ELECTRIC VEHICULE – A NEW DIRECTION FOR SOCIO-ECONOMIC DEVELOPMENT

ŞTEFAN CÎRSTEA
ASSOCIATE LECTURER, PHD, TECHNICAL UNIVERSITY, FACULTY OF ELECTRICAL ENGINEERING, CLUJ-NAPOCA, ROMANIA
E-mail: stefan.cirstea@yahoo.com

Abstract
Mobility is a major factor of economic growth and social development. The vehicle is the centrepiece of what mobility means and it is expected that, in future, the use of vehicle continues to grow, particularly in developing countries. This article wants to highlight the need to implement electric vehicles in contemporary society and, also, highlight some of the advantages and socio-economic benefits that such action entails. The aim of this paper is estimating the possible influence of such shift in different aspects of economics as a whole. The results underline the main advantages and disadvantages of adopting the electric vehicule.

Keywords: *electrical vehicle, transportation, evolutive trends, market study*

JEL codes: *M41, M48*

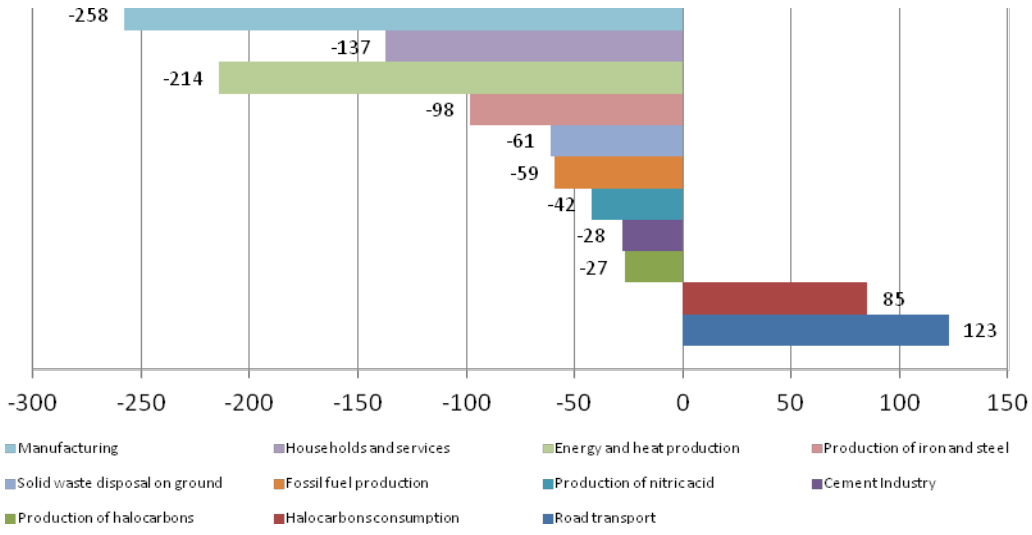
1. Introduction

Nowadays, transportation is dominated almost exclusively by internal combustion vehicles - about 95% of transport is based on carbon liquid fuels derived from crude oil. There is no other sector that shows a high level of dependence on a single source of primary energy. At the same time, the European Emission Standards have become more stringent with the implementation of the European Euro 6 legislation since 2014.

Also, another serious problem that can be observed worldwide is represented by the greenhouse gas emissions. During 1990 - 2006, greenhouse gas emissions (GHG) from transport, including air and maritime transport, have significantly increased (+36%), while emissions from non-transport sectors have decreased (- 14%).

However, analyzing the evolution of GHG emissions during 1990 - 2012, we can observe that road transport is a sector which recorded increases in GHG emissions.

Figure 1 – Overview on the increase/decrease of GHG emissions - the main sources (million tonnes)



Source: European Environment Agency, 2014

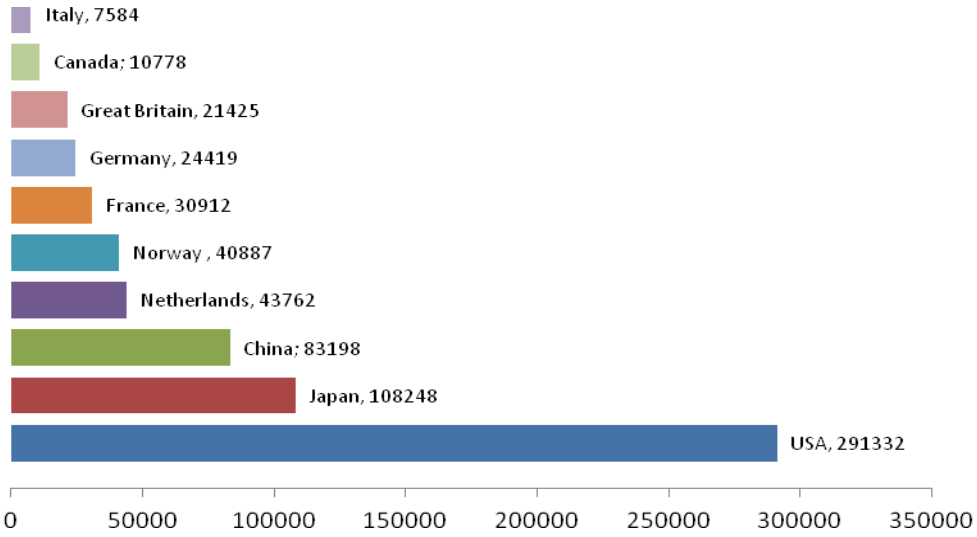
2. Electric vehicle market trends

Annually, about 88 million trucks, buses and cars are produced worldwide. While the vast majority of these vehicles are powered by an internal combustion engine, the energy source chosen in the past 100 years, there is more and more speculation about the role that electric vehicles could play in the next 100. High levels of air pollution and carbon emissions, and a perceived shortage of energy are all cited as reasons why electrical vehicle (EV) will certainly become a major factor in the global automotive industry.

The huge increase of 77% of EV sales in Europe contrasts with the growth of about 4% of global production of vehicles.

Worldwide, until December 2014 more than 712,000 electric vehicles were sold across the world. USA is the market leader with a fleet of over 290,000 electric vehicles sold since 2008, representing 41% of overall sales [2]. Japan ranks second, with over 108,000 units sold since 2009 (15%), followed by China with over 83,000 electric cars sold since 2008 (12%) [3].

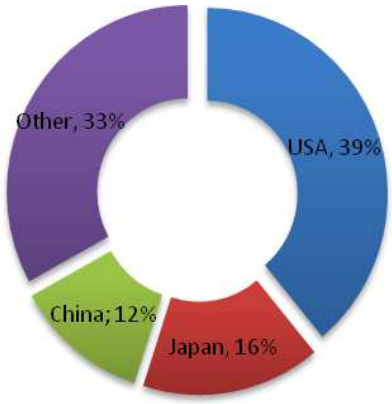
Figure 2 – The size of electric fleet in 2014



Source: Author's projection based on http://www.hybridcars.com/top-6-plug-in-vehicle-adopting-countries-2014/7/

In terms of market shares, the largest share regarding EV is owned by the USA. Only three countries hold about 67% of existing electric vehicles worldwide.

Figure 3 – The market shares of the main three countries that hold electric vehicles



Source: Author's projection based on Global EV Outlook 2015

At European level, the increases registered on EV market are staggering. If in 2013 there were about 15,500 electric vehicles in the main European countries, after the first half of the year their number reached 27,946 vehicles, thus registering an increase of 79%.

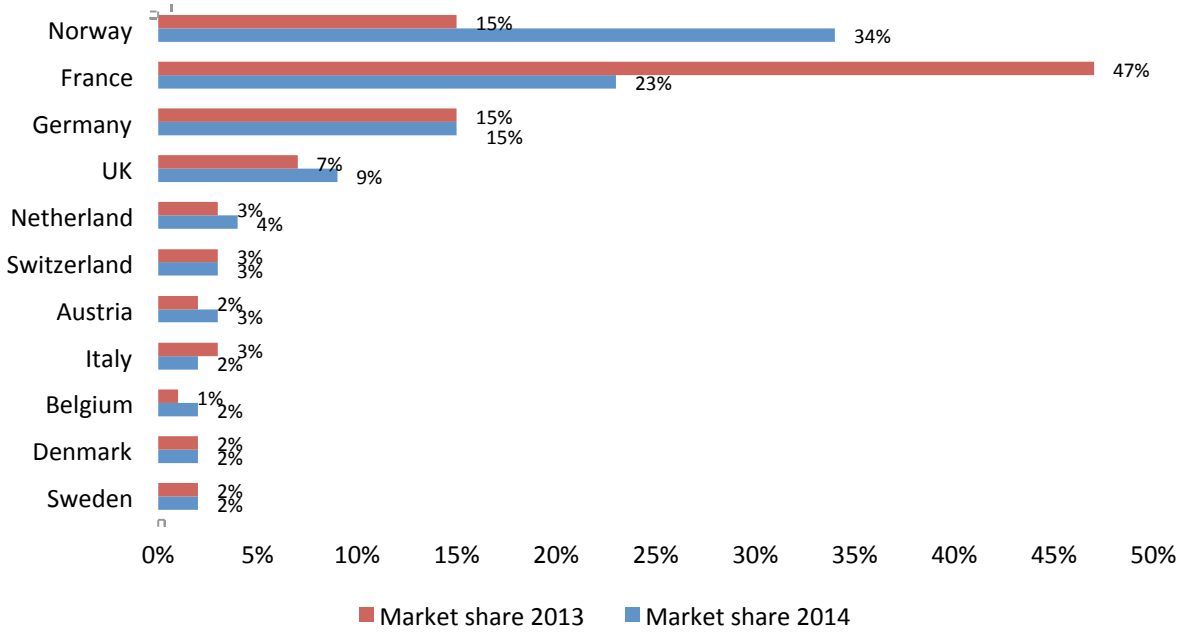
Table 1 – The number of new electric vehicles in the main European countries

Country	2013	2014	Increase
Norway	2373	9550	302%
France	7293	6405	-12%
Germany	2382	4230	78%
Great Britain	1168	2570	120%
Netherlands	437	1149	163%
Switzerland	445	867	95%
Austria	252	709	181%
Italy	494	648	31%
Belgium	195	629	223%
Denmark	254	604	138%
Sweden	298	585	96%
TOTAL	**15591**	**27946**	**79%**

Source: http://evobsession.com/europe-electric-car-sales-77-2014

Thus, the largest increase in EV is registered by Norway, with an increase of over 300% of their fleet, followed by Belgium with an increase of 223%. It can be seen that in the case of France, the number of VE is marked by a decrease of 12%. As regard of market share in 2014, compared to the same period of 2013, we can see that 47% of existing EVs in Europe are found in Norway, while France has 15% of the market share.

Figure 4 – 2013-2014 comparative evolution of market share for electric vehicles in Europe



Source: Author's projection based on http://evobsession.com/europe-electric-car-sales-77-2014/

Norway is the country with the highest market penetration per capita in the world and since March 2014 Norway became the first country where more than 1 out of 100 existing cars on the road is an electric one [5]. It should also be noted that Estonia is the first country who has completed the implementation of an EV charging network with national coverage, with quick chargers available along highways at a minimum distance of between 40 to 60 km [6].

In Romania, the number of VE is extremely low. This type of vehicles holds only 0.01% of the total existing vehicles at national level. However, it is estimated that by 2020, EVs will own a market share of up to 5%, according to APIA [7].

3. Assessing the need to improve urban transport by introducing electric vehicles

E-mobility in Romania is only at the beginning, as it faces problems such as: the high cost of purchasing of electric vehicles, lack of adequate infrastructure correlated with financial limitations of the population, local governments, and the lack of consistent supporting programs at national level. Looking to the figures of the Romanian market for electric vehicles, currently there are 44 electric vehicles according to the statistics available from the Romanian Auto Registry (RAR).

Within the European Union, the issue of climate change and sustainable development is more and more brought into discussion. Taking into account the sustained struggle for sustainability, the EU has begun to put an increasing emphasis on the concept of sustainable mobility in terms of efforts for reducing the GHG emissions. After 2008 there was a further explosion regarding the interest in green vehicles and all these because of an increased mobility in Europe and beyond. However, the market for electric vehicles is one of the least developed across the European Union.

Since 2007, a series of policies governing sustainable mobility was initiated by the European Commission, such as the Green Paper – Towards a new culture for urban mobility, White Paper – Roadmap to a single European transport area or the European Green Vehicles Initiative, documents that identify and analyze the need for the electrification of urban transport and encourage the use of electric vehicles in road transport in general and in urban public transport in particular. European Green Vehicles Initiative [8], promoted in response to the global crisis of 2008 continue in the Horizon 2020 project, materialized into an effective instrument for funding research, development and innovation in sustainable mobility. The central objective of this program is the development of new technologies for sustainable transport, focusing on the transition to propulsion systems energy efficient, with low emissions and which bring a positive impact in combating climate change, reduction of noise and pollution level in large conurbations and beyond. At the same time, the United Nations (UN) formulated in 2014, the Urban Electric Mobility Initiative [9] that recommends and emphasizes the need for increasing the percentage of use of EVs in urban areas, also proposing a series of targets to achieve regarding the GES emission reduction, such as reduction of CO2 emissions by 30% in urban areas.

To the same direction, at the United Nations Summit, was approved the document "Transforming our world: the 2030 Agenda for Sustainable Development"[12]. This Agenda, according to the UN, is a plan of action for people, planet and prosperity, which seeks to strengthen universal peace in larger freedom. The sustainable development goals (SDGs) seek to ensure that in the next 15 years of international development, no one is left behind. The SDGs follow and expand on the millennium development goals (MDGs), which were agreed by governments in 2001 and are due to expire at the end of this year. Out of the 17 goals we highlight:

- Ensure sustainable consumption and production patterns;
- Take urgent action to combat climate change and its impacts;
- Strengthen the means of implementation and revitalise the global partnership for sustainable development;
- Build resilient infrastructure, promote inclusive and sustainable industrialisation, and foster innovation.

In parallel and complementing the policies regarding transport, in general and urban transport, in particular, the Partnership for Smart Cities and Communities [10] advocates for the development and implementation of smart urban technologies and services that can open great prospects in terms of solving large urban areas problems.

In Romania, a number of programs and policies that advocate for the use of electric vehicles, for developing and implementing new sustainable technologies focused on energy efficiency and significant contribution to mitigating climate change, pollution and noise levels has been initiated. Among these policies we can notice Strategy for Sustainable Transport and Perspectives for 2020, 2030, National Strategy for smart cities in Romania [11], the National Climate Change Strategy 2013-2020 and the National Strategy for Sustainable Development of Romania 2013-2020-2030.

All the above mentioned, together with the demographic change (aging, immigration, labour mobility), changes in the behaviour of people (high mobility, Internet dependence, etc.) or the changing regarding the way people work (lifelong learning, longer distance) determine the need for new innovations and openness to new transport technologies, materials, equipment for smart, green and integrated transport both urban and for the entire road transport sector. One of the main ways to solve the previously identified needs is the development of advanced technologies and materials for smart electric vehicles.

We can identify the need to implement programs of academic research, development and innovation in partnership with the business environment, research institutes or even with the final beneficiaries that will be focused on certain directions such as: (1) high energy efficiency; (2) silence; (3) reduced weight; (4) handling; (5) operating comfort and safety.

3.1 Need for new innovations in road transport

In this context, one of the issues most frequently raised refers to climate change, which came to jeopardize economic growth and have effects, sometimes devastating, on social development. 2014 was the warmest year in history, being considered the peak of a series of years in which global temperatures were rising.

All those listed above lead to the necessity to take measures to minimize the impact of climate change and the level of GHG released into the atmosphere must be reduced substantially. As we have previously noticed, one of the sectors that have a negative influence on the environment is the road transport. So, we should consider the implementation of solutions and innovations in this sector in order to mitigate its harmful effects and to contribute to socio-economic growth of a business environment always looking for new sources of revenues.

One of the existing solutions which significantly contribute to reduce the negative impact of road transport on the environment is the electric vehicles.

The development and innovation of electric vehicles are a topical segment with a significant dynamic and positive result for road transport, in general, and road transport in urban areas, in particular. It is becoming increasingly clear that in terms of personal mobility, the electric propulsion is the way to follow, from a number of reasons, such as:

- Significantly higher efficiency than other forms of propulsion used today - whether for internal combustion engines it can be obtained an average efficiency of 25%, for EV, the average efficiency is 80% (of 100 energy units, 80 reached the wheel and put the car in motion).
- It provides the ability to recharge EV from renewable energy - even if there are GHG emissions from power plants that supply electricity to public networks, EV offers the possibility to choose the type of energy with which they will be fed and if this energy comes from renewable sources, then we will have zero GHG emissions. The internal combustion vehicles will rely only on fossil fuels as an energy source.
- Wherever the electricity came from, it produces zero emissions at the tailpipe - thus a cleaner air for those who live in urban areas, extremely overcrowded and polluted now, will result.

Electric propulsion vehicles are seen as an attractive option on the path to low emission vehicles, which would allow the transport sector to significantly reduce GHG emissions. Electric vehicles are characterized by the highest engine efficiency of existing propulsion systems and zero emissions. Using electricity as an energy source for these vehicles offers an opportunity to expand the range of primary energy sources used in road transport.

3.2 The main socio-economic advantages and disadvantages of electric vehicles

Primarily, an electric vehicle is an opportunity for consumers to save money. Besides this major advantage, we can identify a number of socio-economic advantages that an electric vehicle has:

- **Do not use fossil fuels** – according to U.S. Environmental Protection Agency, an EV "consume" $ 3.74 for a journey of 100 miles, while a conventional vehicle "consume" $ 13.36 for the same distance, in terms of fuel costs.
- **Savings** - these vehicles can be fuelled at very cheap prices and many new cars will get substantial stimulus from governments and central authorities. Electric vehicles can be also a great way to save money.
- **No emissions** - electric cars are 100% eco-friendly as they run on electric engine, thus contributing to a healthy and green climate.
- **Profitability** - in the past, holding a large EV was quite costly. Because of the technological progress, both costs and maintenance have decreased. Providing tax incentives significantly reduced total cost of an EV, making it more cost effective.
- **Low maintenance** - EV runs on electric engine and therefore, there is no need for lubrication of engines. Also, other expensive repairs to the engine are not required. Visits to the service for an EV are much less than for conventional vehicles.
- **Low noise** - these vehicles are extremely quiet which contributes greatly to reducing noise pollution in large conurbations.

Many owners of an EV have reported significant financial savings. Given that more and more voices signal the reduction of the amount of existing oil, EV will be, most likely, the normal way of transportation in the near future.

However there are some disadvantages that an EV entails, out of which we can mention:

- **Recharging points** - refuelling points are still under development.
- **Limited autonomy** - most of these vehicles have a range of about 300 km, not being recommended for covering long distances.
- **Silence** - this feature, in the current context, can be interpreted as a disadvantage. In urban areas, where people are accustomed to high levels of noise, quietness of such a vehicle can lead to accidents.
- **Replacing the batteries** – according to the type of battery used, they require replacement after a period of 5-10 years.

The gradually increasing momentum behind EV adoption – both from the side of the consumer and the automotive industry – suggests that electrified powertrains will play an important role in Europe's mobility going forward. Electric vehicles already promise financial savings for certain operators without subsidies. Despite of its disadvantages, EV plays an important role in the developement of the economy and have a key-role in climate change.

4. Conclusion

Against the backdrop of an economic environment oriented more and more towards new technologies that fall between the guidelines of sustainability, sustainable development, reduction of pollution and development of new innovative technologies, we can notice the need and opportunity to develop advanced technologies for smart urban EV.

Both road transport, in general, and urban areas, in particular, are areas that can enjoy the benefits of developing new innovative technologies and through implementing smart electric vehicles we can expect a decrease in the level of GHG emissions, reduction noise and pollution, a cleaner and friendly environment for the main beneficiaries of all innovations categories - Citizens - significant issues that cannot be neglected.

5. References

[1] European Environment Agency, 2014, Annual European Union greenhouse gas inventory 1990–2012 and inventory report 2014 available at http://www.eea.europa.eu/publications/european-union-greenhouse-gas-inventory-2014

[2] http://www.hybridcars.com/top-6-plug-in-vehicle-adopting-countries-2014/7/

[3] International Energy Agency, 2015, Global EV Outlook 2015 available at http://www.iea.org/evi/Global-EV-Outlook-2015-Update_1page.pdf

[4] http://evobsession.com/europe-electric-car-sales-77-2014/

[5] Gronnbil, 2014, Over 20,000 rechargeable electric cars on Norwegian road, available at http://www.gronnbil.no/nyhetsarkiv/over-20-000-ladbare-biler-pa-norske-veier-article366-239.html

[6] http://estonianworld.com/technology/estonia-becomes-the-first-in-the-world-to-open-a-nationwide-electric-vehicle-fast-charging-network/

[7] http://www.apia.ro/publicatii/analize-parc-vehicule/

[8] European Green Vehicles Initiative (EGVI), 2013, Multiannual Roadmap for the Contractual Public Private Partnership European Green Vehicles Initiative available at http://www.egvi.eu/uploads/Modules/MCMedias/1380874049332/ppp-egvi-roadmap-final-sept2013.pdf

[9] http://slocat.net/urban-electronic-mobility-vehicles-initiative

[10] http://ec.europa.eu/eip/smartcities/

[11] http://www.oraseinteligente.ro/index.php/18-strategie-nationala-inteligenta-pentru-orasele-inteligente-din-romania

[12] United Nations, 2015, Transforming our world: the 2030 Agenda for Sustainable Development available at https://sustainabledevelopment.un.org/post2015/transformingourworld