

## ANALYSIS ON ELECTRIC VEHICLE CHARGING INFRASTRUCTURE IN LATVIA

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**Abstract.** The paper contains a review of electric vehicle charging infrastructure in Latvia. Electric vehicles are only gaining popularity in Latvia, but it is essential to develop the exploitation infrastructure, because without it, users can rely only on individually available resources. In March of 2012 there are only 10 public charging points in Latvia, 8 are in the capital Riga. The other two are within 50 km range from Riga – in Jelgava and Jūrmala. Choosing the best exploitation infrastructure for Latvia will mean lower costs, balanced charging points, bigger electric vehicle independence, security for new users of technology and faster integration. Before the development of the electric vehicle market in Latvia has gained speed and serious infrastructure has been built, there is still time to learn from success and mistakes made in other countries and choose the most suitable way of creation of charging infrastructure. Significance of a unified marking standard for equipped parking spaces and charging stations is discussed. The authors review the necessity of simple and straightforward user interface.

**Keywords:** charging point, electric vehicle, infrastructure.

### Introduction

Use of electrically powered means of transportation in Latvia predates hype that started around the year 2009 concerning a new generation of electric passenger vehicles. Electric trams were introduced in year 1901. In 1914, there were 14 lines of electrical trams in Riga, with the total length of 50 km, carrying 52.1 million passengers yearly [1]. Of course, a tram does not need a charging infrastructure but it is a great demonstrator of the use of electrically powered means of transportation. The technology demonstrates comfort, reliability, ecological and economical points. In 1980's the price for tickets for public transportation was the following – bus 5 kopecks, trolleybus 4 and tram only 3 [2].

Electrical forklifts were widely used in factories in warehouses since their introduction in 1906 [3]. With zero emissions it is an irreplaceable tool in closed areas and a great demonstrator of technology. Electric motors and controllers, used in forklifts are a popular source of components for enthusiasts of internal combustion vehicle (ICE) converters to electrical vehicles [4].

The industrial charging infrastructure for forklifts in Latvia exists for many years. The experience obtained by its maintainers and users should be used when developing a new charging infrastructure for modern electrical vehicles.

More and more strict laws are introduced for emission gasses and waste water. Cities are struggling with smog and noise. People are used to personal transportation for longer than a century, but there is always a prediction ahead, that oil resources will run out despite exploring new reserves. The Earth's population and wealth are growing, so there is the need for transportation. The political situation and oil demand causes the fuel prices to grow. That leads to more activity in fuel alternative field.

In 2010 almost 60 % of the electric energy, produced by the largest electricity supplier "Latvenergo" in Latvia came from renewable resources - mainly from hydroelectric power stations [5]. Electric energy can be considered as a natural resource of Latvia. If an atomic power plant in Lithuania will be built, it may have a major impact on the energetic independence of the Baltic States from the current supplier. To increase the economical independence of Latvia, consumption of oil products and natural gas should be replaced by electricity. In the field of transportation it means replacement of the current, ICE powered fleet with electrical one. Currently the demand for electrical vehicles in the Western world exceeds the production capacity. Only few producers are ready to supply EV's. Currently they are Mitsubishi, PSA and Renault-Nissan. To give the best experience to the customers, only countries with developing charging infrastructure are served. It is a job of NGO, municipalities and government institutions to show that a specific country has strong and serious intentions for developing of charging infrastructure.

### Current situation of charging infrastructure

Development of a public EV charging infrastructure in Latvia is beginning. At the moment, there is not much to charge. Currently, there are only two officially registered M1 and N1 class electric vehicles in Latvia. Around 500 electrical bicycles and 25 slow moving EV's, used in the Zoo, hospitals and golf courses are charged in private charging points [6].

The NGO "BIMAB" – Zero Emission Mobility Support Society was founded in 2009 to develop sustainable mobility in Latvia [7]. In cooperation with the local producer of electrical power "Latvenergo" on September, 2011, a map and list public charging points were presented [8].

The public charging points in Latvia on April, 2012 are listed in Table 1.

Table 1

**Public Charging Points**

Address	Parking	Charging	Connections
Brivibas gatve 299, Riga	Free	Paid	1
Jomas iela 4, Jurmala	Free	Free	4
Eksporta iela 3a, Riga	Paid	Paid	1
Stacijas laukums 4, Riga	Paid	Free	10
Z. A. Meierovica bulvaris 8, Riga	Paid	Free	10
Elizabetes iela 55, Riga	Paid	Free	5
Baznicas iela 20/22, Riga	Paid	Free	5
J. Cakstes bulvāris 5, Jelgava	Free	Free	4
Dzirnavu iela 67, Riga	Paid	Free	2
Lielgabala iela 4, Riga	Paid	Free	2

In total 10 public EV charging points so far are introduced in Latvia. Most of them are located in the capital Riga. One charging point is located in the city Jurmala (25 km from the capital), near the administrating building of "Latvenergo". It has a free charging and parking space. This charging point is the only one with IEC-62196; 32 A/230 V/50 Hz (21 kW) type connector, used for electric automobile fast charging. There are sockets for 4 electric vehicles.

The other charging point outside the capital is located in the city Jelgava, at the Faculty of Engineering of the Latvia University of Agriculture (45 km from the capital Riga). It is capable to serve 3 bicycles and 1 car simultaneously. Parking and charging are for free, but this service is not available twenty-four hours a day because of the closed territory during the night time.

The first public charging point in Latvia was opened in October, 2010, at the petrol station "Kursi", Brivibas street 299, shown in Figure 1 [9]. It was developed by the local producer "Eltus" [10].



Fig. 1. Charging point at Brivibas street 299, Riga [9]

There are 6 charging points in Riga. One is near the Old Gertrudes Church for 5 vehicles. Free charging, but parking requires payment. The second is not far from the city center, in Old Riga. Charging is for free, but there is a parking fee. Ten vehicles can be parked there. The third is near the Riga Passenger Port, it can serve one vehicle and both, charging and parking, are not for free. Another charging point is near the Latvian National Museum of Art. It has free charging, but paid parking spaces for 5 vehicles. Another big electric vehicle charging point for 10 vehicles is near the Central Railway Station. Here also there is paid parking and free charging.

Currently, there are no agreements for unified marking of the charging points in Latvia. An example of marking at Europark parking is shown in Figure 2.



Fig. 2. Marking of charging point at Europark parking [11]

### Future development

The public limited company “Latvenergo” is the biggest energy power supply enterprise in Latvia. It has been estimated that the first level extension could consist of 50 charging points in the biggest cities (12 in the capital Riga) and could cost around 2.5 million EUR [12]. The possible locations are shown in Figure 3. Charging points could be located near malls, state enterprises, housing estates, the city center, near catering establishments and along highways. There is a commitment to develop up to 500 charging points in Latvia till 2020 [13].

If the market will develop successfully, many car manufactures will offer EV's via the local dealers. To fulfill their contracts, the dealerships will develop their own public charging points, including the designated ones for fast charge with direct current.

In the middle of 2012 financial support from the Latvian Government program KPFI will be available for development of the EV park and charging infrastructure. The total amount is 3.5 million LVL. The KPFI program is funded by selling CO<sub>2</sub> quotas, according to the Kyoto protocol [14].

There was an immediate public reaction after this announcement, in the form of willingness to purchase EV at few dealerships of the current EV producers. Unfortunately, in Latvia there is no commercial offer of EV from the world's leading producers. Probably, it can be wise to direct the available funding in the development of the charging infrastructure.

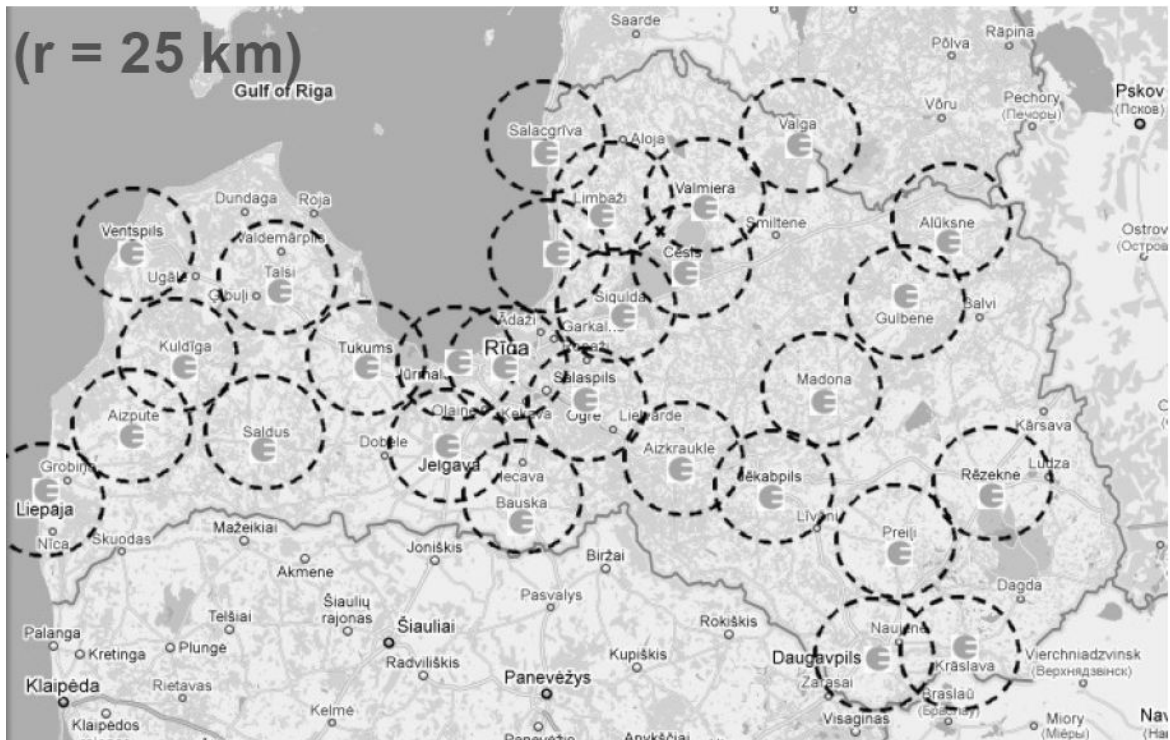


Fig. 3. Plans for location of charging points by Latvenergo [12]

**Local production of charging equipment**

The first public charging point in Latvia, located at the petrol station “Kursi” at Brivibas street 299, was equipped with locally manufactured charging equipment. It was supplied by the company “Eltus”.

The charging device type M2 Universal is shown in Figure 4.

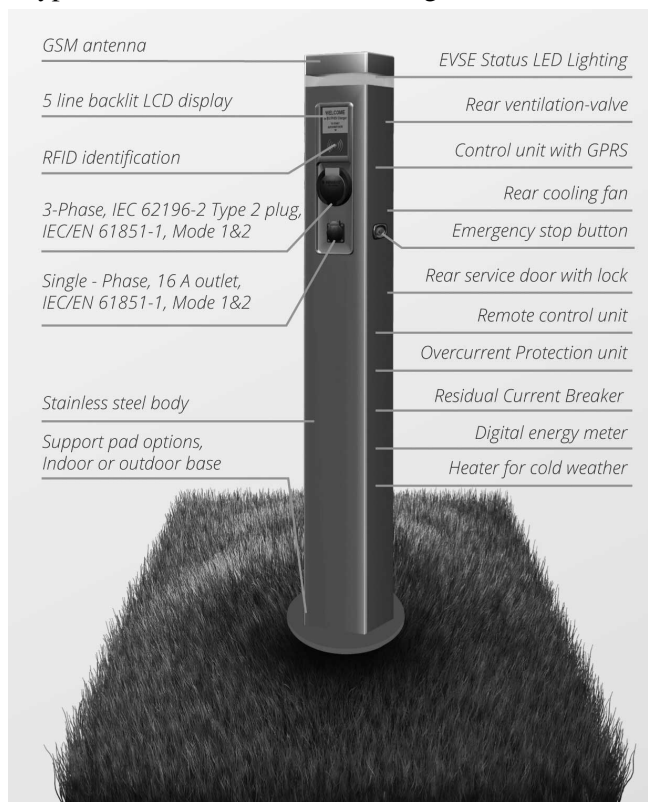


Fig. 4. Charging device Eltus M2 Universal [10]

The main features are listed in Table 2.

Table 2

**Technical Characteristics, Eltus M2 Universal**

AC Power Input	400 VAC, 32A Max, Three Phase
AC Power Output	Three Phase, 400 V, 32 A (22 kW)
	Single Phase, 230 V, 16 A (3.7 kW)
Charging Connections	Three Phase according IEC-62196 (Mennekes)
	Single Phase – Country Specific (Schuko)
Overcurrent Protection	Cut-off 40A per phase
Leakage Current Protection	30mA, optional programmable auto retry
Cable Type Detection	Yes, on IEC-62196
Energy metering	Class 1, resolution 0.1 KW·h <sup>-1</sup>
Local Area Network	RS-485, Ethernet
Wireless Local Network	Zig-Bee, according 802.15.4 (optional)
Wide Area Network	GSM/GPRS commercial network
RFID Smart Card Reader	ISO-14443, ISO-15693 or both (optional)
Electrical Compliance	2006/95/EC (Low Voltage directive)
	2004/108/EC (EMC directive)
Operating Temperature	-30 °C to +50 °C
Operating Humidity	< 95 %
Dimensions	1400 mm × 180mm × 120 mm
Weight (including packaging)	25 kg

The company “Eltus” was founded in 2010 in collaboration with the Kurland Business incubator in Latvia and a private investor. The company is located in the city Liepaja.

The project launched electric charging point prototype and test unit development for electric and plug-in hybrid electric cars. After finishing the pilot project in 2011, the manufacturer is now starting serial production of the charging points [10].



**Fig. 5. Sockets for engine heating in town Nokia, Finland**

In northern Europe countries a lot of cars are equipped with engine heaters with external power supply. In some parking places there are sockets for this purpose (see Fig. 5). Currently, there are more than a million engine heating stations already in place [15]. These engine heating stations are used for a short period of time and are not planned for big electrical loads (16 A fuse), so only slow charging is available. If the owner of those parking places allows free long-time charging, then there will already be a simple infrastructure for charging electric vehicles. But there are very few electric vehicles in Finland- the Finns do not believe they would survive their harsh winters. Latvia should also encourage companies for a simple electric vehicle infrastructure nearby their social buildings.

## Conclusions

1. All 10 electric vehicle charging stations are located densely in the central part of Latvia, but are not well recognizable among Latvians.
2. All charging stations are different, because of the lack of standards for marking and charging.
3. The infrastructure is developing at a moderate rate due to social activists despite the lack of governmental support.
4. The main supplier of electrical power "Latvenergo" has announced commitment to develop a large network of charging points till 2020.
5. Financial support for charging infrastructure development from the Government funded program in the total amount of 3.5 million Lats will be available in 2012.
6. Latvia has the technology for creation of a modern and complicated electric vehicle infrastructure.
7. A basic charging infrastructure can be created using simple solutions and equipment.

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