Smart grid pilot projects in Europe

In brief

- The decarbonisation of the energy system calls for new ways of generating and consuming energy as well as new forms of relations between energy producers and consumers.
- It is important to understand the complexity of factors influencing the effectiveness and success of smart grid initiatives targeted at small consumers across Europe.
- It is equally important to assess the impact local solutions have on the whole energy system before applying them widely at regional or national level.

What is it about?

Improving energy efficiency and replacing fossil fuels with renewable energy are amongst the most important measures on the road to sustainable energy systems. This calls for new ways of generating and consuming energy as well as new forms of cooperation between energy producers and consumers. A number of practical approaches are currently being developed and tested in pilot projects across Europe.

This raises a number of questions: What do comprehensive, smart energy solutions for small consumers look like? How do they contribute to the transformation of energy systems? Which factors influence the effectiveness and success of such initiatives? What has proven to be successful and what needs to be improved or done differently in the future? A comparison of current smart grid pilot projects in Norway, Austria and Denmark has shown which key factors are relevant for the development of integrated and smart energy solutions. The results will provide designers, system planners and policymakers with insights on how to improve the development of smart energy solutions for small consumers such as households or small and medium-sized enterprises (SMEs).

Urban wind turbine integrated in the building

In Austria, an e-mobility project (VLOTTE in Vorarlberg), a local field test with a large number of photovoltaic (PV) systems (Köstendorf municipality in the state of Salzburg) and a residential building as part of the power grid (Rosa Zukunft in the city of Salzburg) are examples of three general types of solutions that are frequently used in smart grids. (1) *Demand-side management (DSM) and demand-response (DR)*: These are solutions that aim to react to fluctuations in production on the end user side by adjusting consumption over time. *(2) Micro-generation*: Decentralised generation of electricity from renewable sources is another central element. The pilot projects that were evaluated used PV systems, biogas-operated combined heat and power (CHP) plants as well as small hydropower plants. *(3) Energy storage solutions*: Storage systems for thermal and electrical energy are the third important element. In addition to stationary and vehicle battery systems, we also found approaches based on the inter-coupling of sectors (electrical energy is stored in the form of heat) and approaches in which electricity is chemically stored in the form of hydrogen.

Basic data

Project title:	MATCH: Markets, actors and technologies – A comparative study of smart grid solutions
Project team:	Bettin, S.; Gutting, A.; Sinozic, T.; Strauß, S.; Ornetzeder, M. (in an international consortium)
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Key results

Balancing generation and demand: Solutions aimed at balancing production and consumption on the demand side (DSM) are only successful under certain conditions. This requires a high degree of social interaction and local learning processes. The most successful projects enabled participants to discuss their energy behaviour on a regular basis. Through public events and information, participants were comprehensively informed about the advantages of time-shifting and the associated prevention of expensive peak loads.

A high proportion of PV can supply an electric fleet

Fleet vehicles powered by renewable energy: Political support as well as existing resources and competencies are crucial for success: A hydrogen project in Norway has shown how initial small technical experiments and a close network of research and university institutes contributed to the success. In an example in Austria, it was the close cooperation between regional companies and the public sector that were particularly helpful. In both cases, a corporate culture consistently geared towards sustainability as well as "realistic" development conditions proved decisive.

Comprehensive energy concepts: These are projects in which several aspects are optimised together. Several sectors (electricity, heat, mobility) are coupled to achieve highly efficient solutions. Here, a wide range of different competencies, technologies and actors must come together. In this research, this was achieved on the basis of experience from previous cooperation and integration into long-term political visions and local development models.

Upscaling and its impact on the energy system: Surprisingly, computer modelling showed relatively little positive impact of the researched solutions at national levels. From the point of view of the overall system, other solutions must therefore be developed in the future.

What to do?

How to design and implement "successful" local energy solutions? A comparison of solutions from three European countries produced the following policy guidelines:

- Smart energy solutions work when they are designed as socio-technical systems from early on. The successful implementation of new solutions largely depends on a well-designed interplay of social and technical elements.
- Smart grid projects must closely involve participants in order to achieve good local integration of the solutions. This, in turn, promotes high levels of local legitimacy and allows local resources and actors to take on an active part in the energy transition.
- Technology users play a multifaceted and decisive role. It is important to ensure diversity of different roles of utilisation and their associated perspectives, interests and requirements from early on.
- Solutions that work well locally do not necessarily have a significant (positive) impact from the point of view of the entire energy system. Hence, it is important to examine the various systemic effects locally successful solutions have on existing energy systems (regional, national) before replicating or upscaling them.

Further reading

Ornetzeder, M. *et al.* (2018): Recommendations for researchers, designers and system planners. Institute of Technology Assessment, Austrian Academy of Sciences. Deliverable D5.1.
match-project.eu/digitalAssets/438/438368_match_d5.1_v2-1.pdf

Contact

Michael Ornetzeder

Email: tamail@oeaw.ac.at

Phone: +43(1)51581-6582

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