

Drivers of Transportation Fuel Demand: Is Policy Expanding the Reach of Alternative and Fuel Efficient Vehicles?

About KAPSARC

The King Abdullah Petroleum Studies and Research Center (KAPSARC) is a non-profit global institution dedicated to independent research into energy economics, policy, technology, and the environment across all types of energy. KAPSARC's mandate is to advance the understanding of energy challenges and opportunities facing the world today and tomorrow, through unbiased, independent, and high-caliber research for the benefit of society. KAPSARC is located in Riyadh, Saudi Arabia.

Legal Notice

© Copyright 2016 King Abdullah Petroleum Studies and Research Center (KAPSARC). No portion of this document may be reproduced or utilized without the proper attribution to KAPSARC.

Key Points

The transportation sector accounts for about 25 percent of all energy consumed worldwide and light-duty vehicles constitute the largest portion of this. Policy has a significant role in increasing vehicle fuel efficiency and expanding the reach of alternatively fueled vehicles.

Many government policies are currently in place to promote greater vehicle fuel efficiency and market penetration of alternative fuel vehicles, especially electric vehicles.

Nonetheless, light-duty electric vehicle sales remain modest in major markets such as China and the United States, where they have reached just 1 percent of total new vehicle sales. In contrast, policies in Norway have led to a 14 percent new vehicle market share for electric vehicles.

Replicating successful Norwegian policies in other countries could prove challenging, as there are impediments to significant future electric vehicle penetration in those markets, such as competing long-term fiscal commitments and increasing fuel efficiency by existing internal combustion engine technology.

Summary for Policymakers

The transportation sector accounts for about 25 percent of all energy consumed worldwide. Light-duty vehicles, fueled primarily by motor gasoline in most regions of the world, comprise the largest portion of this sector. Understanding the role of policy in expanding the reach of more fuel efficient conventional vehicles and alternatively fueled vehicles is important because of the potential for significant growth in light-duty vehicle ownership in many non-OECD countries, as well as the desire to reduce petroleum consumption and greenhouse gas emissions in several OECD countries.

Although fuel efficiency and electric vehicle policies are often considered together, the drivers for these policies differ slightly. Greater light vehicle fuel efficiency is an important policy goal to reduce transportation-sector greenhouse gas emissions and to increase energy security in consuming countries. Encouraging light-duty electric vehicle

use is also a priority in many countries, although the rationale for such promotion differs. In countries with a low-carbon electricity supply, such as Norway, reducing greenhouse gas emissions is a strong policy driver. In countries with higher-carbon electricity supply, such as parts of the United States and China, energy security concerns are more important.

Many governments have implemented policies to promote fuel efficiency and alternative fuel vehicles, especially electric vehicles. However, these policies have had only a minor impact on light-duty electric vehicle sales in major markets, reaching just 1 percent in China and the United States.

In contrast, policies in Norway have led to a new light-duty vehicle market share for electric vehicles of nearly 14 percent. However, replicating these policies in other countries could prove to be challenging, as there are market impediments to significant electric vehicle market penetration.

Background to the Workshop

On November 9, 2015, KAPSARC hosted a one-day workshop in Riyadh, Saudi Arabia, exploring the role of policy in expanding the market for fuel efficient and alternative fuel vehicles, especially electric vehicles. A mix of government officials, industry trade group representatives and leading researchers attended the workshop.

Attendees at the workshop discussed current status of efficiency and electric vehicle policy around the world, the market potential of electric vehicles, lessons learned from policy challenges and future scenarios and industry dynamics. Three themes emerged from the discussions:

Many government policies are currently in place to promote greater vehicle fuel efficiency and market penetration of alternative fuel vehicles, especially light-duty electric vehicles.

Electric vehicle policies have had a relatively minor impact on light-duty electric vehicle market share in major markets, such as China and the United States.

Electric vehicles have achieved a much greater market share in Norway, but replicating Norway's experience in other markets will be challenging.

Government Fuel Efficiency and Alternatively Fueled Vehicle Policies

Many governments, including China, Europe and the United States, have policies in place to promote vehicle fuel efficiency. Saudi Arabia is implementing a Saudi Corporate Average Fuel Economy Standard, similar to that in the United States, as well as minimum energy performance standard for used vehicles. The goal of these policies is to reduce oil consumption.

Many governments also have policies to promote the sale or require the use of alternatively-fueled vehicles, especially light-duty electric vehicles. These policies usually address the demand-side (consumers), the supply-side (manufacturers), or both. For example, demand-side policies include purchase incentives, tax breaks, fee reductions, energy incentives, building recharging infrastructure and non-monetary provisions such as high occupancy vehicle lane access. Supply-side policies include mandatory sales requirements, such as California's Zero Emission Vehicle regulations, or the ability to bypass standard license plate lotteries

in cities like Beijing, China. California has both demand- and supply-side policies in place. Saudi Arabia has no policy to promote alternative fuel vehicles, although several government organizations, such as the Saudi Standards, Metrology and Quality Organization (SASO) and Saudi Energy Efficiency Center (SEEC) are studying the issue.

Norway provides a unique example of how governments can use demand-side incentives to drive electric vehicle adoption. Vehicle buyers in Norway are subject to a high vehicle purchase tax as well as a 25 percent value added tax. These taxes are waived for electric vehicles. Norwegian electric vehicle owners also face lower annual road tax, pay no charges on toll roads or ferries, receive free municipal parking and have access to bus lanes. In addition, Norway has undertaken several measures to alleviate the uncertainty consumers may have about owning and operating an electric vehicle, such as promotional long distance trips to assuage concerns about range anxiety.

The Impact of Electric Vehicle Policies

China and the United States, the world's two largest new vehicle markets, have considerable incentives and policies in place to promote the adoption or even force the purchase of light-duty electric vehicles. However, these measures have only modestly affected electric light-duty vehicle sales. Electric vehicles make up about 1 percent of total light vehicle sales in both countries.

Figure 1 shows market share for light-duty electric vehicles in various countries in 2014. Electric vehicle sales remain low in most of these countries for several reasons. In the absence of policy incentives and mandates, the consumer market for electric vehicles is modest, based on the types of people that buy them. For example, in the United States, electric vehicle buyers tend to place high value on environmental friendliness and new technology. However, within this group there are differences

among buyers in demographics, reasons for purchase and geographic characteristics. Taking these discrete characteristics into account and matching them to non-electric vehicle buyers, the current maximum potential market share for electric vehicles is just 2.5 percent.

Further, electric vehicles without incentives are generally more expensive than a comparable vehicle with an internal combustion engine. This characteristic matters less for the current, relatively more affluent 'pioneer' electric vehicle buyer, but is important for mainstream 'mass-market' consumers. Fuel prices also remain low, dampening the financial incentive for consumers to purchase alternatively fueled vehicles.

Finally, recharging infrastructure for electric vehicles is expanding, but is not ubiquitous similar to that for conventional fuels such as gasoline. Expansion of fast charging stations is particularly important.

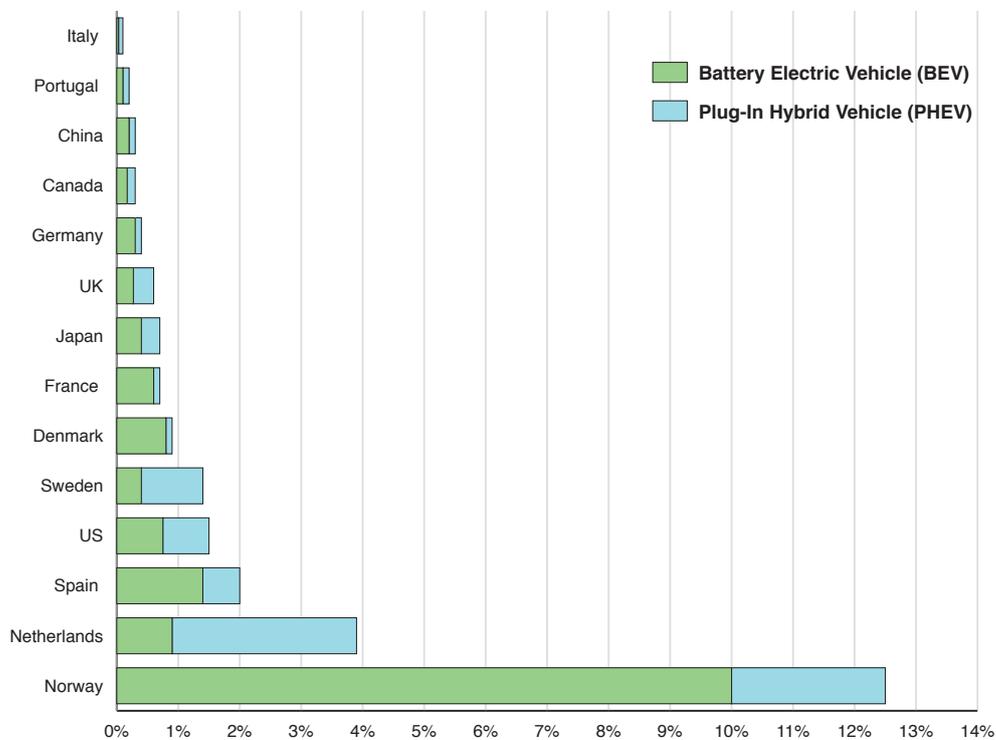


Figure 1. Market Share of Light-Duty Electric Vehicles in 2014 for Select Countries.

Source: EVI Global EV Outlook 2015.

The Challenge of Replicating Norway's Electric Vehicle Policies

In Norway, electric vehicles make up 14 percent of total new vehicle sales, reaching beyond pioneer buyers into early adopters and early mass-market consumers. The combination of substantial incentives and mass-market campaigns that specifically address consumer uncertainty beyond pioneer markets has been successful. Norway's electric vehicle policy measures are justified with a clear policy goal: reducing the nation's greenhouse gas emissions. Norway's electricity system largely runs on hydropower, giving electric vehicles a clear emissions advantage.

Attendees questioned whether Norway's policy measures could be easily copied in other countries, such as China and the United States. Long-term fiscal policies that promote electric vehicles are difficult to maintain amid other worthy policy goals that compete for resources. Even the decision to have a clear and explicit policy goal is challenging. In China or the United States, electric vehicle promotion is justified in many ways, including energy security, environmental concerns and industrial policy. These policy justifications may even compete against each other. For example, incentivizing the adoption of electric vehicles for energy security reasons, ostensibly to reduce petroleum consumption, might increase greenhouse gas emissions in areas where coal is used to produce electricity. Norway's clear environmental benefit makes electric vehicle policy easier to justify.

Unlike in Norway, many current policies in China and the United States do not explicitly target early mass-market consumers. Many new car buyers are not aware of the incentives available for electric vehicles and dealers sometimes do not know what the incentives and tax structure are for electric vehicles. Incentives do not work well when the buying public is unaware of them.

Moreover, future consumer preferences, vehicle prices, fuel economics and infrastructure availability will differ from the present day, perhaps significantly. These changes could either help or hinder further development of electric vehicle policy and wider adoption of electric vehicles. For example, market acceptance of electric vehicles could increase as electric vehicle costs decrease, fuel prices rise, or consumer preferences change based on greater electric vehicle availability or real-world experience. On the other hand, market penetration of electric vehicles could remain small as the internal combustion engine becomes more efficient due to vehicle fuel efficiency standards. Internal combustion engine fuel economy will increase in years to come due to the inclusion of technology to meet fuel economy regulations, such as the Corporate Average Fuel Economy (CAFE) in the United States. This improvement will reduce the relative fuel cost savings of electric vehicles compared to vehicles with internal combustion engines. Thus, despite battery cost declines, the fuel economics could decrease or even be completely offset by the improvements in incumbent vehicle technologies.

New technologies such as electric vehicles also face other impediments to market acceptance. They require consumers to take new actions, such as plugging-in to refuel instead of using one of the ubiquitous refueling stations. There is also consumer 'range anxiety' — drivers' fear of running out of power without an easy option for recharging. Additionally, manufacturers may be hesitant to invest significant funds in new technologies that may not sell quickly or at a large enough scale.

However, attendees noted that new technology offers consumers and manufacturers new opportunities, even without policy support. For example, 2- and 3-wheeled electric vehicles are rapidly entering the market in China with little or no support from the government. The concept of using electric 2- and 3-wheeled vehicles may revolutionize mobility, especially in emerging markets. For example, 2- and 3-wheeled vehicles account for around 8 percent of on-road passenger fuel demand in China and 25 percent in India.

Conclusion

There are many government policies in place promoting light-duty electric vehicles, but these have not yet led to considerable sales uptake in major markets. Following the discussions in this workshop, future research should focus on understanding the impact of policy on new electric vehicle markets. Furthermore, there is no one-size

fits all approach; a successful policy in one country may not be as effective in another country or region. Regional case studies could investigate the impact of these local policies on electric vehicle economics, consumer behavior and sales. In addition, because consumer preference plays such an important role, it should be integrated in the policymaking process.

About the Workshop

KAPSARC convened a workshop in November 2015 with some 30 international experts to discuss the role of policy in expanding the reach of alternative and fuel efficient vehicles. Attendees explored the current state of policy, market potential for electric vehicles, lessons learned, policy challenges, future scenarios and industry dynamics. The workshop was held under Chatham House rules.

List of Participants:

Mohammed Alajaji, research analyst, KAPSARC

Samer AlAshgar, president, KAPSARC

Saad Alkasabi, governor, Saudi Standards, Metrology and Quality Org (SASO)

Majid Al-Moneef, Former secretary general of the Supreme Economic Council, Kingdom of Saudi Arabia

Musaad Almosaind, associate professor in Urban Planning, College of Architecture and Planning

Fahad Alsa'ad, Saudi Standards, Metrology and Quality Org (SASO)

Jonn Axsen, assistant professor, Simon Fraser University

Sjoerd Bakker, Independent Consultant

Christina Bu, secretary general, Norwegian EV Association

Alexander Busse, consultant, fka Forschungsgesellschaft Kraftfahrwesen mbH Aachen, Strategy and Consulting

Nicholas Chase, research fellow, KAPSARC

Marcello Contestabile, Research Fellow, KAPSARC

David Daniels, chief energy modeler, U.S. Energy Information Administration

Salman Dossary, Saudi Aramco

Rubal Dua, senior research associate, KAPSARC

Tiffany Groode, senior director, IHS CERA

David Hobbs, head of research, KAPSARC

Lester Hunt, program director, KAPSARC

Zhenhong Lin, senior researcher, Oak Ridge National Laboratory

Daniel Mabrey, research fellow, KAPSARC

Jakki Mohr, professor, University of Montana

Sunita Narain, Director General, Center for Science and Environment

Maxime Pasquier, ADEME Transport & Mobility Department

Aymeric Rousseau, Systems Modelling and Control Group Manager, Argonne National Laboratory

Andreas Schafer, Professor of Energy and Transport, UCL Energy Institute

Jian Shi, researcher, China Automotive Technology and Research Center

Khalid Sayouhi, demand analyst, Saudi Aramco

Steve Szakaly, chief economist, NADA

Jacob Teter, energy analyst, International Energy Agency

Peter Wells, Professor of Business and Sustainability, Cardiff University Business School

Kenny White, senior research analyst, KAPSARC

Masaru Yarime, professor, University of Tokyo

Sonia Yeh, research scientist, Institute of Transport Studies

Coby Van der Linde, director, Clingendael International Energy Program

About the Team



Mohammed J. Alajaji

Mohammed is a research analyst. He received a bachelor's degree in industrial engineering and a bachelor's degree in economics and mathematics with honors from Northeastern University.



Nicholas Chase

Nicholas is a research fellow focusing on the future of transportation energy demand in China and India. He holds an MA from the Johns Hopkins University and a BA from the University of Michigan-Ann Arbor



Marcello Contestabile

Marcello is a research fellow specializing in energy transitions and innovation policy. He has a PhD in Energy Policy and Technology from Imperial College London.



Rubal Dua

Rubal is a senior research associate. He holds a PhD in Environmental Science and Engineering from KAUST, KSA and an MSc degree in Chemical Engineering from University of Pennsylvania, USA.



Daniel Mabrey

Daniel is a research fellow in the Human Geography of Energy program and is project lead on KAPSARC's studies in Eastern Africa. He is also an Associate Professor at the University of New Haven in CT, USA.



Kenneth White

Kenneth is a former senior research analyst analyzing transportation and Chinese energy policy. He has an MPP from Stanford University.

About the Project

The workshop series “Drivers of Transportation Fuel Demand” provides a forum for discussing key sustainability issues in transportation and current policy strategies to address them. In particular, much emphasis is placed on the adoption of fuel-efficient and alternative-fuel vehicles for road transportation, innovation in fuel and vehicle technology mixes and the shift from road to other modes of transportation.

Notes

Notes

Notes



مركز الملك عبدالله للدراسات والبحوث البترولية
King Abdullah Petroleum Studies and Research Center

www.kapsarc.org