Smarter*

with Plus Project Smartest in Amsterdam**

Team

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Partners

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Period

1 April 2014 – 01 October 2018

* **Full title:** Realizing the smart grid: aligning consumer behaviour with technological opportunities

** **Full title:** SMARTEST: Smart energy systems in the Amsterdam area: Electric vehicle as gateway to smart and sustainable energy use

Getting a grip on heterogeneity in consumers' energy behaviour

The transition to smart energy systems is a radical and systemic innovation that is expected to greatly increase heterogeneity in consumers' energy behaviour. Besides, the envisioned benefits of smart energy systems will only be realized if consumers adopt smart energy technologies, and use these in a way that is aligned with energy system reliability, efficiency, and sustainability. Scenarios and simulation models should take consumer heterogeneity into account, which requires micro-level models of consumer behaviour.

* Empirical analysis, evidence-based SES development scenarios and recommendations

The project has resulted in evidence-based recommendations for further smart energy system development which (1) include an accurate model of consumer behaviour, taking into account consumer preferences and behaviour, (2) take into account the capacity of the energy system, (3) and are location specific. The scenarios inform distribution system operators and policy makers on where and when changes in energy infrastructure, investments and incentives are most needed and appropriate.

The Plus Project among electric vehicle drivers was conducted with project partner New Motion and proposes a new route to promote the sustainable use of electric vehicles via organizations.

Read more

1 M. van Der Kam, W. van Sark (2015), *Smart charging of electric vehicles with photovoltaic power and vehicle-to-grid technology in a microgrid; a case study*, *Applied Energy*

2 M. van der Kam, A. Meelen, W. van Sark, F. Alkemade (2018), *Diffusion of solar photovoltaic systems and electric vehicles among Dutch consumers: Implications for the energy transition*, *Energy research & social science*

3 A. Peters, E. van der Werff, L. Steg, (2018), *Beyond purchasing: Electric vehicle adoption motivation and consistent sustainable energy behaviour in The Netherlands*, *Energy Research & Social Science*

4 M. van der Kam, A. Peters, W. van Sark, F. Alkemade (submitted), Agent-based modelling of charging behaviour of electric vehicle drivers

5 A. Peters, E. van der Werff, L. Steg (submitted), Mind the gap: the implications of not acting in line with your planned actions after installing solar photovoltaics in the Netherlands

6 E. van der Werff, A. Ruepert, L. Steg (forthcoming), An organizational route to pro-environmental behaviour

The research programme Uncertainty Reduction in Smart Energy Systems (**URSES**) aims to make a quick transition to a reliable, affordable and sustainable energy system possible. It is a joint initiative of several departments of NWO, Shell, AMS and the TKI Urban Energy.

Insights & recommendations

[1] A case-study in Lombok, Utrecht, shows that smart charging algorithms can significantly increase the self-consumption of photovoltaic power, especially when vehicle-to-grid and optimization techniques are included.

[2] Photovoltaic energy (PV) and electric vehicles (EV) are popular in very different parts of the Netherlands. EVs are popular in the Randstad, while PV is more popular in rural areas, especially the North. This uneven spatial development will have implications for the stability of the electricity grid. The difference in adoption levels of PV and EV can for a large part be explained by the difference in consumer characteristics (e.g. income, education level).

[3] The more people adopt an EV for environmental reasons, the stronger their environmental self-identity, in turn increasing the likelihood that they have also engaged in other sustainable energy behaviours. In contrast, adopting an EV for financial or technological reasons was not consistently related to environmental self-identity and sustainable energy behaviours. This means that the motivation for adopting an EV is crucial for the likelihood that people engage in sustainable energy behaviour consistently, which is key to achieving a sustainable energy transition.

[4] An information and feedback campaign can have similar positive effects compared to interventions using either financial incentives or automated smart charging. This was shown with an agent-based model based on a recent theory from environmental psychology to determine agent behaviour, contrary to earlier simulation models, which have focused on technical and financial considerations.

[5] The vast majority of people use their PV in a less sustainable way than they anticipated beforehand. After installation people are also less likely to see themselves as a sustainable PV user and less likely to believe that PV have positive environmental consequences. So it is important to support people in ways to use their PV in a sustainable way in order to facilitate that they can translate their good intentions into effective actions. Yet, environmental self-identity did not change from pre- to post-installation of PV. Hence, using PV in a less sustainable way than anticipated seems unlikely to have wide range implications.

[6] Sustainable use of electric vehicles can be promoted via organizations: the more people perceive that their organization aims to reduce its environmental impact, the more likely they see themselves as a pro-environmental person. The more people see themselves as a pro-environmental person, the more likely they are to use their electric vehicle in a sustainable manner and engage in other pro-environmental actions. Interestingly, this goes for employees as well as customers. It was also found that the more you perceive your government to reduce its environmental impact, the more likely you are to see yourself as a pro-environmental person, which in turn promotes pro-environmental behaviour.

NWO Netherlands Organisation for Scientific Research

AMS AMSTERDAM INSTITUTE FOR ADVANCED METROPOLITAN SOLUTIONS

TKI URBAN ENERGY Topsector Energie