

HARNESSING CONSUMER FOR A FLEXIBLE ENERGY SYSTEM ARCHITECTURE (“Flexible customer”)

Consumer behavior and demand side flexibility will be in a central role in the future energy system. Sustainable energy system will be a complex combination of centralized and local generation, and a large variety of local energy resources such as energy storages and renewables. De-carbonization targets require increases of the intermittent energy sources, like wind, solar and wave power. As the consequence, both the short-term balance of the power system and the longer-term adequacy of the power and energy capacity will be a critical issue. This situation requires a new energy system architecture in order to increase the flexibility both at the generation side and at the consumption side. Activating the customer, and harnessing the flexibility in the customer side, is a very complicated and multi-disciplinary issue, which makes it an interesting and fruitful research question. In Finnish conditions, the situation is made even more challenging due to large seasonal variations in both the demand and in some energy sources like solar power and solar heat.

The objective of the research consortium is to bring the consumer to the center of the new power system designs by combining a rich set of high-quality Finnish register data on consumer technologies, characteristics, and behavior with the traditional power system analysis. The ultimate goal is to develop “energy lab of Finland” where socio-economic databases for consumer behavior are utilized in a power system context to experiment with architectures for market interactions, incentive schemes, power balancing, and drastic changes in the capacity portfolios. The focus is on four closely interlinked research topics which are 1) Data-based assessment of consumer flexibility in the new energy system, 2) Incentives for the customer flexibility and analysis of different market mechanisms 3) control architectures for integration of flexible loads with the energy markets, 4) and analysis of the consumer flexibility as a resource in future sustainable energy system.

The results of the project will enable harnessing the consumer flexibility for balancing the energy production and consumption and this way pave way to the maximal utilization of renewable energy resources and smooth transition towards sustainable energy systems. Scientifically, the project takes Finland to the leading edge in research regarding consumer active participation in sustainable energy systems.

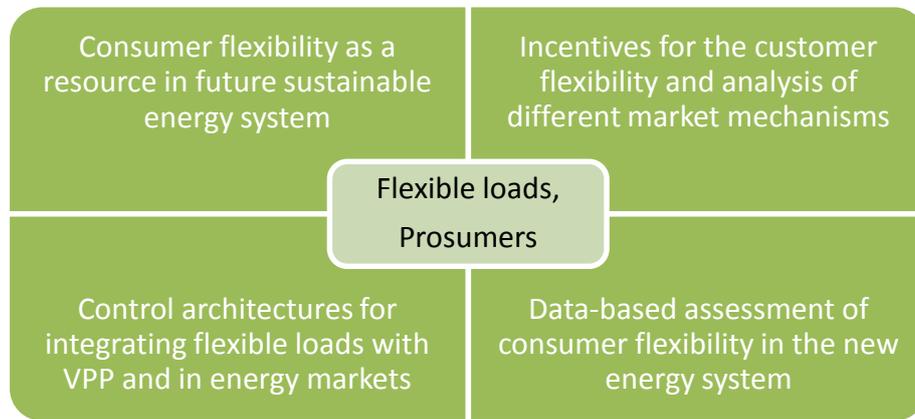


Figure: Focus research topics of the project.

The Consortium

Matti Lehtonen is professor in power systems and is specialized in energy use control and optimization and in Smart Grid related research. He is currently leading the project “Smart Control Architectures For Smart Grids – SAGA”, which belongs to Aalto Energy Efficiency research programme. He has also been active partner in Smart Grids and Energy Markets Programme of Cleen Oy.

Matti Liski is professor in Economics in Aalto University and a visiting professor in Toulouse School of Economics and faculty associate in MIT Center for Energy and Environmental Policy Research. His research interests include Energy, resource, and environmental economics, Microeconomics and Principles of economics. Of special interest is also Energy and Environmental Markets and consumer behavior.

Valeriy Vyatkin is a professor in Information and Computer Engineering in Automation in Aalto University. He has previously held Associate Professor positions in University of Auckland, New Zealand, and in Taganrog state university in Russia. His research interests include dependable distributed automation, distributed architectures and multi-agent systems, as well Smart Grids and building energy management systems.

Contact info: Matti Lehtonen, Aalto University, School of Electrical Engineering, matti.lehtonen@aalto.fi, 040-5815726