Title
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Publication Date
2020

UCDAVIS
INTERNATIONAL EV POLICY COUNCIL

POLICY BRIEF
January 2020

Exploring the Role of Cities in Electrifying Passenger Transportation

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Key Takeaways

1. The electrification of passenger vehicles should be one part of a city's transportation plan. Shifting from internal combustion engine vehicles to plug-in electric vehicles (PEVs) can improve urban air quality, reduce greenhouse gas emissions, and reduce energy consumption.

2. Recent studies show that electric vehicle awareness is low even in mature markets; cities should promote electric vehicles to residents by leveraging existing promotional campaigns.

3. Various financial and non-financial incentives can effectively encourage electric vehicle uptake, including: free, discounted, or preferential-location parking; free or reduced road and bridge tolls; and allowing electric vehicles to drive in bus or carpool lanes.

4. Several cities are restricting or planning to restrict the access that internal combustion engine vehicles (ICEVs) have to certain areas. If these restrictions apply to most (or all) passenger ICEVs, they can promote PEV purchase and use in cities.

5. Infrastructure development in cities should follow the same fundamental approach as that used outside of cities. The priority should be ensuring that PEV owners and prospective PEV buyers have access to charging at or near home. Workplace and public charging should be developed for those who cannot access charging at or near home.

6. Cities should be strategic in their approach, first identifying the goals they want to achieve, and then exploring what steps they can take to meet these goals. The steps available will likely differ between cities due to the different ways in which roads, parking, and any other vehicle infrastructure is governed.

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Introduction

In this brief we focus on personal passenger vehicles, as in many cities they are (still) a dominant mode of transport. In the car-dependent United States, 85% of trips are completed by car and even in London, United Kingdom 36% of all journeys are by car. Electrifying cars will not solve all issues cities face (e.g. congestion, competition for space, etc.), but can contribute to addressing air quality concerns, reducing energy consumption from transport, and reducing greenhouse gas emissions.

In previous policy briefs we have explored national activities such as purchase incentives [1], zero emission vehicle mandates [2], and charging infrastructure [3]. Within the governance landscape, cities, local governments, local policymakers, and municipalities can also play an important role. In this policy brief we explore what actions these actors can take to promote plug-in electric vehicle (PEV) adoption in cities. We acknowledge that governance at a local level differs between countries and even within countries, and that control of roads, pavements or sidewalks, infrastructure, and parking may be performed at the level of city government, county government, local transport authority, mayor's office, or other agency. Due to these complexities this policy brief outlines potential actions that could be taken in the city context, without specifying exactly who should take this action –we use the term 'local authority' in a broad sense, to include any relevant actor who may implement action at the city level. Local authorities may also engage with non-governmental stakeholders including car dealerships, charging network operators, utilities, electric vehicle interest groups, and non-profits including citizen initiatives.

Below we outline activities local authorities can engage in to promote PEV adoption and use.

Consumer Awareness and Knowledge

Research has shown that consumers' awareness and knowledge of PEVs are generally low [4–6]. Despite recent PEV market growth, mainstream consumers lack a clear understanding of PEVs. 'Ride and drives,' PEV experience centers, dealer education, co-operation with NGOs, developing PEV owner organizations, and using traditional and social media campaigns can all be used to promote PEVs and raise awareness. This should also include strengthening networks between potential customers and car dealers, utilities, and charging providers.

Rather than creating their own campaigns, which can take time and be costly, local authorities should leverage existing resources. This will have the additional impact of reinforcing existing efforts and increasing their impact on the transition to PEVs. Current education and awareness initiatives include Veloz in California (USA), Forth in Oregon (USA), Electrify America in the USA, The Norwegian EV Association, Go Ultra Low in the United Kingdom, Elbil Sverige (Electric Car Sweden), and Vereniging Elektrische Rijders (Electric Drivers Association) in the Netherlands, among others.

Incentives

A substantial body of research shows the importance of financial purchase incentives in increasing PEV adoption [7–12]. Local authorities may have fewer financial resources available to introduce purchase incentives compared to state or national governments. At a local level, utilities and air quality management districts or clean air agencies may be able to provide some financial incentives to consumers. Reoccurring incentives may be more

feasible for local authorities to introduce compared to purchase incentives, especially as local authorities often have greater control over roads and parking. Reoccurring incentives for PEVs include discounted or increased access to: parking; congestion charge zones or low emission zones; toll roads, bridges, or tunnels; and bus or carpool lanes with a single occupant in the vehicle. These incentives have been implemented in cities in Germany, United Kingdom, Norway, USA, and elsewhere, and research shows they can have a positive effect on PEV sales [8,11–15]. The aim of these incentives should be for PEVs to displace conventional vehicles, consideration should be given to the risk of encouraging increased private vehicle usage, which may conflict with goals of increasing use of public and active travel modes and reducing congestion.

Access restrictions for internal combustion engine vehicles

Several local authorities have announced plans to ban internal combustion engine vehicles in all or some parts of the city by 2030. Examples include London, Barcelona, Seattle, Vancouver, Mexico City, and Los Angeles [16]. Most of these ambitious targets are yet to be ratified by law. If legislated and enforced, these could send a signal to the automobile industry [17]—in a similar way as ZEV mandates have [18]—but should be phased in and accompanied by stakeholder dialogues, infrastructure provision for PEVs, development of public transit, and walking and biking infrastructure. Some of these initiatives ban only older internal combustion engine vehicles, meaning drivers are not incentivized to purchase PEVs as they can still enter the city in a newer compliant combustion engine vehicle. In contrast, if programs restrict access (or charge fees) to all internal combustion engine vehicles but provide exemptions to PEVs, they can incentivize drivers to switch to PEVs. Successful implementation will require special attention to equity and considering the mobility of everyone who lives in or travels in a city's limits.

In their efforts to reduce combustion engines in cities, local authorities are taking different approaches. Oslo, Norway has removed all on-street parking of vehicles in the city center. Since 2003, London, the UK has had a congestion charge zone that allows free access to PEVs while ICEVs pay £11.50 to enter (or £14 if paid the day after entry). Beijing has a cap for new vehicle registrations and requires prospective combustion engine vehicle buyers to enter a lottery to obtain a vehicle registration where only 1 in 500 people obtain a registration. These three different approaches underline the different strategies cites may have to take to achieve the same goal.

Infrastructure

The purpose of developing charging infrastructure should be twofold: increasing PEV sales and increasing the number of miles that are travelled electrically.

Due to differences in vehicle use and the parking locations in cities compared to suburban and rural areas (notably a lack of private off-street parking), infrastructure provision will have some differences, however it should follow the same fundamental approach. This should be a pyramid with home location chargers forming the base, followed by workplace, and finally public (including fast chargers) at the top. Local authorities should prioritize infrastructure roll-out for home and work charging.

Existing studies have consistently shown that home charging is the most preferred and the most frequently used charging location [19–21]. Home charging is less likely to occur in a private garage or driveway in cities compared to suburban or rural areas. Infrastructure in cities should still allow for charging while PEV drivers are at home, including in off-street locations, parking lots of multi-unit

buildings or apartments, nearby parking structures, and off-street lots in residential areas. On-street residential charging infrastructure should be considered where off-street parking is not available but may be most costly to install.

Work or commute location is the next most commonly chosen charging location for PEV drivers [22]. Work location chargers can include charging stations in publicly owned parking lots or garages, private parking lots or garages, on street parking in business areas, and employers' parking lots or garages. Local authorities should encourage employers to provide charging to employees via existing green business programs and air quality programs.

Public chargers are the least commonly used charging location [23]. During later market phases, (semi-)public charging stations at shopping centers become more relevant for PEV buyers who can neither charge at or near home nor at their place of employment. Public chargers also include fast chargers, which may be used by consumers on long-distance trips between cities [24], but are also used inside cities. Results from Norway suggest that there is a demand for fast charging in cities with some city locations having higher utilization than chargers outside of the city [25].

Some stakeholders are promoting the idea of DC fast charging plazas that would allow PEV charging in a manner similar to conventional vehicle fueling. This type of charging might be an alternative in large and dense city centers where the majority of vehicle owners have to rely on street parking. However, PEV owners generally prefer charging at their travel destination or origin (e.g., at home and work) [26] and having access to charging at these locations has been shown to be more influential in encouraging consumers to purchase PEVs compared to public charging [27–29].
Using the appropriate data can allow charging infrastructure to be placed where there is demand for chargers and in locations where local grids are able to support it [30,31]. Decisions on charging level (i.e., slow or fast chargers) should be based on the anticipated time that drivers will remain in one location. Tariffs or clear rules on the length of charging events should be used to prevent PEV drivers from charging for longer than they need to or when they don't need to charge at all.

Simplifying Building Codes, Planning Permissions, and Permitting

Local authorities may have a role in simplifying permitting, planning, and building codes to make it easier for other organizations, workplaces, and consumers to install infrastructure. Building codes should be updated to mandate or encourage new buildings to be PEV-ready, as installing charging infrastructure at the time of construction can be 4 times cheaper than a retrofit [32]. Some cities, for example San Francisco, are adopting standards that require 100% of parking spaces to have sufficient electrical supply to facilitate the easy installation of chargers in the future, with capacity to supply power to 20% of spaces simultaneously [33]. Similar standards should be applied to single family homes (detached homes) or should mandate the installation of a charger at the time of construction. Local authorities can develop a clear and simple process for permitting and inspection of new charging installations that are easy for property owners, suppliers, and installers to comply with and understand. The state of California is doing this through regulation [34], which mandates that cities should "create an expedited and streamlined permitting process for electric vehicle charging stations." A guide outlines how cities can achieve this [35].

Strategic Planning

Local authorities should act strategically to foster the electrification of transport. This means that they integrate their activities regarding PEVs with broader city development strategies and identify steps for how these goals can be reached. Research from Germany has shown that cities that act more strategically are more successful than cities that do not [36]. For example, German cities typically start with developing charging infrastructure and by electrifying municipal fleets and then moving on to targeting households, company fleets, and car-sharing. A further step is to coordinate with organizations in the energy system and to develop plans for local renewable generation and electricity supply for charging infrastructure.

Local authorities can also provide information to political entities at higher administrative levels and can suggest revisions to national laws to allow for the introduction of local incentives. For example, in Norway it was not possible to offer free parking or free toll roads for PEVs before national laws were changed in the late 1990s [37].

Summary

Implementing the incentives, conventional vehicle restrictions, infrastructure, and awareness campaigns outlined above will require effort from multiple stakeholders. When seeking to increase PEV uptake, local authorities should first consider the programs they wish to introduce and then investigate what regulatory power they could use to implement the programs. The parking restrictions in Oslo, congestion fee in London, and registration lottery in Beijing illustrate different strategies local authorities have used to achieve the same goal of reducing the number of combustion engine vehicles in a city. This highlights the need for local authorities to be innovative and flexible in their approach. Cities should also consider the potential for unintended consequences, particularity the risk of an overall increase in private vehicle usage. A fine balance may be needed to promote PEVs without increasing the total number of vehicles on the roads.

Future Policy Briefs

Cities are a hub for new mobility, including ride sharing and car sharing. The electrification of these new mobility services, in addition to public and commercial vehicle fleets, will be important in reducing emissions in cities [38]. Upcoming policy briefs will explore how to electrify these other sectors of transportation in cities.

Aknowledgements

The International Electric Vehicle Policy Council is coordinated by the Plug-in Hybrid & Electric Vehicle Research Center at UC Davis and is funded by ClimateWorks Foundation and The Paul G. Allen Family Foundation. Thanks to Seth Karten and Noam Baharav for copy editing this brief and Mounika Bodagala for designing and formatting the brief.

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