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Electric vehicles challenges and opportunities: Lithuanian review

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ABSTRACT

Electric vehicles (EVs) are reviewed in the context of policy and technical aspects taking into consideration the Lithuanian national picture over the global and European Union developments within this field. The paper presents also the best practices for deployment of EVs including the potential niche markets and the challenges and opportunities within the energy and power systems support. A critical evaluation is also performed on the relevant research and developments in Lithuania. Finally, the paper evaluates the strengths, weaknesses, opportunities and threats through a developed SWOT analysis. This review will provide insight to the EVs challenges and opportunities within the Baltic Region. It is expected this will inspire individuals, business and policy makers to allow and incentivise deployment of EVs to enhance efficiency in transport and consequently contribute towards GHG emissions reduction.

Contents

1. Introduction

The global and local markets of electric vehicles (EVs) is still at its infancy. There is a spectrum of technology such as battery electric vehicles (BEVs), plug-in hybrid electric vehicles (PHEVs) and hybrid electric vehicles (HEVs). In addition developments in

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internal combustion engine vehicles (ICEVs) is an ongoing process with many manufacturers adopting technologies such as energy recovery systems [1].

However transport electrification is considered as the main technological alternative which has significant potential to reduce pollution and energy dependence on fossil fuels [2–4], reach environmental objectives [5,6], allow smoothly the deployment of alternative energy sources for electricity production [7–11], enhance energy consumption efficiency [7,8,12], develop clean urban transport [7,12–15], low transport costs [13,16] and support the electricity grid within a smart grid environment such as vehicle-to-grid (V2G) [17–19], vehicle-to-home (V2H) [20,21], vehicle-to-building (V2B) [20,21], vehicle-to-load (V2L) [21], vehicle-to-premise (V2P) [21], and grid-to-vehicle (G2V) [21] concepts.

The potentials, trends, best practices, infrastructure and new technological discoveries in e-mobility have been widely discussed as a viable option for the United States [22,23], China [24], Taiwan [24], Japan [23,25,26], Australia [27,28], Spain [29], Italy [30], Romania [31], Denmark [32], Poland [33], Germany [34,35], Austria [36], Portugal [37], Malta [14,15], and elsewhere [38,39]. Examination of these issues and adaptation of best practices to the local context and integration into the global movement of electric mobility is extremely relevant to Lithuania.

In 2012, the Baltic States have registered about two thousand EVs each. However, the numbers of BEVs remained very low, for example four in Lithuania. EVs annual global sales are expected to reach nearly 4 million by 2020 [40]. By 2025 about 10% of global new vehicle sales will be EVs from more than 80 different models [40–42]. Major OEMs such as Audi, BMW, Nissan, Mitsubishi, Ford, Renault, Volkswagen, and Citroen have already started production of at least one EV model such as the Nissan Leaf, Mitsubishi i-MiEV, Ford Focus Electric, Renault Fluence Z.E., Volkswagen e-Up!, Citroen C-ZERO [43–48] as shown in Table 1 and Fig. 1. Meanwhile, further manufacturers are in the pipeline of launching their vehicles to market such as PSA Peugeot Citroen VeLV.

1.1. The European Union (EU) market

In 2009, the average tailpipe CO_2 emissions stood at 145.7 gCO_2/km, while tailpipe emissions are targeted to reach below 130 and 95 gCO_2/km by 2015 and 2020, respectively. The Ricardo-AEA company reports a possible 75 gCO_2/km by 2025 if sales ratio between HEVs and ICEVs reached 22:78 down to 60 gCO_2/km if sales ratio of the ICEVs:HEVs:PHEVs:BEVs:FCEVs (Fuel Cell Electric Vehicles) reached 52:24:15:7:2 [49].

A spectrum of EU Framework 7 working programmes [50], such as “Green Cars Initiative” and “Green eMotion” have already inspired research and demonstration activities in transportation across the continent. The IBM “SmartCloud Enterprise” [51] is a platform which allows the integration of electric power supply services to vehicles to respond more effectively to changes and plan their activities and create a market of services. Provision of adequate grid capacity and appropriate grid operation tools in order to integrate EVs and become beneficial for power system operation are investigated and demonstrated [52]. The “Green eMotion” EU-funded project aims to create European wide infrastructure for EVs by 2015. The viability of mass rollout of EVs and PHEVs across the EU-27 is assessed by a multi-criteria perspective involving techno-economic, and socio-environmental aspects to understand the system-wide impact on European continent electricity infrastructures [50].

The current EVs infrastructure is developed within pilot projects. Expansion of the EV market is largely funded by direct financial support from projects or financial incentive support schemes on initial capital, which is mainly driven by the public or semi-public institutions.

Furthermore, the deployment of EVs has integrated incentives in subsidies, tax rebates and various other direct and indirect

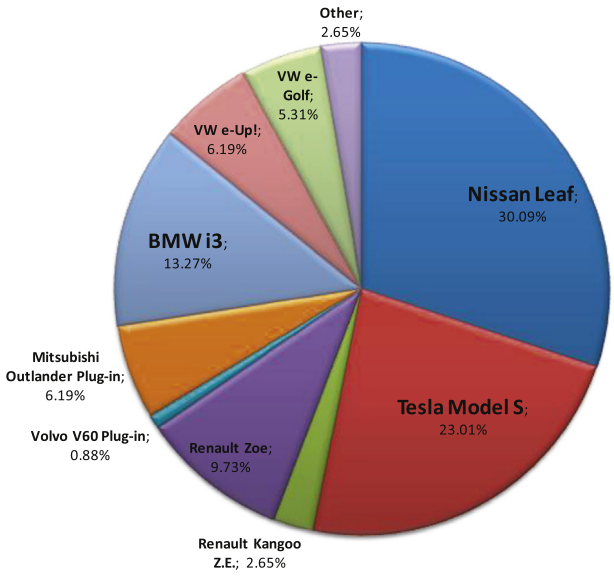

Fig. 1. The best-selling electric vehicles in European countries (Germany + France + Netherlands + Norway) in 2014.

Table 1
Technical characteristics of road cars with a top speed above 105 km/h.

Model	Top speed/acceleration	Charging time	Nominal range	Market release date
BMW i3	150 km/h 0–100 km/h in less than 8 s	240 min with the 240 V charging unit 30 min. at public DC charging stations	130–160 km	Released in Europe in 2013
Citroën C-Zero	130 km/h 0–100 km/h in 15.9 s	420 min. when charged from household 30 min when charging from a quick charger system	150 km	Released in Europe in 2013
Mitsubishi i-MiEV	130 km/h –	420–840 min when charged from household 30 min when charging from a quick charger system	170 km	Released in 2009
Renault Fluence Z.E.	135 km/h –	Battery replacement in 5 min	135–150 km	Released in 2010
Nissan Leaf	150 km/h –	Up to 1200 min when charged from 110/120 V outlet 480 min when charged from 220/240 V outlet 30 min when charging from a quick charger system	117–121 km	Released in 2010
Volkswagen e-Up!	130 km/h –	540 min when charged from 220/240 V outlet		
Ford Focus Electric	135 km/h 0–97 km/h in 10.2 s	1080–1200 min when charged from 110/120 V outlet 180–240 min when charged from 220/240 V outlet	122 km	Released in USA in 2010 Released in Europe in 2013