

Plug-in Electric Vehicle Market Overview

Charles Zhu

*Executive Workshops on Strategies and Best Practices for State
Departments of Transportation to Support Commercialization of
Electric Vehicles and Infrastructure*



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- **Benefits**

- Why is there a market for PEVs, and why might DOTs be interested?

- **PEV Sales**

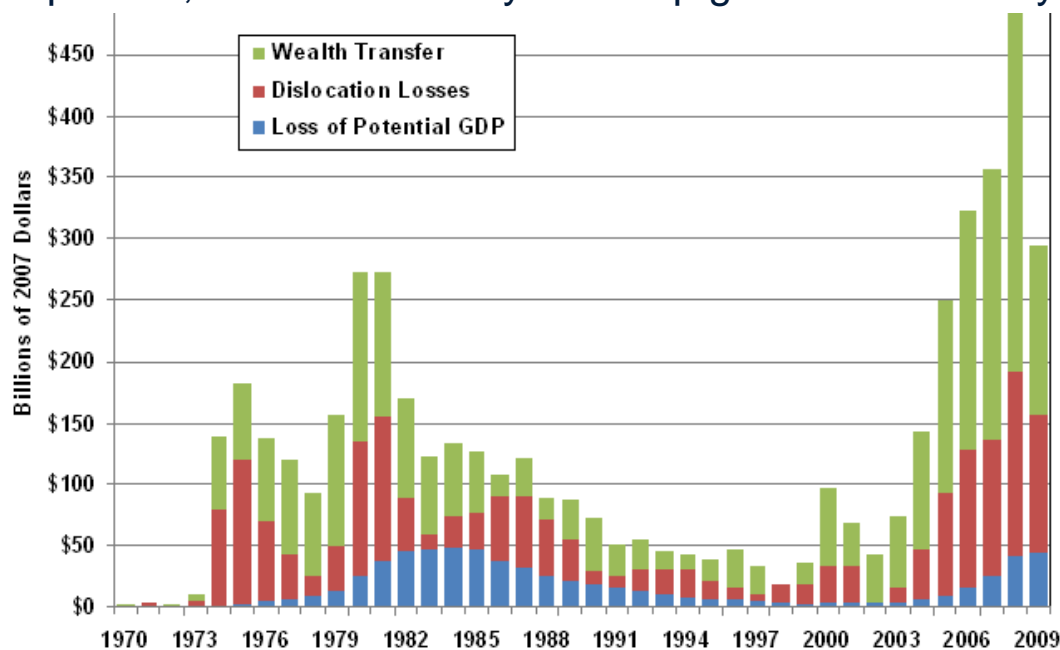
- Over time
- Nationwide and by geography

- **Market Determinants**

- Cost of PEVs
- Uncertainty about new technology
- Other components of the total value proposition including environmental and image benefits

• Energy security and economic growth

- Dependence on oil causes GDP losses of nearly \$5.5 trillion or 4 percent of cumulative GDP since 1970 (U.S. DOE).
- 94 percent of the end use market for oil is in transportation (EIA).
- From a microeconomic perspective, the PEV industry can help grow the economy and create new jobs.





• **Can PEVs improve air quality?**

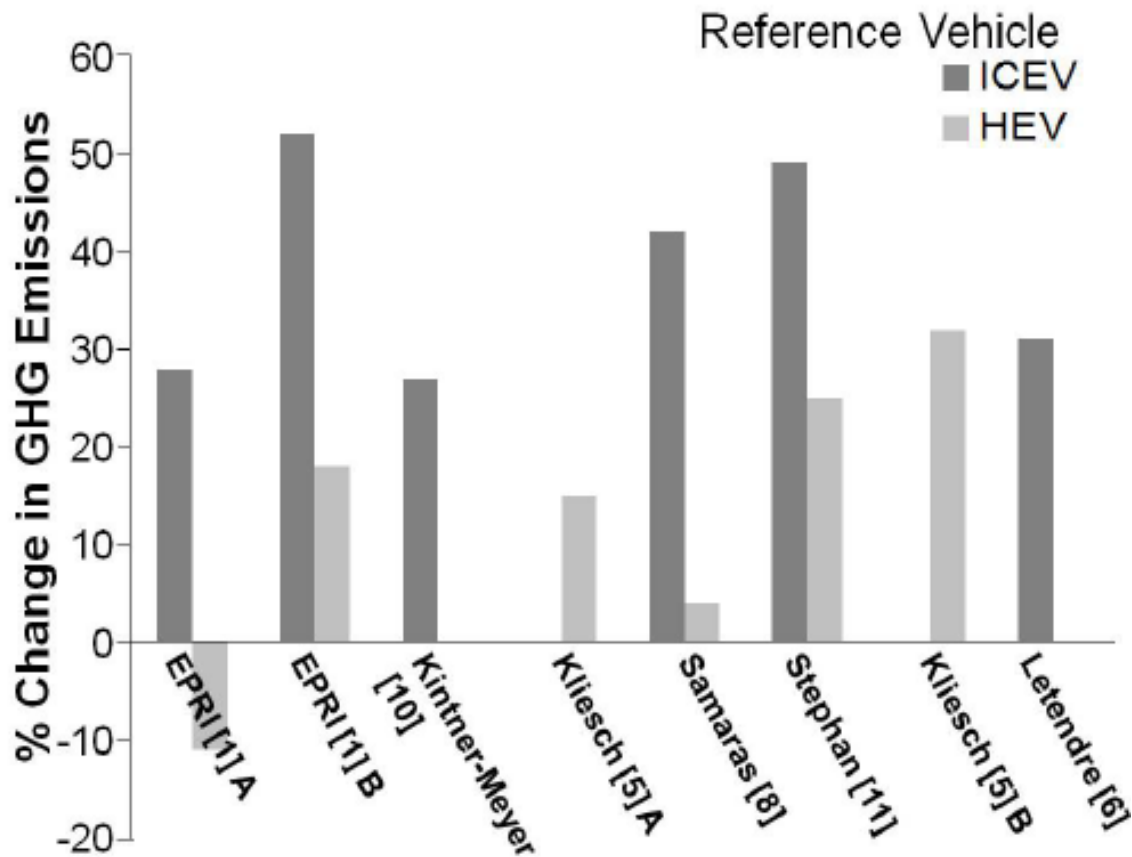
- Heavily dependent on power mix, but preliminary research shows benefits with respect to ozone.
- EPRI and NRDC: 61 percent of US population would see decreased ozone levels and 1 percent would see increased ozone levels with 40 percent PEV deployment by 2030.
- Pacific Northwest National Labs: Assuming 73% of energy required to power national fleet came from electricity, VOCs and NOX would decrease by over 90 percent.
- However, PM₁₀ would increase 10 to 18 percent (assuming steady state coal generation).
- Greatest benefits in dense urban areas; pollution increases in areas near coal plants

PEV Benefits: Carbon Emissions



Percentage change in carbon emissions when switching from PEVs to ICEVs/HEVs

- Studies show ICEVs increase emissions by at least 25% compared to PEVs.
- Grid getting cleaner: “First day is the dirtiest day,” EPA rules



Taken from Hines et al (2010). [1]A assumed charging with electricity generated from coal power plants while [1]B assumed that the electricity was generated from combined cycle natural gas. [10], [5]A, [8] and [11] all used the national average generating mix while [5]B & [6] used regional averages for CA and New England respectively. Taken from (Farmer, Hines, Dowds, & Blumsack, 2010)

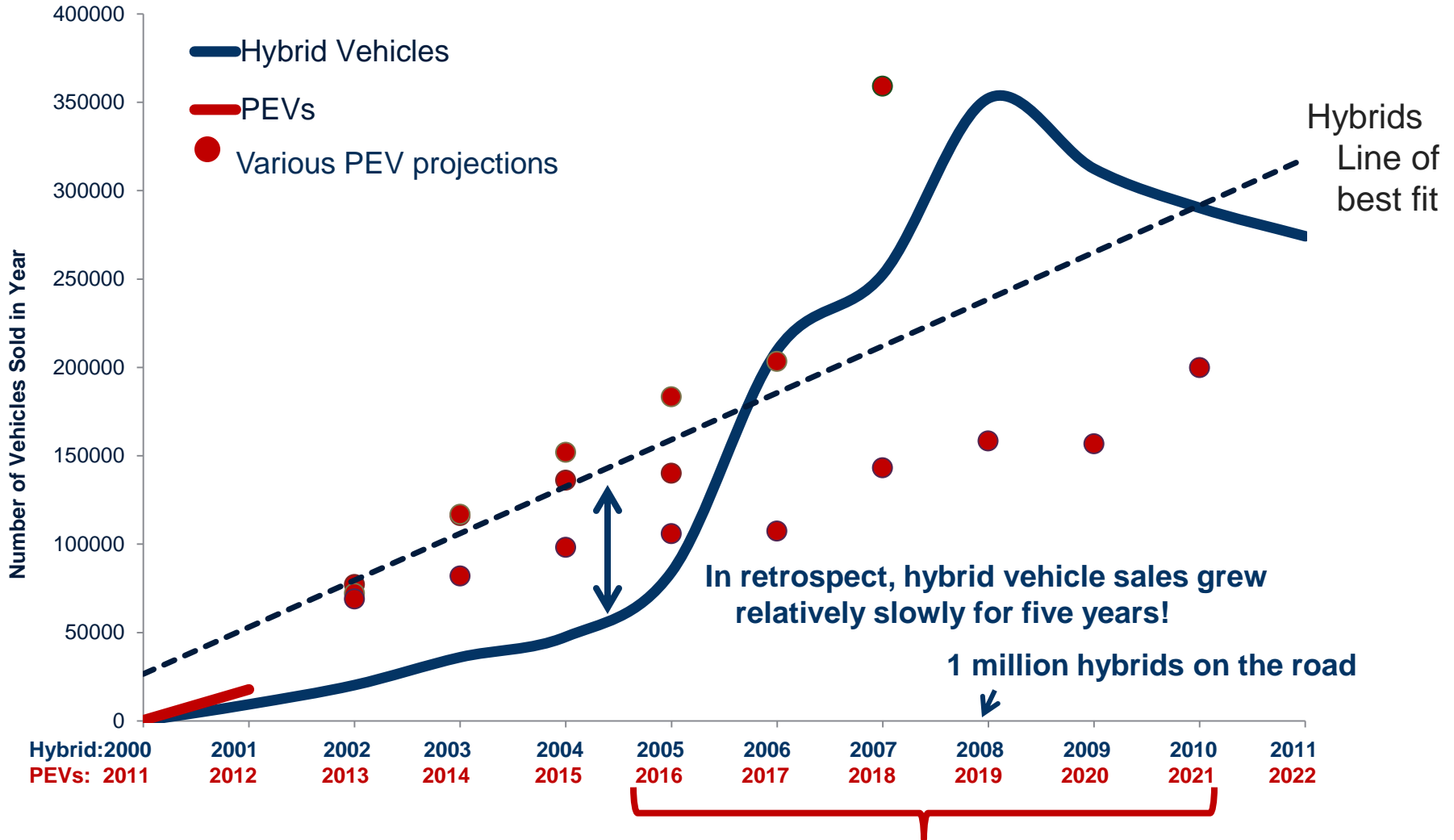


- **Total sales in a given year: highly uncertain**
 - ~18,000 PEVs sold last year (more than hybrids in their first year)
 - Combined sales in January and February 2012: 2,780
 - Month-over-month growth expected
 - In addition to LEAF and Volt, about 8 new PEVs being introduced to the market in 2012
- **Unlike the 24-hour news cycle, PEV growth is a long-term game...**

Market Size: Nationwide Market



Hybrid Sales and Projected PEV Sales by Year





- **Hybrids and PEVs in the national context**

- Highest annual market penetration for hybrids: 2.79% in 2009
- Most optimistic projections of PEV market share in 2020 remains under 10%.

- **Long-term view**

- Hybrid electric vehicles have only just begun penetrating the mass market.
- PEV growth will also travel a decades-long route.



• PEV sales by geography

- PEVs likely to gain high penetration in large metropolitan areas (Pike Research, 2011; McKinsey, 2010).
- CAR (2010) used hybrid penetrations as a key factor in determining PEV penetration.

State	2007-2009 Hybrid Registrations / 10,000 Residents	Estimated PEVs on road by 2015	Estimated PEVs / 10,000 Residents by 2015
AZ	33.6	12,442	19.2
CA	54.0	112,328	29.8
MI	15.1	8,427	8.5
NC	21.5	11,810	12.2
OH	17.8	11,532	10.0
OR	45.6	9,776	25.2
WA	44.4	16,671	24.4
WI	20.2	7,649	13.4

- **Market Determinants: what affects consumer demand?**
 - Uncertainty about new technologies
 - Consumer uncertainty
 - Range anxiety
 - Costs
 - Upfront vehicle costs
 - Fuel costs
 - Other components of the total value proposition
 - Environmental benefits
 - Status/image benefits
 - Energy security benefits



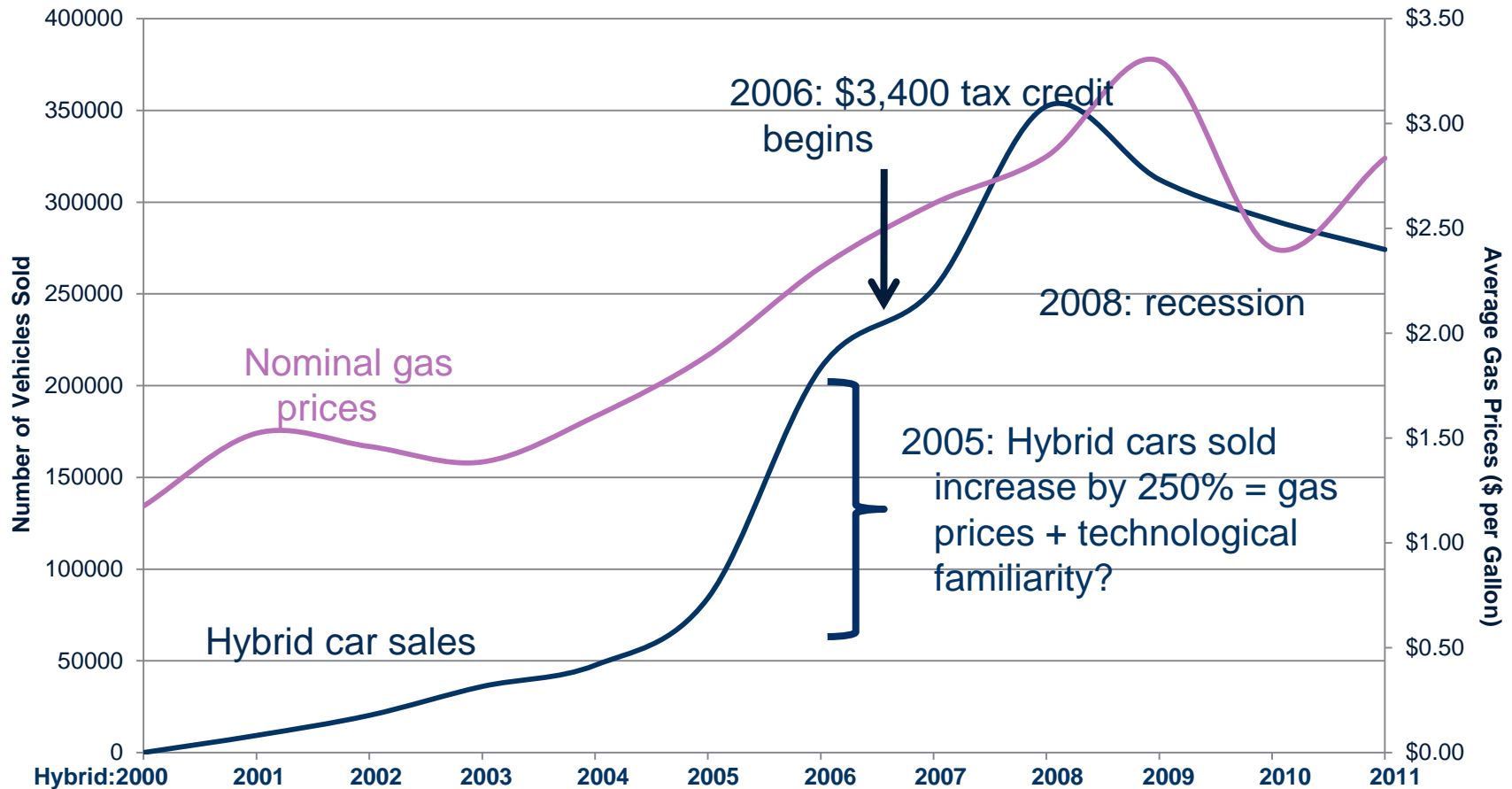
- Consumer uncertainty
 - Consumers are wary of new technology and the need to change behaviors in order to charge – most consumers still don't know how hybrid technologies work.
 - Worried or unaware of reliability, places to service and recharge the vehicle
- Range anxiety
 - Fear of being stranded
 - Deloitte survey: 63 percent of consumers expect a range of 300 miles per single charge...
 - ...even though 78 percent of drivers commute fewer than 40 miles per day
- Uncertainty and confusion will lessen with time and education.
- Car is the 2nd most expensive thing people will buy and the choice is often made irrationally.



- Upfront cost
 - \$7,500 Federal tax credit for light duty vehicles (up to \$15,000 for heavy duty vehicles) brings PEVs to the average price of a new car.
 - But PEVs are still more expensive than other cars in their class.
 - Battery costs can be decreased through tech breakthroughs and scaling up – but would mainly act to offset the tax credit if it is removed.
- Fuel and maintenance costs
 - The cost of an electric mile traveled is a quarter to a fifth of the cost on a gasoline mile traveled.*
 - Can be even lower if utilities offer lower “off-peak” rates and consumers charge off-peak
 - Maintenance costs are also lower because electric motors are simpler than internal combustion engines.
 - Consumers undervalue fuel cost savings: Discount rate of 20% on fuel savings while an analytical rate closer to 4%.

*\$3.50/gallon gas and \$0.10/kWh electricity

Hybrid Electric Vehicle Sales and Gasoline Prices by Year



- Survey by Deloitte: at gas prices of \$3.50 per gallon, 30 percent of respondents would be more likely to purchase a PEV. At \$5 per gallon, the proportion of respondents increases to 78 percent.

Market Determinants: Other Components of Total Value Proposition

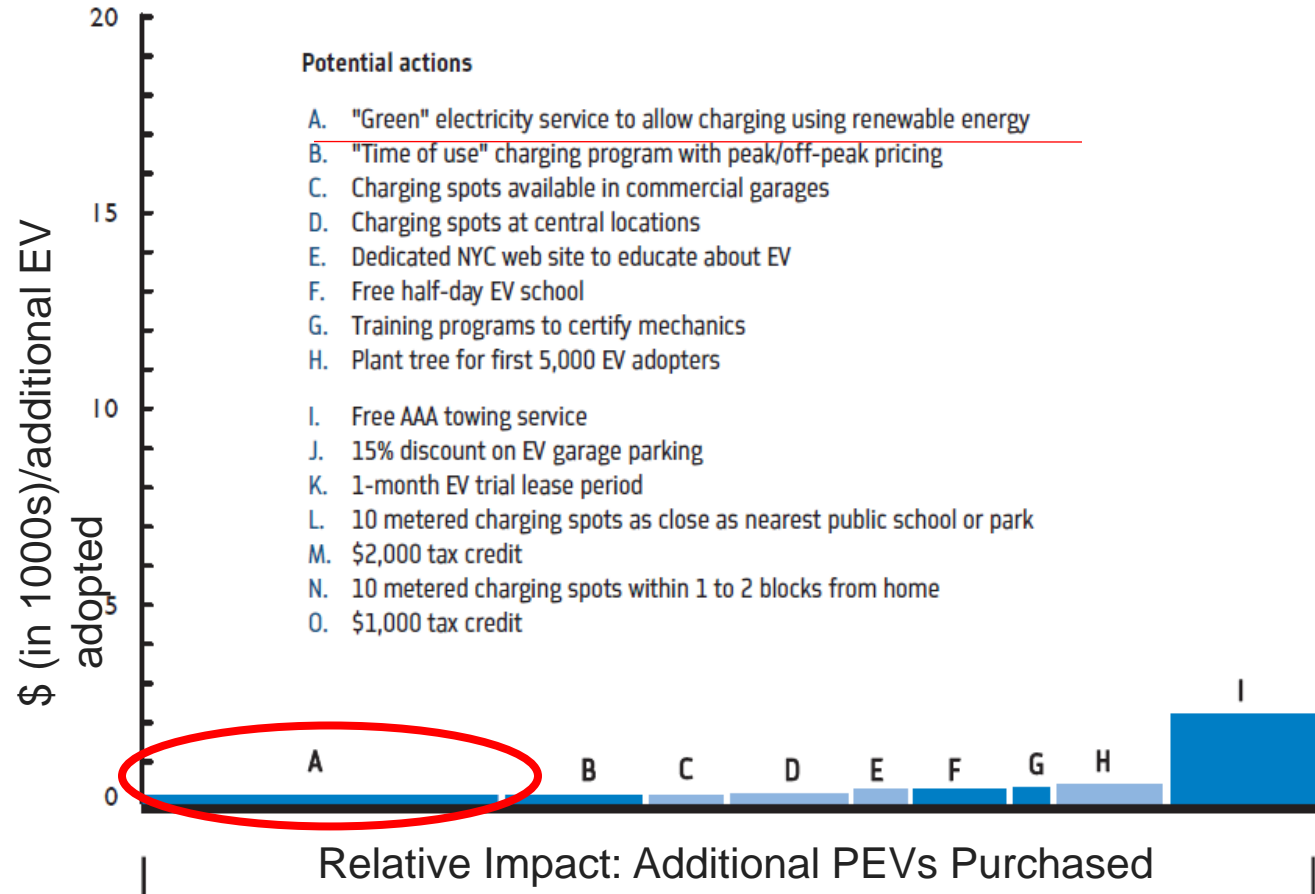


- **Other factors in creating the value of a PEV**
- **Hard perks (policies and incentives)**
 - HOV lane access in certain states
 - Free parking in certain cities
- **Soft perks (status, image, and recognition of environmental/energy security benefits)**
 - “Prius Effect”: areas with high environmental sentiment were willing to pay \$1,875 to \$7,186 more for the Prius than areas with low environmental sentiment.

Market Determinant: Other Components of the Total Value Proposition



- Which policy would get the most people to consider adopting a PEV per dollar spent?
- [McKinsey survey](#) in New York City showed that a “green” electricity service to allow charging using renewable energy would be highly effective.



- PEV growth is highly uncertain.
- Long-term growth and adoption is more relevant than year-to-year sales.
- Three critical market determinants
 - Cost
 - Consumer uncertainty
 - Other components of the total value proposition (e.g. feeling of improving environment, energy security, image)



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