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How a City Prepares to e-Mobility in Terms of Public Charging Infrastructure

Case Study - The City of Zurich

Denise Schuler, Giorgio Gabba
Protoscar SA, Via Ronchi 18, CH – 6821 Rovio
d.schuler@protoscar.com

Short Abstract

The study estimates the charging infrastructure that will be necessary to meet the needs of the electric mobility in Zurich. In order to estimate the charging stations, the number of EVs and PHEVs circulating in 2020 in Zurich have been defined taking into account the specific characteristics of the city. The study rated the city of Zurich 7.9% more likely to introduce EVs and PHEVs, compared to the Swiss average in 2020. The medium scenario expects 11,200 EVs; 20,000 private power outlets; 750 public charging stations; and 10 public fast chargers.

1 Research Focus

ewz, the Zurich municipal electric utility, strives to prepare the charging infrastructure for the city according to the EV[1] demand. On behalf of ewz, Protoscar conducted this study that is subdivided in three parts. This paper concerns the first part. The aim of the first part of the study was to estimate the required charging infrastructure that will cover the demand arising from the market penetration of EVs in Zurich in 2020. The second part of the study analyzes the business models of the public charging infrastructure, assessing the cost of the installation of the public charging stations. The third part concerns the technical specifications of the public charging stations.

2 Procedure

The following steps have been undertaken to estimate the required charging stations in Zurich.

2.1 Quantification of EVs in Zurich

Three scenarios that investigated the Swiss EV market penetration in 2020 serve as starting point. Through a preliminary strengths and weaknesses analysis of the introduction of EVs in Zurich, relevant impact factors have been identified (e.g. politics, income, demographic evolution, etc.). The impact factors have been evaluated to define the deviation from the Swiss average. Following, they have been applied to the three existent Swiss EV market penetration scenarios.

[1] Electric Vehicle, includes BEVs (Battery Electric Vehicles), REEVs (Range Extended Electric Vehicles) and PHEVs (Plug-in Hybrid Electric Vehicles)

2.2 Identification of other Parameters Influencing the Charging Infrastructure Demand

The charging infrastructure demand and the placement of the different types of stations not only depend on the number of EVs but also on other parameters, e.g. statistics regarding households, parking places, commuter flows, etc..

2.3 Definition of the Charging Infrastructure

For different charging needs different charging stations are required. Therefore, different types of charging stations have been proposed for the city of Zurich.

2.4 Quantification of the Charging Infrastructure for the City

Finally, the amount of each type of charging station has been calculated, for the whole city as well as for each of the 12 districts of Zurich.

3 Main Results

The charging infrastructure has been categorized as follows:

- Primary Infrastructure (I): for usual charging processes. Typically installed at home, at work and at parking places for fleets, i.e. where the car charges most of the needed energy. A charging station is considered corresponding to a power outlet. Each EV needs a primary charging station.
- Secondary Infrastructure (II): for occasional charging processes. Typically in parking places on the street, at shopping malls etc. A charging station is considered corresponding to at least two power outlets. The number of secondary charging stations will be inferior to the number of cars.

This causes the amount of charging stations (primary and secondary) to exceed the number of EVs. Installing more public charging stations in strategic places reduces uncertainty related to the range by offering supplementary charging possibilities. Initially, this charging infrastructure will facilitate the market introduction of EVs by exercising a positive psychological effect.

3.1 Three Market Penetration Scenarios

The basic scenarios to estimate the market penetration of EVs in Zurich result from the following three different sources that examine the EV Swiss market in 2020:

- scenario MAX corresponds to the Alpiq Vision2020: 15% of all vehicles have a plug in 2020
- scenario MID is the basis vision of ewz: 7.4% of all vehicles have a plug in 2020
- scenario MIN is based on the SFOE's[2] study: 2.2% of all vehicles have a plug in 2020

Considering the impact factors, specific to the city, the following market penetrations have been estimated for Zurich. Compared to the Swiss average (100%) the city of Zurich has been rated to be more likely to the introduction of EVs: 2.5% in 2012 and 7.9% in 2020. These results have been applied to the three scenarios that outline the number of EVs in Switzerland. According to the study in 2020 in the city of Zurich there will be:

Table1: Estimated number of EVs in the city of Zurich in 2020

Scenario	EVs in Zurich in 2020
MAX Alpiq	22,700 (16.3%)
MID ewz	11,200 (8.1%)
MIN SFOE	3,300 (2.4%)

[2] SFOE: Swiss Federal Office of Energy

3.2 Charging Infrastructure in the City of Zurich

The main results regarding the charging stations that will be necessary in 2020 to meet the needs of the electric mobility in Zurich are displayed in the following boxes:

Scenario MAX
approx. 22,700 EVs (4,000 EV and 18,700 PHEV)

approx. **40,000** private power outlets allocated as follows:
- 18,000 in garages (I)
- 10,000 power outlets for commuter (place of work) (I)
- 8,500 power outlets for fleets (I)

3,200 public power outlets (only approx. 8% of the total) – approx. 1,500 public charging stations on the streets (I and II)

10 public fast charging stations installed in strategic places (II)

Scenario MID
approx. 11,200 EVs (1,200 EV and 10,000 PHEV)

approx. **20,000** private power outlets allocated as follows:
- 9,000 in garages (I)
- 5,000 power outlets for commuter (place of work) (I)
- 4,000 power outlets for fleets (I)

1,500 public power outlets (only approx. 8% of the total) – approx. 750 public charging stations on the streets (I and II)

10 public fast charging stations installed in strategic places (II)

Scenario MIN
approx. 3,300 EVs (300 EV and 3,000 PHEV)

Approx. **6'000** private power outlets allocated as follows:
- 2,700 in garages (I)
- 1,500 power outlets for commuter (place of work) (I)
- 1,200 power outlets for fleets (I)

500 public power outlets (only approx. 8% of the total) – approx. 250 public charging stations on the streets (I and II)

5 public fast charging stations installed in strategic places (II)

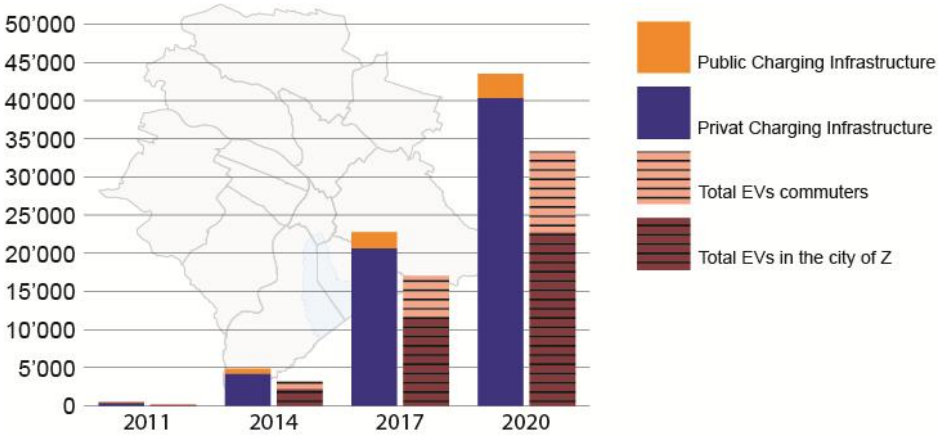

Figure 1: Public and private charging infrastructure and EVs

4 Other Considerations

Only the results of the first part of the research are delivered in this paper. However, the study continues in a second part that addresses the financial aspects of the public charging infrastructure. The focus is on assessing the costs of installing the public charging stations. Also the possible savings resulting from a suitable early planning of the charging infrastructure for EVs are evaluated in the second part.

The same procedure applies for other cities or regions that would like to prepare to the forthcoming electric mobility by installing public charging stations. In fact, the same procedure for establishing the needed charging stations in the Canton Ticino (Switzerland) is in progress. Moreover, also synergies with other projects as EVite, the nationwide and public accessible fast charging network of Switzerland can be built.

For cities and municipalities it is very important to consider also all the technical specifications of the charging infrastructure, as well as access and possible payment systems, in order to integrate everything in an early developed plan.

References

[1] *Protoscar*, www.protoscar.com

[2] *ewz, Elektrizitätswerk der Stadt Zürich*, www.ewz.ch

[3] *SFOE, Swiss Federal Office of Energy*, http://www.bfe.admin.ch

Protoscar SA

Protoscar SA is a Swiss company founded in 1987 with a wide experience in the field of EVs. The unique experiences gained with the different projects and the decisive collaborations with internationally known partners – as the Fraunhofer Institut IAO – allow Protoscar not only to develop forward looking strategies and outstanding vehicle concepts, but also to support the market introduction of CleanCars and the communication activities of these technologies. Furthermore, the insights of other projects contributed to this study: the "Vision 2020", developed with Alpiq, as well as the practical lessons learned with the Pilot Project in Mendrisio, VEL-1 (1994-2001) allow Protoscar a holistic approach.

Authors

Denise Schuler, Protoscar SA

Project Development and Communication, d.schuler@protoscar.com

Denise Schuler holds a MSc in Corporate Communication and Economics from the University of Lugano. She joined Protoscar in summer 2011 after a professional experience in London.

Dott. Ing. Giorgio Gabba, Protoscar SA

Project Manager, g.gabba@protoscar.com

Giorgio Gabba has studied aeronautics at the Politecnico of Milan. After his engineering degree, he started working in the field of composites materials. Later he worked in the development of electric vehicles and their components. In 1999 he joined Protoscar in charge of project management.

Contact

Protoscar SA, www.protoscar.com
Via Ronchi 18, CH – 6821 Rovio
Denise Schuler, d.schuler@protoscar.com

ewz, www.ewz.ch
Tramstrasse 35, CH – 8050 Zürich
Valentin Peter, valentin.peter@ewz.ch