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"Improving the design of future energy systems and their smart energy products"

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Abstract: In this presentation about the ERA-Net Smart Grids + project CESEPS, an innovative design-driven approach towards the evaluation and improvement of future energy systems will be presented which involves (1) data analysis of existing smart grid pilots, (2) design, prototyping and evaluations of smart energy products and (3) demonstrating future energy systems and products in pilots on university campuses. The focus will be on the design of sustainable home energy systems and products as well as renewable energy supply products- such as solar energy and hydrogen energy - for transportation. The presentation will be illustrated by real-life experiments and demonstrators.

Prosumers' energy consumption and production patterns from a residential smart grid pilot: A Dutch Case Study

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Abstract: This study presents insights into energy consumption and production patterns of the prosumers from a residential smart grid pilot in the Netherlands with PV systems. The analyzed data of the pilot PowerMatching City contains 22 households and two types of distributed energy resources: PV systems with heat pumps and with µCHP, respectively 12 and 10 households. Both systems are compared in perspective of efficient integration of renewable power into electricity networks. By using algorithms in MatLab, we processed and analyzed each household's data with 29 variables for the year 2012. The self-sufficiency in weekly resolution is detailed and discussed, with a cost analysis and other benefits of usage of such equipment for the grid and for the sustainability. The study has been executed in the ERA-Net Smart Grids Plus project "Co-Evolution of Smart Energy Products and Services". In conclusion, the diverse benefits of combining distributed energy resources are highlighted.

Keywords: PV Systems, Smart Grid, Heat Pumps, energy consumption, distributed energy resources, prosumers

Capabilities of strict power limits at prosumer households for solving network load issues at LV grids: An Austrian Case Study

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Abstract: Based on the agreements of COP22 and the 2030/2050 strategies of the European Commission, generation of electricity will change significantly during the upcoming decades. As part of this movement, the mass-introduction of distributed energy resources to medium and low voltage power grids already started. Small generation units, such as photovoltaic (PV) systems, but also new technologies such as electric vehicles (EV) and battery electrical stationary storage (BESS) systems are changing the characteristics of the power consumption profile of end-customers. So-called prosumer households (equipped with PV, EV and/or BESS) show a significant different residual load profile than grid connected customers without such systems.
Distribution system capacities, especially at LV grids, are limited and grid connected customers usually have a contractually agreed maximum power value of 2-4 KW per household (depending on the distribution system operator DSO). In Austria the contracted maximum value (over a 15-minute duration) is under "fair use" conditions and not executed strictly. Whilst in the past, only energy and not power was measured at end customer premises, the introduction of automated metering systems provides new insights and options for power management at LV grids. Due to the mass introduction of DERs, the residual load and maximum power consumption at prosumers households show significant infringements of the contracted value, which might lead to substantial investment costs of grid reinforcement measures for the DSO. In order to limit or avoid such investment costs several options and strategies are currently under discussion. Besides common Smart Grid strategies (where often price signals, centralized controllers and ICT are used) also regulatory changes like system charges tariffs or increased introduction of home energy management systems (HEMS) could provide solutions for this problem.
The work described in this paper is focusing on a scenario where strict power limits are applied to prosumer households. Those prosumer households are equipped with PV, EVs, BESS and HEMS. Also, part of this scenario are end-customers without such systems and options for self-management. Based on the nominal transformer characteristics, a maximum power limit is introduced to all prosumers, which must be fulfilled during each 15-minute measurement interval of the metering system. Each prosumer household is managed individually by its HEMS, focusing on staying within power limits, maximizing the usage of its own PV generation and minimizing possible negative effects on the household owner (e.g. limiting recharging of EV).
The expected results will show the effectiveness of the chosen approach for supporting grid congestion issues at LV levels, as well as its limitations, requirements and possible negative effects to prosumer households.

Demand shifting: Stakeholders' Experiences and Future Expectations

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Abstract: Active involvement of users in smart grids is often seen as key for a beneficial development of smart grids. While such involvement could take plural forms, the main focus of both research and experiments is on demand shifting. In this paper, we investigate the experiences with demand shifting of the diversity of stakeholders involved in smart grid pilot projects. We explore whether and to what extent such experiences lead to a social learning process and adaptation of expectations regarding the future of smart grids in general and three key issues related to demand shifting more specifically: 1) automation and control; 2) financial incentives, and 3) feedback and communication. This is done on the basis of an extensive literature study and interviews with stakeholders of pilot projects.

Keywords: demand shifting; smart grid pilot projects, future expectations; social learning