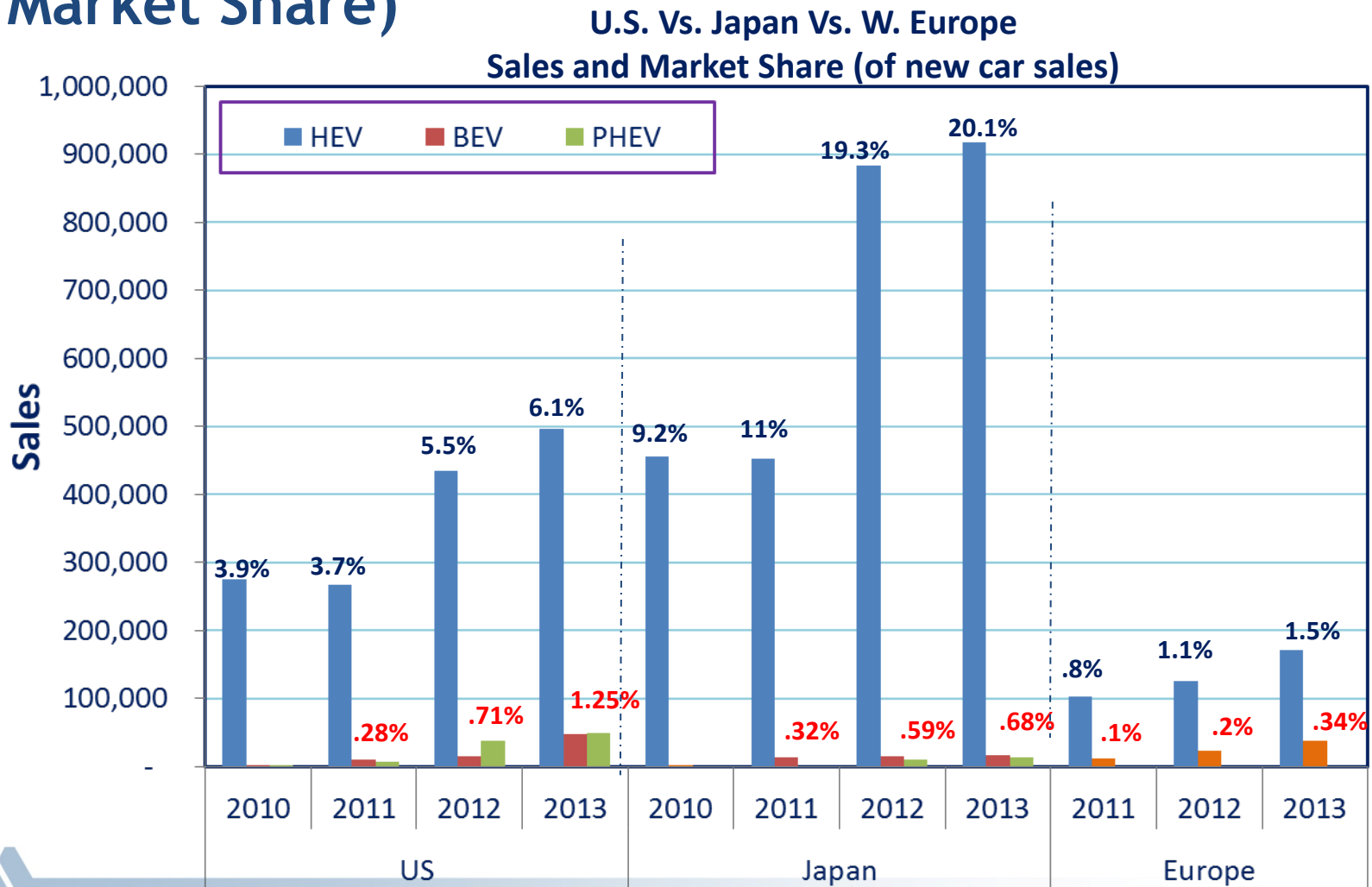
- **Numerical Targets:** Chinese State Council established the goal that the accumulated sales of PEVs would reach 5 million in 2020 through “Ten Cities One Thousand Vehicles” energy-saving and new energy vehicle (NEVs) demonstration program
- **Regulation/Emission Standards:** A target of achieving a fleet average fuel consumption rate of 5 L/100 km (47 mpg) by 2020
- **Fiscal Incentives to Consumers:**
 - **Phase 1 Subsidy:** (2009-2012), only for purchases of vehicles used for public service, such as taxis and transit buses.
 - Phase 1 Subsidy was extended in 2012 to nationwide. Subsidies were based on each vehicle’s battery capacity: about \$490/kWh toward any private PEV purchase (maximum \$8200 per PHEV and \$9835 per EV).
 - **Phase 2 Subsidy:** (9/2013- Present), the basis for obtaining a subsidy shift from battery capacity to electric range: about \$5700 - \$9800 for range over 30 miles.



Accomplishment 1(Cont'd): Factors Could Impacting Early EV Sales (For Example: in Japan)



Accomplishment 1(Cont'd): Global E-drive Sales Comparison: Although the U.S. Sells More PEVs, Japan's Sells Many More HEVs (and Much Higher Market Share)

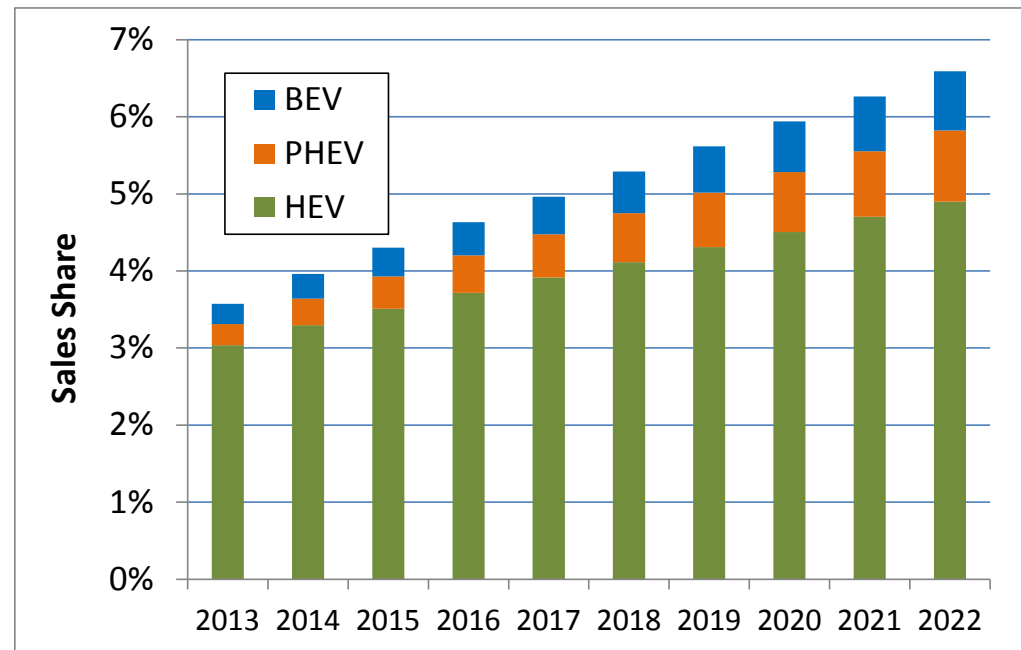


Note: Europe sales are BEV and PHEV combined

Accomplishment 1(Cont'd): E-drive Sales Forecast Using Navigant Smart Transportation Research Service

- **Market-relevant data and analysis provided on a range of topics relevant to DOE:**
 - PEV Adoption and Sustainable Transportation
 - Vehicle-to-Grid, Vehicle-to-Building
 - EV Charging, Carsharing
- **Contract with Argonne gives VTO analysis team access to Navigant reports, data and analysts**

Projection: North America, Light-duty vehicle sales shares



Source: "Electric Vehicle Market Forecasts, Global Forecasts for Light Duty Hybrid, Plug-In Hybrid, and Battery Electric Vehicle Sales and Vehicle Parc: 2013-2022," Navigant Research Report, Published 4Q 2013.



Accomplishment 1(Cont'd): Navigant Reports on Following Topics are Available to VTO Analysis Team

- **Electric Vehicles**
 - Plug-in Hybrid Electric Vehicles
 - Battery Electric Vehicles
 - Hybrid Electric Vehicles
 - Electrified Trucks and Buses
 - Electric Bicycles, Motorcycles, and Scooters
 - Electric Vehicle Battery Technologies
 - Electric Vehicle Charging Infrastructure
 - Consumer Attitudes, Preferences, and Behavior
- **Advanced Transportation Technologies**
 - Intelligent Transportation Systems
 - Emerging Drivetrain Technologies
 - Refueling and Charging Infrastructure
 - Transportation / Smart Grid Integration
 - Natural Gas Vehicles
 - Autonomous Vehicles

Summary of Task 1 Accomplishments

Task 1: Track Global E-drive Vehicle Sales

What we have:

Detailed global sale data by make/model

Policy matrix by each country/region

Market projection for major vehicle technologies

Why DOE needs the details:

Compare market status and policies cross regions

Provide reference data for vehicle choice modeling and policy impacts analysis

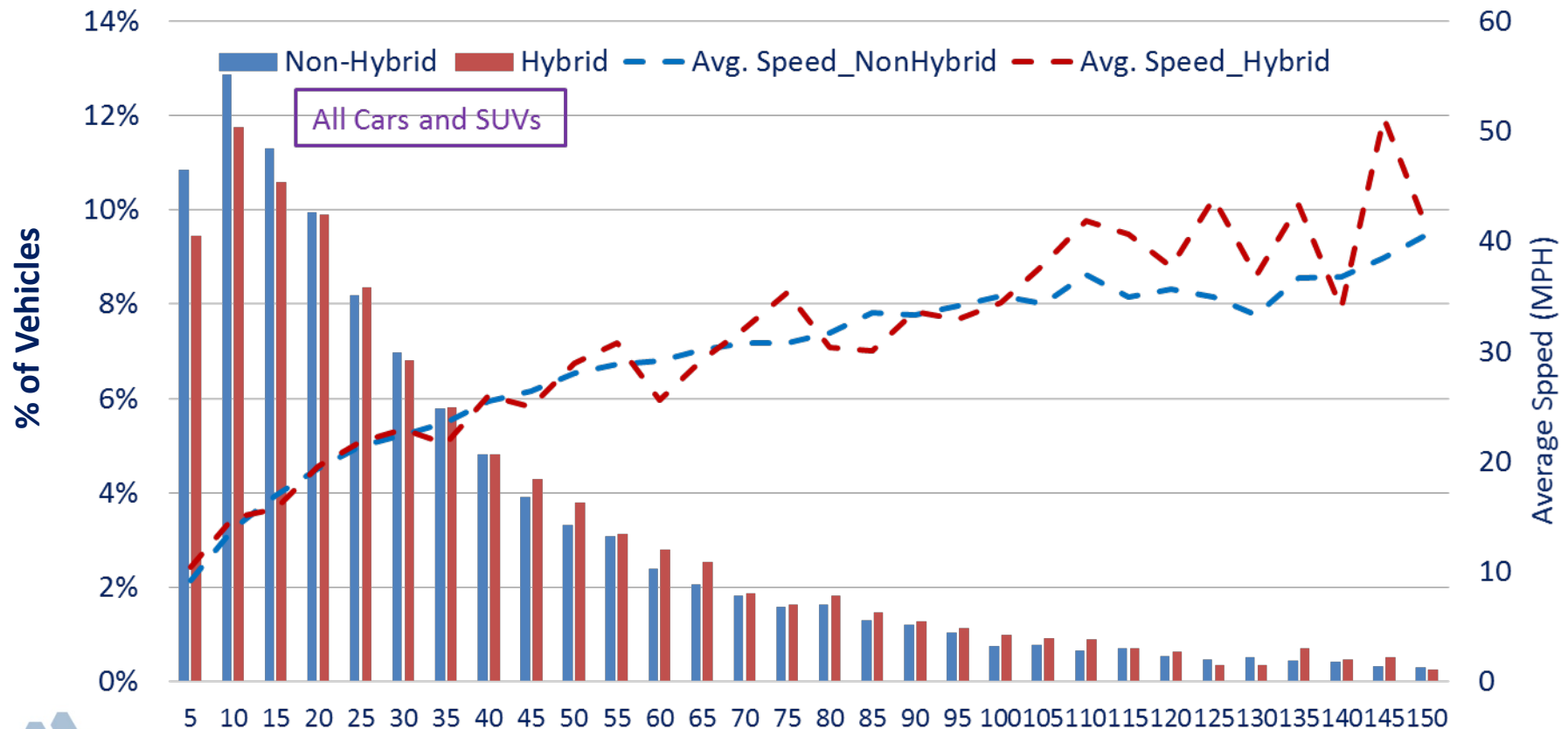


Accomplishment 2: Daily Distance, Average speed, Travel time, Trips per vehicle Show No Significant Difference between HEVs and Conventional Vehicles

Q: Are HEV used differently than conventional counterparts ?



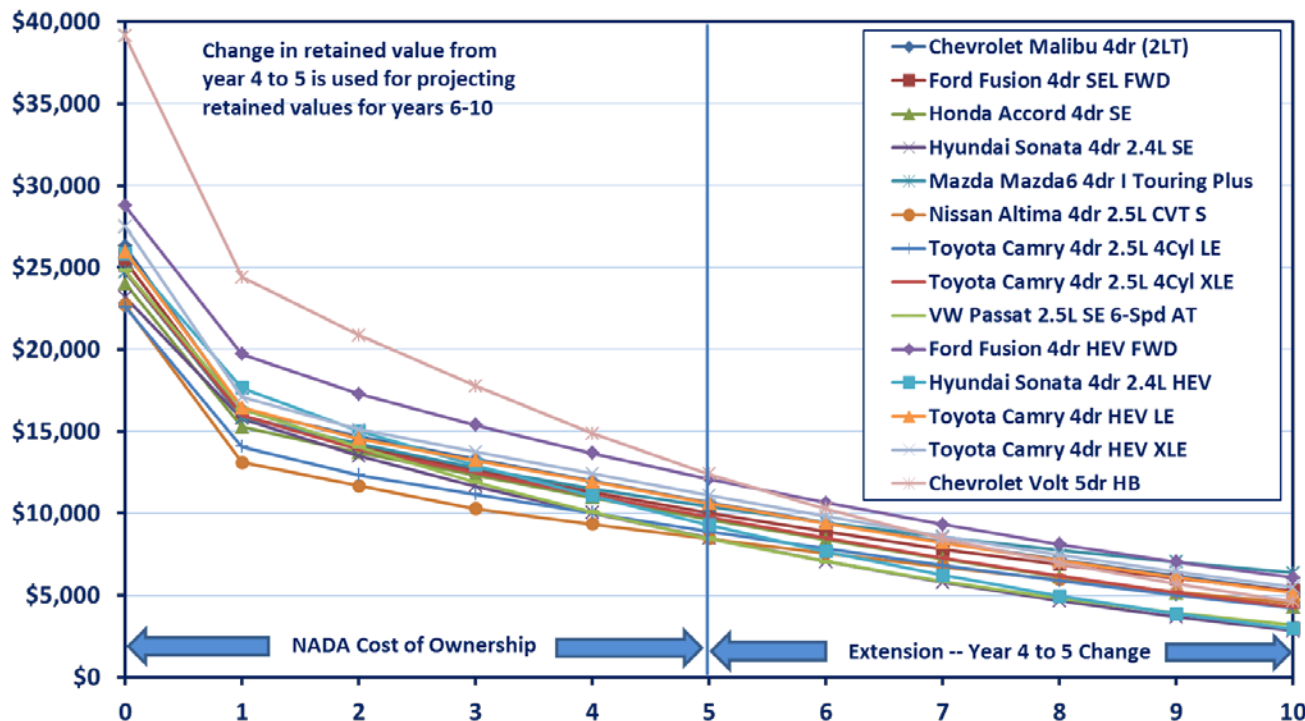
A: No, based on T-test performed on daily travel items



Accomplishment 3: Depreciation Rate Comparison: PEVs Vs. Conventional

Q: Is cost structure of owning PEV different from conventional?

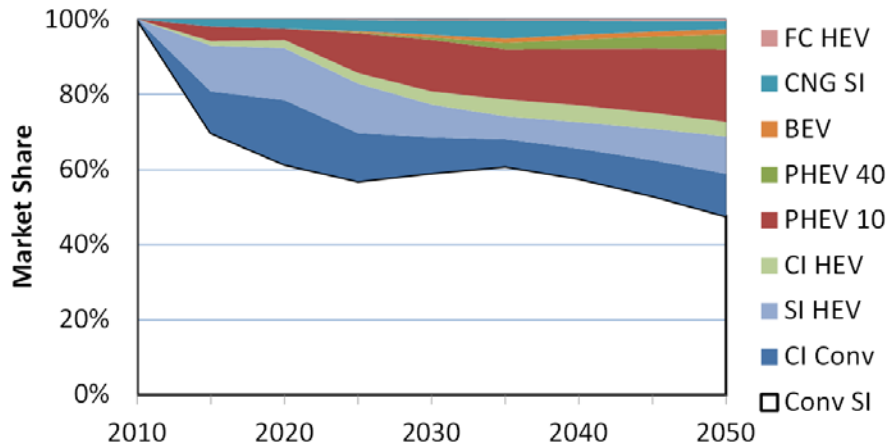
A: Yes, PEV may depreciate fast at first



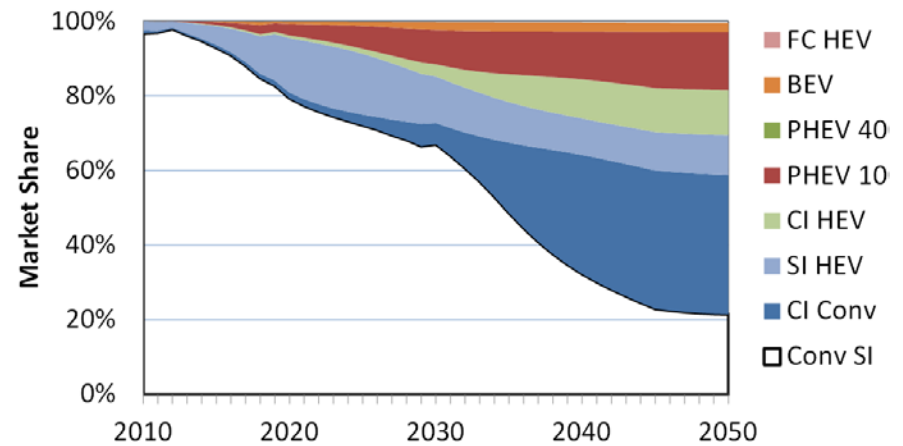
Summarized 5-year ownership cost of major PEV models and comparable conventional models (using data from KBB, Edmunds and NADA)

(On-going work) Compiling a cost list of market available EVSE models (Level 1, 2 and DC fast charger)

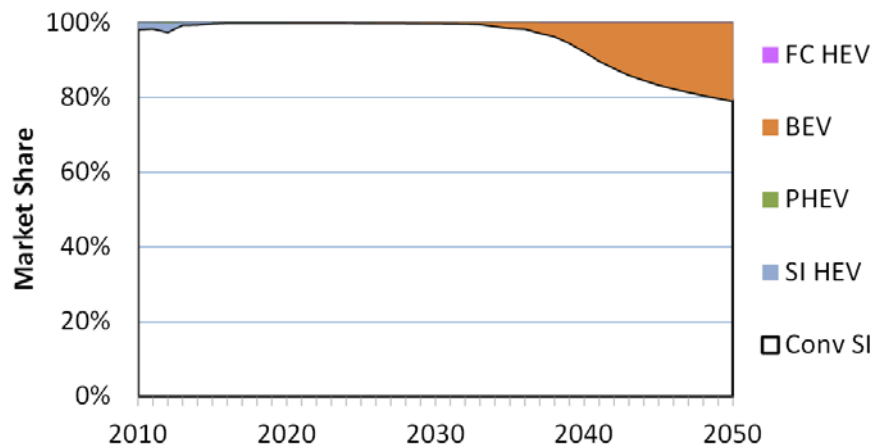
Accomplishment 4: Developed Standardized Inputs for Vehicle Choice Model Comparison



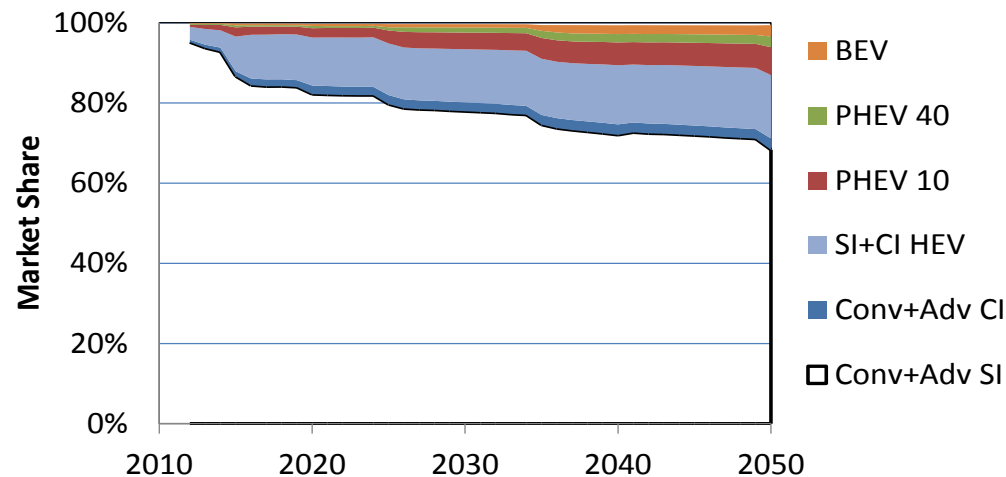
LVChoice (TA Engineering)



MA3T (ORNL)



LAVE-Trans (ORNL)



ADOPT (NERL)

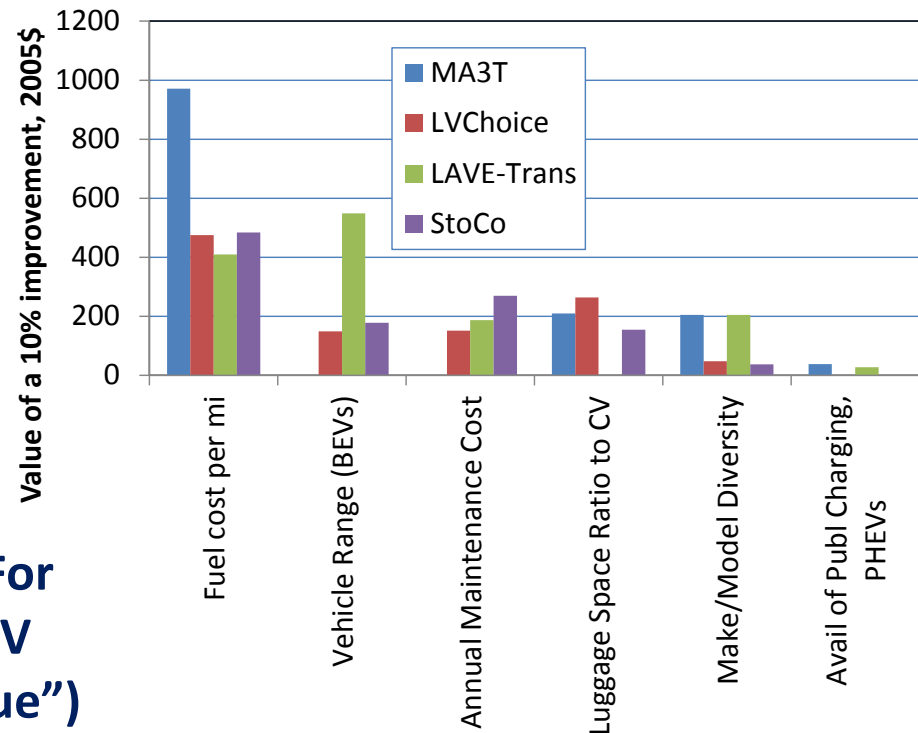
Accomplishments 4(Cont'd): Why Do Projections Differ? Answers are Important for Model Improvement

- Not all inputs were the same, e.g. differences in

- Make/model diversity
- Market segmentation
- Number of vehicle technologies

- Diversity built in model structures help VTO to approach the same question differently

- Models have different sensitivity (For example: a 10% improvement to PEV attribute has different “Implied value”)



Collaboration and Coordination

Explore opportunity
for data acquisition
and analysis with
Navigant Research



Collaborate with Z. Lin (ORNL), C. Liu (ORNL), A. Birky (TA Engineering, Inc.), A. Brooker (NREL) and D. Manley (Sandia) on standardizing vehicle choice inputs, VCM comparison and overall VTO analysis coordination

Tsinghua University,
Beijing provides
sales from China
and Japan market



European Automotive Industry
Newsletter (based in UK)
provides European sales and
gives permission to use the data

Proposed Future Work

Area	Task	Future Work
Data Collection	Task 1: Track global E-drive vehicle sales	<ul style="list-style-type: none"> Continue tracking monthly sales in four major markets: U.S., Europe, China and Japan Gather and maintain international E-drive vehicle sales and incentives databases for comparing market development and related market and policy analysis Investigate sales by battery capacity and type
Market and Policy Analysis	Task 2: Examine HEV usage trends and survival rates	<ul style="list-style-type: none"> PEV Market Niches: Examine advanced vehicle sales trends geospatially using national and regional Polk data Estimated levelized cost by market niche
	Task 3: Extend levelized cost to include more components	
	Task 4: Improve vehicle choice modeling using standardized inputs	<ul style="list-style-type: none"> Additional scenarios Additional models (ParaChoice from Sandia) Sensitivity analysis



Summary

■ Relevance

- Support vehicle choice and market modeling and related energy and GHG emission estimation in support of DOE advanced vehicle programs

■ Approach

- Collect sales from collaborators and provide analysis & interpretation
- Examine travel survey data to understand advanced vehicle usage pattern
- Collect key ownership cost items for advanced vehicle technologies
- Compare market penetration projections from VCMs using similar inputs

■ Technical Accomplishments

- U.S. E-drive sales by make and model published on both ANL and DOE websites
- E-drive vehicle policy matrix for different countries/regions
- Sales trends comparison of HEV, PHEV and EV from different counties/regions
- Factors impacting early E-drive vehicle sales
- HEV daily usage pattern comparison with conventional vehicles
- Total cost of ownership data for PEVs and comparable conventional vehicles
- Difference in projections of market penetration



Summary (Cont'd)

■ Collaborations

- Collect data and information from Tsinghua University and other agencies
- Collaborate with other national labs for standardizing inputs in VCM comparison

■ Future Work

- Continue tracking monthly sales in four major markets: U.S., Europe and Japan
- Gather and maintain an international E-drive vehicle sales and incentives databases for comparing market development and related market and policy analysis
- Separate sales by battery capacity and material for further comparison
- PEV Market Niches: Examine important advanced vehicle sales trends geospatially using national and regional Polk data
- VCM Comparison Expansion

Technical Back-up Slides

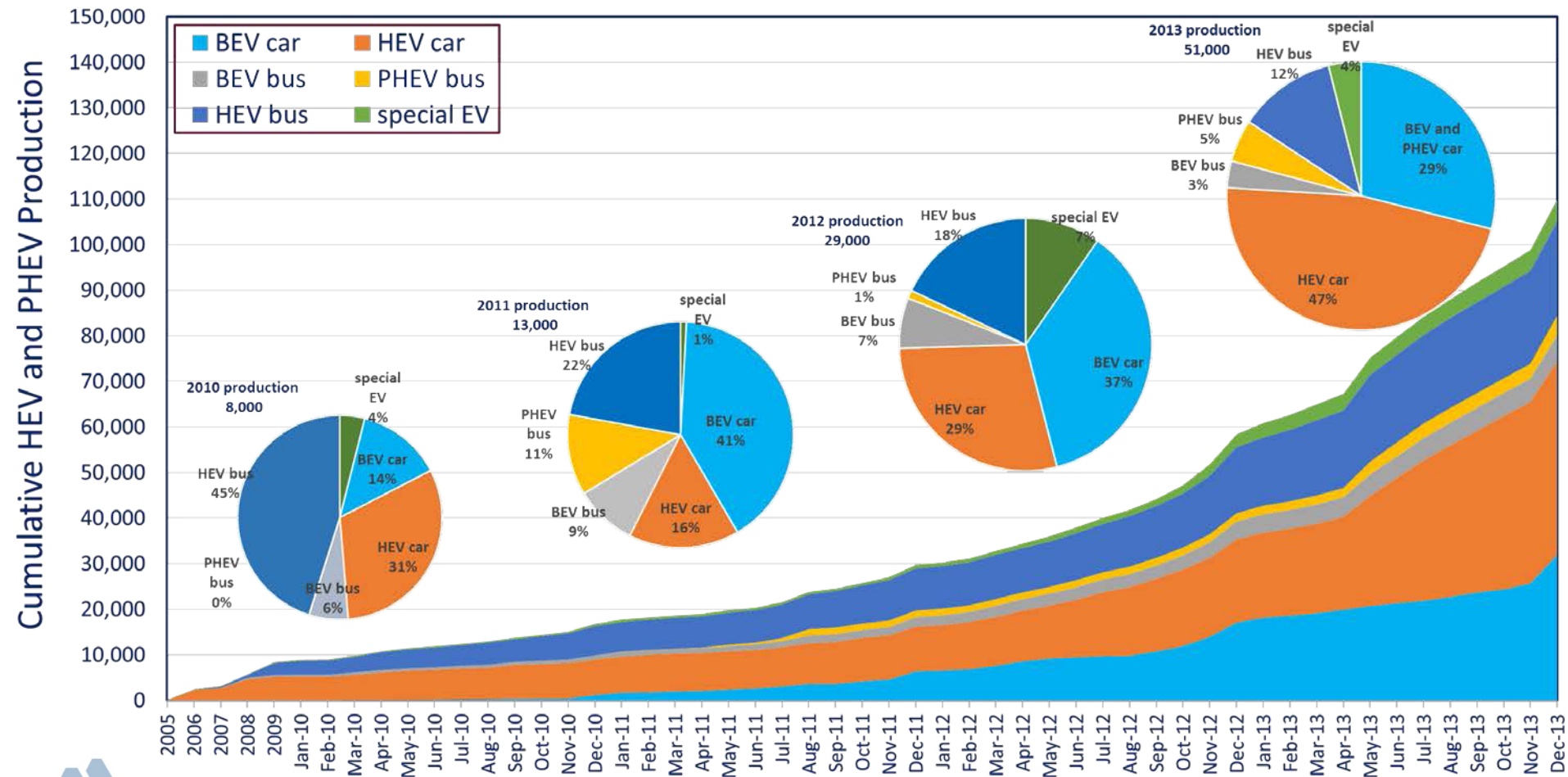


China's Phase I and Phase II EV incentives for both passenger vehicles and buses

			Phase1		Phase 2	
Target market			Public	Private	Public and Private	
Incentive duration			2009-2012	2010-2012	2013-2015	
Incentive scope			HEV, PHEV, BEV, FCEV	PHEV, BEV	PHEV, BEV, FCEV	
Subsidy Standard	HEV	PV	Up to 50,000¥			
		Bus	Up to 420,000¥ (L>= 10 m)			
	PHEV	PV	Up to 50,000¥	3,000¥/kWh	35,000¥ (R>=50 km)	
		Bus	Up to 420,000¥ (L>= 10 m)		250,000¥ (L>=10 m)	
	BEV	PV	60,000¥	3,000¥/kWh	35,000¥ (80km <R<150 km)	
					50,000¥ (150km <R< 250 km)	
					60,000¥ (R>=250)	
		Bus	500,000¥ (L>=10 m)		300,000¥ (6m<L<8m)	
					400,000¥ (8m<L<10m)	
					500,000¥ (L>=10m)	
		SPV			2,000¥/kWh	
	FCEV	PV	250,000¥		200,000¥	
		Bus	600,000¥ (L>=10 m)		500,000¥	
Phase-out mechanism			NA	NA	10% reduction in 2014 20% reduction in 2015	
Pilot cities			25 cities	6 cities	28 cities and regions	

1 US dollar = 6.1 Chinese Yuan (¥); L = length, R = range, PV = passenger vehicle, SPV= special purpose vehicle

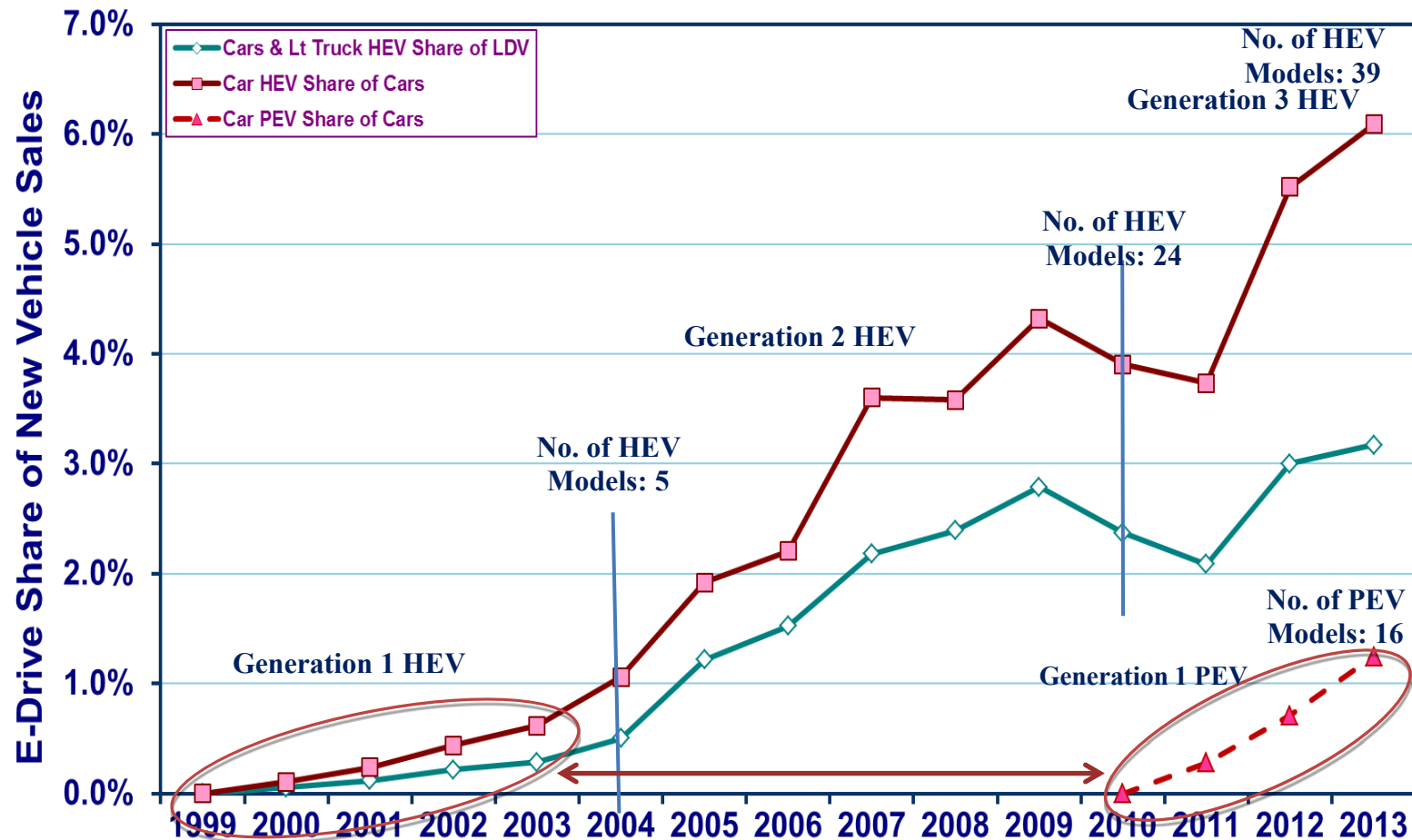
China: E-drive bus production has experienced steady increases since the 2008 Olympic games and the 2009 “Ten Cities One Thousand Vehicles” EV demonstration program



We compared PEV sales with HEV sales trend: Reason for optimism for PEV sales growth in the US

Generation 1 PEV sales (starting in 2010) in the US has outpaced those of Generation 1 HEVs (starting in 1999).

Cumulatively, over 4 million HEVs have been sold in the U.S. since 1999



Like the U.S., Norway and the Netherlands' PEV yearly share of passenger cars has exceeded 1% of the new car market

