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Plug-in electric vehicle readiness: Rating cities in the United States

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ABSTRACT

In order to accelerate the adoption of plug-in electric vehicles (PEV), many municipalities, along with their parent states, offer a variety of benefits to owners and operators of PEVs to make PEV adoption easier and more affordable. Example benefits include financial incentives, infrastructure perks, such as access to high occupancy vehicle (HOV) lanes, and streamlined processes for installing charging equipment. Additionally, some cities are making investments in PEVs and PEV infrastructure for both municipal and public use. However, the policies of states and cities are by no means uniform, and some jurisdictions are doing more than others to promote PEVs.

This study presents an index that identifies and ranks the "readiness" of 36 major U.S. cities to deploy electric vehicles. Readiness is the degree to which adoption of electric vehicles is supported, as reflected in the presence of various types of policy instruments, infrastructure development, municipal investments in PEV technology, and participation in relevant stakeholder coalitions. The study also compares cities within states that participate in the Zero Emission Vehicle program, with those that do not, with the objective to understand whether participation in that program has a meaningful impact on PEV readiness.

1. Introduction

Large-scale deployment of plug-in electric vehicles (PEV) is advocated on the grounds that it will both enhance energy security and reduce greenhouse gas emissions by reducing dependence on carbon-intensive liquid petroleum fuels (Egbue and Long, 2012; Krause et al., 2013; Lyon et al., 2012). Since the Chevrolet Volt, Nissan Leaf and Tesla Model S were offered for sale in the 2008–2010 period, sales of PEVs have grown rapidly in the United States, even more rapidly than did the early sales of the conventional hybrid (Graham et al., 2014). However, consumer interest in PEVs is not yet high enough to meet the production goals of individual manufacturers or the policy goals set by the federal government and a coalition of ten states led by California and its Zero Emission Vehicles (ZEV) program (Graham et al., 2014).

A rapidly growing body of literature is exploring the barriers to, and opportunities for, transport electrification (Sovacool and Hirsh, 2009), including promising measures that might stimulate consumer interest in electric vehicles. A generous federal income tax credit up to $7500 is available to consumers that purchase a qualified PEV, and the Obama administration has proposed that Congress enlarge this credit to $10,000 and make it available to car buyers at the point of sale rather than at the end of the tax year. However, cities, along with the states in which they are located, vary considerably in their overall "readiness" to integrate PEVs into their physical, financial and policy structures. As a result, some parts of the United States are considered more "ready" for integration of PEVs into the transportation sector than others. A city's level of readiness is also impacted by the local utility's readiness to support PEV adoption, which is in part reflected in the availability of time of use rates or a special rate structure for PEV owners.

In this article, we rate American cities in terms of their readiness for deployment at significant scale of plug-in electric vehicles. We focus on cities – rather than small towns and rural areas – because it is generally accepted that urban locations with high population densities present a more promising opportunity for PEV market penetration. Such locations are likely to have commuting distances within the range of current-generation PEVs, and there would be enough PEV owners in cities to support a

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network of public charging stations. We consider PEVs to be any motor vehicle that makes use of electricity from the electrical grid, whether it is a plug-in hybrid electric vehicle or a fully battery-operated vehicle.

We hypothesize that cities located in states that have joined the ZEV program will be more accommodating to PEVs than cities located in states that have not. In order to meet some of the requirements of the Clean Air Act, the State of California was the only state in the country permitted to enact its own vehicle emissions standards that are more stringent than the standards adopted by the U.S. Environmental Protection Agency. California has enacted a ZEV requirement applicable to all significant-volume vehicle manufacturers doing business in the state. In effect, California has mandated that at least 15% of new vehicles sold in California by 2025 be ZEVs. As a practical matter, a ZEV is a qualified PEV or hydrogen fuel-cell powered vehicle, though conventional internal combustion vehicles that meet efficiency and emissions requirements can qualify for partial credits. While Congress did not permit other states to enact their own vehicle standards, Congress did permit other states to adopt a program identical to the ZEV program as established by California. Nine states in the West and Northeast have done so: Connecticut, Maine, Maryland, Massachusetts, New Jersey, New York, Oregon, Rhode Island, and Vermont (C2ES, 2015). Of the ten ZEV states, including California, eight have organized themselves and signed a memorandum of understanding that pledges to promote the sale of ZEVs in their jurisdictions. Not participating in the memorandum are New Jersey and Maine.

The article is organized as follows: Section 2 describes the most common policy instruments that states and municipalities employ to encourage PEV adoption. Section 3 describes the rationale for our selection of cities, the attributes we have chosen to consider when rating cities in terms of PEV readiness, and our methods of data analysis. Section 4 provides the main results, which are ratings and rankings of American cities using two types of scoring systems. It also provides our main results comparing cities in ZEV states to cities in non-ZEV states. Section 5 discusses the policy implications of our results, the impacts of electric vehicle adoption on electricity provision, the limitations of our work, and some promising directions for future research.

Table 1
Variables included in city ranking.

Variable	Description	Rationale	Source
Hard purchase-related incentives			
Consumer purchase incentives	Whether the city or state offers a tax credit or rebate for consumers to purchase a PEV	Purchase incentives bring down the upfront costs of PEVs to be more competitive with traditional vehicles	AFDC (2015a,b)
Public/Private purchase incentives	Whether the city or state offers a tax credit or rebate for businesses or government entities to purchase a PEV		AFDC (2015a,b)
Consumer EVSE incentives	Whether the city or state offers a tax credit or rebate for consumers to purchase and/or install EVSE		AFDC (2015a,b)
Public/private EVSE incentives	Whether the city or state offers a tax credit or rebate for businesses or government entities to purchase and/or install EVSE		AFDC (2015a,b)
Time of use/special PEV electricity pricing	Whether the main utility in the city offers TOU pricing (unrelated to PEV ownership) or a specific PEV charging rate to PEV owners	Low electricity prices for overnight PEV charging decreases costs to consumer	AFDC (2015a,b)
Reduced fees	Whether a PEV is afforded special consideration with regard to registration fees, vehicle tax, or sales and use tax	Decreased costs for PEV driver	AFDC (2015a,b)
Soft incentives			
Charging stations per capita	Total number of level 1, level 2, and DC fast chargers in the city (as of February 2015) per capita	Access to more chargers reduces range anxiety	AFDC (2015a,b) and U.S. Census Bureau (2014)
HOV lane access	Whether the state affords special HOV access to PEV owners	HOV lane access reduces commuting time for PEV drivers in cities with high congestion problems	AFDC (2015a,b)
EVSE Permitting	Whether the city has streamlined the permitting process for installing EVSE	Speeding up the process to have the proper wiring and charger installed in a consumer's home or business	AFDC (2015a,b) and city websites[a]
Parking privileges	Whether the city offers free, reduced cost, or reserved parking for PEV owners	Free or dedicated parking can save PEV drivers time and money	AFDC (2015a,b)
Fuel cost environment			
Gas price	April 2015 prices	Higher gas prices may make PEVs more attractive to consumers	GasBuddy (2015)
Electricity price	2013 electricity price for the main utility in the city	Lower electricity prices may make PEVs more attractive to consumers	EIA (2015)
Special fleet programs			
Municipal fleet	Whether the local government has made efforts to integrate PEVs into municipal fleets ("Lead by example")	Cities that are leading by example help demonstrate the benefits of PEVs to citizens	ACEEE (2015) and city websites[a]
EV car sharing service	Whether an electric vehicle car sharing service is offered in the city	PEV car sharing offers more opportunities for residents to experience PEVs, and it is indicative of the general attitude towards PEVs	ACEEE (2015) and media reporting[a]
Additional indicators			
Clean cities coalition	Whether a Clean Cities Coalition exists in the city	Clean Cities coalitions assist in the promotion of PEVs in their communities	DOE, 2016
Tesla direct sale	Whether Tesla is allowed to sell directly to consumers in the state.	This is considered an indicator of the general attitude towards PEVs in the state	Voelcker, 2015

[a] Full list of sources for all data can be provided upon request; please contact the authors with any inquiries.