



Photovoltaic (PV) based grid-interactive and off-grid electricity system

Professor Jarmo Partanen, Lappeenranta University of Technology, FINLAND
Institute of Energy Technology, Laboratory of Electricity Market and Power Systems
Dr. C. N. Bhende, Indian Institute of Technology (IIT) Bhubaneswar, Professor Mishra Sukumar,
IIT, Delhi, INDIA

Historically, electrification has focused mainly on centralized electricity production, transmission and distribution systems. In recent years, the rapid technological and economic developments in energy storages and small scale power production, especially in the field of solar power production, have opened up possibilities for sustainable, local electricity production. In many countries the price of electricity produced by PV is nowadays lower than the total price of electricity taken from the centralised grid including the costs of production, transmission and distribution plus taxes.

The goal of project is to develop and verify concepts, technology, simulations models, optimization algorithms and operational management systems for the off-grid as well as grid connected microgrids based on the application of solar power, energy storages, flexible loads and tools of digitalization.

Generating wealth from knowledge and mutual benefit from research team collaboration – Today, there is over billion people living without decent supply of electricity around the world. Access to electricity has been recognised as one of the most important enablers for providing welfare and increasing the standard of living. The research work will be performed jointly by a research team working at Lappeenranta University of Technology in the field of electricity distribution and energy market led by professor Partanen and by a research team at IIT Delhi and IIT Bhubaneswar led by professor Sukumar Mishra and Dr. C. N. Bhende respectively. The mutual objective is to reinforce expertise on the field of solar power based grid-interactive and off-grid electricity system development, and to thus build competitive advantage for both Finland and India.

The results of the proposed research will be valuable for the communities and societies of Finland and India, but will also apply globally across many other living communities. Knowledge and innovations will be valuable for the energy industry in both countries. The research will enhance our understanding of the technological and economic possibilities offered by solar power based grid-interactive and off-grid system development. This coupled with new in-depth knowledge of customer behaviour and needs in different environments will open up new business models and potential for industrial players in both countries.

The developed concepts, methods and solutions will be piloted and validated both in Finland and in India by the research partners. The main goals for the piloting tasks will be a) to show the technical and economic suitability of PV, battery and power electronic based microgrid installations in different operational environments b) to validate the operation of off-grid systems (web-portal based monitoring; power balance, energy balance, voltage quality, energy efficiency) supplied by PV cells integrated with energy storages and flexible loads and c) to offer flexible research platforms for further development.

Research teams and research environment, LUT & IIT

The research group in the field of electricity distribution and market (EDM) at LUT led by Prof. Jarmo Partanen comprises professor, four post-docs and 7 doctoral students.

- Prof. Jarmo Partanen (electricity distribution technology and business)
- Samuli Honkapuro, D.Sc. (customer behaviour, market models)
- Jukka Lassila, D.Sc. (EVs & energy storages, planning of distribution systems)
- Tero Kaipia, M.Sc (D.Sc.) (development of distribution systems, LVDC, battery & grid interaction)
- Antti Pinomäki, D.Sc (ICT, communication, digitization)
- Pasi Nuutinen, M.Sc (D.Sc) (power electronics)
- Pasi Peltoniemi, D.Sc (control of smart electricity systems)
- Janne Karppanen, M.Sc. (protection in LVDC)

In Indian side research team consists of Prof. Sukumar Mishra (IIT Delhi), Dr. C. N. Bhende (IIT Bhubaneswar) and two PhD students.



Fig. 1. Wintertime measurements at the LVDC microgrid research site in Finland.



Open your mind. LUT.
Lappeenranta University of Technology