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## Review of Policies for Promotion of Electric Vehicles

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### Abstract

This paper presents the review of policies and their possible effects for promoting the use of electric vehicles. Suggestions on faster implementation of electric vehicles can also be identified within best practices from abroad. Various countries have adopted different policies to promote the use of electric vehicles which include fiscal or other forms of incentives that would persuade people into buying electric vehicles. Possible effects are hard to determine since many variables affect a consumer's purchasing decisions. That is why identification of policies that have proven to be successful and those that have not achieved projected results and should be improved is necessary. Research has shown that countries with most promising policies for promotion have the biggest share of electric vehicles and invest the most in their promotion (fiscal incentives).

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## 1. Introduction

Oil crisis in 1970s has had a huge effect on the formation of first policies for promoting the use of EV (EV). In that time various countries already adopted the first plans that predicted promoting the use of EVs which would eventually replace vehicles powered only by internal combustion engine, which represents a huge environmental polluter with their exhaust fumes (Cowan and Hulten, 1996; Krause et al., 2013). Battery EV, hybrid vehicles (and plug-in hybrids) and fuel cell vehicles (EV) are types of EVs on which the article focuses. Countries, especially Japan and United States of America (USA), have achieved progress in the area of introduction of electric vehicle with the help of policies for promoting the use of EV. European countries have followed these trends and that is why they introduced their own policies for promoting the use of EV, which some countries continue using and upgrading, being a part of the European Union (EU).

Policies for promoting the use of EV can be analysed from geographical point of view adopted on international, national or local level (Nilsson et al., 2012; Ward, 1998) and from legal point of view on international binding and unbinding

policies. Policies can include fiscal and non-fiscal incentives of different sort (Steenberghen and Lopez, 2008; Kahn, 2009). From end-buyer's or user's point of view measures from these policies can be divided into direct or indirect. With direct measures the use of EV can be promoted among potential buyers of EV while with indirect measures development of EV can be stimulated so as to achieve the level of development that customer or even legislative body demands. Policies can be accepted unilaterally or as an agreement between representatives of the society (Calef and Goble, 2007; Åhman, 2006).

To be able to solve challenges connected with different policies to promote the use of alternative fuel vehicles (AFV), policies from other countries concerning promoting the use of EV must be studied so that they could be further analyzed ~~them~~ and, afterwards, the outcomes of these policies could be compared with one another. The purpose of this paper is, therefore, to present the actual effects of policies for promoting the use of EV and the way how the activities regarding policies for promoting the use of EV changed through time from decision-making viewpoint, regarding the content of policies for promoting the use of EV.

## 2. Experimental

For demonstration of policies concerning the introduction of EV in other countries, the necessary data were collected from publications prepared by international organizations, such as International energy agency (IEA), and articles from web databases. The following databases were used so as to find appropriate articles: Emerald Insight, ProQuest Social Science Journals and ScienceDirect. For presentation of policies for promotion of EV in the EU, publications and internal information from organizations and individual project reports were used. All the gathered data were analysed and research-needed information was extracted to be further used. Investment in alternatively fuelled vehicles, i.e. infrastructure, technology development and fiscal incentives, was discussed. Multiple methods were used in this research, such as a method of compilation in order to represent different policies for promoting the use of EV through time by summing up other authors from this field of research. Method of description was used to describe the policies for promoting the use of EV that have been carried out or are still being carried out in the EU. Also The method of analysing was used to make predictions and discover available models of EV with the use of a database including vehicles, registered for the first time,

The review of policies for promoting the use of EV through time was restricted to public accessible documents. The study focused on the period after the oil crisis in 1970s as Cowan and Hulten (1996) claim that after the oil crisis in 1970s we can notice first policies for promoting the use of EV coming into force and until 2014 when EV promotional policy at least in Slovenia changed significantly

## 3. Results and discussion on reviewing policies for the promotion of the use of electric vehicles

IEA (2013) divides measures that are part of policies for promoting the use of EV into measures which include fiscal incentives, measures which are connected with research and implementation of infrastructure for EV and measures which are designed for supporting the research and development (R&D) of technology connected with EV.

Policies for promoting the use of EV were at first intended for manufacturers to develop and to make EV, because the technology needed for introduction of EV had not been developed sufficiently yet. Incentive came from government institutions. Development and production of EV gave car manufacturers the possibility to offer EV to people for purchase. With EV coming onto the market, the first goals for the number of EV on the roads in the nearby future were set. These goals would also serve as a good tool to measure results of government incentives. However, the first goals, regarding the number of EV on the road, were not met.

Nevertheless, manufacturers were able to develop EV which were demanded by governments, and launched them on the roads. It must be understood that it is hard to demand from manufacturers full development of EV and then production of EV, all in a very short time (Cowan and Hulten,

1996). All of this has led to realization that plans regarding introduction of EV must be adjusted alongside with the development of technology (Åhman, 2006), technological forecasting must be performed and market expectations must be identified.

This was taken into account in Europe, where in some countries a wish to establish the market of EV can be seen. Groups of companies connected into technology clusters and technology platforms also took part in this and were financially supported by the state. A goal of these groups was to identify needs and desires of potential users of EV and to discover deviations from preferred characteristics of EV and technological reality. They determined that it is impossible to achieve the preferred characteristics of EV with current developed technology (Cowan and Hulten, 1996). Since the start of research on the field of EV a lot of money has been invested into the development of EV. Financial support was higher at the beginning than it was in years after the initial research was ended. The development of technology of EV lost its initial impetus, which was especially beneficial for existing technology i.e. the internal combustion engine. This technology was a commanding force on the field of transport vehicles in the 20th century. However, investment in technology of EV grew strong again at the beginning of the 21st century (see Fig. 1) (IEA, 2013).

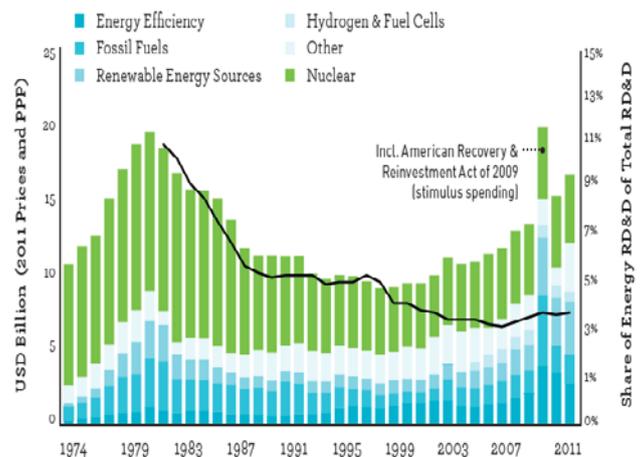
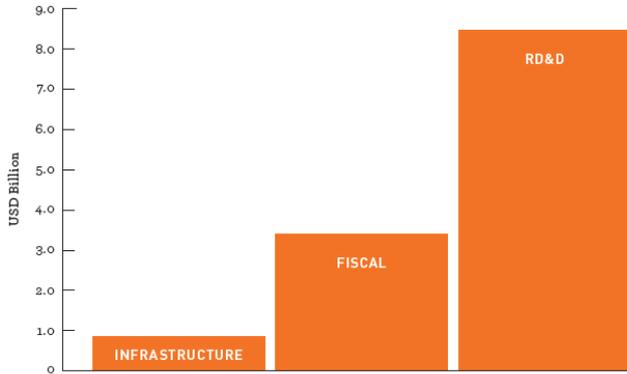


Fig. 1. Investments into R&R in IEA member countries  
Source: IEA, 2013, pp. 16.

In recent years the biggest part of investments has been intended for the R&D, which is being followed by fiscal incentives (financial grants etc.). The smallest share has been intended for the development of infrastructure (see Fig. 2).

An important breakthrough in the introduction of EV occurred in 1990. California adopted a law which determined maximum levels of exhaust fumes allowed for new vehicles (Pilkington and Dyerson, 2006). Cowan and Hulten (1996) claim that this is the first example of a government law which promotes development of low emission vehicles (LEV). This law demanded from car manufacturers to make such vehicles in a certain time frame, although appropriate

technology of EV which was identified as one with the best potential to comply with the law was not evolved yet (Calef & Goble, 2007). Legislation adopted in several federal states in the USA, represented a trigger of technological changes on the field of promoting the use of EV (Pohl and Yarime,



2012).

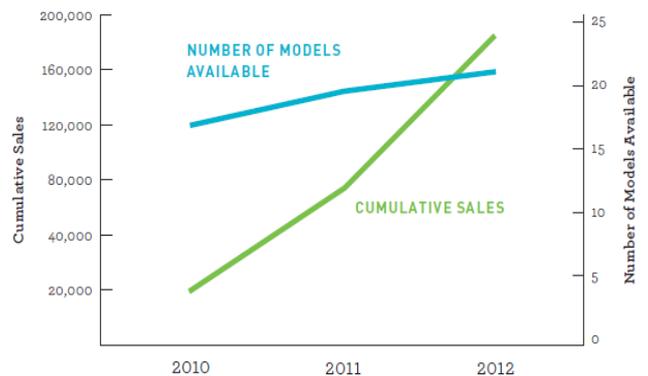
**Fig. 2.** Investments in IEA member countries from 2008 to 2012 (Source: EVI, in IEA, 2013, pp. 16)

Despite evident opposition of the American car industry, this challenge was accepted and the development of appropriate vehicles began. Adoption of this law allowed smaller car manufacturers to enter the market of EV (Pilkington and Dyerson, 2006; Calef and Goble, 2007; O'Dell, 2012). Authorities supported the car industry in its goal to develop and to make these vehicles through fiscal and non-fiscal incentives (Gallagher and Muehlegger, 2011; Ward, 1998). Companies managed to develop EV and present them to public. Nevertheless, the number of EV was smaller than expected. Adoption of this law in California also affected the rest of the world. Japanese carmakers did not resist these adopted regulations as much as carmakers in the USA. Because they were present on the American market they offered solution which were in accordance with the law. They developed EV which have been adequate not only for the USA, but also for Japan and Europe (Åhman, 2006; Pohl and Yarime, 2012). The adopted financial incentives offered support for EV when they entered the market. This had an influence on growth in sales of EV. Development in the field of EV has changed the way of determining policies for promoting the use of EV.

Policies for promoting the use of EV are now made not just by authorities but also with the help of companies, educational institutions, government agencies and local authorities (Åhman, 2006). Goals regarding target numbers of EV on the roads are not legally set by governments alone anymore but are accepted as an agreement between working partners. Each partner takes its own part of responsibility for introduction of EV (Calef and Goble, 2007).

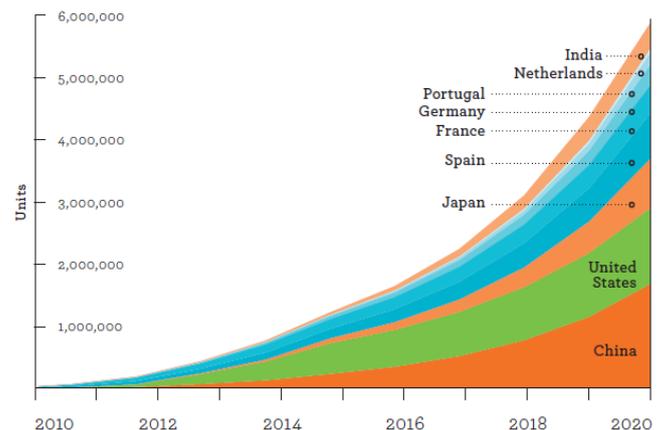
Policies for promoting the use of EV have actually not changed so much over time. The only thing that has been changing is the level of responsibility for carrying out each of the incentives programs, regarding EV and infrastructure, between the authorities and the industry (Toyota, 2013; Nelson and Tanabe, 2013).

Preparing and implementing policies on several levels (where the highest level has an influence on lower levels) can be easily seen in Europe through EU. What can be noticed in countries joining the EU is occurrence of orientations on the field of promoting the use of EV on EU level that affects carrying out policies in member states because of adopted EU measures in the form of strategies, legislative orientations and support for carrying out individual projects (Europa Press releases, 2013; European Commission, 2014; Fernandez et al., 2005). Policies for promoting the use of EV have been adopted in the EU Member states and they include fiscal and non-fiscal incentives (Gass et al., 2014).



**Fig. 3.** How can new available models of EV effect on growth of sales (Source: MarkLines Database, in IEA, 2013, pp. 10)

Effects of those policies are seen in the sale of EV. Sales of EV are rising but share of EV out of all vehicles sold is still very small. New models of EV that customers can actual buy have also influenced on the growing number of sales of EV, which can be seen in Fig. 3 (MarkLines Database, in IEA, 2013, pp. 10).



**Fig. 4.** Forecast regarding sales of EV in IEA member countries (Source: EVI, in IEA, 2013, pp. 10)

In the following years further growth in sales of EV can be expected. Based on IEA forecasts, in 2020 EV should reach up to 5.900.000 vehicles in IEA member countries (see Fig. 4)

## 4. Summary and conclusion

The research on the field of promoting the use of EV showed that there has not been a review in which effects of policies for promoting the use of EV would be reviewed.

Supplementation of area of policies for fuel cell vehicles is also needed because AFV as well as more efficient transport and route planning enabled owing to the emerging technology of autonomous vehicles can significantly reduce environmental impacts caused by the transportation sector (Barsi, 2018 and Knez et al., 2014). Certain government institutions which are implement various policies for promoting the use of EV in their reports present effects of each project, but every report is just one piece of the puzzle and there is no connection between these partial reports. How can we know where are we on the road to implementation of EV? Review of policies for promoting the use of EV is very important because it specifies which policies have been successful, as based on the review of past actions. It can be used as a basis to prepare improvements. Findings of such research can be used to determine strategy for the introduction of EV.

## Reference

- Åhman, M., 2006. *Government policy and the development of EV in Japan*. Energy Policy, 34(4), 433-443.
- Barsi, A., Nyerges, A., Poto, V., Tihanyi, V., 2018. *An offline path planning method for autonomous vehicles*. Production Engineering Archives, 19, 37-42. DOI: 10.30657/pea.2018.19.08
- Calef, D., Goble, R., 2007. *The allure of technology: How France and California Promoted electric and hybrid vehicles to reduce urban air pollution*. Policy Sciences, 40(1), 1-34.
- Cowan, R., Hultén, S., 1996. *Escaping Lock-in: the case of the electric vehicle*. Technological Forecasting and Social Change, 53, 61-79.
- Europa Press release, 2013. *EU launches clean fuel strategy*. Retrieved 20 March 2014 from: [http://europa.eu/rapid/press-release\\_IP-13-40\\_sl.htm](http://europa.eu/rapid/press-release_IP-13-40_sl.htm)
- European Commission. 2014. *Green cars initiative*. Retrieved 22 March 2014 from: [http://ec.europa.eu/research/transport/road/green\\_cars/index\\_en.htm](http://ec.europa.eu/research/transport/road/green_cars/index_en.htm)
- Fernandez, T.R.C., Chen, F., da Graça Carvalho, M., 2005. *"HySociety" in support of European hydrogen projects and EC policy*. International Journal of Hydrogen Energy, 30(3), 239-245.

- Gallagher, K.S., Muehlegger, E., 2011. *Giving green to get green? Incentives and consumer adoption of hybrid vehicle technology*. Journal of Environmental Economics and Management, 61(1), 1-16.
- Gass, V., Schmidt, J., Schmid, E., 2014. *Analysis of alternative policy instruments to promote EV in Austria*. Renewable Energy, 61, 96-101.
- IEA, 2013. *Global EV Outlook*. Retrieved 20 March 2014 from [http://www.iea.org/publications/globalevoutlook\\_2013.pdf](http://www.iea.org/publications/globalevoutlook_2013.pdf)
- Kahn, M.E., 2009. *The Green Economy*. Foreign Policy, 172, 34-38.
- Knez, M., Jereb, B., Obrecht, M., 2014. *Factors influencing the purchasing decisions of low emission cars: a study of Slovenia*. Transportation research. Part D, Transport and environment, 30, 53-61.
- Krause, R.M., Carley, S.R., Lane, B.W., Graham, J.D., 2013. *Perception and reality: Public knowledge of plug-in EV in 21 U.S. cities*. Energy Policy, 63, 433-440.
- Legislation, co-financing and EU [Elektro črpalke], 2014. Retrieved 17 March 2014 from: <http://www.elektro-crpalke.si/1/Bazaznanja/Zakonodajna-sofinanciranje-in-EU.aspx> (in Slovenian language).
- Nelson, T.D., Tanabe, M., 2013. *Japan Continues To Offer Electric Vehicle Incentives*. Retrieved 24 March 2014 from <http://www.mondaq.com/unitedstates/x/263904/Renewables/Japan+Continues+To+Offer+Electric+Vehicle+Incentives>
- Nilsson, M., Hillman, K., Magnusson, T. (2012, June). How do we govern sustainable innovations? Mapping patterns of governance for biofuels and hybrid-electric vehicle technologies. Environmental Innovation and Societal Transitions, Volume 3, 50-66.
- O'Dell, J. 2012. Will California's Zero-Emissions Mandate Alter the Car Landscape? Retrieved 24 March 2014 from <http://www.edmunds.com/fuel-economy/will-californias-zero-emissions-mandate-alter-the-car-landscape.html>
- Pilkington, A., Dyerson, R., 2006. *Innovation in disruptive regulatory environments: A patent study of electric vehicle technology development*. European Journal of Innovation Management, 9(1), 79-91.
- Pohl, H., Yarime, M., 2012. *Integrating innovation system and management concepts: The development of electric and hybrid EV in Japan*. Technological Forecasting and Social Change, 79(8), 1431-1446.
- Steenberghen, T., Lopez, E., 2008. *Overcoming barriers to the implementation of alternative fuels for road transport in Europe*. Journal of Cleaner Production, 16(5), 577-590.
- Toyota, 2013. *Toyota, Nissan, Honda and Mitsubishi to Provide Financial Assistance for Electric Vehicle Charging Infrastructure in Japan*. Retrieved 24 March 2014 from: <http://www2.toyota.co.jp/en/news/13/11/1112.html>
- Ward, J., 1998. *Financing your AFV fleet*. The American City & County, 113(3), Retrieved 18 March 2014 from <http://search.proquest.com.ezproxy.lib.ukm.si/socscijournals/docview/195953689/616443E8BF894C00PQ/507?accountid=28931>

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## 电动汽车推广政策评述

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### 關鍵詞

电动汽车  
运输政策  
环境政策  
替代燃料车辆

### 摘要

本文介绍了电动汽车的使用。关于加快实施电动汽车的建议。各个国家都采用了不同的电气概念。对消费者购买决策可能产生的影响。这就是为什么不可能投射和改进它的原因。财政激励措施。

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