# E-drive Vehicle Sales Analyses

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**Project VAN011**

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

# Overview

## Timeline

**Start Date: October 2014**
**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
- Limited understanding of existing E-drive vehicle purchase trend

## Budget

**Total Project Funding (DOE)**

- FY14: $84k (plus $56K for Navigant report subscription)
- FY15: $90k

## Partners

**Interaction/Collaborations**

- Hybridcars.com
- European Automotive Industry Newsletter
- Kelley Blue Book, NADA
- Navigant Research
- Tsinghua University, Beijing, China
- National Renewable Energy Laboratory

# 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: Collect vehicle ownership cost data and projections**

**Objective:** More comprehensive levelized cost for advanced vehicle technologies

**Task 3: Characterize regional purchase pattern of E-drive vehicles**

**Objective:** Examine geographic distribution and demographics to characterize market

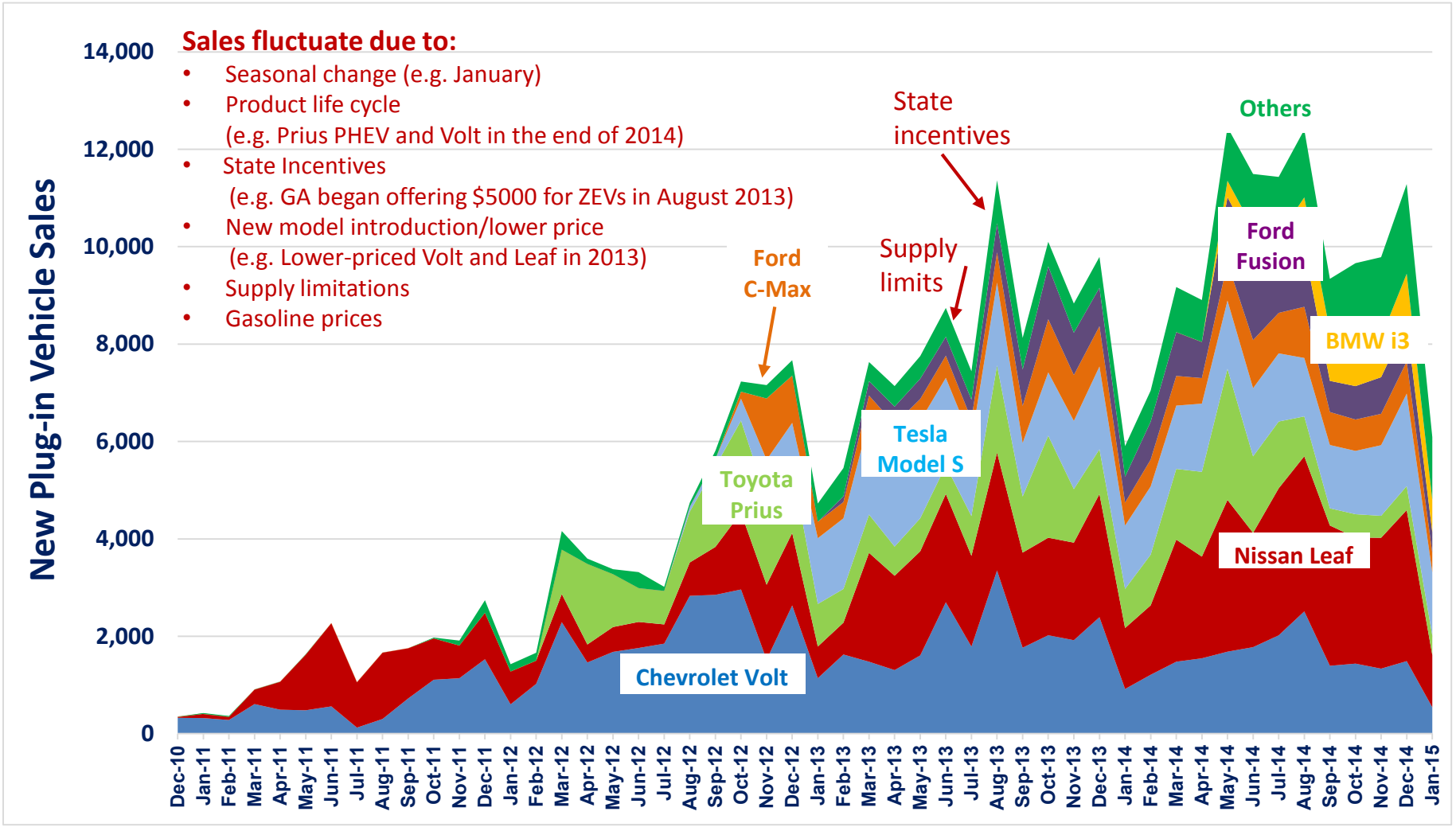
# Approach and Accomplishments

| Task | Approach | Accomplishments |
|---|---|---|
| **Task 1**: Track global E-drive vehicle sales | Collect historical sales by make and model<br><br>Summarize financial and non-financial policies matrix | • Monthly U.S. EV sales market report<br>• Monthly data products published on ANL and DOE website<br>• International sales trend comparison<br>• E-drive vehicle policy matrix for each country/region |
| **Task 2**: Characterize regional purchase pattern | Analyze sales by geographic and demographic factors to determine locations of plug-in vehicle sales and identify market niches | • Regional PEV adoption pattern<br>• Identified E-drive vehicle market niches in city/suburb/rural areas |
| **Task 3**: Collect vehicle ownership cost data and projections (New task) | Collect vehicle resale values and total ownership cost by model and market segment | • Summarized ***who has what*** based on data review and discussion with different data providers |

# Milestones

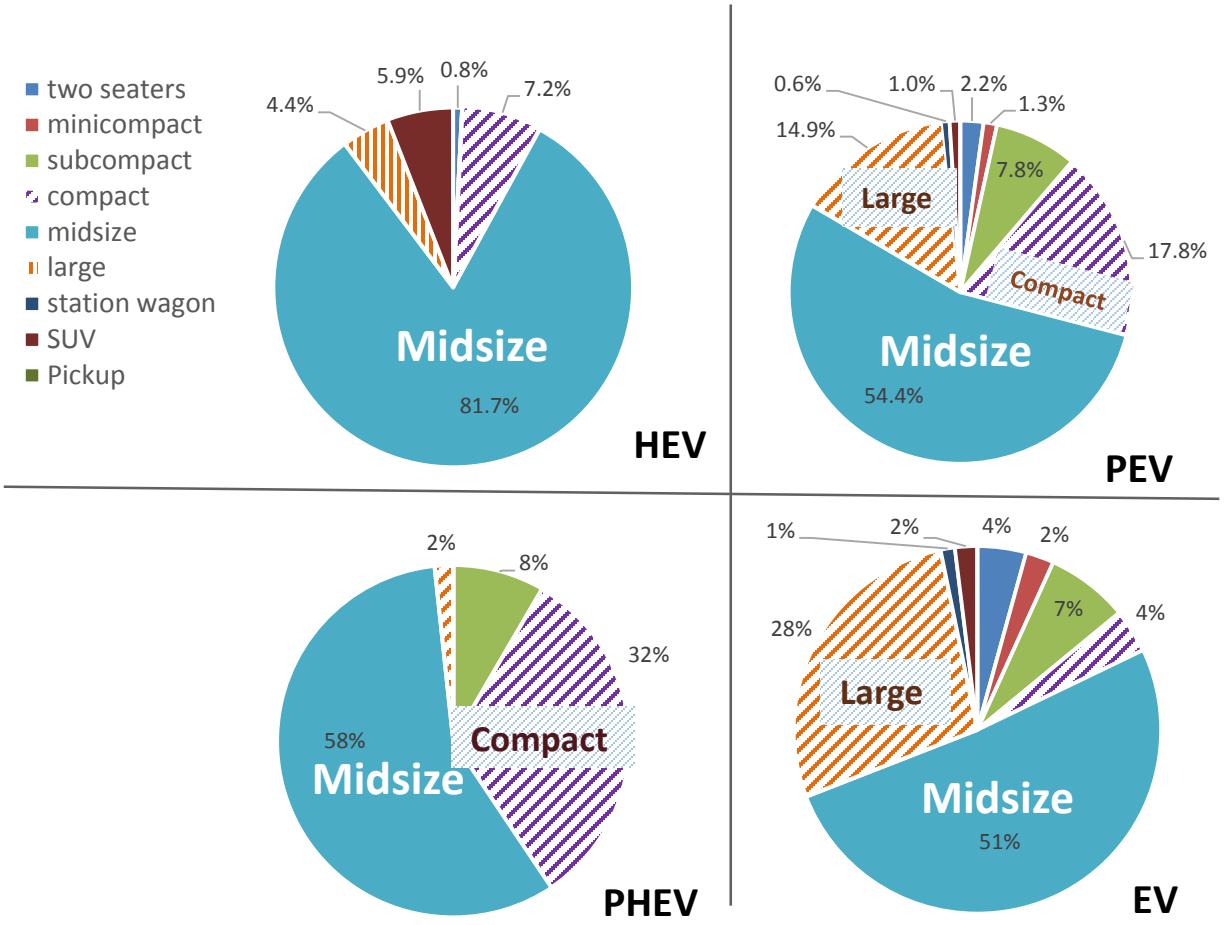
| Due Date | Milestones | Status |
|---|---|---|
| Q1 FY2015 | Publish monthly sales and market reports | Completed |
| Q4 FY2015 | Summarize total ownership cost by model and market | On schedule |
| Q4 FY2015 | Summarize adoption trend and market niches in 4 selected regions | On schedule |

# Plug-in Electric Vehicles sales are growing, if somewhat erratically




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

# PEVs are available in diverse models covering more vehicle classes and types than HEVs




2014 Sales by EPA Size Class

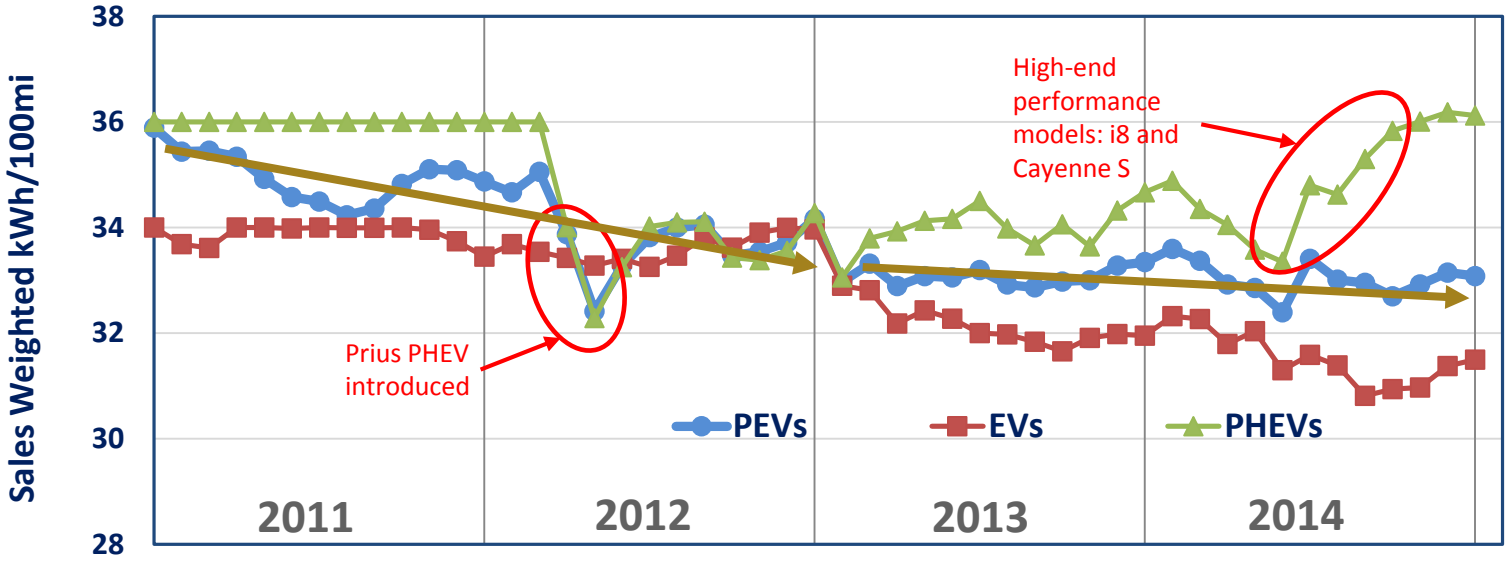
HEVs are predominantly mid-size cars

PHEVs tend to be smaller than HEVs, with larger shares of compacts and subcompacts

BEVs are larger on average than PHEVs (due to success of the large Tesla Model S and the mid-size Leaf)

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

# Fleet efficiency (kWh/100 mi.) is improving over time, but recently at a diminishing rate




**Fleet Efficiency = Plug-in vehicle sales weighted kWh/100 mile**

**Improvement is due to higher motor efficiency, better batteries and improved charging efficiency**

**EV kWh/100 mi improved notably in 2013-14 vs. 2011-12**

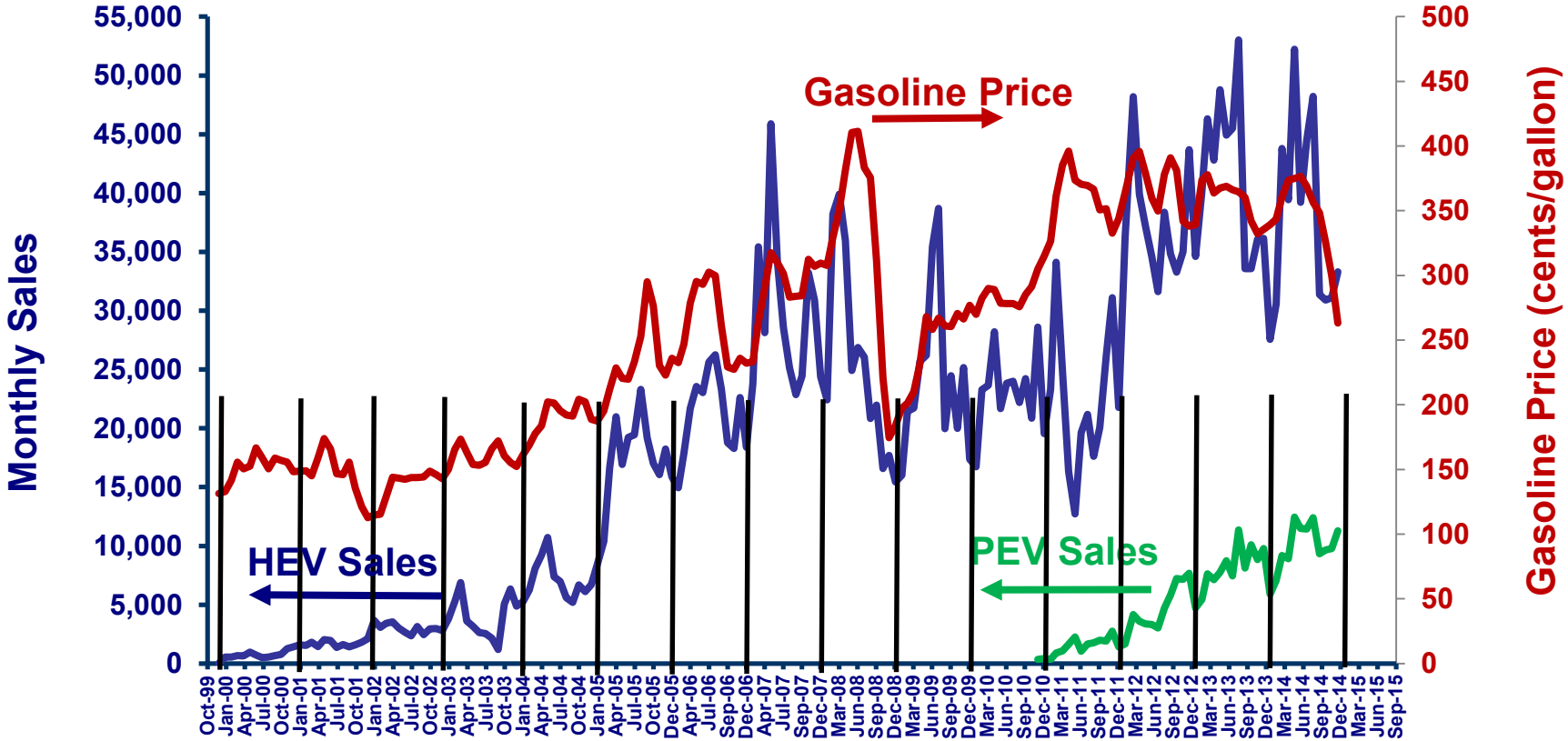
**Recent increase in PHEV kWh/100 mi is due to introduction of high performance models**

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

Efficiency: www.FuelEonomy.gov

# Declines in the price of gasoline tend to reduce the incentive for people to buy HEVs. PEVs?

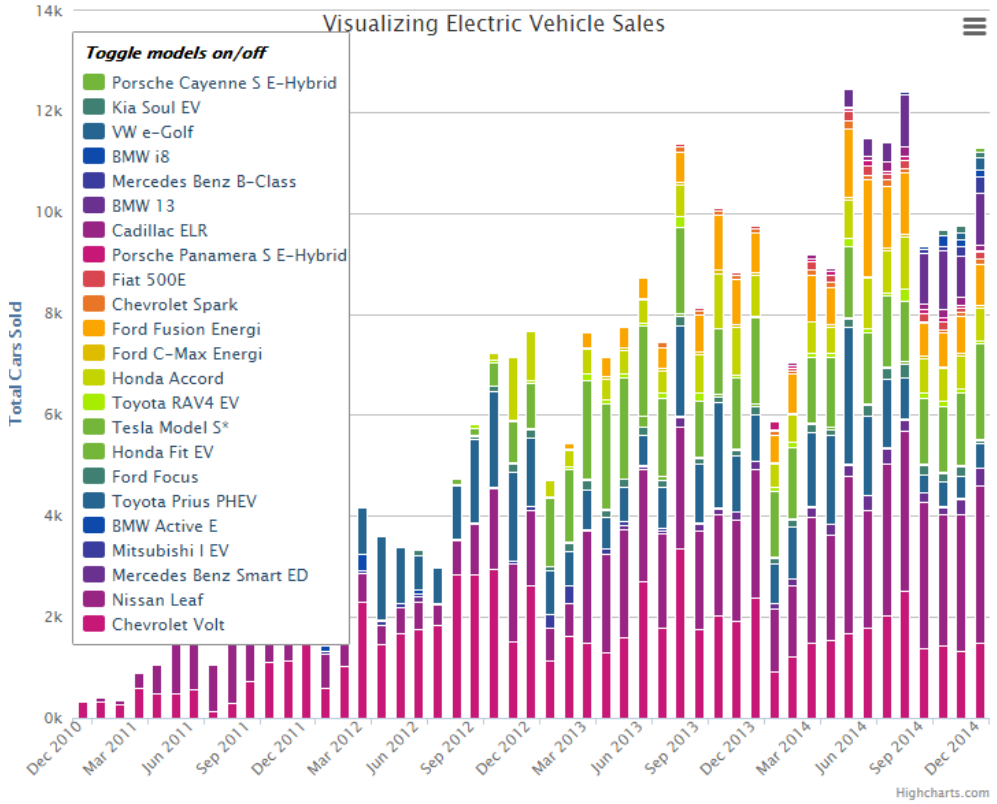
**The price of gasoline is beyond the control of the automakers. So far it has affected HEVs more than PEVs.**




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

# Extensive use of data products by DOE programs and other agencies

- 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.)
- National Science Foundation links to ANL EV sales webpage

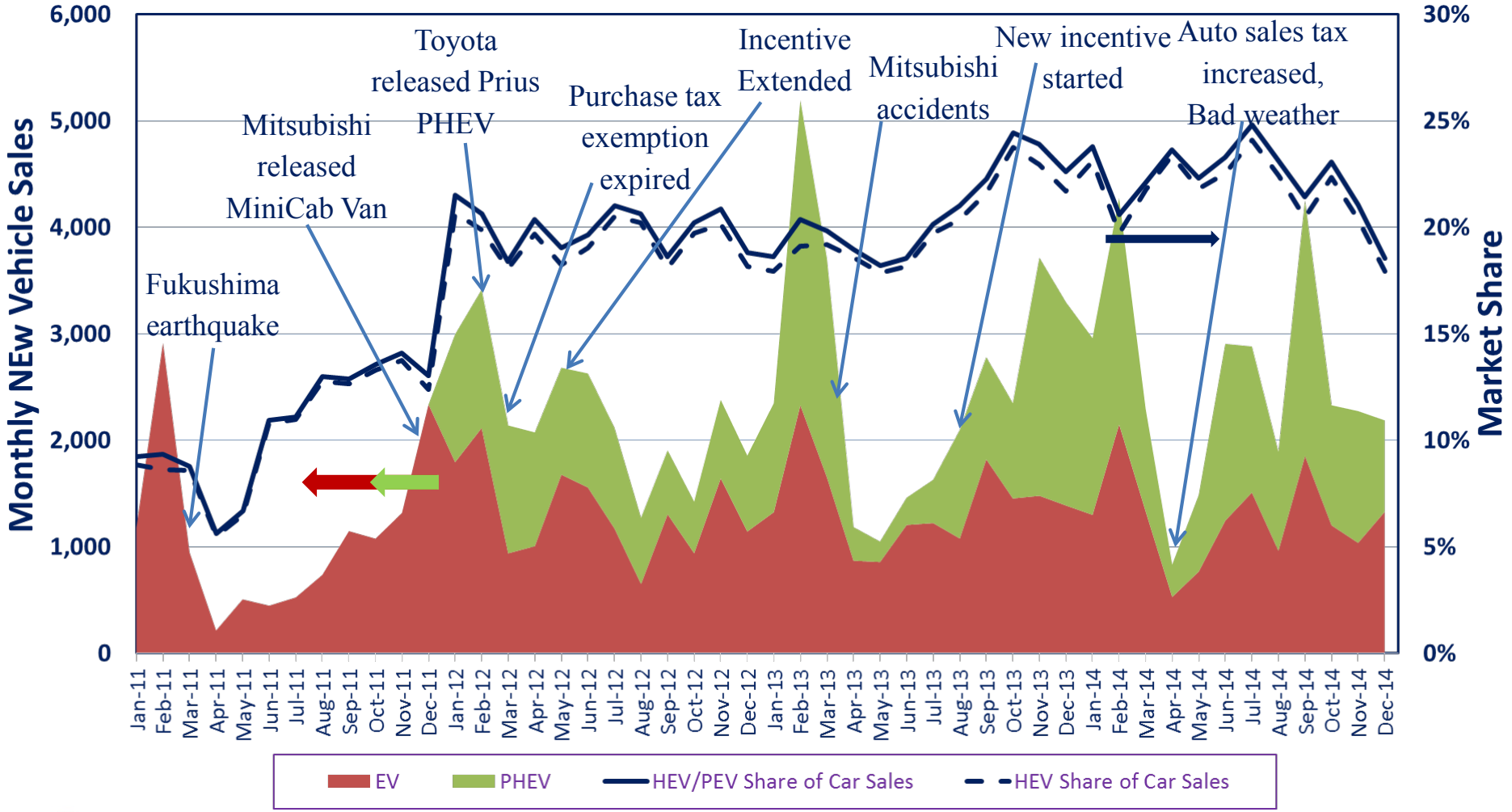



**DOE Website:**
http://energy.gov/articles/visualizing-electric-vehicle-sales
**ANL Website:**
http://www.transportation.anl.gov/technology_analysis/edrive_vehicle_monthly_sales.html

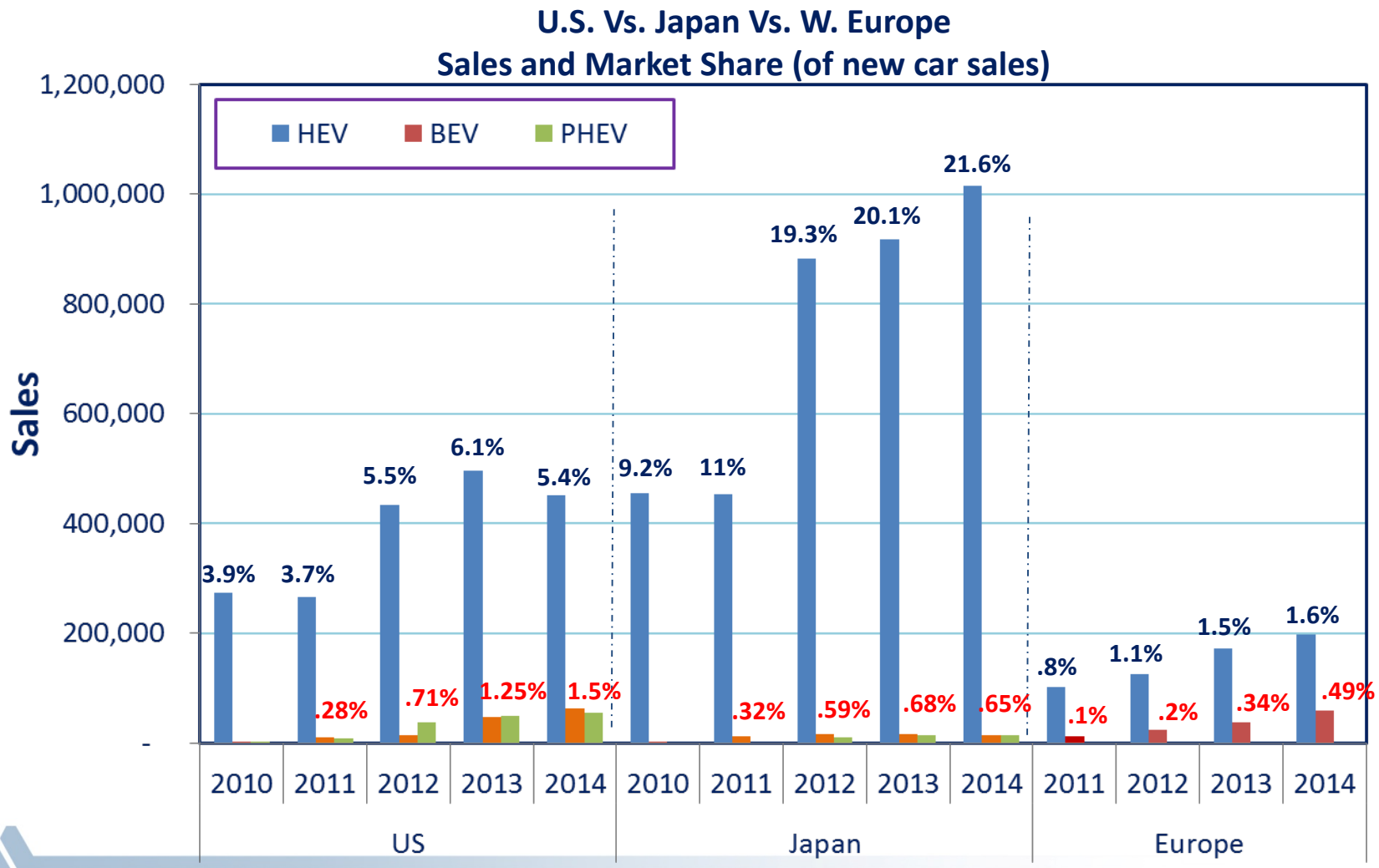
# E-drive vehicle policy matrix for each country/region (China example)

- **Numerical Targets**: Chinese State Council established goal 5 million PEV sales by 2020 under "Ten Cities One Thousand Vehicles" program
- **Regulation/Emission Standards**: Set fleet average fuel consumption target of 5 L/100 km (47 mpg) by 2020
- **Fiscal Incentives to Consumers**:
  - ***Phase 1 Subsidy***: (2009-2012) for purchases of vehicles used for public service, such as taxis and transit buses in selected cities.
  - 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 subsidy shifted from battery capacity to electric range (about $5700 - $100,000 for range over 30 miles)
  - Phase 2 Subsidy will scale back by 20% in 2017-2018 and by 40% in 2019-2020

# Factors impacting early EV sales (Japan example)

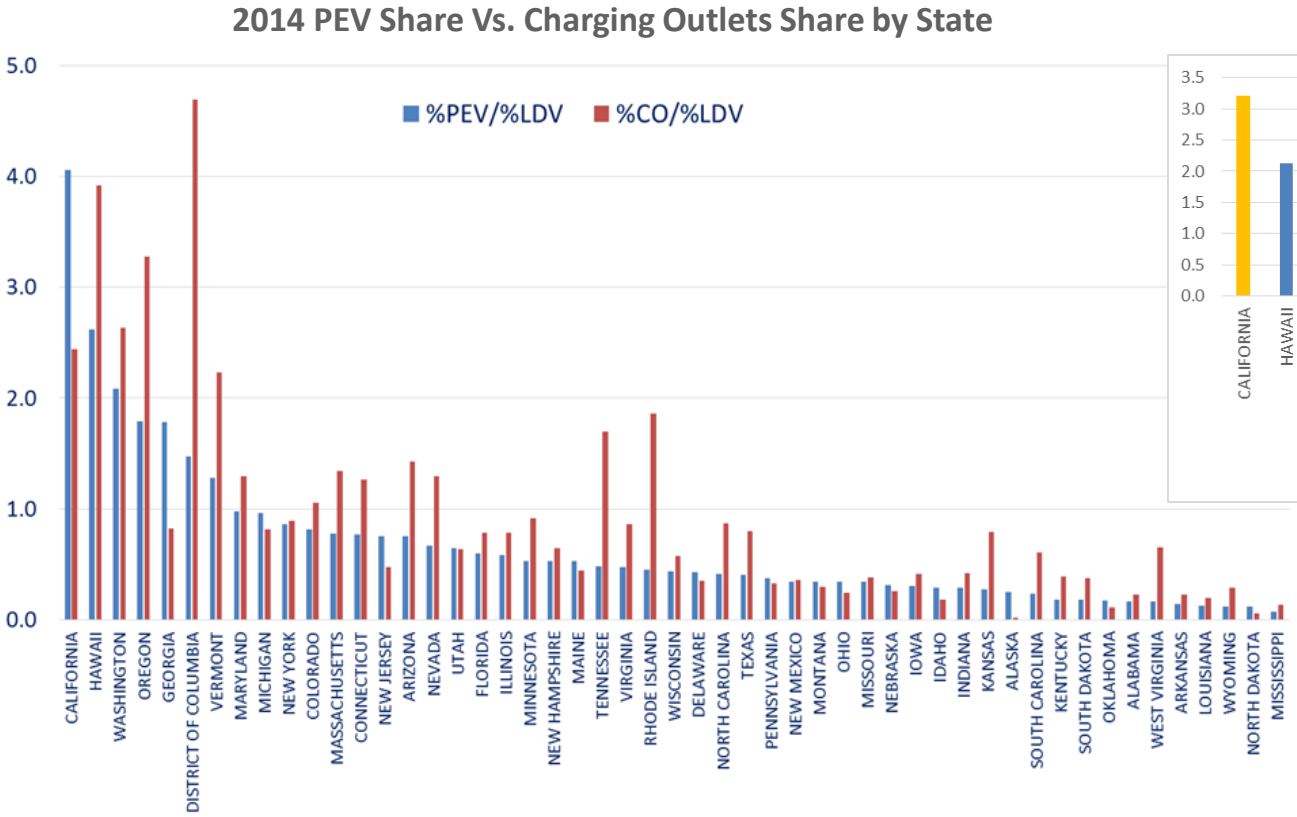


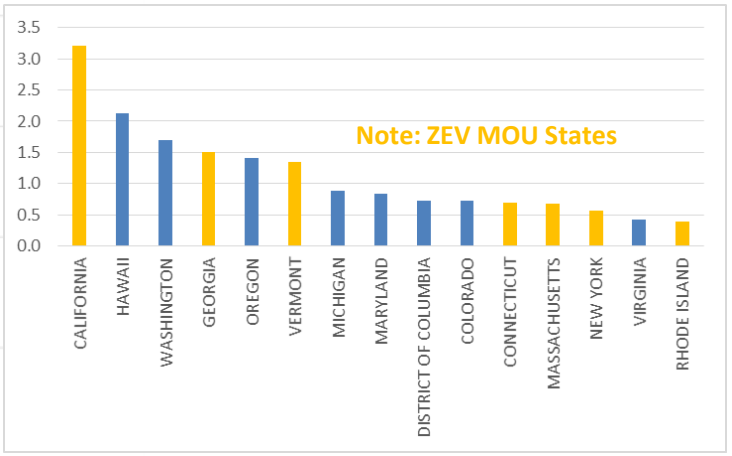
# Although the U.S. sells more PEVs, Japan sells many more HEVs and has a much higher market share



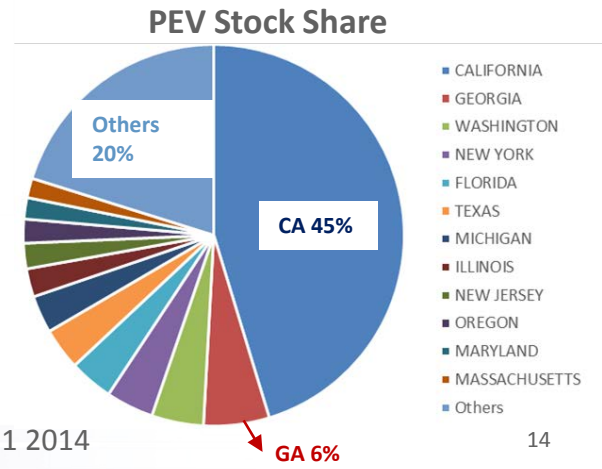

Note: Europe sales are BEV and PHEV combined

# California leads the US in the adoption of PEVs. Charging infrastructure matches fairly well with PEV share.



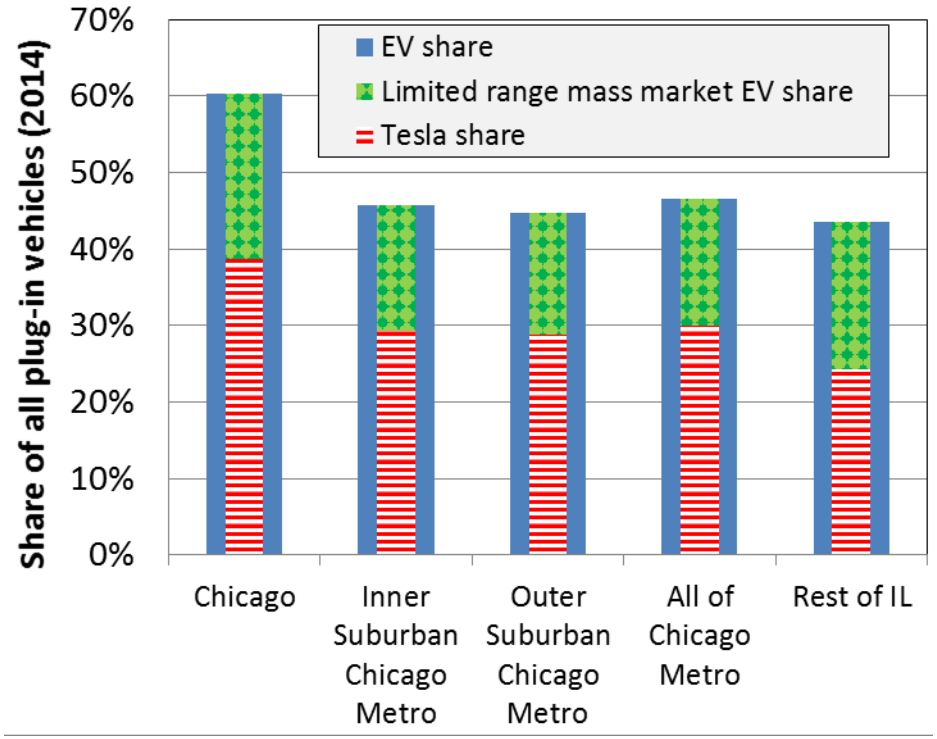

%PEV: state share of PEVs %CO: state share of charging outlets
%LDV: state share of LDVs



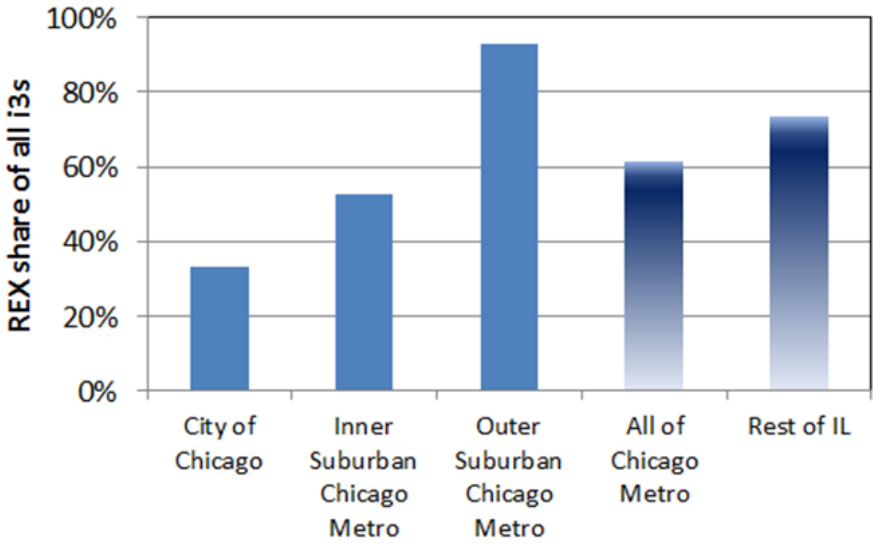

Sources: Registration data provided by National Renewable Energy Laboratory
Population data estimated from U.S. Census Bureau Population Estimation by July 1 2014

# BEVx most successful in outer suburbs; EREVs beat BEVs & PHEVs throughout suburbs (Chicago example)

## While BEVs in total look competitive in IL, affordable,100 mi. range mass market BEVs do not



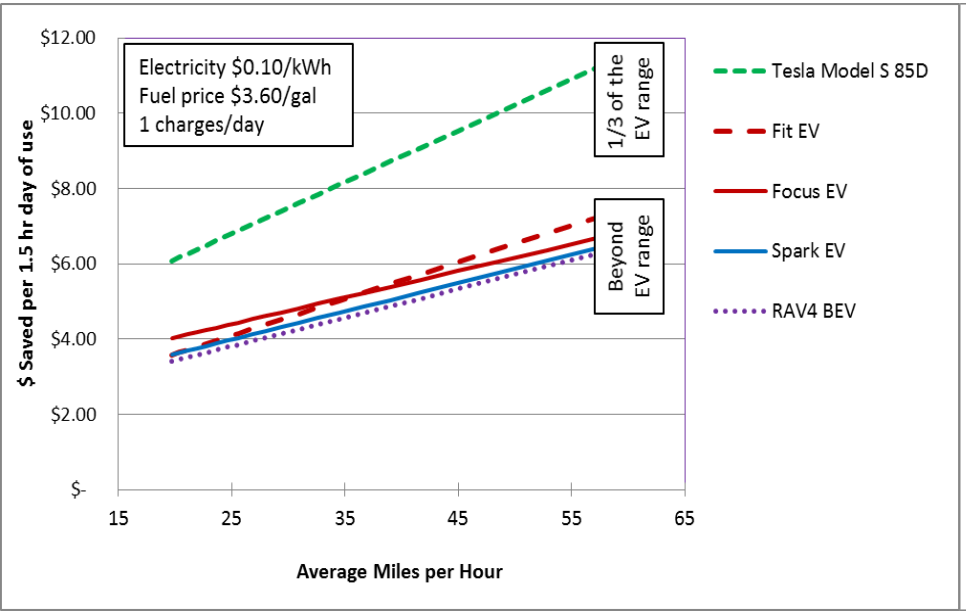

## REX' added gasoline range increases i3 marketability, expands low density suburban and rural shares.

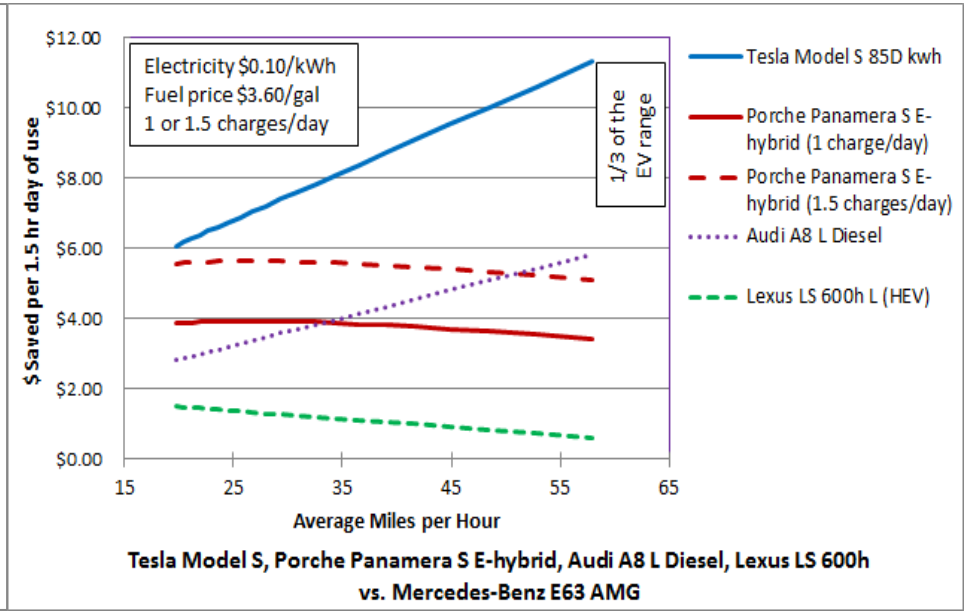



Source: Registration data provided by National Renewable Energy Laboratory

# High performance BEV benefits far exceed those of standard performance BEVs at all mph

## High performance BEVs save much more than PHEVs



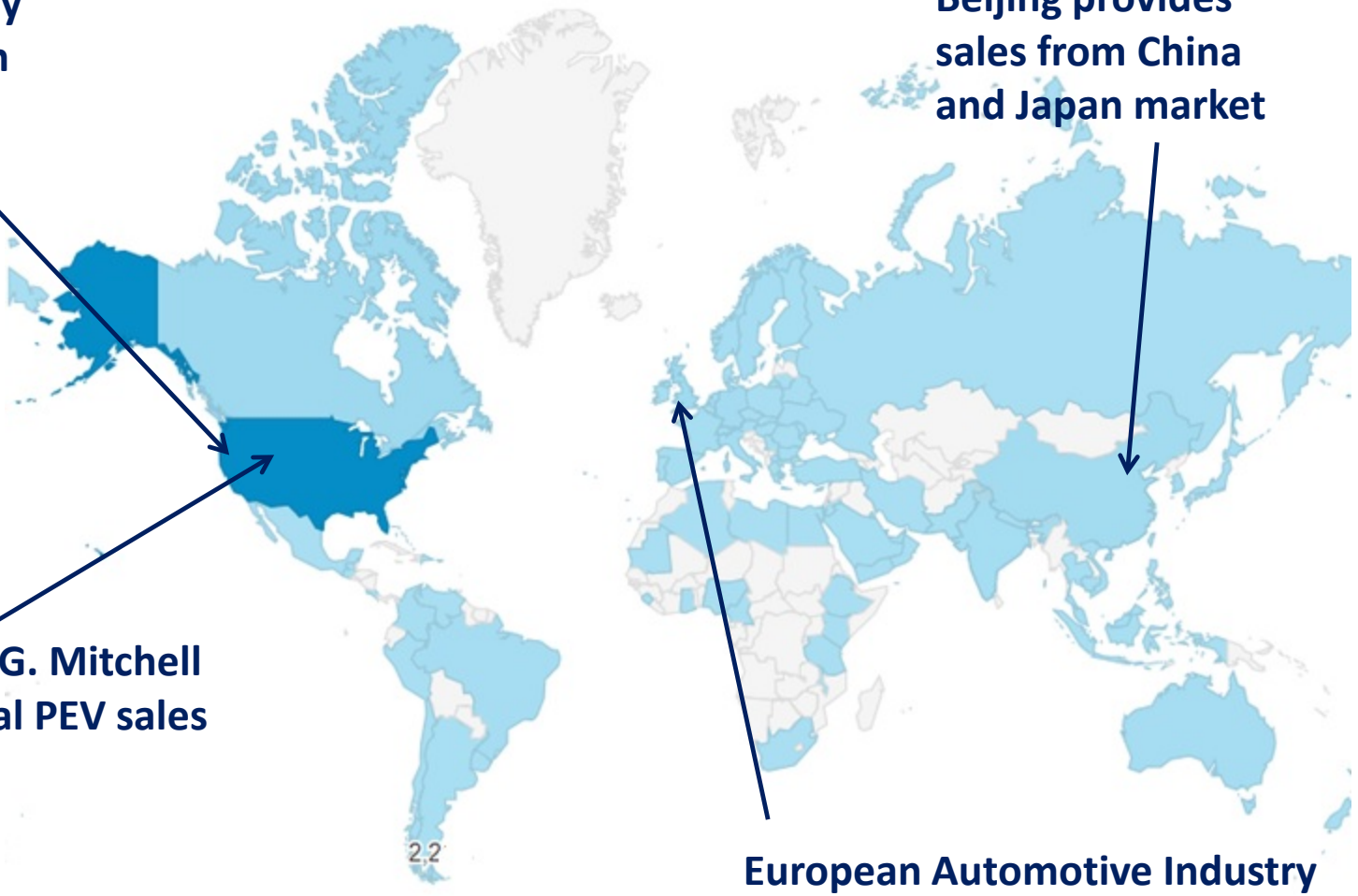

Compared to comparable gasoline vehicle

Infrastructure Impact Question: Will workplace charging be enough to help high performance PHEVs?

# Collaboration and Coordination

Explore opportunity for data acquisition and analysis with Alg, Vincentric, etc

Tsinghua University, Beijing provides sales from China and Japan market




Collaborate with G. Mitchell (NREL) on regional PEV sales analysis

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

# Proposed Future Work

| Task | Future Work |
|---|---|
| Collect global E-drive vehicle sales | • Continue tracking U.S. sales and publish data products monthly<br>• Gather and maintain international E-drive vehicle sales and incentives databases for comparison<br>• Analyze sales to show trend and market niches |
| Characterize regional purchase pattern of E-drive vehicles | • Additional cities/regions (Atlanta, Boston, Los Angeles)<br>• Derive heterogenic national purchase/adoption trend |
| Collect vehicle ownership cost data and projections | • Collect resale data of E-drive vehicles from chosen database<br>• Analyze levelized cost (TCO) and depreciation by market segment |

# 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
  - Summarize vehicle resale values and total ownership cost by market segment
  - Characterize market characterization by geographic and demographic factors to determine locations and identify market niches
- Technical Accomplishments
  - Monthly U.S. EV sales market report
  - Monthly data products published on ANL and DOE website
  - International sales trends comparison
  - E-drive vehicle policy matrix for each country/region
  - Regional PEV adoption pattern
  - E-drive vehicle market niches in city/suburb/rural areas
- Collaborations
  - Collect data and information from Tsinghua University and other agencies
  - Collaborate with NREL on regional E-drive vehicle adoption analysis
- Future Work
  - Continue tracking U.S. sales and publish data products monthly
  - Gather and maintain international E-drive vehicle sales and incentives databases for comparison
  - Analyze sales to show trend and market niches
  - Additional cities/regions (Atlanta, Boston, Los Angeles)
  - Derive heterogenic national purchase/adoption trend
  - Collect resale data of E-drive vehicles from third party
  - Analyze levelized cost (TCO) and depreciation of E-drive vehicle by market segment

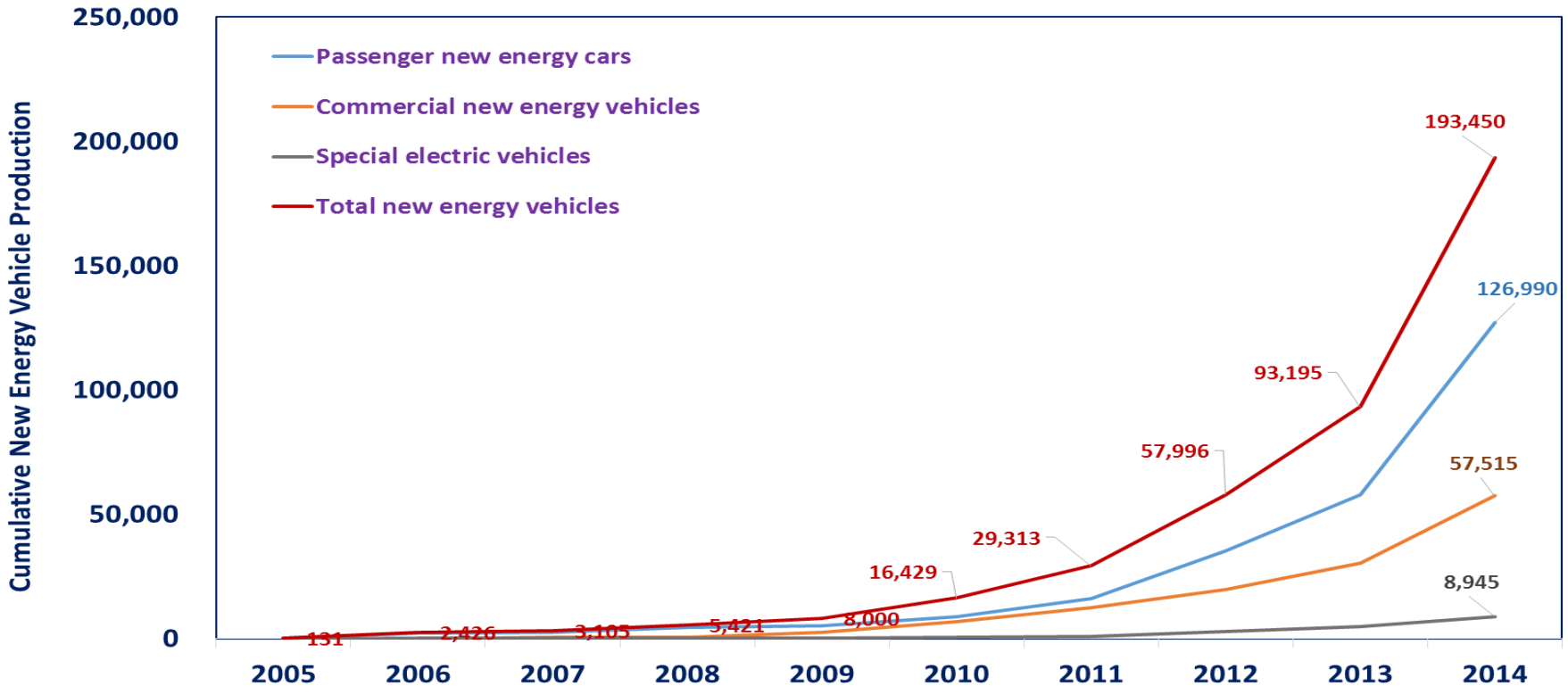
# Technical Back-up Slides

# 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 |

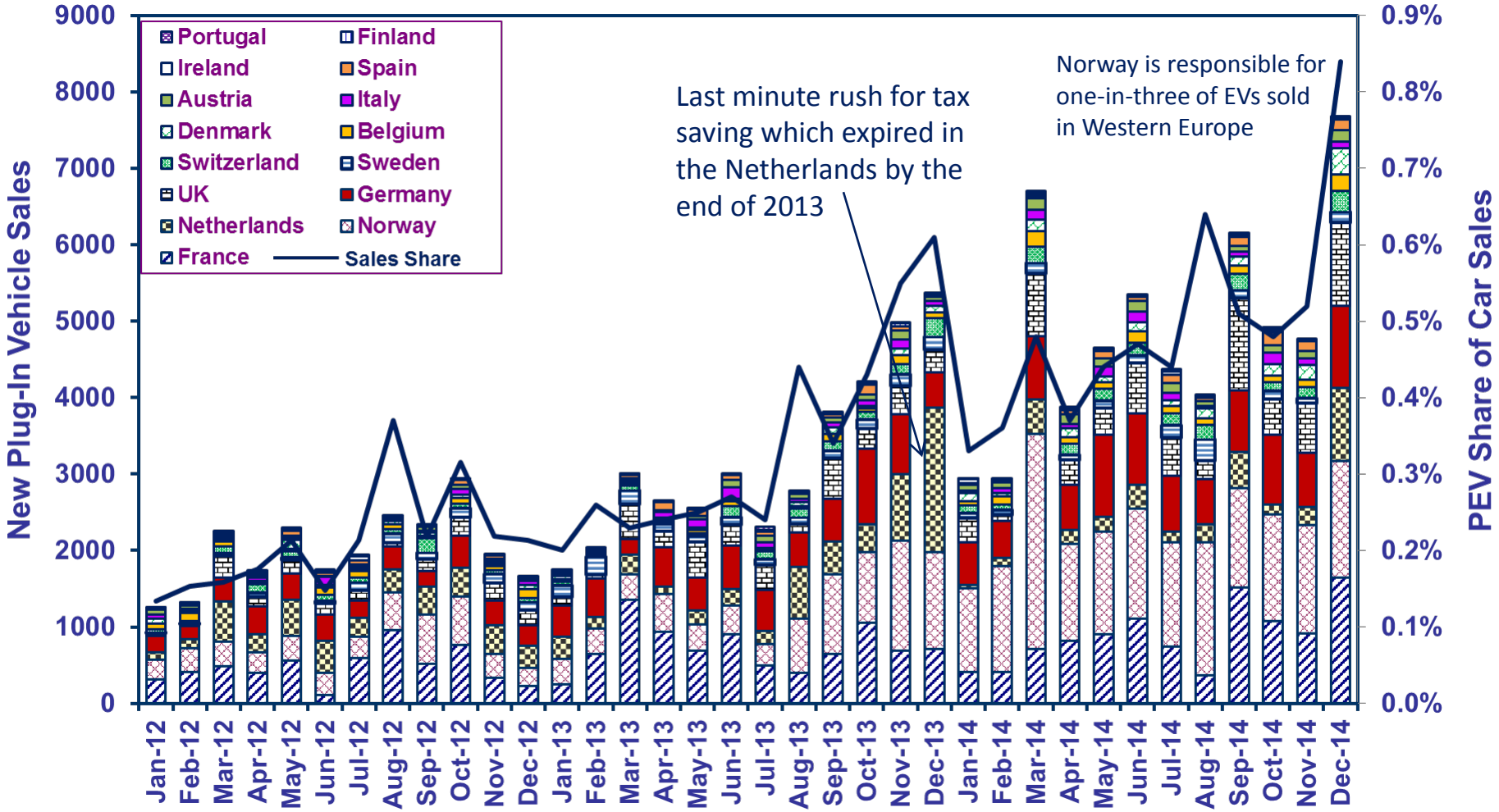
1 US dollar = 6.1 Chinese Yuan (¥); L = length, R = range, PV = passenger vehicle, SPV= special purpose vehicle

# China: NEV share of total car production only reached 0.35% in 2014 but NEV bus market share of total large-size bus production reached 5.2%



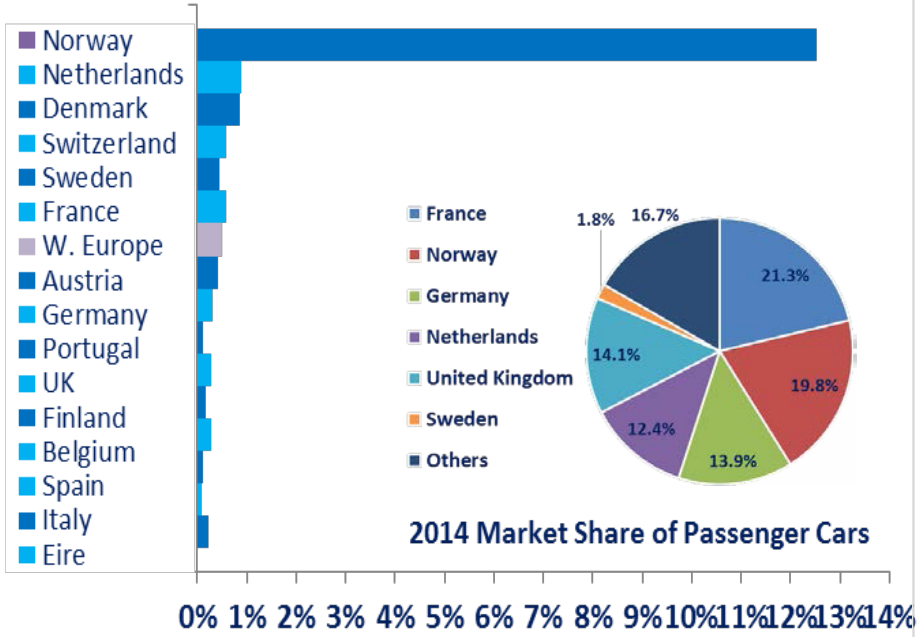

Data source: Tsinghua University, Beijing, China

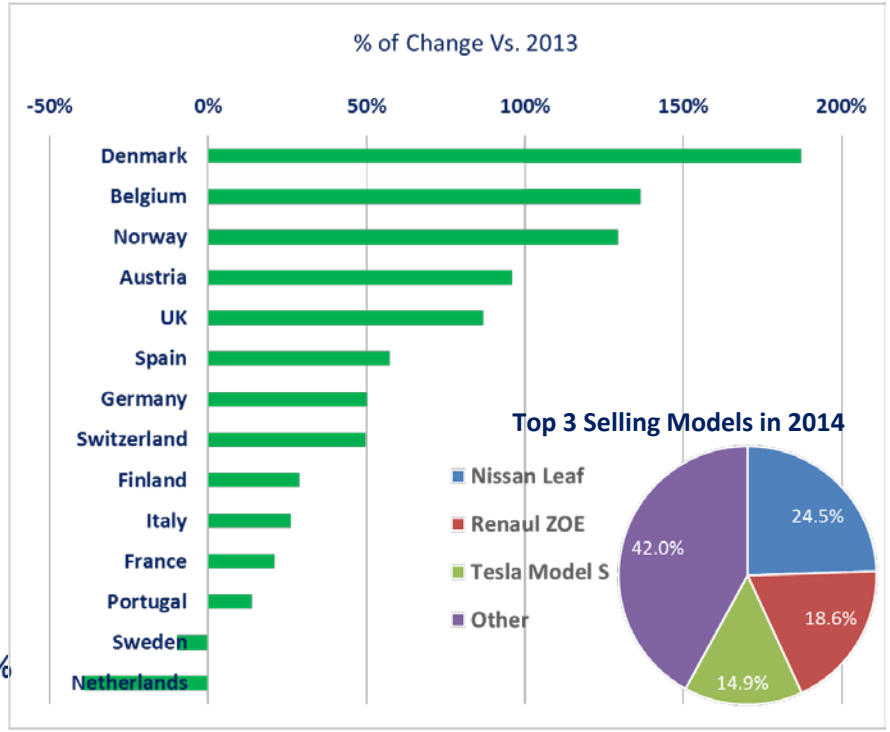
# Western Europe: Electric car sales pace, far from growing, is slowing




Data source: Automotive Industry Newsletter

# W. Europe: 2014 PEV sales is up 51.7% from 2013 with 58,582 units sold. Norway still leads the market but gradually maturing

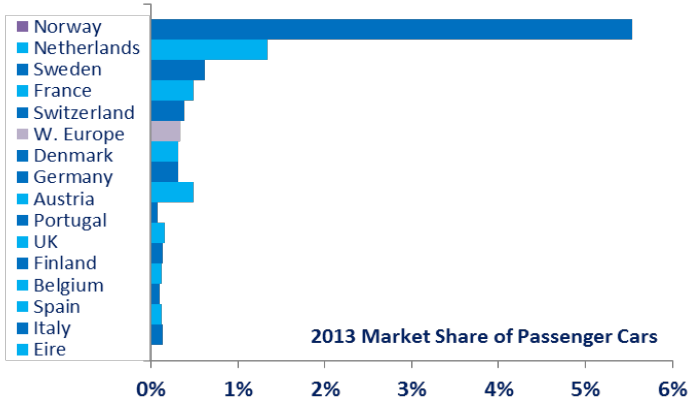


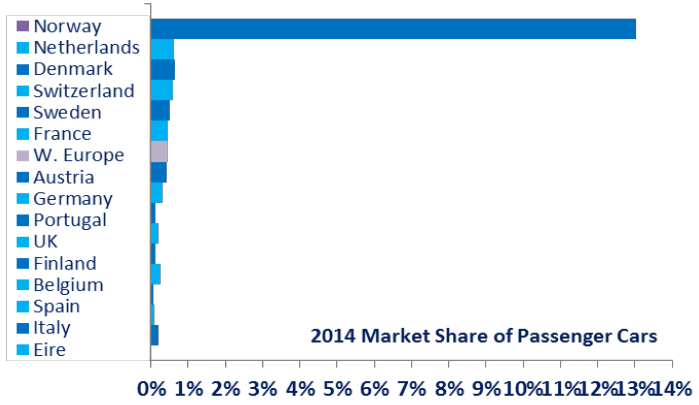




Data source: Automotive Industry Newsletter

# Highlights from Western Europe E-drive Market

- Norway is responsible for one-in-three of EVs sold in Western Europe (WE). Monthly EV sales share of passenger cars reached record high in August, 15.2%
- Top selling PEV models includes Nissan Leaf (25.1%), Tesla Model S (18.1%), BMW i3 (16.7%) and Renault Zoe (13.5%)
- Over half of BMW i3 sold in Germany now come equipped with the range-extender engine
- In France, in spite of a tempting €6,300 government sweetener to anyone buying a qualifying electric car, the segment has barely taken off, accounting <10% of WE EV market




Data source: Automotive Industry Newsletter