accenture

*High performance. Delivered.*

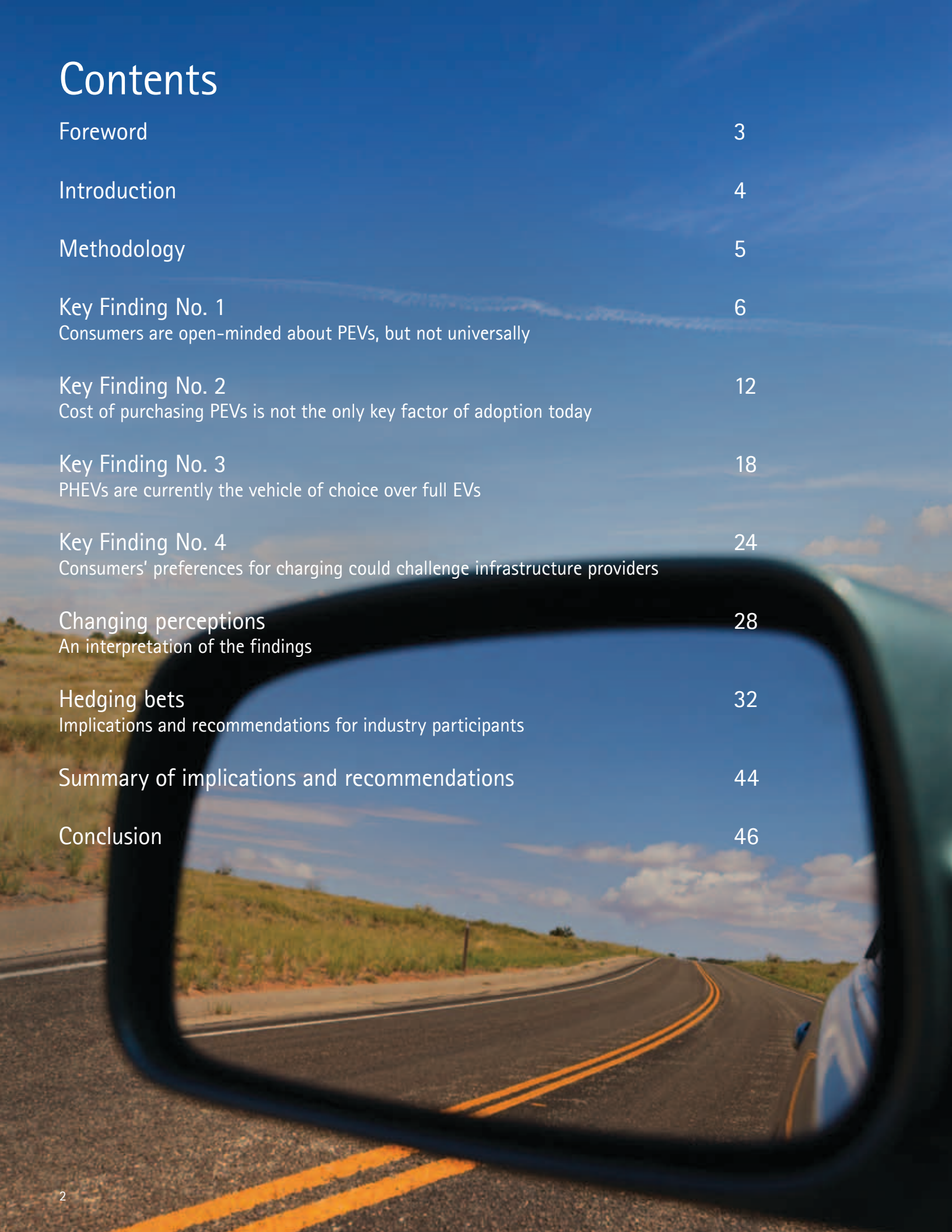
# Plug-in electric vehicles
# Changing perceptions, hedging bets

## Accenture end-consumer survey on the electrification of private transport

• Consulting • Technology • Outsourcing

# Contents





# Foreword

The year 2011 may well be remembered as the year when plug-in electric vehicles (PEVs) first became a common sight in automobile showrooms. However, despite the high-profile vehicle launches, recent forecasts indicate that industry watchers may need to wait until the next decade before PEVs account for even one in 10 vehicles on the road around the world.[1]

In the next 20 years, there will be significant competition between multiple fuel and vehicle platforms. At Accenture, we anticipate a mixed landscape that, in addition to featuring both forms of PEV—plug-in hybrid electric vehicles (PHEVs) and full electric vehicles (EVs)—will also include advanced combustion engines, a greater use of biofuels, natural gas vehicles, and possibly even hydrogen fuel cells and other fuels.

PEVs have received much attention and support from governments and industry alike and are therefore a potential game changer in the realm of transport fuel technologies. As industry players monitor how the electrification of transport evolves, one of the key fronts to watch is the battle between PHEVs and full EVs. PHEVs run on batteries that are charged by plugging into the power grid, but also have a conventional engine fueled by gasoline or diesel. Full EVs run purely on batteries charged from the grid. PHEVs require limited changes to driving habits and demand less of power grids. Full EVs require a greater leap of faith from the end consumer as well as more advanced supporting infrastructure and services.

If consumers prefer not to change the way they run and manage their cars, the popularity of dual-fuel PHEVs could hold back the adoption of full EVs. If drivers are more open to entirely new ways of running their cars, full EVs could enjoy stronger growth. The outcome of the battle between the two vehicle types will impact the investment decisions of electricity retailers, power generators and network operators, and determine the infrastructure they build. It will have an even more direct impact on the core business prospects of charging service providers, battery manufacturers and automotive manufacturers. City authorities are also critical players, given their role in the early implementation of infrastructure.

This paper, *Plug-in electric vehicles: changing perceptions, hedging bets*, addresses two issues: whether consumers are open to changing their driving-related perceptions, preferences and habits, and what actions industry stakeholders can take amid the uncertain outlook for PEVs. The paper is based on Accenture's global consumer survey and explores the inertia of ingrained driver practices and how they relate to PEVs. It also offers recommendations to the industry as competitors prepare to make their investments. In particular, the paper shines a light on the important battle between dual-fuel PHEVs and full EVs.

Accenture's recent report, *Changing the game: the electrification of transport pilots*,[2] revealed that while technological progress is being made on production lines and in pilot rollouts, consumer interest is clouded by uncertainty. Combined with this new study, our body of analysis shows that the development of the PEV market must begin with an understanding of consumer preferences. To satisfy these preferences, new forms of partnerships will need to be created across industry business models. While stakeholders will have to make fixed commitments in technology or infrastructure, agile business and operating models will be critical to success.

The battle between full EVs and PHEVs will not just be determined by technology, but by consumers' perceptions and preferences. If drivers do not break out of ingrained habits or alter their perceptions, the popularity of PHEVs could hold back the adoption of full EVs. The outcome is uncertain and will have significant implications for electricity utilities, gasoline/diesel retailers, city authorities and charging service providers, as well as battery and automotive manufacturers.

# Introduction

Accenture set out to understand consumer preferences toward the electrification of private transport by commissioning a global survey of consumer attitudes and opinions. We conducted a survey of more than 7,000 individuals in 13 countries. The survey results answer some of the key questions being asked by sectors and service providers considering participation in the PEV market:

- Do consumers have a clear awareness and understanding of PEVs?
- Do they have intentions to make purchases of PEVs in the coming years?
- What are the factors that matter most to consumers when considering PEVs?
- What preferences do consumers have for charging and charging services?
- Do they have a preference for full EVs or for PHEVs? If so, why?

## Full EVs or PHEVs?

The survey covers PEVs and distinguishes between full EVs and PHEVs. Full EVs depend entirely on battery engines that are charged by plugging into the electricity supply. PHEVs have a conventional gasoline/diesel engine and a battery-powered engine, which is charged from the electricity supply. PHEVs allow drivers to continue driving on conventional fuel once the battery power has run down. The survey does not cover hybrid electric vehicles, which do not source their electricity from being plugged in.

# Methodology

Our quantitative global survey of consumer opinions and preferences toward PEVs and supporting services is based on a 20-minute survey of 7,003 individuals across 13 countries. It was conducted online in native languages during December 2010 and January 2011.

The survey targeted consumers with drivers' licenses. Ninety-seven percent of the respondents are car owners. The survey probed consumer attitudes toward PEVs by asking attitudinal and behavioral questions about driving habits, perceptions of and preferences for PEVs and PEV-charging services.

The survey also presented choice-based questions about various combinations of factors that would influence their PEV purchase decisions. The information was evaluated using a conjoint analysis to understand how much consumers weight each factor in their consideration of PEVs.

The survey sample was representative of the general population, in terms of gender, age and income in every country, with the exception of China, where the sample was representative of the urban population. Data collection was completed for Accenture by GfK NOP.

## Countries included in the survey with numbers of participants

| | |
|---|---|
| Australia | 500 |
| Canada | 500 |
| China | 500 |
| France | 500 |
| Germany | 500 |
| Italy | 500 |
| Japan | 500 |
| Netherlands | 500 |
| South Korea | 502 |
| Spain | 501 |
| Sweden | 500 |
| United Kingdom | 500 |
| United States | 1,000 |
| Total | 7,003 |

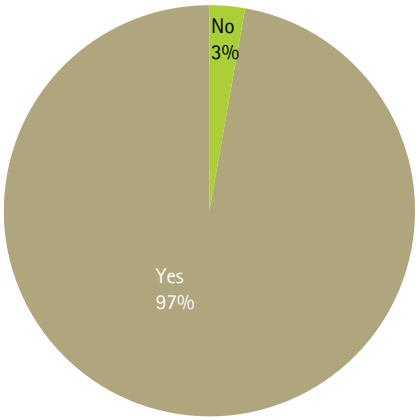
# Key Finding No. 1

## Consumers are open-minded about PEVs, but not universally

## Our research shows high levels of awareness of PEVs among car drivers but a need for more information. There is support for PEVs replacing conventional vehicles; however, it is not universal.

Consumers are strongly aware of the emergence of PEVs, but our research shows that they require more information before they are in a position to make purchase decisions. As Figure 1 illustrates, virtually all car drivers have heard of PEVs.

Figure 1. Have you ever heard of electric vehicles?

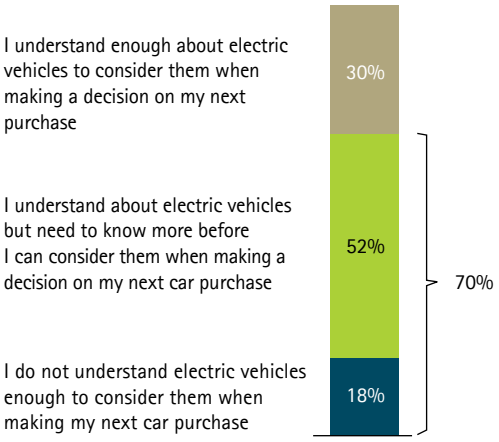



Base: All respondents
Note: The term electric vehicle (EV) is defined as plug-in EVs (PEVs), including both full EVs and plug-in hybrid EVs (PHEVs).

Figure 2 shows that more than two-thirds of respondents either need to know more about PEVs before they can consider them when making a decision on their next car purchase, or do not understand PEVs enough to do so.

Perhaps more surprising is the fact that 30 percent of consumers claim they know enough about PEVs to make a decision with their next car purchase. This is higher than one might have expected, given that most consumers have not yet had a chance to consider purchasing a PEV. The results for Figure 2 may be explained by the coincidence of this survey with the high-profile launches of full EVs by Nissan and Renault and of PHEVs by GM.

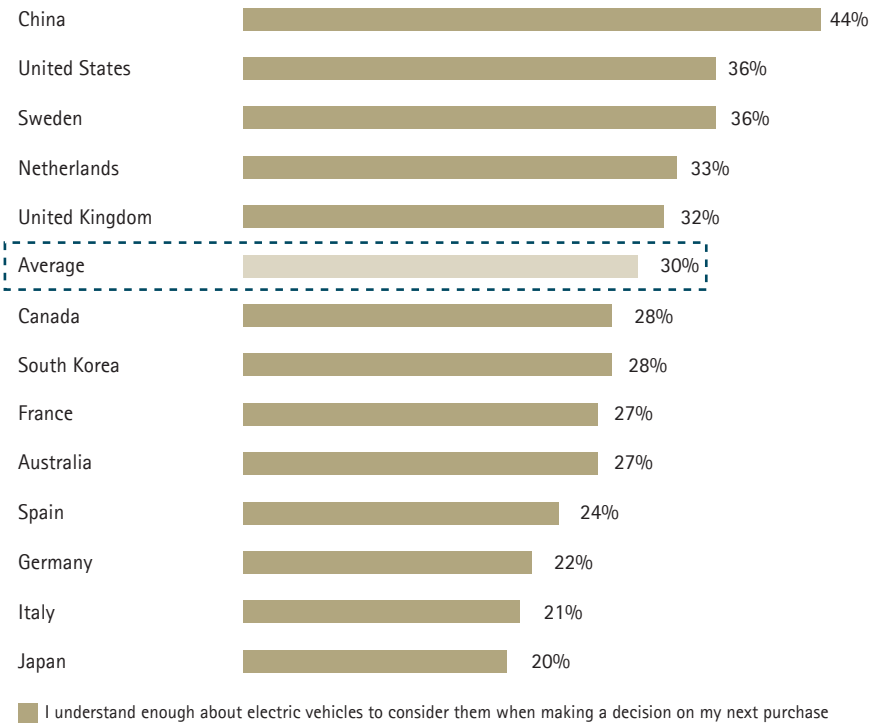
Figure 2. Which of the following most reflects your level of understanding of electric vehicles?




Base: All respondents
Note: The term electric vehicle (EV) is defined as plug-in EVs (PEVs), including both full EVs and plug-in hybrid EVs (PHEVs).

The proportion of those who claim they understand enough about PEVs to consider them with their next car purchase varies significantly around the world (see Figure 3). Only a fifth of Japanese consumers place themselves in this category, despite the fact their country is a leader in the sector, while almost half of urban Chinese respondents rate their understanding as high, perhaps due to the strong government action and public campaign for PEVs there. Our own interpretation is that some of the people in this category may be overstating their level of knowledge.

Figure 3. Which of the following most reflects your level of understanding of electric vehicles?

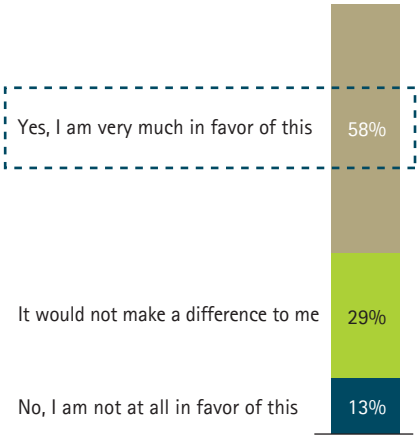



Base: All respondents
Note: The term electric vehicle (EV) is defined as plug-in EVs (PEVs), including both full EVs and plug-in hybrid EVs (PHEVs).

## Support for PEVs varies

A clear majority of car drivers is strongly in favor of PEVs replacing conventional vehicles over time (see Figure 4). There is, however, a significant minority of consumers who either do not favor such a development (13 percent) or who do not feel it would make a difference to them (29 percent). This view may change as understanding grows and as perceptions alter, but the split between those who are in favor and those who are not does perhaps reflect Accenture's point of view that the automotive industry is headed toward a mixed landscape of various fuel technologies rather than a migration toward only PEVs.

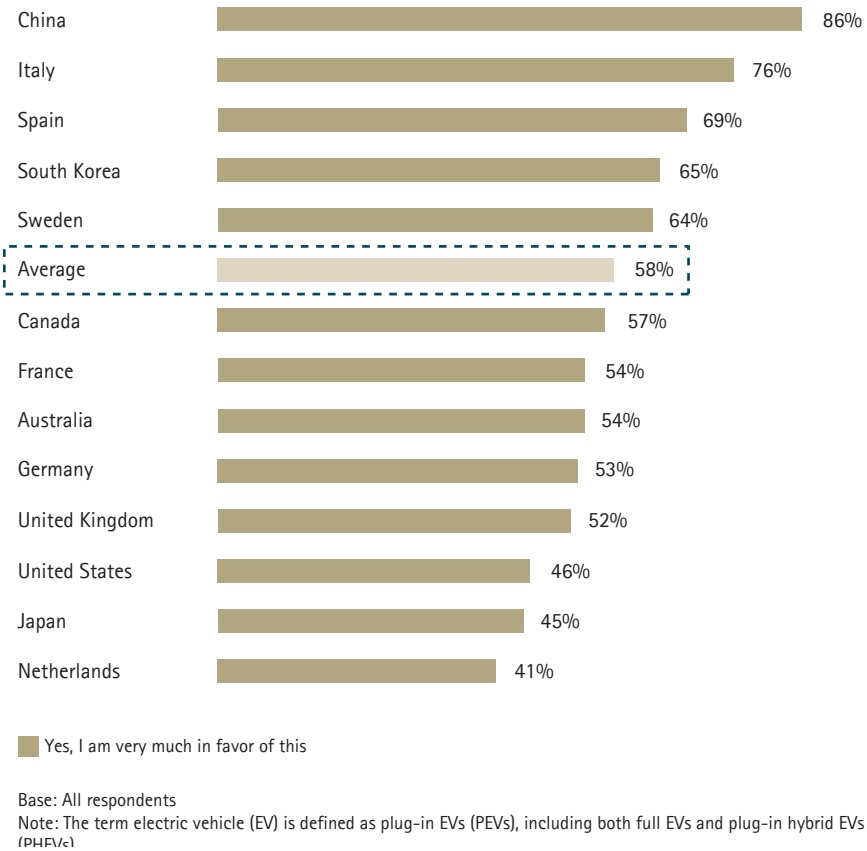
Figure 4. Are you in favor of electric vehicles (plug-in hybrid electric vehicles and full electric vehicles) replacing conventional cars over time?




Base: All respondents
Note: The term electric vehicle (EV) is defined as plug-in EVs (PEVs), including both full EVs and plug-in hybrid EVs (PHEVs).

A country breakdown of this "positive support" data shows the strength of opinion in some markets. Forty-one percent of Dutch car drivers are very much in favor of PEVs replacing conventional vehicles over time, and less than half of US and Japanese respondents fall into this category (see Figure 5). At the other end of the scale, 86 percent of Chinese respondents and more than three-quarters of Italian respondents are strongly in favor of PEVs replacing conventional cars—closely followed by 69 percent of Spanish respondents and just under two-thirds of respondents from South Korea and Sweden.

Figure 5. Are you in favor of electric vehicles (plug-in hybrid electric vehicles and full electric vehicles) replacing conventional cars over time?

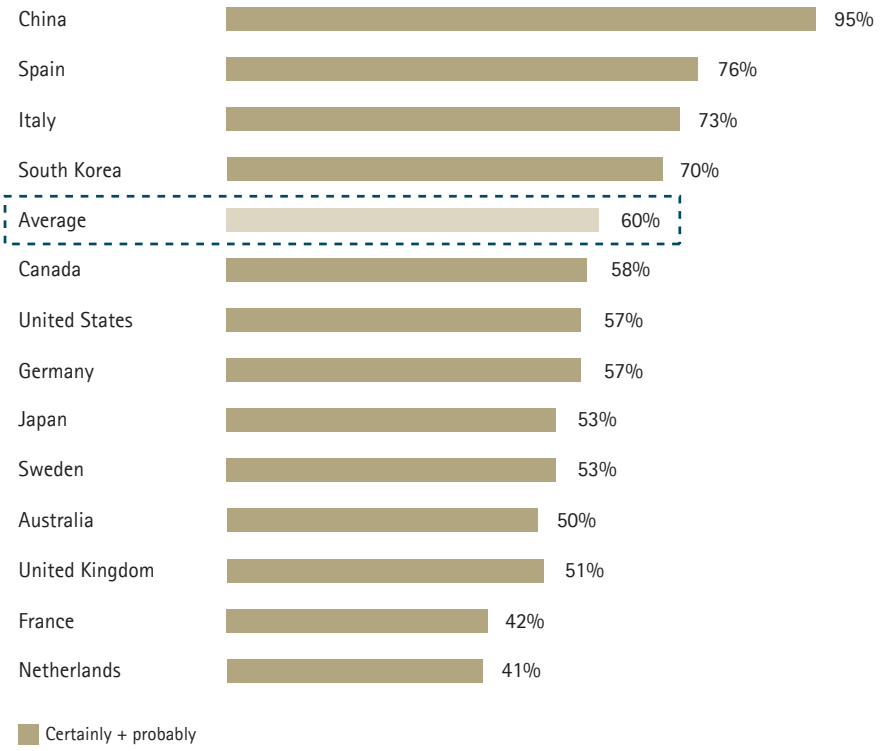



Base: All respondents
Note: The term electric vehicle (EV) is defined as plug-in EVs (PEVs), including both full EVs and plug-in hybrid EVs (PHEVs).

## Strong stated intentions to buy PEVs in the short term

When asked if they would consider PEVs (either full EVs or PHEVs) as an option for their next car purchase, 60 percent of those respondents who intend to make a car purchase within the next decade say that they will probably or certainly consider PEVs (see Figure 6). Again, those in China, Spain, Italy and South Korea are the most eager.

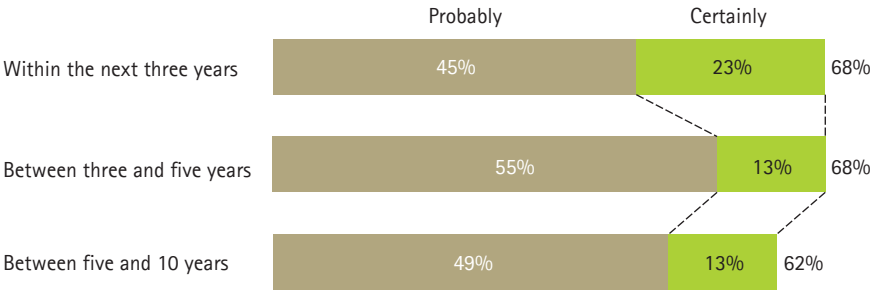
Figure 6. Would you consider electric vehicles (plug-in hybrid electric vehicles or full electric vehicles) as an option for your next car purchase?




Base: All respondents who expect to buy a new car in the next 10 years
Note: The term electric vehicle (EV) is defined as plug-in EVs (PEVs), including both full EVs and plug-in hybrid EVs (PHEVs)

It is important, however, to distinguish between the short and long term. Figure 7 depicts that 23 percent of those respondents who expect to buy a car in the next three years would certainly consider a PEV. This falls to 13 percent among those consumers who are considering buying a car more than three years from now. This pattern may reflect the awareness in many markets of current government subsidies for car purchase and the general uncertainty about how PEVs and alternatives will develop in the longer term.

Figure 7. Would you consider electric vehicles as an option for your next car purchase?

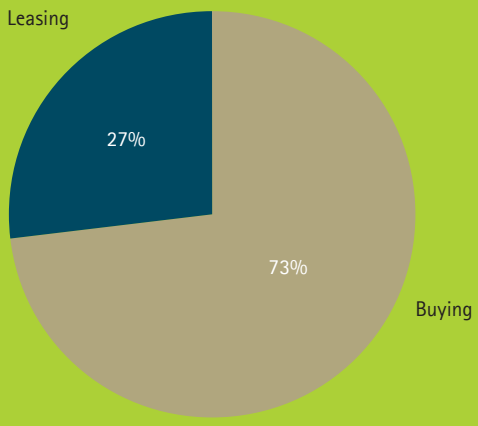



Base: All respondents who expect to buy a new car in the next 10 years
Note: The term electric vehicle (EV) is defined as plug-in EVs (PEVs), including both full EVs and plug-in hybrid EVs (PHEVs)

## A bias against leasing

When consumers are given the choice between buying or leasing their PEVs, the majority prefers to buy (see Figure 8). This purchasing preference reflects the existing culture in most markets of buying vehicles and poses a challenge to companies that plan to offer subscription-based services. Even though subscription options may provide greater convenience and avoid potentially high upfront costs of purchasing an PEV, for now, consumers are sticking with what they know—ownership over leasing.

**Figure 8. Some companies propose a leasing package that includes the use of an electric vehicle (you do not own the vehicle), its maintenance and all the charging costs (based on your average daily driving distance). If you had decided to get an electric vehicle, which option would you prefer between buying and leasing the vehicle?**




Base: All respondents
Note: The term electric vehicle (EV) is defined as plug-in EVs (PEVs), including both full EVs and plug-in hybrid EVs (PHEVs).

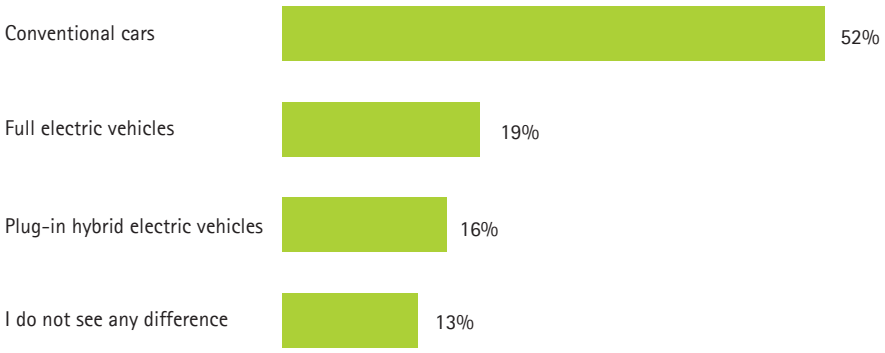
# Key Finding No. 2

Cost of purchasing PEVs is not the only key factor of adoption today

The industry consensus is that the purchase cost of PEVs is the main barrier to adoption. The survey results suggest that while purchase cost is a key factor, it is not the only key factor for many consumers today. This counterintuitive result may reflect consumers' preoccupation with other issues that might fade in significance once consumers develop a fuller understanding of PEVs.

Figure 9 illustrates consumer awareness of the price difference between conventional cars and PEVs. Fifty-two percent say conventional cars are cheaper to purchase. In contrast, fewer consumers consider full EVs and PHEVs to have a lower cost to purchase (19 percent and 16 percent, respectively).

**Figure 9. Thinking of the two types of electric vehicles and conventional vehicles, which would you expect to have the lower cost to purchase?**



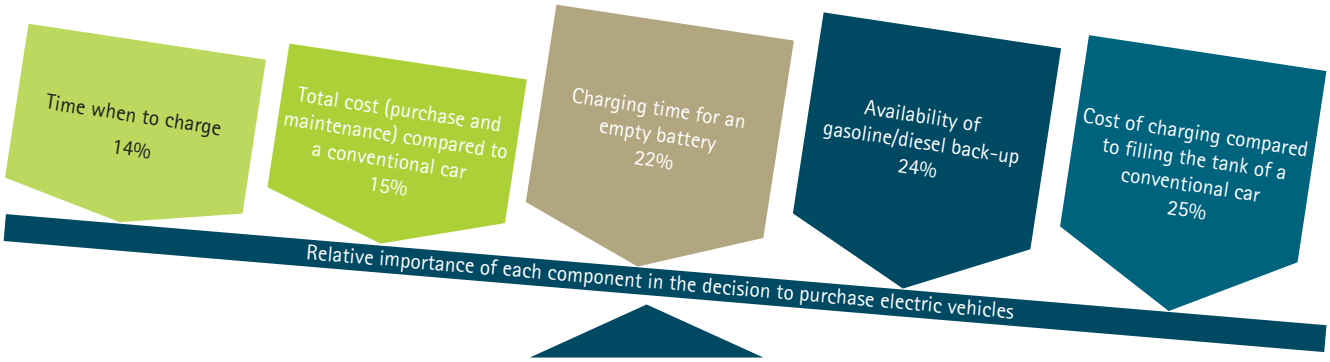

Base: All respondents
Note: The term electric vehicle (EV) is defined as plug-in EVs (PEVs), including both full EVs and plug-in hybrid EVs (PHEVs).

Accenture presented respondents with a series of PEVs, each with a different combination of charging and cost attributes. The respondents stated their preferences for each PEV by "trading off" attributes against each other. This approach enabled us to weight the importance that consumers gave to these factors.

The cost of charging compared to filling the tank of a conventional car ranked as the most important consideration (see Figure 10). The back-up availability of diesel or gasoline/petrol carried almost the same weight, providing us with the first hint that PHEVs may be more popular than full EVs. The time it takes to charge an empty vehicle battery ranked next. Surprisingly, the total cost of purchasing and maintaining a PEV in comparison to a conventional car was significantly less important, recording a weighting of 15 percent (compared to the 22 to 25 percent for the leading factors). The flexibility over when to charge carries a similar significance.

When adding the purchase and maintenance cost (15 percent) to the cost of charging (25 percent), the entire cost of owning and running a car was the most significant overall factor. Our study, however, demonstrates current preoccupations with nonpurchase price factors that need to be taken into account as motivators.

Figure 10. When consumers make decisions regarding electric vehicles, they place different levels of importance on the components.




**Time when to charge**

- Time when you can charge will be decided by the service provider operating at the charging point
- You can charge whenever you need/want

**Total cost (i.e., cost of purchase and maintenance) compared to a conventional car with the same level of performance**

- 10 percent less
- Same
- 10 percent more
- 20 percent more

**Charging time for an empty battery**

- Fast charging fixed at 20 to 30 minutes
- Slow charging fixed at six to eight hours
- Variable charging: you do not know how long charging will take (minimum six hours and no maximum time)

**Availability of petrol/diesel back-up**

- Yes
- No

**Cost of charging compared to filling the tank of a conventional car with the same level of performance**

- 50 percent less
- 25 percent less
- Same
- 25 percent more

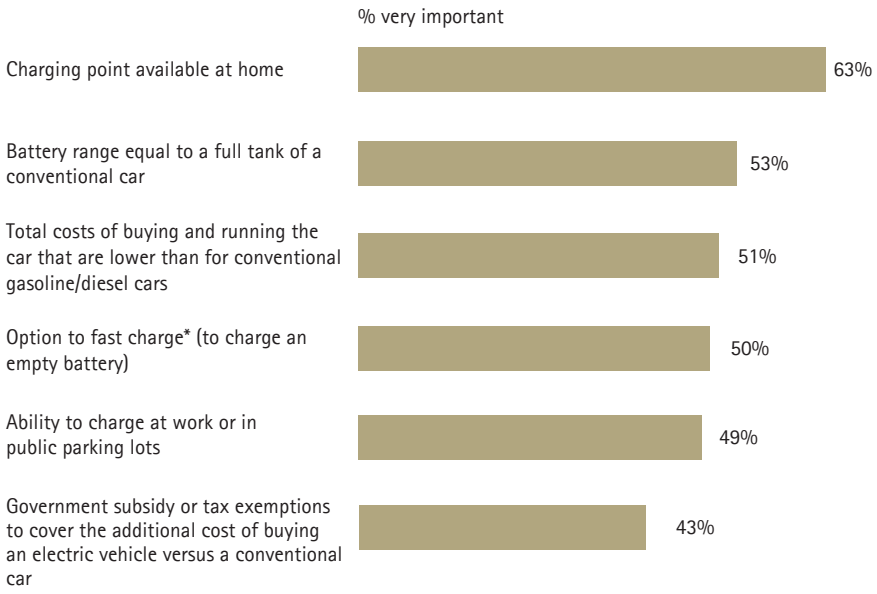
Base: All respondents
Note: The term electric vehicle (EV) is defined as plug-in EVs (PEVs), including both full EVs and plug-in hybrid EVs (PHEVs).
Methodology note: Results based on a conjoint analysis

## Convenience matters

Convenience and concerns over battery range prove to be the most critical factors when motivating consumers to buy a PEV for their next purchase.

When asked about the critical factors that may influence their decision (see Figure 11), only 43 percent cited government subsidies or tax exemptions to compensate for the extra cost of a PEV over a conventional car. Fifty-one percent cited the total cost of buying and running a car. However, the desire for a battery range equal to a full tank in a conventional car was selected by 53 percent of car drivers. The ability to charge at home topped the table with 63 percent.

Figure 11. How important would each of the following factors be to motivate you to buy an electric vehicle for your next purchase?



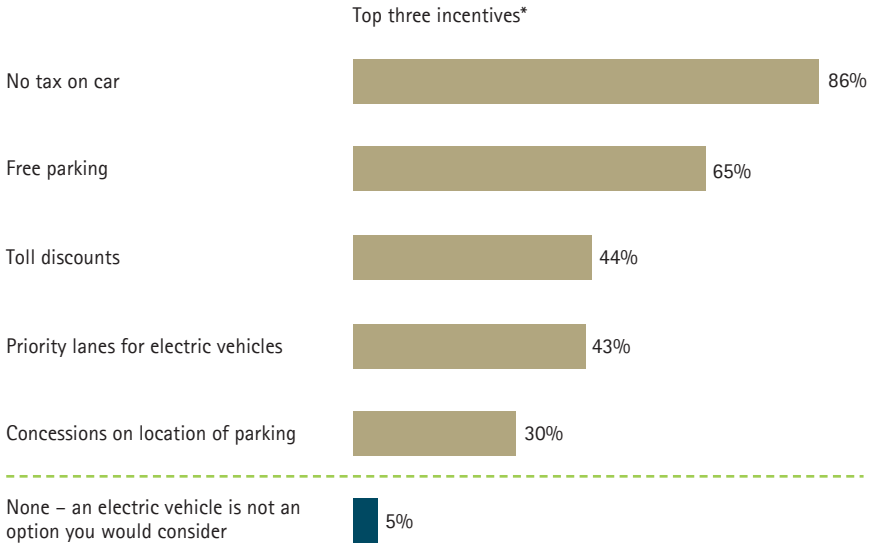

*Option to fast charge (approximately 20 to 30 minutes)

Base: All respondents
Note: The term electric vehicle (EV) is defined as plug-in EVs (PEVs), including both full EVs and plug-in hybrid EVs (PHEVs).

When we asked respondents to rank the incentives that would make them consider switching from conventional vehicles to PEVs (see Figure 12), the waiving of car tax on the purchase of a PEV topped the list (86 percent of consumers put this in their top three choices).

Sixty-five percent of respondents put free parking in their top three choices. When we look at those respondents who give it their first choice, there is a difference between age groups: 28 percent of those younger than 25 years of age opt for this factor, in comparison to just 9 percent of those older than 55 years of age. This 19-point spread suggests that in certain urban areas where parking is difficult, service providers and local authorities should consider segmenting consumers to accelerate adoption of PEVs. Other factors of convenience resonate, such as priority lanes for PEVs and concessions on the location of parking.

Figure 12. Which incentives would make you consider switching from a conventional car to an electric vehicle?



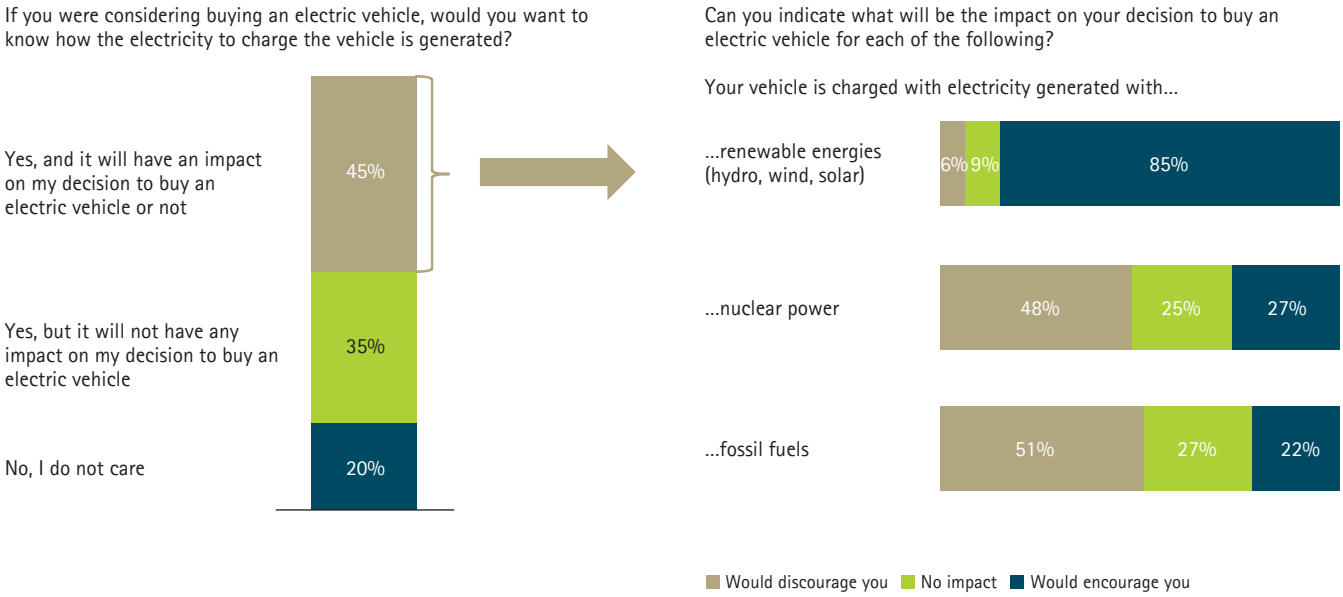

*All incentives appeared among respondents' top three

Base: All respondents
Note: The term electric vehicle (EV) is defined as plug-in EVs (PEVs), including both full EVs and plug-in hybrid EVs (PHEVs).

# Fuel source is important

Concern for the environment is also important to consumers. Figure 13 illustrates that, unless electricity or charging service providers can guarantee that the source of power is "green" (i.e., from renewable energy), they may have difficulties winning customers over to PEVs. Almost half of respondents say that not only do they want to know how the vehicle-charging electricity is generated, but that it would impact their decision to buy a PEV.

Figure 13. Fuel source impact on electric vehicle purchase decisions.



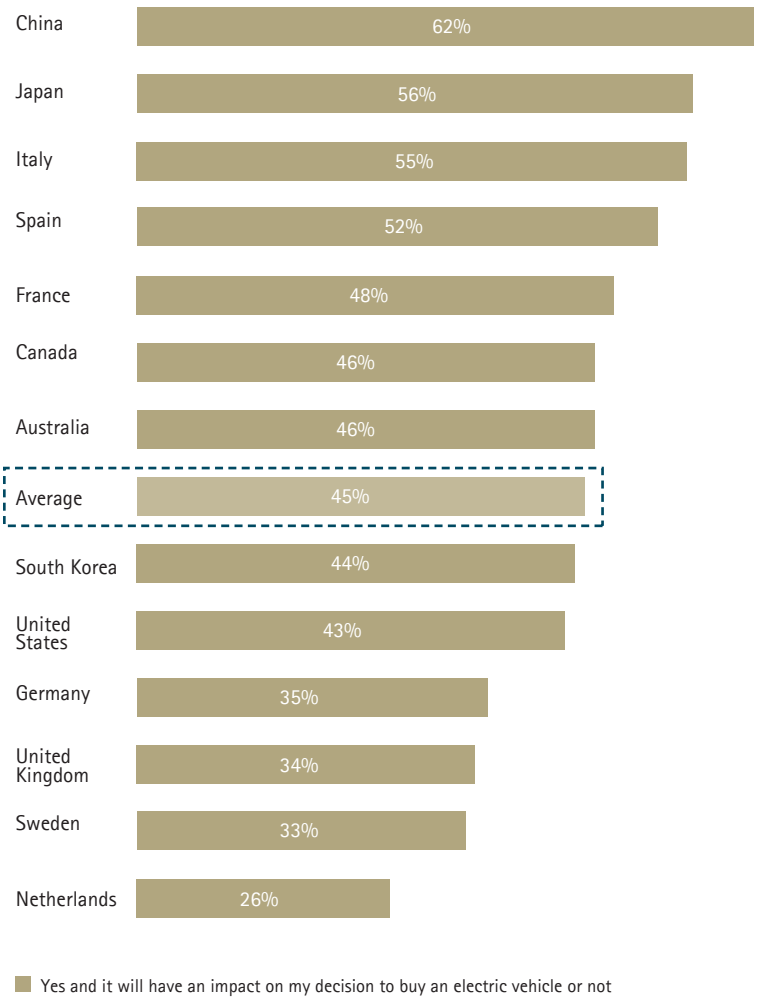

Base: All respondents.
Note: The term electric vehicle (EV) is defined as plug-in EVs (PEVs), including both full EVs and plug-in hybrid EVs (PHEVs).

Base: Respondents who indicated that how the source of electricity used to charge their vehicle will have an impact on their decision to buy an electric vehicle or not.
Note: The term electric vehicle (EV) is defined as plug-in EVs (PEVs), including both full EVs and plug-in hybrid EVs (PHEVs).

Figure 14 reveals the large variation between countries in terms of the proportion of consumers for whom the source of power would have an impact on their decision to buy a PEV. The data shows that utilities and charging service providers in China, Japan, Italy and Spain need to be particularly sensitive to the preferences of consumers on this question. In more liberalized markets, there may be opportunities for service providers to carve out competitive niches by addressing these sensitivities. Even in less liberalized ones, such as China, there may be opportunities for new renewable generation to be used for the electrification of transport.

Of the 45 percent of consumers who wish to know the source of the electricity, the use of wind, solar or hydro power would encourage them to make the switch (refer to Figure 13). But almost half currently say they would be discouraged from switching their conventional cars to PEVs if they knew nuclear power was the source of the energy. The use of fossil fuels was only marginally more discouraging. Electricity retailers may therefore need to address concerns through communications programs in those countries where fossil fuels and nuclear power are due to or already make up a significant portion of the national fuel mix.

**Figure 14. If you were considering buying an electric vehicle, would you want to know how the electricity to charge the vehicle is generated?**



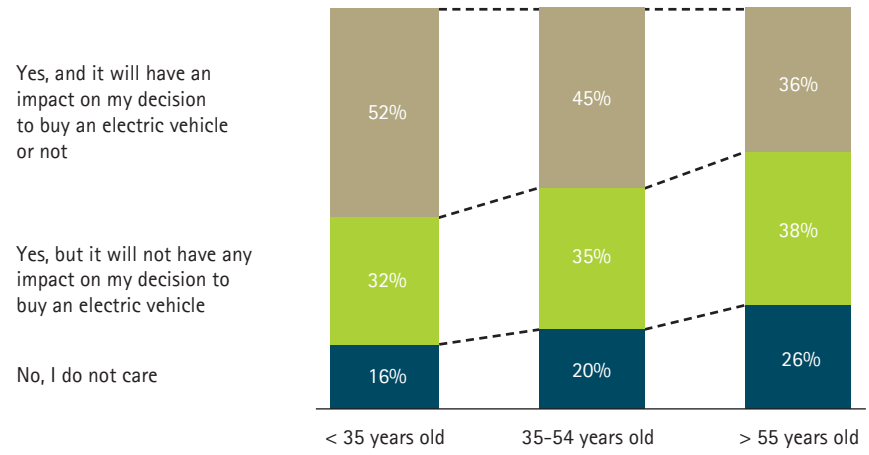

Base: All respondents.
Note: The term electric vehicle (EV) is defined as plug-in EVs (PEVs), including both full EVs and plug-in hybrid EVs (PHEVs).

## Younger drivers more concerned about fuel source

Our research shows that younger people are more motivated by the source of fuel in PEVs than older drivers (see Figure 15). More than half of those respondents under 35 years of age would want to know the source of the fuel powering their car, whereas barely more than a third of those older than 55 years of age have the same need. If utilities and charging service providers are able to satisfy the demands of this generation, early adoption patterns may shift accordingly.

**Figure 15. The age groups have different views on the importance of fuel source.**

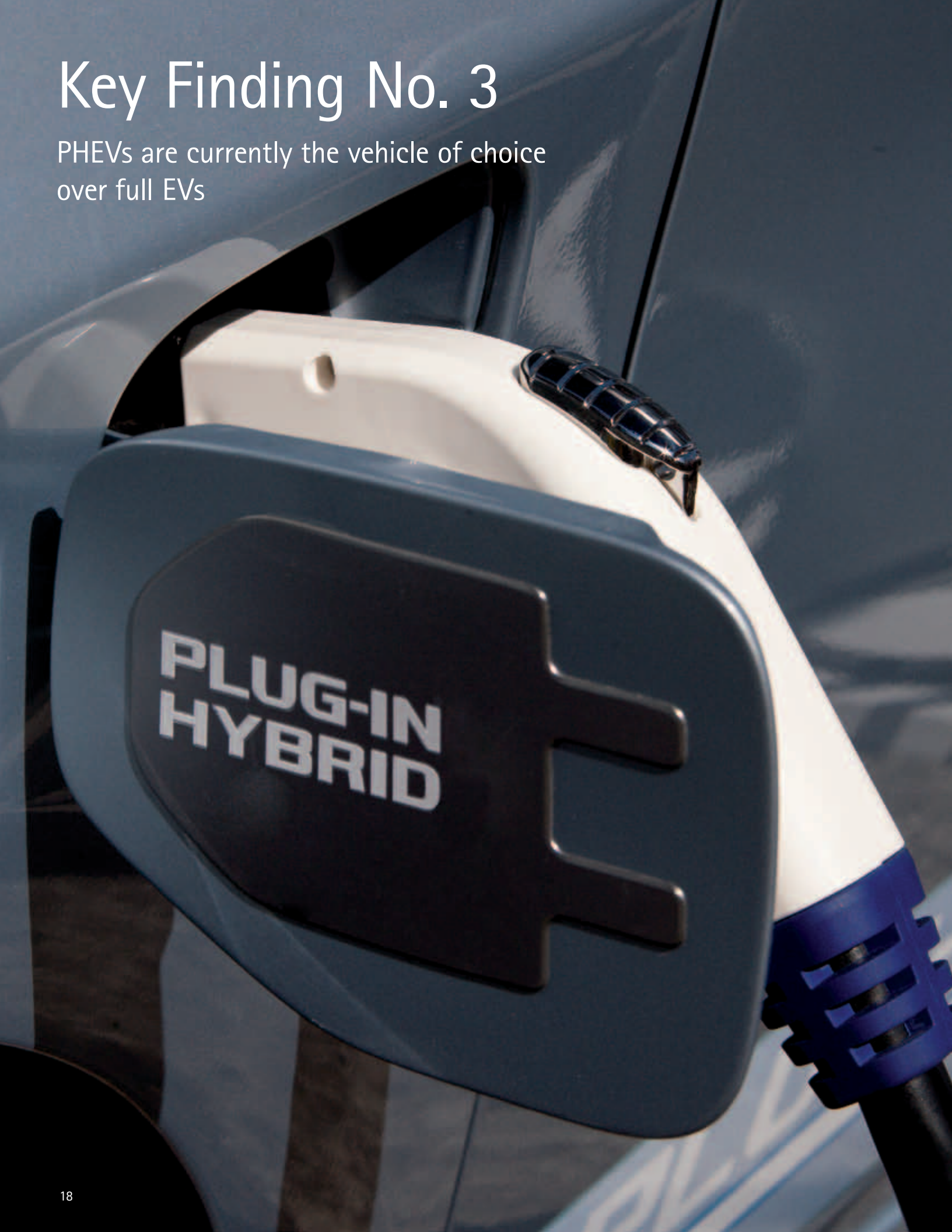
If you were considering buying an electric vehicle, would you want to know how the electricity to charge the vehicle is generated?




Base: All respondents.
Note: The term electric vehicle (EV) is defined as plug-in EVs (PEVs), including both full EVs and plug-in hybrid EVs (PHEVs).

# Key Finding No. 3

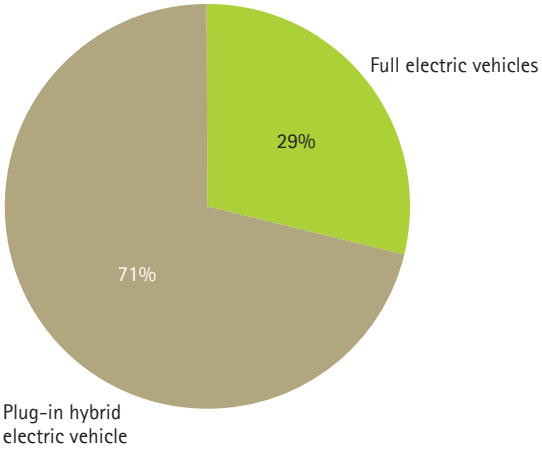
## PHEVs are currently the vehicle of choice over full EVs



The popularity of full EVs versus PHEVs will have an impact on supporting infrastructure. This survey reflects preferences based on consumer perceptions. Actual experience of using PEVs is likely to alter drivers' attitudes and choices. The results show that, today, PHEVs are clearly the PEV of choice.

More than two-thirds of car drivers would prefer to drive a PHEV rather than a full EV (see Figure 16). The reasons for this choice reflect the weighting consumers give to the various factors depicted in Figure 10—preference is largely a matter of perceived convenience.

**Figure 16. What is your preference between full electric vehicles and plug-in hybrid electric vehicles based on your current knowledge?**

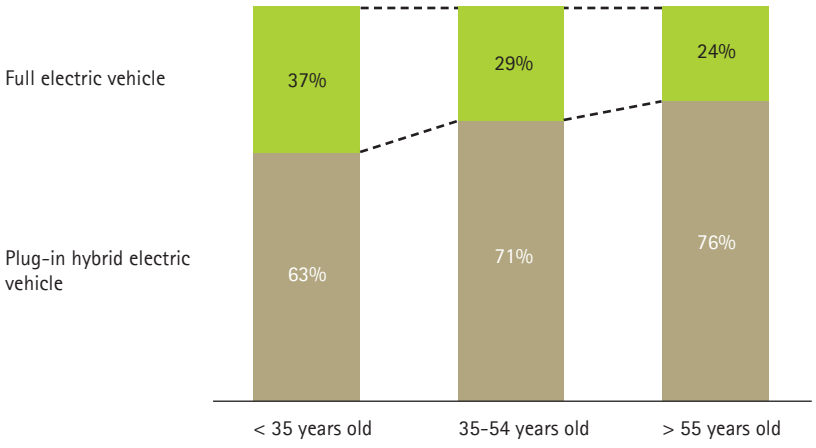



Base: All respondents

This overall preference for PHEVs does not, however, tell the full story. Automotive manufacturers, city authorities and utilities should look further into customer segments. For example, Figure 17 illustrates that those respondents younger than 35 years of age are more in favor of full EVs (37 percent) than those over 55 years of age (24 percent).

**Figure 17. The younger age group is more open to full EVs.**

What is your preference between full electric vehicles and plug-in hybrid electric vehicles based on your current knowledge?

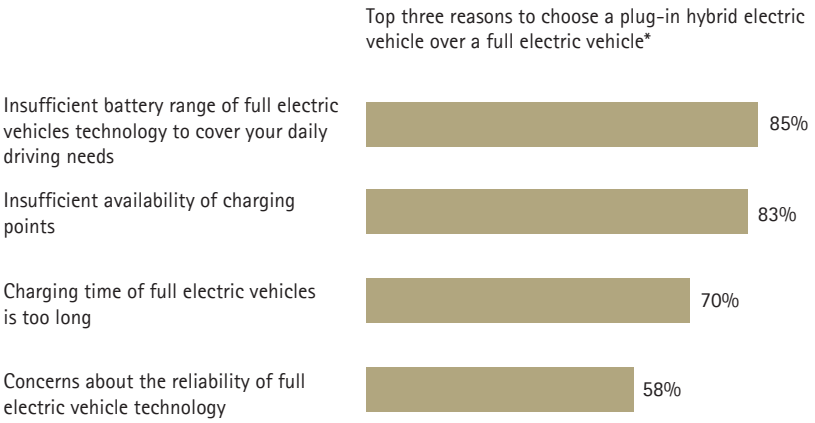



Base: All respondents

## Range anxiety and convenience drive bias toward PHEVs

Figure 18 illustrates that the primary reason to opt for PHEVs is the perceived insufficient battery range of full EVs (85 percent put this in their top three factors). The present insufficient availability of charging points comes a close second (83 percent). The perceived long charging time for full EVs is also an important issue.

**Figure 18. What would be the main reasons for you to choose a plug-in hybrid electric vehicle rather than a full electric vehicle?**



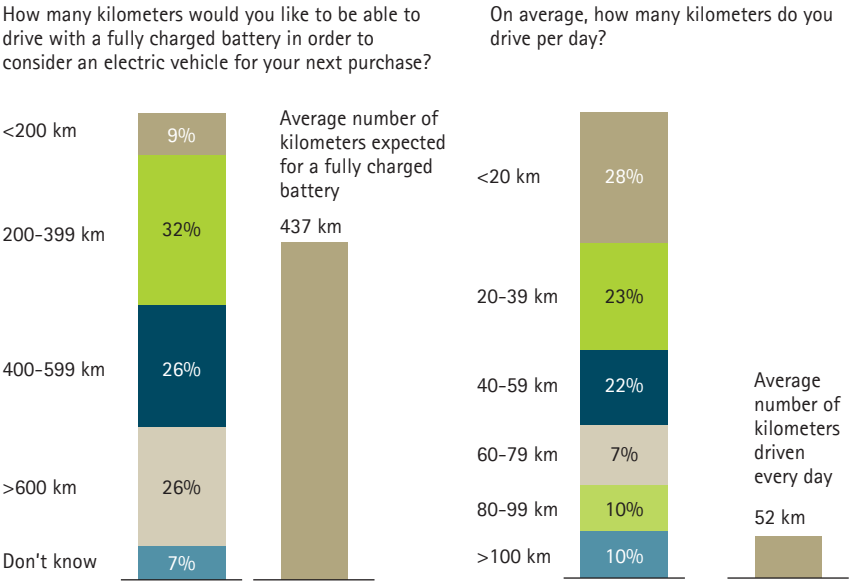

*All reasons appeared among respondents' top three

Base: All respondents

For further proof that range anxiety is the primary reason to choose a PHEV, Figure 19 illustrates that although the average consumer drives no more than 40 miles/60 kilometers (km) per day, more than half of the respondents (52 percent) say that to consider any form of PEV for their next purchase, that vehicle would need to offer a range of more than 400 km.

When we ask respondents to compare the attributes of PHEVs, full EVs and conventional cars, it becomes evident that consumers' preference for PHEVs comes in spite of some perceived relative weaknesses.

**Figure 19. What range would consumers want their electric vehicle to have, compared to their daily driving distance?**




Base: All respondents
Note: The term electric vehicle (EV) is defined as plug-in EVs (PEVs), including both full EVs and plug-in hybrid EVs (PHEVs).

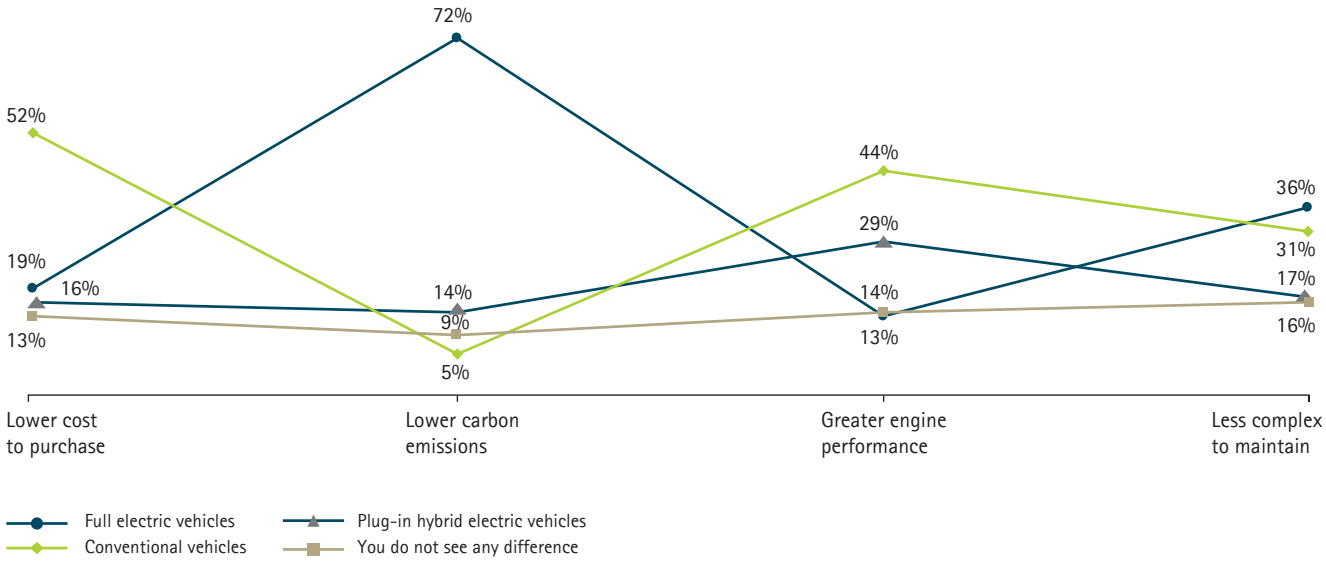
Base: All respondents excluding Don't know

As Figure 20 illustrates, consumers see little price difference between full EVs and PHEVs, even though PHEVs are in reality currently more expensive. In addition, consumers clearly believe that full EVs produce lower carbon emissions than PHEVs. That holds true if PHEV drivers regularly rely on their conventional engine once the battery runs low—behavior which is possible but by no means inevitable.

Respondents do not believe that either form of PEV has the engine performance of conventional cars. However, where 29 percent think PHEVs have the best engine performance of all vehicle types, only 14 percent think the same of full EVs. Meanwhile, full EVs are seen as the easiest to maintain, with PHEVs perceived as the most complex.

So while consumers may opt for PHEVS, they do so despite the widespread belief that they are similar in cost to full EVs, that they have less impact on emissions and that they are more complex to maintain.

**Figure 20. Thinking of the two types of electric vehicles and conventional vehicles, which would you expect to perform best in each of the following areas?**

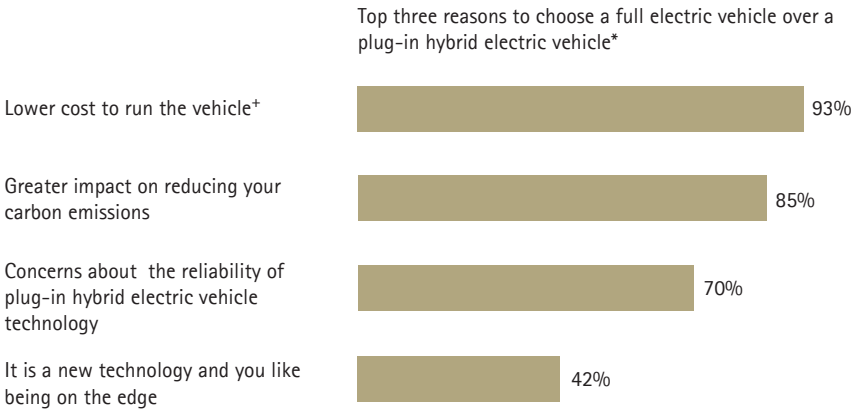



Base: All respondents
Note: The term electric vehicle (EV) is defined as plug-in EVs (PEVs), including both full EVs and plug-in hybrid EVs (PHEVs).

## Reasons to prefer full EVs

We then asked respondents to rate the main reasons why they might choose a full EV over a PHEV (see Figure 21). The primary reason is the lower cost of running the vehicle (93 percent put this in their top three factors) i.e., they only have to pay for electricity and not a mix of electricity and gasoline/diesel. Eighty-five percent point to the greater impact of reducing carbon emissions. A smaller proportion would be swayed by concerns over the reliability of PHEV technology and therefore appear to perceive PHEVs as possibly less reliable than full EVs.

**Figure 21. What would be the main reasons for you to choose a full electric vehicle rather than a plug-in hybrid electric vehicle?**

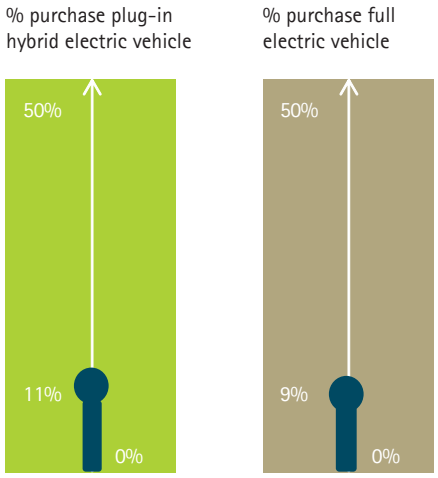



+Lower cost to run the vehicle, i.e., only have to pay for electricity, not a mix of electricity and gasoline/diesel
*All reasons appeared among respondents' top three

Base: All respondents

In addition to asking respondents to rank statements of preference, intent or opinion, we also presented various PEV options with varying fuel, cost and charging attributes (see Figure 22) and asked them to trade off between these options. Here, our analysis shows that, given a realistic set of attributes, consumers are more or less split between their preferences of PHEVs over full EVs than their earlier statements of intent indicate.

**Figure 22. Trading off plug-in hybrid vehicles and full electric vehicles.**




| | % purchase plug-in hybrid electric vehicle | % purchase full electric vehicle |
|---|---|---|
| Total cost (i.e., cost of purchase and maintenance) compared to a conventional car with the same level of performance | +20% | +15% |
| Cost of charging compared to filling the tank of a conventional car with the same level of performance | -20% | -50% |
| Charging time for an empty battery | 6 to 8 hours | 6 to 8 hours |
| Time when to charge | Whenever you need to | Whenever you need to |
| Availability of gasoline/diesel back-up | Yes | No |

Base: All respondents
Methodology notes: Results based on a conjoint analysis; analysis made on realistic scenario in terms of cost for PHEV and full EV.


POWER

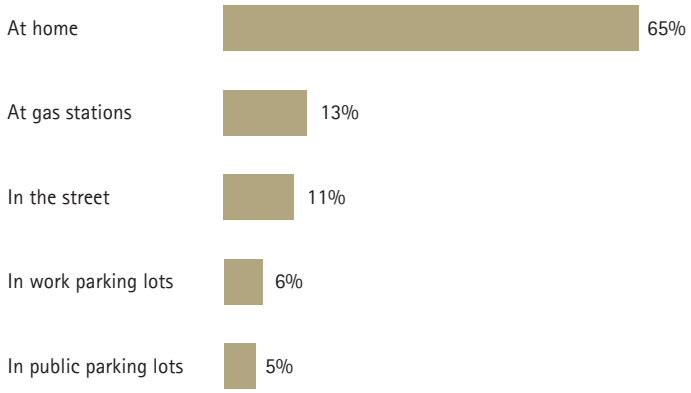
# Key Finding No. 4

## Consumers' preferences for charging could challenge infrastructure providers

One of the most important considerations for service providers is the management of demand to avoid peak loads and stress on the grid. The survey shows that ingrained consumer behaviors could hinder grid management. Convenience is a key factor for consumers. Driving-related behaviors will have implications for the location and type of charging and the ownership of the consumer relationship at the point of charging.

Two-thirds of respondents would prefer to charge at home, as illustrated in Figure 23. Other charging locations get a far smaller percentage of primary preferences, although when asking consumers to list their top three choices, charging at gasoline/diesel stations shows up well.

**Figure 23. Where would you most prefer to charge your electric vehicle?**

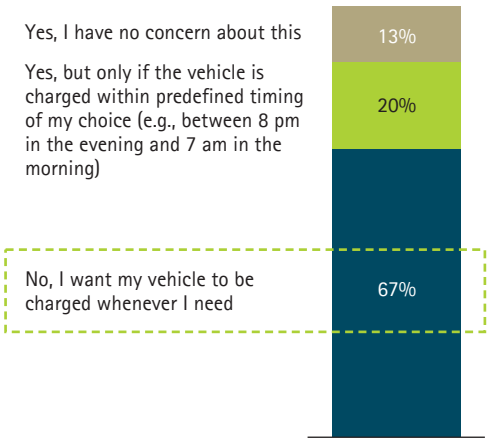



Base: All respondents
Note: The term electric vehicle (EV) is defined as plug-in EVs (PEVs), including both full EVs and plug-in hybrid EVs (PHEVs).

## Consumers want freedom over charging time

Figure 24 illustrates that more than two-thirds of consumers want to have total control over when they charge their vehicle. Only a third would be prepared to give up some or all control over precisely when they can charge their vehicle.

**Figure 24. Would you be willing for the charge point operator to determine when your vehicle can be charged?**




Base: All respondents

# Consumers prefer charging to battery swapping

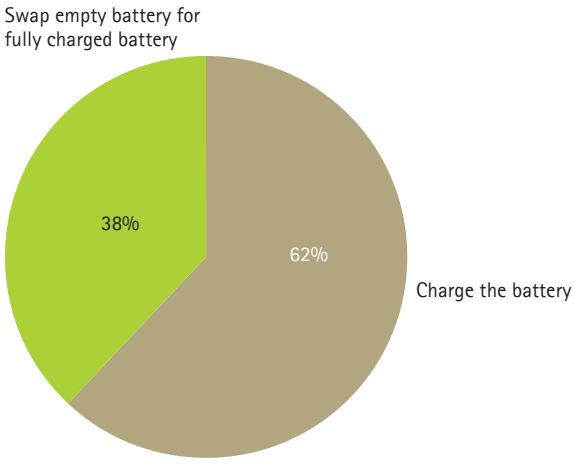
One way to alleviate the impact on the grid, at least of full EVs, is to maximize off-peak charging. The use of battery-swapping services in place of charging would allow service providers to recharge batteries off peak and off grid. However, our survey shows that 62 percent would prefer to charge rather than to swap their battery (see Figure 25). Younger people are more open to battery swapping: 42 percent of respondents younger than 35 years of age would prefer to swap batteries to charge vehicles, in comparison to 34 percent of those over the age of 55 years old.

Figure 25. How would you prefer to charge your electric vehicle?

Consumers may have the choice of charging or swapping their electric vehicle battery.

- With battery swapping, you would have to drive to a service station where your existing battery is replaced by a fully charged battery, taking a few minutes.
- With charging, you would have to plug the car to a charging point. This will take longer than swapping, but you can charge up when the car is parked at any number of charging points, and your battery remains untouched.

How would you prefer to charge your electric vehicle?

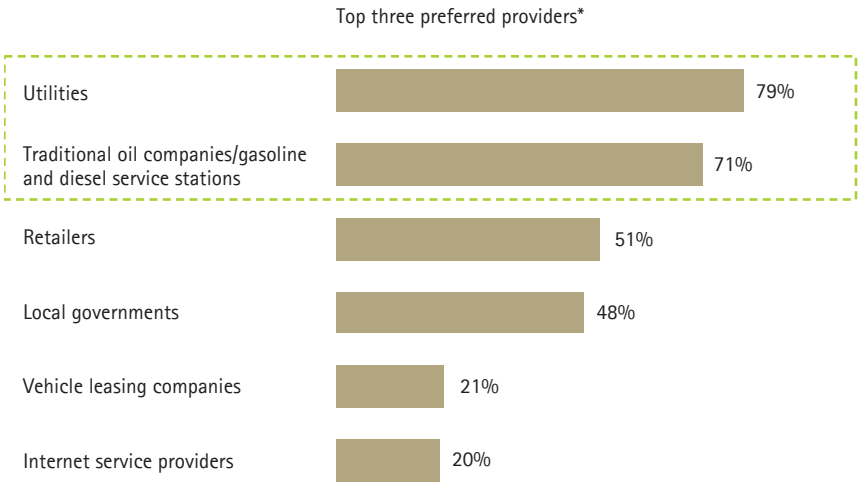



Base: All respondents
Note: The term electric vehicle (EV) is defined as plug-in EVs (PEVs), including both full EVs and plug-in hybrid EVs (PHEVs).

## Competition for the customer

There is mixed evidence for utilities and the role consumers expect they will play in the provision of charging services. When we asked respondents who they would prefer to buy charging services from, the majority prefers utilities. Seventy-nine percent of respondents put utilities in their top three choices (see Figure 26); however, utilities have their work cut out. Traditional oil companies/gasoline and diesel service stations come a close second, with retailers and even local governments commanding the support of half of respondents.

Figure 26. Who would you prefer buying charging services from?

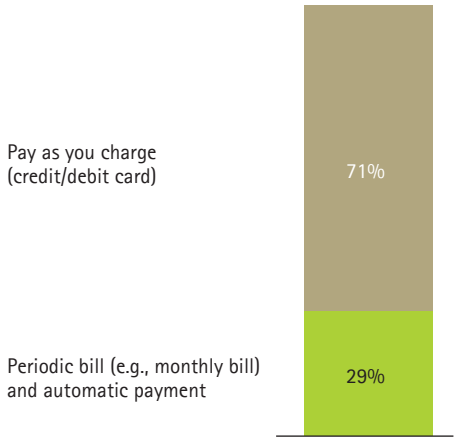



*All providers appeared among respondents' top three

Base: All respondents
Note: The term electric vehicle (EV) is defined as plug-in EVs (PEVs), including both full EVs and plug-in hybrid EVs (PHEVs).

Consumers also prefer to pay as they charge their vehicles, using credit or debit cards (see Figure 27). Less than a third would opt for a periodic bill. This could be a challenge for utilities and an opportunity for new-entrant charging service providers. When the complexity of roaming networks for charging are taken into account, utilities' ability to maintain a consumer relationship at the point of charging looks increasingly challenging.

Figure 27. How would you prefer to pay for the charging of an electric vehicle?




Base: All respondents
Note: The term electric vehicle (EV) is defined as plug-in EVs (PEVs), including both full EVs and plug-in hybrid EVs (PHEVs).

# Changing perceptions

## An interpretation of the findings

Our survey's four key findings demonstrate that although respondents are well-disposed to PEVs, their current driving experiences are setting expectations and perceptions that could be difficult to reconcile with changes in consumer behaviors conducive to the effective management of infrastructure.

In summary:

- Consumers are broadly open to purchasing and driving PEVs, but this support is not universal.
- The cost of purchasing a PEV is not currently the only key factor of adoption.
- Consumers currently prefer PHEVs to full EVs, as PHEVs would require fewer changes to current habits and levels of convenience.
- Consumers' charging preferences could pose challenges to sustainable PEV business models.

## Purchase cost: Not the leading motivator today, but could be tomorrow

The industry regards the high cost of purchasing PEVs as a major barrier to adoption. Governments in many markets are offering subsidies to neutralize the costs of batteries, which account for a large proportion of PEV cost due to the relatively immature capabilities in mass producing reliable and long-lasting batteries. US consumers benefit from a maximum tax credit of $7,500[3] to reduce the cost of their purchase. UK consumers are being offered £5,000 (almost US$8,000).[4]

Our survey, however, suggests that the level of purchase price is currently not consumers' only concern. The factors that would most influence purchase decisions for PEVs are the cost of charging, time to charge and vehicle driving range. Our interpretation of the survey results is that consumers' current preoccupations with factors beyond purchase cost reflect their understandable lack of knowledge and experience of PEVs and their financial and practical implications.

The relative importance of factors other than purchase price should not give comfort to battery and automotive manufacturers. Accenture's view is that a convergence of greater PEV availability and better knowledge will result in total cost of ownership becoming a more significant purchase decision factor. Consequently, the cost of battery technology needs to be driven down to coincide with a time in the not too distant future when more knowledgeable consumers will begin to place purchase cost at the forefront of their minds and when public subsidies may no longer be so generous.

## Preference for PHEVs

Consumers overwhelmingly state that they favor PHEVs over full EVs. PHEVs demand less of a leap of faith on the part of consumers. The back-up gasoline/diesel engine neutralizes range anxiety and allows drivers to enjoy a similar driving and "tank-filling" experience as they do with conventional cars. Until battery range improves and charging facilities become ubiquitous, it is possible that PHEVs will remain consumers' preference. PHEVs appear to provide consumers with a practical transition from today's conventional cars.

The competition between PHEVs and EVs, however, is not merely a question of technology or charging availability. The current status of preference reflects today's perceptions rather than experience. When short-range drivers (e.g., those in urban areas) get behind the wheel of PEVs, their preferences may change. Nevertheless, we anticipate that the market segment for PHEVs could be larger than for full EVs for the foreseeable future, although fiscal incentives and driving needs may push the outcome in favor of full EVs in some localities.

## Charging preferences challenge infrastructure and service providers

The competition between PHEVs and full EVs is not the only factor determining the scale of the challenge for infrastructure and service providers. Whether PHEVs or full EVs are on the road, consumers' charging preferences will require careful demand and grid management.

Consumers have clear expectations of how to run and maintain their PEVs. They want to charge at home and be free to charge at a time that suits them. They prefer to purchase a car and battery instead of leasing them. They are not in favor of battery swapping. These preferences show that consumers highly prize convenience and freedom. And these choices are not necessarily conducive to effective and affordable grid management or charging provision.

## A chance to change perceptions

There is, however, a chance to change perceptions. The majority of consumers drive short distances most days (refer to Figure 19). Most urban dwellers could cover their usual commuting journeys and errands without having to go out of their way to charge. Once drivers experience using full EVs, it is likely that their other current concerns may become less important; battery swapping may become more convenient than charging overnight. Leasing may become preferable, and paying for fuel via a utility bill may appear more convenient than paying via debit cards at gasoline and diesel service stations. Throw in local incentives, such as parking concessions, and the consumer mindset could shift toward full EVs sooner than expected. These possible shifts could also encourage consumers to switch from conventional vehicles to PHEVs.

Our recent research of PEV pilots reveals that, although many trials have further to go, drivers do change their prejudices and attitudes toward PEVs once they are given the keys to them.[5] As a result, PEV pilots are critical. While their current focus is predominantly on issues of technology, they will have to become more focused on the consumer experience in the future. A pilot's primary focus should be to influence a consumer mind shift by exposing false assumptions, lowering psychological barriers to new behaviors and introducing incentives that help manage demand.

# Hedging bets

## Implications and recommendations for industry participants

It is unclear how popular PEVs will be and whether PHEVs or full EVs will dominate. Some automotive manufacturers have begun to "place their bets," while other industry participants are biding their time. Whatever the outcome in the split between PHEVs and full EVs, and however strong the overall adoption of PEVs, infrastructure and service providers will have to plan their investments carefully. For many prospective investors at this stage, it is a question of hedging bets and minimizing risks. The following recommendations can help industry participants enter the nascent market and plan investments while mitigating risks.

# Utilities

Utilities stand to gain from the adoption of PEVs. As incumbent electricity retailers, they can extend their customer relationships on the back of PEV-related services. Utilities are already in consumers' top choices for preferred charging service providers (refer to Figure 26).

However, they face a threat from emerging competitors. Our recent survey, *Revealing the values of the new energy consumer*,[6] shows that 73 percent of consumers would consider buying electricity, energy-efficient products and related services from a provider other than their electricity supplier. For instance, 59 percent of respondents would buy such services from retailers. As the consumer electricity market diversifies and becomes less commoditized, alternative consumer brands could successfully exploit PEVs to enter the electricity retail market via relationships with distribution network operators (DNOs) and charging service providers.

Meanwhile, utilities must ask themselves what retail revenues they can expect to earn from PEVs. Charging costs will likely be less per mile/kilometer than the cost of gasoline/diesel, and utilities may need to incentivize off-peak charging with discounted tariffs at night. Against the cost of infrastructure, PEV charging revenues could therefore result in modest margins. On the other hand, revenues could be improved if demand management was achieved through premium pricing to deter consumers from peak-time charging, rather than through discounting to pull them. Utilities could also generate new revenue streams by offering premium fast charging. They could cross-sell value-added services from PEV offerings in conjunction with smart home providers or by linking up with automotive manufacturers to offer "e-mobility" services, such as the provision of real-time information on charging point availability.

Utilities could also benefit from the lower cost of power generation, whether or not they are in a vertically integrated or unbundled market. If nighttime charging becomes the norm, utilization rates for otherwise unused base load capacity will rise. Returns on wind generation could also be maximized. This, in turn, would keep a lid on the cost of electricity generation.

DNOs, the utilities businesses that provide and maintain electricity grid infrastructure, play a crucial role between the customer-facing players and generators. As the PEV market evolves, DNOs will need to effectively manage this dynamic to balance demand and supply and to mitigate strain on the grid.

PEVs are not the only new burden on the distribution network. A range of new power-hungry devices are also emerging, as are new sources of distributed generation capacity, residential power generation and storage systems. DNOs must improve their understanding of the impacts of these converging demands on the grid and prepare to optimize the grid accordingly.

## Reach consumers beyond the traditional utilities marketplace

The arrival of PEVs in car showrooms will extend the point of sale for electricity services beyond utilities' traditional marketplace. Alternative consumer brands and charging service providers could therefore compete for customers as they buy PEVs. Utilities must actively position themselves at the forefront of the PEV consumer proposition. And they start from a strong base: our survey shows that utilities are consumers' preferred charging service providers (79 percent putting them in their top three choices).

• Utilities should consider establishing commercial alliances between their retail operations and the automotive industry (including its retail networks) to exploit their incumbent advantage. They should also forge agreements with fleet owners, such as delivery companies and taxi networks. Working together, both parties can benefit from offering a more comprehensive one-stop-shop package at the point of sale, combining cars and charging services. With the outlook uncertain, collaboration would give electricity retailers an accurate market pulse to monitor, helping them respond to consumer trends and mitigate risks.

• Utilities should exploit the lack of consumer knowledge about PEVs to their advantage. Our survey tells us that 70 percent of consumers either do not understand PEVs or need to know more before they can consider them when making their next car purchase. Utilities are already planning for a transition in their customer relationships, thanks to the emergence of smart meters and the energy-efficiency agenda. PEVs will add to this transition and, while it offers new opportunities, it also demands major investment in new processes and capabilities that underpin a more consumer-oriented business model. Consumers have never expected utilities to be specialists in domestic appliances such as refrigerator freezers or flat-screen televisions, but they will likely demand such specialist expertise in relation to PEVs, given their need to understand the impact of driving and charging habits on their electricity consumption.

By developing specialist knowledge and capabilities oriented toward the automotive sector, utilities' retail businesses can improve their understanding of consumer adoption and make investment decisions more quickly. Part of the solution will lie in creating partnerships with different parts of the automotive industry—from car manufacturers and dealerships, through to networks of car maintenance service providers.

## Engage with consumers through market segmentation and consumer-oriented PEV pilots

The uncertainty of consumer behaviors with PEVs requires utilities to improve their understanding of consumer preferences. As they consider incentives to encourage drivers to switch to PEVs and adopt certain charging habits, a shift in the focus of pilots will be necessary in some circumstances.

• Utility retail operations will need to identify consumer segments and target them appropriately to drive adoption in commercially viable ways. Our survey shows that different segments of the market register varying levels of concerns and priorities. Their preferences are sometimes counterintuitive. For example, younger people have a greater need to know the fuel source behind the electricity powering their cars (refer to Figure 15), but they would be less discouraged by nuclear power or fossil-fueled electricity than older car drivers. That would indicate a need for transparency rather than a need for a shift in fuel mix. Younger drivers in urban areas may also be more concerned about the availability of parking concessions than about the price of charging. Once utilities have identified these segments and preferences, they will need to target messages more accurately, carve out competitive niche offerings with higher margin consumers and invest appropriately to deliver those services.

• Utility retail operations and DNOs will have to actively shift PEV pilots from a technology focus to the consumer experience if they are to respond to consumer preferences and to mitigate any negative impact of charging intentions on grid infrastructure. Our recent study of PEV pilots[7] demonstrates that technology and technology integration are often the priorities of these pilots.[8] In future, pilots should give greater weight to the testing of assumptions on charging preferences, billing requirements and tariff options.

## Consider role as charging service provider

The market will see the emergence of charge point service providers independent of electricity utilities. These providers could cut incumbent utilities from the PEV market, especially if they applied alternative payment solutions (such as through mobile phone bills, prepaid cards or pay-as-you-go options).

• Utilities currently have the incumbent advantage, but where 79 percent of consumers count them as their first choice for charging service providers, gasoline and diesel service stations are close behind at 71 percent (refer to Figure 26). Half of respondents selected retailers as their third choice. Utilities will have to position themselves to expand their customer relationships by using PEV services to offer greater value to the market. They must make the decision to form alliances with independent charging service providers or to act as charging service providers themselves, working in partnership with the charging point operators, which will be responsible for building and providing the infrastructure. In some markets, utilities may also have to consider whether to play the role of charging point operators, should infrastructure providers not be forthcoming.

## Optimize infrastructure through closer collaboration between utility retail and distribution network operations

The uncertainty about the speed and nature of PEV adoption may explain why some utilities are hedging their bets. In the next 10 years, the volume of PEVs is expected to be modest. There will, however, be local clusters that require greater grid support, even in the short term. The uncertain pattern of adoption beyond that could either result in strain on the grid in some hot spots or the risk of financially unviable investment to support less-clustered demand in others (as stated in Accenture's report, *Changing the game: plug-in electric vehicle pilots*[9]).

The different interests of utility retail arms and network operators will have to be addressed. Utility retailers aim to optimize their cost base by limiting peak demand and associated electricity costs. DNOs maintain an interest in mitigating congestion on the grid. It is in both parties' interests to work together to maximize the use of lower cost power and to optimize grid capacity management. Where the utility is also a generator of renewable energy, the use of renewable energy at given time frames needs to be optimized, requiring the utility retail business and DNO to work closely together, whether in a vertically integrated or unbundled market.

• DNOs should consider the impact of PEVs in the context of a rise in demand for other power-hungry applications. For instance, the emergence of PEVs will coincide with the rise in demand for air conditioning in buildings in some markets, the growth in domestic power generation and more localized forms of electricity storage. The grid will face not just greater demands for capacity, but more variable and greater two-way flows of energy. While the core high-voltage networks can cope, the local low-voltage networks will be more vulnerable. DNOs must work with utility retail businesses to improve their visibility of these new demands on the grid, ensuring that PEVs are not considered in isolation. Collaboration should focus on studying local hot spots and monitoring patterns of consumer demand.

• DNOs will have to influence utility retail arms to reduce grid congestion. Our view is that retail tariff incentives will not play a major part in driving off-peak demand in the short term. If the cost of charging a PEV is low relative to filling the tank of a conventional car, price differentials for charging may not be large enough to significantly alter behaviors. More important is the need to prepare the way for smart charging, whereby PEVs are automatically charged at speeds and times that are optimal for the grid, within boundaries set by the service provider and the customer. DNOs can influence retailers through local marginal prices for distribution that encourage retailers to offer consumer incentives that displace peak demand and reduce grid congestion. DNOs must therefore develop optimization capabilities and interact with multiple parties in the ecosystem. They will also have to deploy a range of technologies to boost grid capacity in some areas and to improve real-time monitoring of charging demand.

• DNOs should make use of analytics solutions to aid long-term grid investment planning. Analytics solutions help exploit consumer usage and network data to better determine future patterns of demand and supply. Analytics can be also be used to improve short-term management and performance of infrastructure by harnessing several data types including the flow of power in the grid, the condition and behavior of assets and network incidents.

# Infrastructure players

Charging infrastructure players are responsible for developing and installing charging infrastructure, which could extend to metering and billing solutions. The market is in its infancy and will develop in terms of its functionality and interoperability. It is currently unclear what topology of charging networks will be required. Their density, their capabilities (for fast or slow charging) and their payment functions will all depend on the rate and nature of PEV adoption and on the players that enter the service market.

Infrastructure is complex and expensive to deploy and, given the uncertainty of charging demand, the infrastructure will have to be flexible and future-proofed to cope with changes in consumer requirements and unpredictable rates of growth.

## Evaluate charging service models

Infrastructure providers will have to consider the commercial viability of various charging service models. They will also need to evaluate whether they can successfully offer retail services in addition to wholesale charging.

- There are three main business models for charging services and service providers will need to consider which play best to their strengths and financial positions.[10] The costs, returns and grid impacts will differ between these models. Charging service operators that build and provide the charging infrastructure will need to assess the topology and timing of their investments in these models.

The provision of public infrastructure in streets and public spaces will be driven by municipalities and will act as a market starter. It will require significant upfront investment but usage is likely to be unpredictable. As such, this model will be primarily driven by municipalities and may require an extended payback period. The private infrastructure model will seek a return. Centered on home charging, but also including private sites such as office parking lots and service stations, the model will likely result in a range of premium services, such as fast charging. It will also likely exploit off-grid charging. The end-to-end model will offer consumers a single point of contact and package vehicle purchase, charging and maintenance in a monthly service fee. This model disaggregates the cost of the battery from the vehicle purchase cost and will likely depend on battery swapping and off-grid charging.

- Charging infrastructure providers and operators should evaluate the retail versus wholesale charging opportunity. Charging service providers will either acquire or lease the infrastructure from charging operators to offer services to the public. But equally, charging infrastructure providers/operators

themselves could opt for a consumer-facing business model, either in the form of residential or public charging services. Consumer preferences could pose challenges. For instance, our survey shows that 65 percent of consumers would most prefer to charge at home (refer to Figure 23). The eventual balance between public and residential charging will be unclear for many years to come, but the requirements for the equipment will be very different between the two. Charging infrastructure providers must make their choices and prepare their capabilities. Will they be consumer-facing providers, or will they only serve charging service providers?

## Optimize charging infrastructure models

Our survey and previous Accenture research reveal preferences about where consumers want to charge their PEVs. The availability of home charging could accelerate adoption of PEVs, but public charging points will also play an important role in supporting adoption and more needs to be done to improve their viability.

- Lowering the cost of public charging infrastructure will be required to improve the business model for local governments that are to provide it. Our recent report on PEV pilots[11] demonstrated that the lack of appetite for using public charging points could weaken the business case for such public sector-led investments. And the survey carried out for this report shows that consumers will prefer to charge at home (this is the case in most countries except Italy, Germany, Spain, South Korea and China—refer to Figure 23). Charging infrastructure providers will have to reduce the cost of public infrastructure charging to improve the viability of services and to encourage increased use.

Infrastructure providers should exploit opportunities to improve the appeal and viability of public infrastructure. For instance, many drivers will be unable to charge at home and short battery ranges will require charging "top ups" away from home. Some employer and fleet parking and charging facilities may be limited, offering an opportunity for public infrastructure to expand its appeal and relevance.

- For home charging, it is clear that, technically, slow charging for PHEVs could require less infrastructure support than fast charging for full EVs (the former requires lower voltage than the latter). Relatively simple upgrades to residential electricity supplies can be made with little cost to enable slow charging at home. The challenge, however, is not so much the voltage requirement for fast or slow charging, but the control over the grid. Even with low-voltage residential PHEV charging, the industry will have to work with utilities' retail arms to develop optimal residential charging units as well as technology that enables the rest of the value chain to monitor patterns of demand and offer affordable and appropriate charging solutions for various segments of the market.

## Drive standards to boost roaming and reduce costs

DNOs and infrastructure providers must work with their competitors, utility retail operations and standards bodies to establish common policies and standards regarding electric vehicle services equipment (EVSEs)—i.e., connection points and meters.

- From state to state in the United States, or across the continent of Europe, a single interoperable connector will be critical if the industry is to support roaming. In the United States, progress has been made on connector standards. But it is not yet certain whether a driver from Madrid can be sure of finding a compatible charging unit in Paris, and this could increase investment risk. For roaming between charging providers or across national borders, standards are also needed to enable billing. Authentication, authorization and accounting protocols will be required.

# Gasoline/diesel station retailers

The traditional gasoline/diesel station has an opportunity to exploit its incumbent status as the place where consumers fill their tank. As per Figure 26, 71 percent of survey respondents listed gasoline/diesel stations as their second choice of charging service provider, just behind the leading contender, utilities. And if PHEVs dominate adoption in the next decade, the disruption to their market will be minimized. However, it is clear that charging points will be deployed in multiple locations, taking cars and retail opportunities away from gasoline/diesel stations for the first time. Gasoline/diesel station retailers will have to monitor demand for charging to understand the threats and opportunities posed by PEVs.

## Evaluate the market opportunity for fast charging

To satisfy PEV drivers, gasoline/diesel stations will need to invest in fast charging. A 20- to 30-minute charge is currently possible for full EVs, and that time will inevitably fall. But gasoline/diesel stations are limited to fast charging, which requires heavy investment, with costs for charging units currently in the realm of $50,000 per unit. Added to the costs are safety issues. Dual-fuel locations will require significant investment to comply with safety standards. On the other hand, the fast-charging model could fit well with the retail forecourt experience, providing more opportunities for dining and other services. Moreover, when asked why they would prefer to buy a PHEV rather than a full EV, 70 percent of consumers say that charging for full EVs is too long. There is clearly a market to satisfy and fast charging provides opportunities for premium pricing.

## Explore the opportunity for the battery swapping market

Our survey shows that consumers are less interested in battery swapping than charging, with 38 percent of respondents opting (refer to Figure 25). However, there is clearly an opportunity for this niche to establish itself. The battery-swapping experience can be quick and will become quicker. The gasoline/diesel station forecourt is therefore an ideal location for battery swapping, given that retail and automotive services are already well-established there. Competing gasoline/diesel station networks could strike distinct and innovative partnerships with battery-swap operators to create a strong competitive advantage.

# Service providers

A range of service providers will enter the market—including direct providers such as battery service operators, and secondary service providers such as online brands and telecommunications operators. The latter are already forging relationships with DNOs, given their role in smart grids and smart meters, which require communications networks to exchange real-time data on grid performance and consumption. Secondary providers have both consumer and business-to-business opportunities to exploit.

## Develop cross-industry partnerships to offer value-added, business-to-business services

Service companies have the opportunity to offer a range of integrated services by striking cross-industry partnerships. The provision of parking and tariff information, route and navigation services, as well as payment and differentiated charging services could reward various members of the supply chain with higher margins and greater customer loyalty.

- Telecommunications and IT companies can offer a range of back-end solutions based on the provision of communications networks connecting charging infrastructure. This could include asset management services to charging operators. They could also provide car identity and geographic information systems (GIS) to help identify PEVs as they connect to charging posts and reconcile charging costs with car drivers. Tracking and car identity solutions will also enable roaming between charging operators and will support the real-time management and prediction of charging demand, helping grid management. Some car manufacturers are already embedding such technology in their vehicles to automate the information connection between PEVs and the grid and charging networks. These early in-vehicle systems could lock out telecommunications operators and hardware manufacturers unless the telecommunications sector builds on its core infrastructure role.

- Telecommunications and IT companies need to establish which part of the value chain they wish to play in and develop strategies to achieve their chosen models. Some will be in a position to develop their own software solutions. Others may need to consider joint ventures and partnerships within and outside the industry, as well as acquisitions of specialist players.

## Create value-added consumer services by exploiting industry strengths

Service providers, such as mobile telecommunications companies, have an opportunity to offer value-added services to consumers. Accenture's report, *Revealing the values of the new energy consumer*,[12] indicates that consumers are already well-disposed to buying electricity services from telecommunications players.

- Telecommunications companies should exploit their brand appeal and roaming expertise by partnering with charging operators on a national and international basis. The telecommunications model for network roaming makes mobile brands ideally suited to offer billing and consumer-facing services, cutting out the retail arms of electricity utilities.

- Mobile phone and technology companies have an opportunity to offer on board valued-added services to improve the consumer experience for drivers of PEVs. Phone applications ("apps") could provide the location of charging stations to drivers in unfamiliar territory, or help drivers use particular charging networks that offer loyalty rewards and discounts. They could provide consumers with information on the fuel source for electricity by charging station. Mobile network or device brands will be able to create customer "stickiness" (that is, loyalty) through such innovations or use them to improve their value and distinctiveness to charging operators.

## Evaluate charging service models

For charging service providers, the consumer-facing companies offering charging and billing services, choices need to be made as to whether they will establish a position in one or more of the three main business models for charging services.

- As previously stated, the three main business models are public infrastructure charging, driven by municipalities; private infrastructure charging, including home charging; and end-to-end charging, with customers subscribing to a comprehensive service package instead of purchasing a PEV. Players entering the market will have to evaluate consumer preferences, incentives and driving requirements on a local basis to determine which model delivers reasonable commercial returns. Participation in and monitoring of pilots will be a crucial part of this evaluation.

# Metropolitan and central governments

City authorities are playing one of the most important roles in the emergence of PEVs. The key challenge with the PEV phenomenon is not technology, but consumer behavior and psychology. We have identified the need for a mind shift in consumers with regards to their prejudices, attitudes and assumptions about PEVs.

For example, if the political goal of a city authority is to rapidly reduce carbon emissions, high adoption of PEVs will require local political intervention. City authorities are certainly best-positioned to coordinate multiple parties in the rollout of PEVs and PEV infrastructure, and we already see this in existing pilots. Accenture's recent report, *Changing the game: plug-in electric vehicle pilots,* refers to examples involving the city authorities, including those of San Francisco, Amsterdam, Newcastle and Vancouver.[13] One of local government's most valuable roles will be to engage with local residents to encourage a transformation in behavior. In the longer term, city authorities should consider their exit strategies to allow the market to take over once PEVs are firmly established.

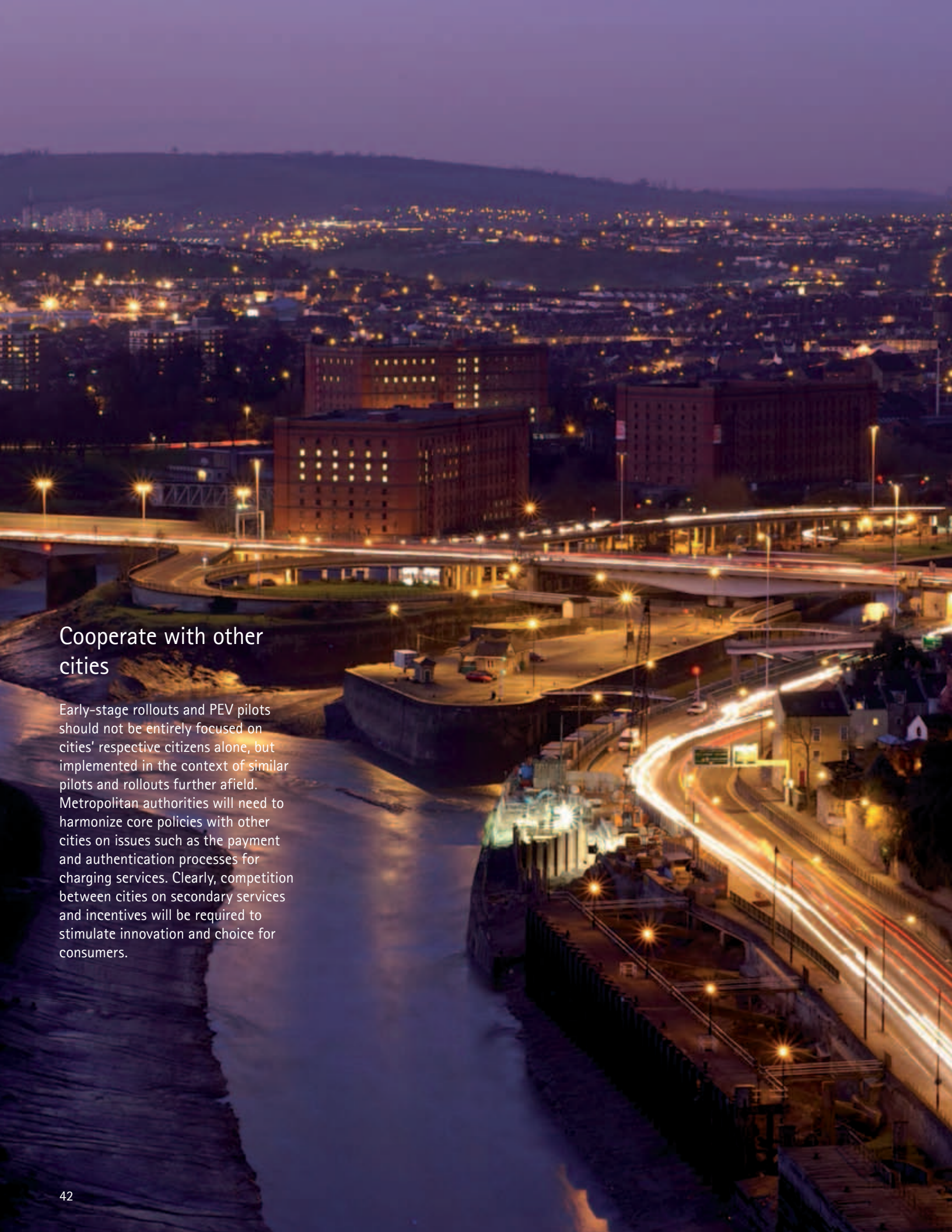
EV implementations can form part of intelligent city strategies that embed electrification of transport into the wider context of comprehensive urban infrastructure programs. These programs can then integrate all relevant domains within the local administration—from traffic management and buildings to natural resource management—to improve the effectiveness of an EV initiative.

## Implement nonfinancial incentives

Our survey shows that, although financial considerations are important, other factors will also play a major role in determining the speed and nature of PEV adoption. City authorities must segment their own market of residents and implement targeted incentives. For instance, the provision of greater public parking facilities or free parking might encourage young urban dwellers. The fuel mix behind local electricity generation may or may not be important for certain geographic or demographic groups. And the balance between home and public charging can best be manipulated by municipalities.

## Track consumer engagement

Figure 7 illustrates that consumer intentions to buy PEVs is stronger for the next three years than in the period beyond that. This may reflect consumer uncertainty, but this uncertainty, combined with the other consumer perceptions and preferences, raises some questions about the commitment to subsidies and to research funding by governments. Policymakers must ensure that taxpayer money (local or national) is seen to be spent wisely and proportionately in relation to the local level of consumer interest in PEVs. Local subsidies and incentives can change over time to respond to the changing nature of prices and consumer adoption. Policymakers must therefore track consumer engagement to ensure that support and incentives are locally relevant and, where appropriate, targeted to segmented consumer groups.



## Cooperate with other cities

Early-stage rollouts and PEV pilots should not be entirely focused on cities' respective citizens alone, but implemented in the context of similar pilots and rollouts further afield. Metropolitan authorities will need to harmonize core policies with other cities on issues such as the payment and authentication processes for charging services. Clearly, competition between cities on secondary services and incentives will be required to stimulate innovation and choice for consumers.

# Regulators

The investments required for charging infrastructure are currently uncertain but likely to be very significant in the future. We have already referred to the opportunity for various players to compete for consumers in the charging service market.

The mixture of public and private sector charging services and infrastructures will support choice and innovation. Regulators will need to play a role as the market develops, but Accenture's view is that definitive regulation would be premature for many years. Competition rules could stifle innovation at this stage. Nevertheless, regulators should act in the following areas:

## Standardization

Standards are emerging in some areas in some markets; for instance, the utilities and automotive industries are working with bodies such as the National Institute for Standards and Technology (NIST) and other bodies in the United States.[14] More needs to be done in the short term to ensure that charging points are interoperable, at least in regional markets such as Europe, where roaming would otherwise be impossible. Telecommunications standards are required to connect charging networks to competing utility systems or for cars to communicate with charging points. Regulators will also need to encourage standards bodies to accelerate the pace of standards processes.

## Open access rules

Aside from standards, rules will be required to ensure open competition. In the early stages, charging service operators and infrastructure owners must be compelled to provide open and equal access to charging service providers entering the market. Rules may be also required for the longer term to enable value-added services to be provided by new layers of service provider in the future.

## Define the division of responsibilities between market participants

It is currently unclear what division of responsibilities will arise between DNOs, retailers and charging point operators. This division is likely to vary from country to country. But it is important that regulatory settlements for DNOs and retailers define how these responsibilities interact with each other to ensure that grid investment is aligned to the demand for PEVs.

Another key consideration that DNOs should encourage regulators to address is who will control issues relating to congestion on the network. Utility retail businesses or charging operators could exploit congestion to charge higher prices and generate higher margins, contrary to the interests of DNOs. As previously stated, the emergence of many new sources of supply and demand on the network mean that PEVs cannot be considered in isolation on this question.

# Summary of implications and recommendations

## Utilities (retail operations)

### Alternative providers compete for electricity customers at PEV point of sale

- Consider commercial alliances with the automotive industry and its retail network

### Consumers have little PEV knowledge

- Develop PEV-related customer care capabilities in partnership with the automotive industry where necessary

### Uncertain patterns of adoption and charging demand

- Engage with consumers through PEV pilots that shift focus from technology to the consumer experience
- Segment the market to satisfy different consumer needs

### Consumers are sensitive to the fuel source of electricity

- Engage with consumers through education, working with power generators
- Consider options for offering fuel source-specific charging services

## Utilities (distribution network operators)

### Uncertain impact of PEV charging on the grid

- Work with utility retail operations to improve visibility of PEV demand
- Assess PEV grid impact alongside impact of other emerging power-hungry applications
- Undertake PEV pilots that shift focus from technology to the consumer experience

### Charging preferences may result in grid congestion

- Invest in analytics solutions to assess consumer demand and network data to help long-term grid planning
- Influence utilities' retail arms to drive off-peak charging through local marginal distribution pricing and encourage the use of smart charging

## Infrastructure and charging service providers

### Uncertain viability of charging models

- Evaluate charging service models: public, private and end-to-end; access retail versus wholesale charging opportunity

### Consumers want to charge at home, not at public charging points

- Lower the cost of public charging infrastructure and exploit the limited practicability of residential/office parking lot charging where possible.

### Uncertain distribution of home-charging demand

- Partner with utility retail operations and car dealerships to improve visibility of demand
- Develop optimal home charging units with utility retail operations

### Lack of interoperability between charging points

- Forge cross-industry agreements on PEV service equipment as well as authentication, authorization and accounting protocols

## Gasoline/diesel station retailers

### PEV charging takes drivers away from gasoline/diesel station forecourts.

- Exploit incumbent status to offer fast charging services
- Explore battery swapping market

## Metropolitan governments

### Consumers are motivated by factors other than purchase price and running costs

- Introduce nonfinancial incentives, such as parking concessions, that maximize convenience
- Segment the market to target different driver groups with relevant incentives

### Inconsistent charging infrastructure further afield deters consumers

- Cooperate with neighboring cities to establish common approaches to charging and charging point densities
- Harmonize policies e.g., on payment and authentication

## Regulators

### Consumers deterred by lack of choice in charging services

- Compel charging point operators to provide open and equal access to charging point service providers

### Grid investment suffers from unclear rules on industry responsibilities

- Clarify division of responsibilities between DNOs, retailers and charging point operators to ensure investments aligned with demand

# Conclusion

*Plug-in electric vehicles: changing perceptions, hedging bets* has identified four findings about consumer preferences in the evolving PEV marketplace:

Consumers are broadly open to purchasing and driving PEVs, but this support is not universal. The cost of purchasing a PEV is not currently the only key factor of adoption. Consumers currently prefer PHEVs to full EVs, as PHEVs would require fewer changes to current habits and levels of convenience. Finally, consumers' charging preferences pose challenges to sustainable PEV business models.

It is likely that consumer perceptions and expectations of PEVs will change as more drivers get behind the wheel and as pilot rollouts become more widespread. Industry participants will increase their chances of success by acting on these four findings and evaluating the key risks and opportunities that PEVs present: the opening up of the retail electricity market to new competitors, the creation of new services by existing and new market players, and the need to invest in infrastructure amid the uncertainty of adoption rates and charging patterns.

Utilities and infrastructure providers are among the most directly impacted industry participants. High performance will be achieved by those that find ways to reach consumers beyond the traditional utilities marketplace, evaluate their position in the charging service market and optimize infrastructure. Cross-industry collaboration will be central to the task.

## References


1 "Future Global Market Demand for Hybrid and Battery Electric Vehicles May Be Over-Hyped," J.D. Power and Associates, PR Newswire, October 27, 2010, via Factiva, © 2010 PR Newswire Association LLC.; "Two New Research Studies Indicate Electric Utility Industry Must Prepare Today for New Reality," Business Wire, September 28, 2010, via Factiva, © 2010 Business Wire.

2 "Changing the game: plug-in electric vehicle pilots," Accenture, 2011, www.accenture.com/SiteCollectionDocuments/PDF/Accenture_Utilities_Study_Changing_the_game.pdf.

3 "Renewable Energy: Obama Outlines Energy Plan," The Wall Street Journal, March 31, 2011, via Factiva, © 2011 Dow Jones & Company, Inc.

4 "The Plug in Car Grant," UK Department for Transport, July 28, 2010, www.dft.gov.uk/pgr/sustainable/olev/grant1.

5 "Changing the game: plug-in electric vehicle pilots," Accenture, 2011, www.accenture.com/SiteCollectionDocuments/PDF/Accenture_Utilities_Study_Changing_the_game.pdf.

6 "Revealing the values of the new energy consumer," Accenture, 2011, www.accenture.com/SiteCollectionDocuments/PDF/Resources/Accenture_Revealing_Values_New_Energy_Consumer.pdf.

7 "Changing the game: plug-in electric vehicle pilots," Accenture, 2011, www.accenture.com/SiteCollectionDocuments/PDF/Accenture_Utilities_Study_Changing_the_game.pdf.

8 Our study of pilots, *Changing the game: plug-in electric vehicle pilots*, covered examples of pilots that were primarily implemented by municipalities and infrastructure companies and which focused on infrastructure issues. Many pilots implemented by automotive companies tend to be more consumer-oriented.

9 "Changing the game: plug-in electric vehicle pilots," Accenture, 2011, www.accenture.com/SiteCollectionDocuments/PDF/Accenture_Utilities_Study_Changing_the_game.pdf.

10 Ibid.

11 Ibid.

12 "Revealing the values of the new energy consumer," Accenture, 2011, www.accenture.com/SiteCollectionDocuments/PDF/Resources/Accenture_Revealing_Values_New_Energy_Consumer.pdf.

13 "Changing the game: plug-in electric vehicle pilots," Accenture, 2011, www.accenture.com/SiteCollectionDocuments/PDF/Accenture_Utilities_Study_Changing_the_game.pdf.

14 "NIST Framework and Roadmap for Smart Grid Interoperability Standards, Release 1.0," National Institute of Standards and Technology (NIST), U.S. Department of Commerce, January 2010, www.nist.gov/smartgrid/upload/FinalSGDoc2010019-corr010411-2.pdf.

## Contacts

**Wade P. Malcolm**
Accenture Smart Grid Services
wade.p.malcolm@accenture.com

**Caroline J. Narich**
Accenture Resources Strategy
caroline.j.narich@accenture.com

**Mark Schutz**
Accenture Smart Grid Services
mark.schutz@accenture.com

## Research team

Stephanie Bronchard

Matthew McGuinness

Caroline Narich

Maarten Noom

Charlotte Raut

Mark Schutz

Melissa Stark

Paul Ubbink

Melina Viglino

Arnout Vos



## About Accenture Research

Accenture Research is Accenture's global organization devoted to economic and strategic studies. The staff consists of 150 experts in economics, sociology and survey research from Accenture's principal offices in North America, Europe and Asia/Pacific. This study involved our European experts in survey research.

## About Accenture

Accenture is a global management consulting, technology services and outsourcing company, with more than 215,000 people serving clients in more than 120 countries. Combining unparalleled experience, comprehensive capabilities across all industries and business functions, and extensive research on the world's most successful companies, Accenture collaborates with clients to help them become high-performance businesses and governments. The company generated net revenues of US$21.6 billion for the fiscal year ended Aug. 31, 2010. Its home page is www.accenture.com.

ACC11-0320/7-1792