[Survey Report]

Diffusion of electric vehicles subject to fiscal incentives

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Abstract

There is growing consensus that diffusion of electric vehicles (EVs) is a highly effective way to decarbonize the road transport sector. However, consumers would not opt for EVs over internal combustion engine vehicles (ICEVs) without additional fiscal incentives. Thus, the objective of this report is to consider the importance of fiscal incentives for EV diffusion, observing market changes in response to changing government policies in Denmark, the Netherlands, the United Kingdom, and China. The results indicate that fiscal incentives are essential to facilitate the transition from ICEVs to EVs because EVs are not price competitive against ICEVs. However, fiscal incentives are dependent on the economic situation, and how long the fiscal incentives will continue is uncertain. Therefore, without a drastic decline in battery costs via technological innovations, a complete transition from ICEVs to EVs will be extremely difficult.

1. Introduction

Electrification is critical for decarbonization in the road transport sector [1]. Several analyses conducted by leading research institutes worldwide have implied that stricter regulations regarding greenhouse gas emissions have increased the importance of electrification [2]. In the transport sector, improving fuel economy via electrification—that is, a transition from internal combustion engine vehicles (ICEVs) to electrified vehicles—is the most promising solution [3–5]. Therefore, both developed and developing countries have outlined their visions for the diffusion of electric vehicles (EVs) in an effort to decarbonize the transport sector. This involves highly ambitious sales targets for zero-emission vehicles and bans on the sales of ICEVs by 2030 [6].

However, contrary to governments' proactiveness on this issue, EV sales in even leading countries were around 1–4 % of overall car sales (e.g., 3.9 % in China [7], 1.4 % in the United States [8], 1.7 % in Germany [9], and 1.9 % in France [9]) in 2019, with the exception of Norway and the Netherlands, where EV sales are, respectively, the highest and second highest globally. Only a few consumers opt for EVs because the difference in prices between EVs and ICEVs is still large due to extremely high battery costs, although fiscal incentives—that is, direct subsidies on EV purchase and tax breaks on purchase and ownership—have been implemented. In Norway, by contrast, EV diffusion is strong because the fiscal incentives are highly attractive and because, in some cases, the annual ownership cost of an EV is lower than that of an ICEV for the same vehicle model [10].

This report finds that a full transition from ICEVs to EVs to achieve strict decarbonization is extremely difficult without sufficient fiscal incentives as long as ICEVs enjoy a price advantage over EVs, as the past has already

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shown in four countries: Denmark, the Netherlands, the United Kingdom, and China. Note that this paper covers only passenger vehicles, not commercial vehicles.

2. Historical sales records in Denmark, the Netherlands, the United Kingdom, and China

Several studies on the factors influencing the selection of EVs by consumers have been conducted. Giffi et al. [11] indicated that consumers would not be willing to pay a premium for EVs over ICEVs in almost every region of the world. Liao et al. [12] indicated that the purchase price of an EV was significantly higher than that of an ICEV in most countries due to high battery costs. Lévay et al. [13] reported that fiscal incentives, such as direct subsidies and tax breaks, played an important role in the promotion of EVs in recent years because the huge difference between the cost of an EV and the cost of an ICEV was a major obstacle. Consumers opt for EVs only when they are aware of the merits of EVs over ICEVs. Thus, even if bans on ICEV sales are planned, to forcibly promote EV diffusion [6], the policies may not be practical given consumers' real behavior.

Many governments worldwide have enhanced fiscal incentives to help accelerate EV diffusion. Norway is the most successful in this respect, because of its highly attractive incentives, such as no purchase/import tax (registration tax), exemption from 25 % value added tax (VAT), and no annual road tax [14]. Consequently, the EV sales share in Norway was the highest at 42.4 % in 2019 [15] (the second highest was the Netherlands, with an EV sales share of 13.7 % [16]).

By contrast, EV diffusion is less than expected in other countries, despite incentives. In the case of Japan, subsidies [17] and tax breaks [18] on EVs have been implemented since 1998 and 2009, respectively, with the scheme being adjusted on several occasions. Despite this, the share of EV sales was a mere 0.5 % in 2019 (calculated from JADA [19] and Zenkeijikyo [20]). In addition, a reduction in or removal of fiscal incentives caused EV (and plug-in hybrid vehicle, PHEV) sales to shrink drastically in several countries. This report shows four cases where a cut in fiscal incentives caused a shrinkage in the demand for EVs and PHEVs: Denmark, the Netherlands, the United Kingdom, and China.

In Denmark, EV sales plummeted 79.8 % in the first quarter of 2016, compared to the same quarter of the previous year [21, 22] (Fig. 1). The number of EV sales fell from 4,584 in 2015 to 720 in 2017. The reason for the drastic decline in EV sales was the hasty phasing out of tax breaks (exemption for EVs from high registration tax of 180 %). The roll back of the tax benefits caused a considerable surge in demand for EVs in December 2015 just before the implementation of the new tax scheme. The situation was best summarized by Lærke Flader, head of the Dansk Elbil Alliance (Danish EV Alliance): "Price really matters, and this tax reform has completely killed the market" [23].

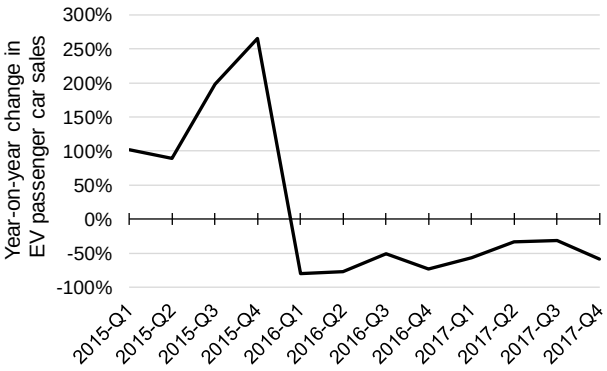

Fig. 1 Double-digit decline of EV passenger car sales due to phasing out of tax breaks in January 2016 in Denmark

The Netherlands was Europe's sales leader for PHEVs in 2015 [6]. However, sales declined quickly after the government significantly scaled back tax breaks for the private use of company cars [24], with a double-digit decline in 2016 [9] (Fig. 2). The number of PHEVs sold declined from 41,280 in 2015 to 18,846 in 2016, a drop of 54.3 %; moreover, the 2017 sales plummeted by 93.7 % (1,184 units) compared to two years earlier. The situation is

best expressed in the words of Emilio Herrera, Kia Europe Chief Operating Officer: "Sales of PHEVs have been very volatile so far and they really depend on the governments' support" [25].

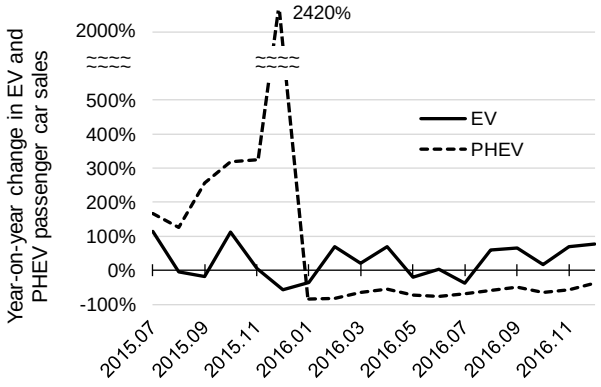

Fig. 2 Double-digit decline in PHEV passenger car sales due to roll back of tax breaks at the end of 2015 in the Netherlands

In the United Kingdom, PHEV sales were on a double-digit downward trend around the first half of 2019, in contrast to EVs, which experienced a double- or triple-digit sales increase [26] (Fig. 3), after the government reduced subsidies—that is, the "Plug-in Car Grant (PICG)"—in early November 2018 [27]. The £2,500 subsidy for PHEVs was cut altogether, and the subsidy for EVs reduced from £4,500 to £3,500. Since 2011, the PICG has subsidized over 160,000 new ultra-low emission vehicles, of which 100,000 were PHEVs. The government considered that the PHEV market was established, choosing to focus instead on zero-emission vehicles such as EVs and fuel cell vehicles (FCVs). Consequently, the trend of growing PHEV sales shifted to that of falling sales. Declining sales, which fell by a third in April 2019, were "evidence of the consequences of prematurely removing upfront purchase incentives before the market is ready," said Mike Hawes, chief executive of the Society of Motor Manufacturers and Traders [28]. In addition, in another interview [29], he said "We knew the impact that the loss of the PHEV incentive would have, we've seen it in Norway, and Denmark, so it is no surprise that the market for these cars has dropped since the decision was made."

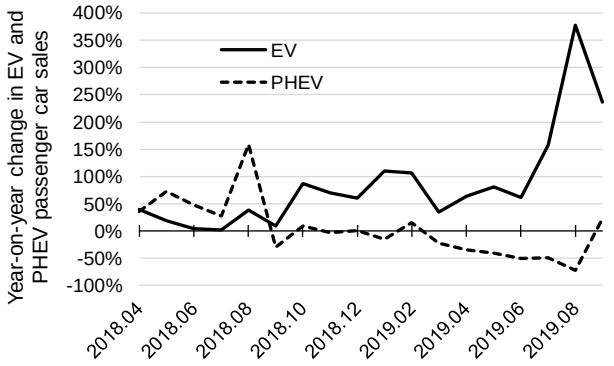

Fig. 3 Double-digit decline in PHEV passenger car sales due to roll back of subsidies in early November 2018 in the United Kingdom

In China, by far the biggest producer and market for EVs, the diffusion of EVs is slowing down due to a reduction in EV subsidies, after two years of rapid market growth [30]. China introduced a subsidy program for new energy vehicles (NEVs)—that is, EVs, PHEVs, and FCVs—in 2009 to promote the automobile industry [31]. The EV market has been successfully growing although there were some adjustments in the program, including some scaling back of subsidies. However, in late June 2019, the Government slashed the subsidy by half or more for most of the vehicle types and completely eliminated subsidies for vehicles with ranges of under 250 km per charge [32]. Announcement of the subsidy cut caused several consumers to purchase EVs in June 2019, just before the increase in EV price [7] (Fig. 4). The market also reacted to the effect of the subsidy changes immediately, with monthly EV sales in July 2019 declining by 4.2 % from July 2018, and maintaining a double-digit decline for several months. The situation of PHEVs was the same as that of EVs although there was no sudden upsurge in demand in June 2019. The annual growth rate drastically fell from 68.4 % in 2018 to 5.8 % in 2019, although the number of EVs sold increased from 788 thousand

in 2018 to 834 thousand in 2019.

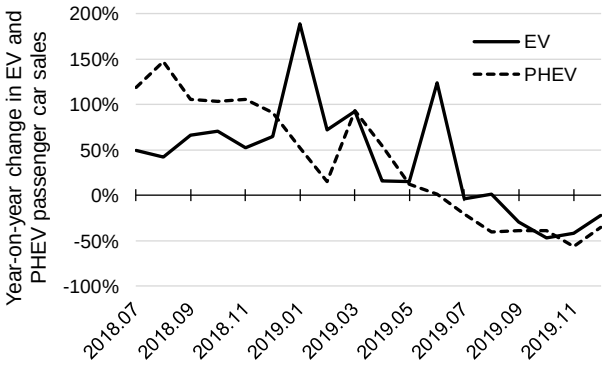

Fig. 4 Double-digit decline of EV and PHEV passenger car sales due to slashed subsidies in late June in China

Thus, reducing or abolishing fiscal incentives while EVs are at a price disadvantage compared to ICEVs, inhibits EV diffusion. However, it is uncertain whether the current level of incentives can continue in the long term. This uncertainty indicates a possibility of constricted EV diffusion in the future. If the current level of incentives continues, incentive schemes will entail additional costs in absolute terms with continuous growth in the volume of EV sales [33] and will have to be ended even if the EV sales share does not reach the target goal for decarbonization.

Developing countries are more sensitive to the payback period than developed countries are [34, 35] and fiscal incentives are more effective in these markets. However, developing countries generally do not have sufficient finances to enhance incentives. Thus, it is also essential to reduce vehicle prices globally by a rapid drop in battery costs via technological innovations.

3. Conclusions

The transition from conventional ICEVs to EVs is a difficult challenge. All the cases of market change in this report indicated that enhancing fiscal incentives was essential for accelerating the EV transition, as long as EV prices are not competitive against ICEVs. However, how long governments can afford sufficient incentives is uncertain.

In conclusion, EV diffusion still requires fiscal incentives globally. However, fiscal incentives are subject to the economic situation in each country. A transition from ICEVs to EVs to achieve strict decarbonization goals is extremely difficult without a dramatic decline in battery costs via technological innovations.

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