

## **Design Challenges in the Development of Charge Stations for Electric Vehicles**

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In recent years the charging infrastructure for electric vehicles has expanded significantly European wide. In the Netherlands more than 2500 public charging points have been installed. The city of Amsterdam is a frontrunner in the implementation of charge infrastructure in the urban environment with 400 charging points placed and 1000 planned for 2015. With its ambition to roll out infrastructure, the municipality aims at bridging the chicken and egg problem for electric vehicles.

Despite the rapid growth of charging infrastructure, there are serious concerns regarding the viability of further roll out in the future: costs of charging points are high (including installation), the comfort of the usage of cables is low, the size of the poles limit pedestrians mobility, visibility of charging points is limited (especially at night), user-interface and intelligence of charging points is poor, to name a few. These problems are likely to become barriers for electric mobility, particularly in case subsidies for charging stations are reduced. In order for charging stations to grow further a new generation of charging stations will have to take into account economic, technical, urban logistic and user-interface considerations.

After two years of placing charging points in the public environment it is valuable for industries and local governments to analyze what kind of charging solutions work and which do not. There are several manufacturers of charging stations situated in the metropolitan region of Amsterdam. In order to establish design guidelines for the next generation charging infrastructure a series of interviews were held among approximately 8 companies that are involved in the development, installation and exploration of charging points for electric vehicles. In the interviews problems and design challenges of current infrastructure as well as possible functionalities, innovative solutions and future 'look and feel' of charge stations are discussed.

This paper builds upon earlier work in the field of design challenges of charging infrastructure and applies views of practitioners to develop a set of requirements for the next generation charging infrastructure for electric vehicles. The conclusions from this analysis can be used to gain insight in the actual challenges in the development of the charging infrastructure and come to recommendations concerning further design criteria, increasing effectiveness and improving the design and business case for charging points. The conclusions and recommendations may have implications for, and may support the stakeholder's electric mobility in the effective development of charge infrastructure.