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Overcoming Barriers to Electric-Vehicle Deployment

Committee on Overcoming Barriers to Electric-Vehicle Deployment

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Origin of Study

Study requested by US Congress after hundreds of millions of dollars spent on electric-vehicle research and infrastructure deployment under the American Recovery and Reinvestment Act and ongoing EV Project.

Study Sponsor: Department of Energy



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Statement of Task

Committee was asked to address market barriers that are slowing the purchase of plug-in electric vehicles (PEVs) and hindering the deployment of supporting infrastructure.

Committee was ***not*** asked to address whether increased PEV adoption is a desirable policy.



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Committee

JOHN G. KASSAKIAN (Chair), NAE, Massachusetts Institute of Technology

DAVID BODDE, Clemson University, South Carolina

JEFF DOYLE, D'Artagnan Consulting, Olympia, Washington

GERALD GABRIELSE, NAS, Harvard University, Cambridge, Massachusetts

KELLY SIMS GALLAGHER, Tufts University, Medford, Massachusetts (until June 2014)

ROLAND HWANG, Natural Resources Defense Council, San Francisco, California

PETER ISARD, Consultant, Washington, D.C.

LINOS JACOVIDES, NAE, Michigan State University, East Lansing, Michigan

ULRIC KWAN, IBM Global Business Services, Palo Alto, California

REBECCA LINDLAND, King Abdullah Petroleum Studies and Research Center, Riyadh, Saudi Arabia

RALPH MASIELLO, NAE, DNVGL, Inc., Chalfont, Pennsylvania

JAKKI MOHR, University of Montana, Missoula

MELISSA SCHILLING, New York University Stern School of Business

RICHARD TABORS, Across the Charles, Cambridge, Massachusetts

THOMAS TURRENTINE, University of California, Davis

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Approach to the Task

- Focused on light-duty vehicles in the United States.
- Restricted discussion to PEVs, which include battery electric vehicles (BEVs) and plug-in hybrid electric vehicles (PHEVs).
- Focused on ways to extend the market from “early adopters” to more mainstream consumers.



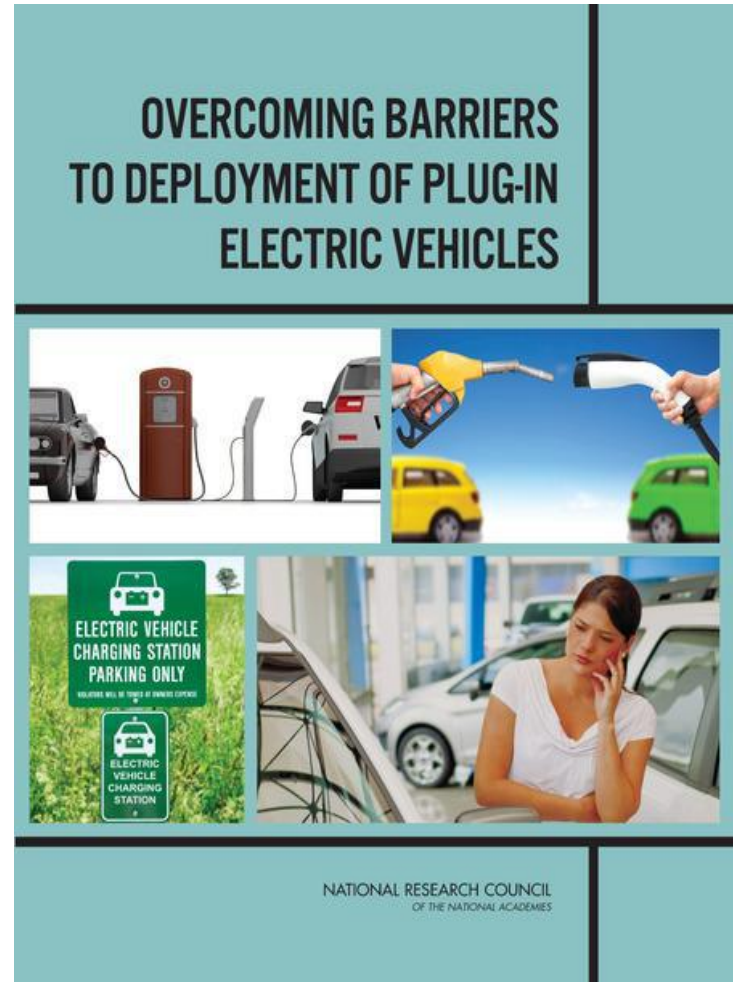
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The Report

- ❖ PEVs and Charging Technologies
- ❖ Understanding the Consumer Purchase and Development Process for PEVs
- ❖ Government Support for PEV Deployment
- ❖ Charging Infrastructure for PEVs
- ❖ Implications of PEVs for the Electricity Sector
- ❖ Incentives for PEV Deployment



<http://www.nap.edu/catalog/21725/overcoming-barriers-to-deployment-of-plug-in-electric-vehicles>



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Consumers and PEVs

The future of PEVs depends not only on the level of technological improvements but also on convincing consumers that these vehicles offer economic and performance advantages over petroleum-fueled vehicles.



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Four Classes of PEVs

PEV Class	Description	Example (Range)
Long-range BEV	Can travel hundreds of miles on a single battery charge and then be refueled in a time that is much shorter than the additional driving time that the refueling allows.	2014 Tesla Model S (AER = 265 miles)
Limited-range BEV	Is made more affordable than the long-range BEV by reducing the size of the high-energy battery. Its limited range can more than suffice for many commuters, but it is impractical for long trips.	2014 Nissan Leaf (AER = 84 miles) 2014 Ford Focus Electric (AER = 76 miles)
Range-extended PHEV	Typically, operates as a zero-emission vehicle until its battery is depleted, whereupon an ICE turns on to extend its range.	2014 Chevrolet Volt (AER = 38 miles; total range = 380 miles)
Minimal PHEV	Its small battery can be charged from the grid, but its AER is much less than the average daily U.S. driving distance.	2014 Toyota Plug-in Prius (AER = 6-11 miles; total range = 540 miles)

Each PEV class has different charging-infrastructure needs.

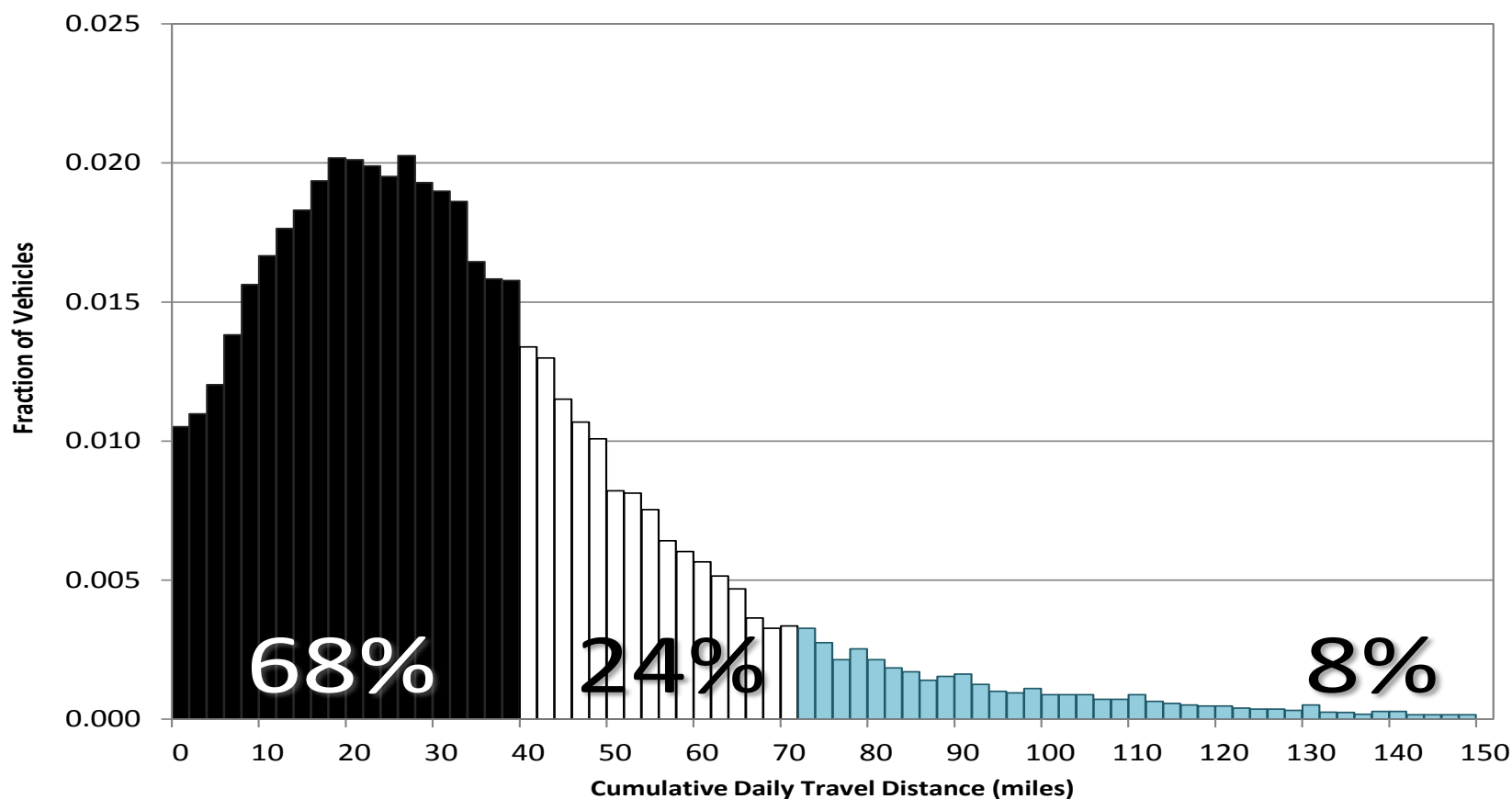


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How Much Are Vehicles Driven



Distribution of daily travel distance (FHWA 2011). Colored ranges are marked at 40 and 73 miles.



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The Market Development Process

- Developers of new technologies, such as PEVs, face challenges in developing a market and motivating consumers to purchase their products.
- Incumbent technologies—in this case, ICE vehicles—can be difficult to unseat.
- One of the main challenges to the success of the PEV market is that people are so accustomed to ICE vehicles and the many choices available.
- Adoption and diffusion of PEVs is likely to be a long-term, complex process, and even modest market penetration could take many years.



The Market Development Process

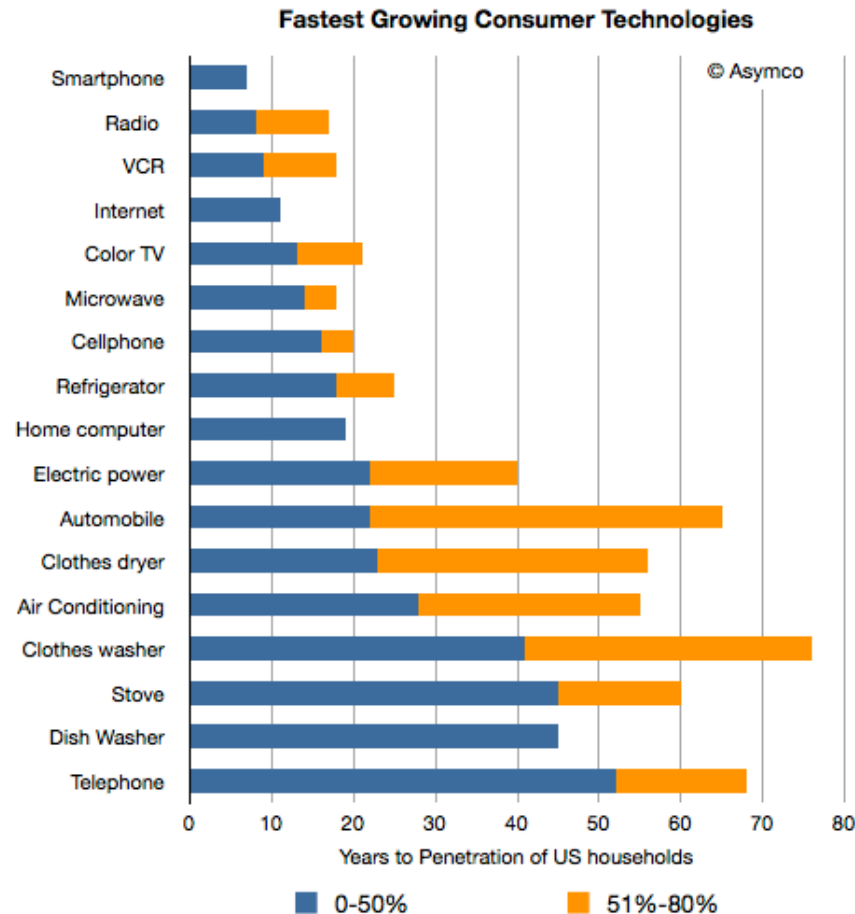


Image courtesy of Horace Dediu, Asymco.

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Potential Markets

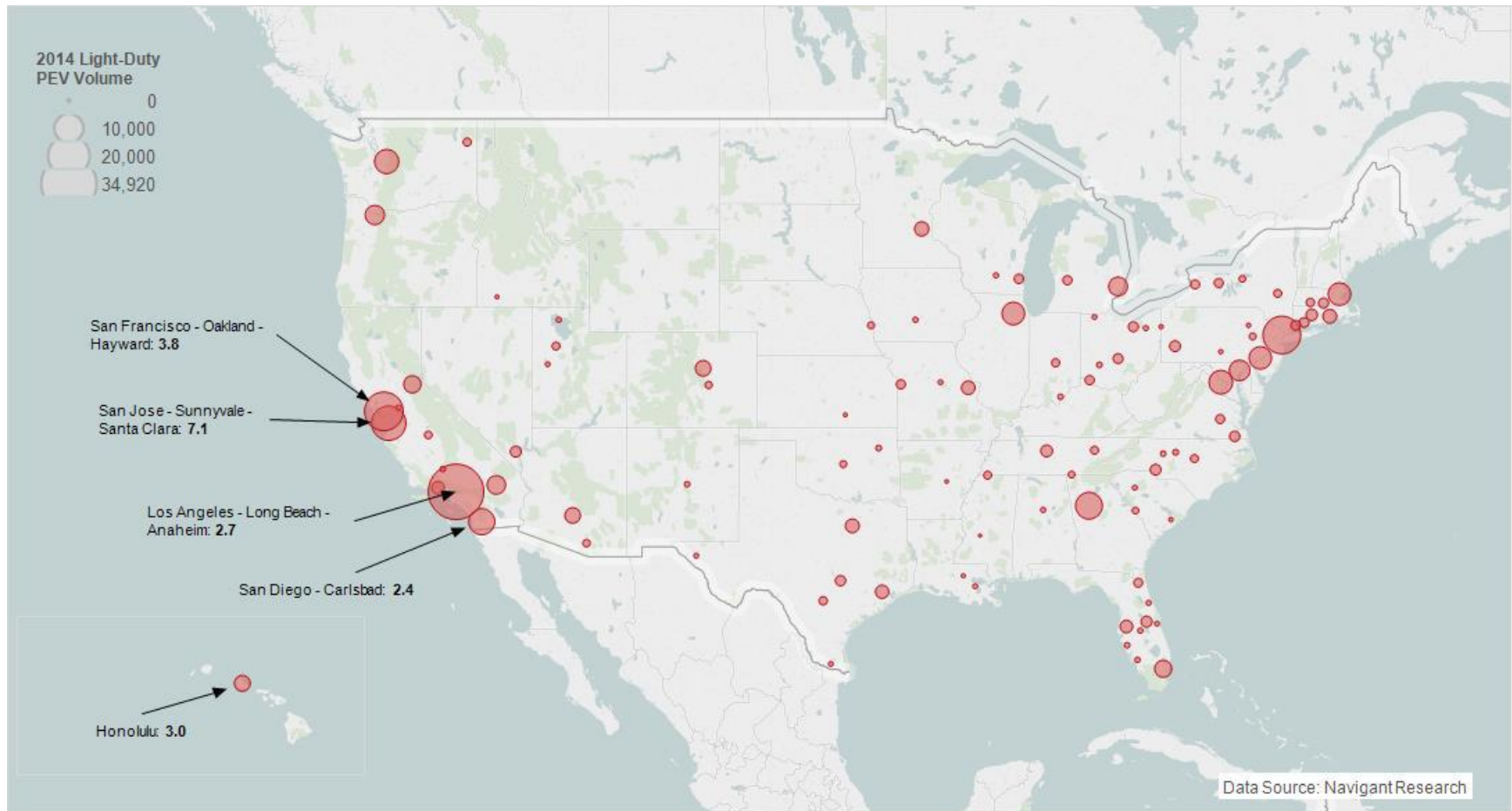


Image courtesy of Shepard and Gartner; Data courtesy of Navigant Research.

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Market Strategy

One strategy for dealing with market complexity is to identify a narrow market segment for which the new technology offers a compelling reason to buy.

That approach appears reasonable for PEVs because the PEV market has been characterized by strong regional patterns that reflect such attributes as favorable demographics, values, and lifestyles; a regulatory environment favorable to PEVs; expensive gasoline; and an existing or at least readily deployable infrastructure.



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Primary Barrier to Consumer Adoption

Vehicle cost is a substantial barrier for PEV deployment.

Without the US federal purchase incentives, PEVs are not currently cost-competitive with ICE vehicles.

Therefore, committee recommended continuing federal purchase incentives with a re-evaluation after a suitable period and continuing federal funding of battery research to facilitate and expedite the development of lower cost, higher performing vehicle batteries.



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Other Barriers to Consumer Adoption

- Limited variety and availability of PEVs.
- Misunderstanding concerning range of PEVs.
- Difficulties in understanding electricity consumption, calculating fuel costs, and determining charging infrastructure needs.
- Complexities of installing home charging.
- Difficulties in determining the “greenness” of the vehicle.
- Lack of information on incentives.
- Lack of knowledge of unique PEV benefits.



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Consumer Needs

Several barriers indicate that consumer awareness and knowledge of PEV offerings, incentives, and features are not as great as needed to make fully informed decisions about whether to purchase a PEV.

The barriers emphasize the need for better consumer information and education that can answer all their questions.

Until consumers are sufficiently informed and educated, they will likely continue to prefer the relative safety, security, and familiarity of an ICE vehicle.

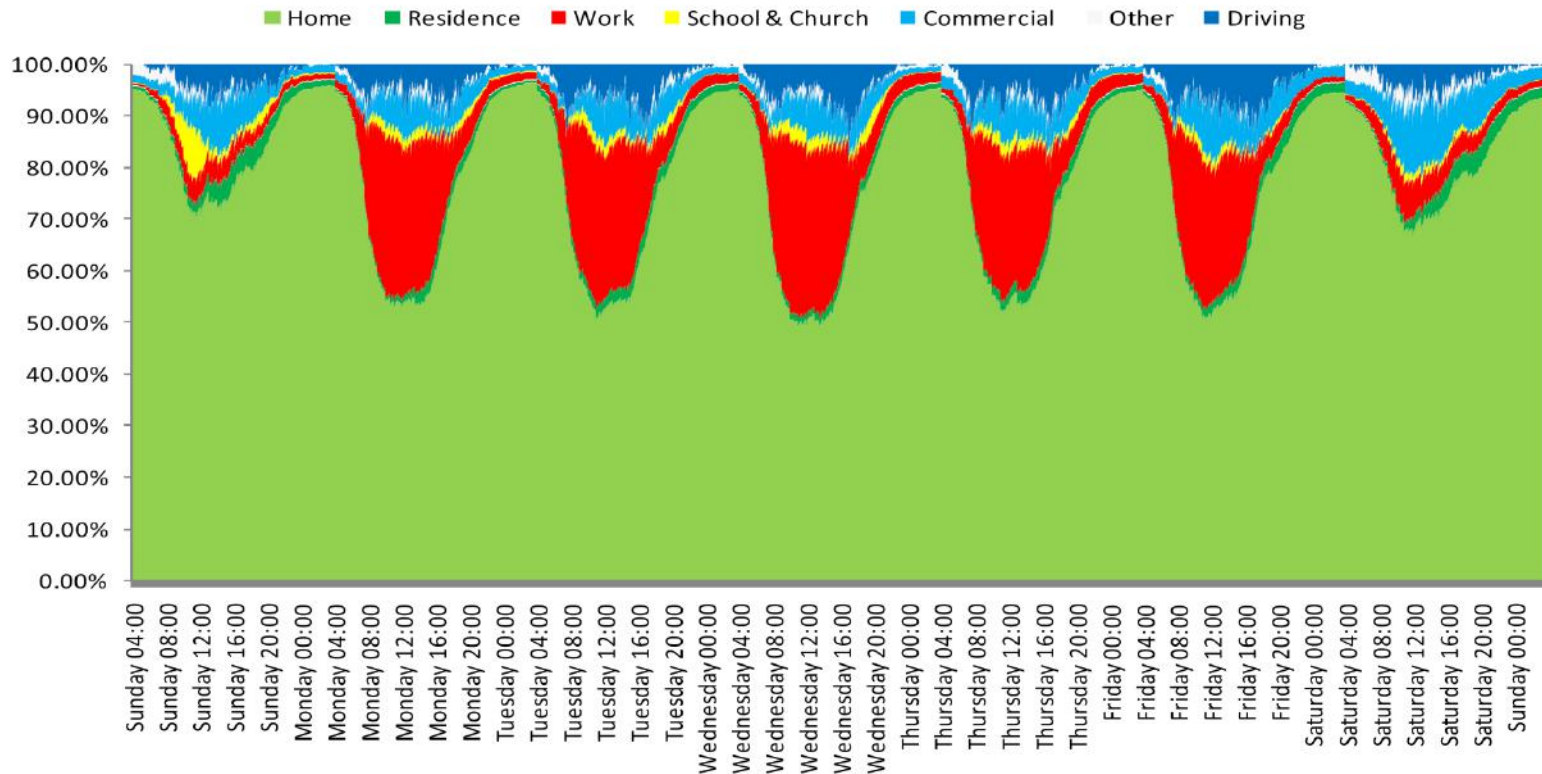


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Where Are Vehicles Parked



Distribution of vehicle locations throughout the week on the basis of data from the 2001 National Household Travel Survey. SOURCE: Tate and Savagian (2009).

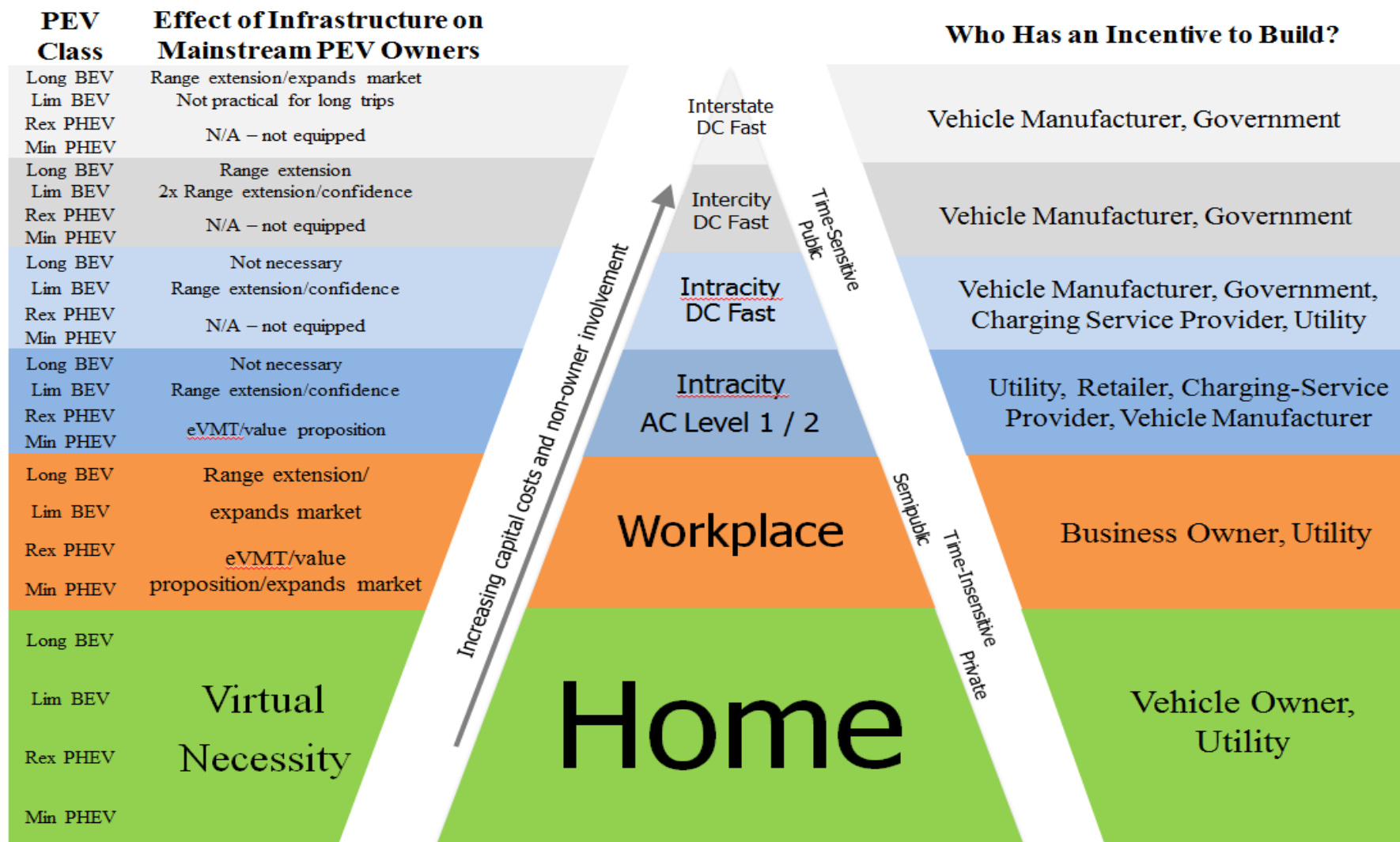


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PEV Charging Pyramid



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Public Charging Infrastructure

The development of public charging infrastructure is the most vexing infrastructure question.

Public charging infrastructure has the potential to provide range confidence and extend the range for limited-range BEV drivers, allow long-distance travel for long-range BEV drivers, and increase eVMT and the value proposition for PHEV drivers.

However, committee found that the impacts of the current federal investment in charging infrastructure on PEV adoption and use are not well understood.



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Recommendation on Public Charging-Infrastructure Deployment

The federal government should fund research to understand the role of public charging infrastructure (as compared with home and workplace charging) in encouraging PEV adoption and use before additional direct federal investment in charging infrastructure installation.



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Observations after Report Release

Dramatic decreases in gasoline prices do not appear to have affected PEV market share in US, although decreases directly affect the value proposition for PEVs.

Some regions in the US and other countries continue to show strong growth in PEV sales.

Level of deployment in strong-growth areas, such as CA and Norway, are highlighting public charging and other infrastructure needs as congestion at charging places has occurred.

Electric utilities, automakers, and others have increased investment in public charging infrastructure to address needs.



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Concluding Remarks

The next 5-10 years will be critical for understanding how various regulatory and market factors will affect the barriers identified by the National Academies' committee.

PEVs have clearly established a presence, but what remains to be seen is how this proven technology will play out in a dynamic market affected not only by energy and technology costs but also by human behaviors, including those related to location of housing, vehicle ownership, and willingness to drive.



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