Infrastructure development for electrical mobility: a Nordic perspective on national and cross-national challenges

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**Introduction**

The transition of an infrastructure system is a fundamental change of the institutional components and the design of the physical infrastructure system. Transition strategies need to be consistent with infrastructure system architecture and the different needs of electricity production and transport to respond to the challenges of climate change. In this paper, we focus on the different approaches taken at the national level to build battery electric vehicle (BEV) charging infrastructure in Norway and Denmark. The paper takes stock of the factors that have contributed to these developments and discusses the implications of further developments in terms of European correlations and in terms of the role of hydrogen-refuelling infrastructure.

**Methods**

The paper is based on custom-developed databases (http://e3.nifu.no) and roundtable discussions with key stakeholders in government, energy companies and.grid companies. The Norwegian datasets were supplemented with information from the Norwegian Environment Agency. The Danish datasets were supplemented with information from the Danish Energy Agency.

The paper focuses on the different approaches that have been taken at the national level to build battery electric vehicle (BEV) charging infrastructure. Norway and Denmark provide apt, contrasting focal points. Despite its position as a large fossil-fuel exporter and its mountainous topography, Norway exhibits high – and rather stable – balancing of electricity between days, which is due to its massive hydropower installed capacity. Denmark has a lower installed hydropower capacity, but it is one of the most densely populated countries in the world. Denmark’s electricity generation varied from 43% renewable in 2005 to 54% in 2012. The paper is complemented by a comparison of Norway and Denmark – rather different starting points and solutions for BEVs and PHEVs.

**Results**

1. **New ownership models for BEVs**: (car sharing, car renting
2. **Considerable, but non-permanent tax-reduction on BEV operators**
3. **Need for smart grids to exploit fluctuating wind power.**
4. **Wind power generation varied from 39% to 51%**
5. **Regulation**: Industrial and competitive market
6. **Consideration of costs and benefits of using hydrogen as an energy carrier (fuel cell vehicles)**
7. **Early roll out of charging infrastructure in Norway, Denmark and the Netherlands**
8. **Building own commercial actors, bottom-up approach**

**Conclusions and Implications**

European transport-policy aspirations face a number of challenges in the road to harmonizing region-wide recharging-infrastructure for electric mobility. Our work compares the distinct districts in which two Nordic countries have attempted to shape electric mobility infrastructure up until now. The Norwegian and Danish cases represent two "natural experiments" in the dissemination of distributed technological systems. Our approach here pairs these two rather small countries in an attempt to control for important country effects (affecting both the road on the Norwegian side).

**Further analysis of the interplay between factors can help inform a discussion of the transition from national to European transportation infrastructure. It can also help us draw implications for the building out of infrastructure for new energy carriers, including the potential expansion of hydrogen-refuelling infrastructure.**

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**References**
