

Dissertation press release

08.05.2019

Reliability and sustainability of solar electricity in emerging markets

Analysis of reasons for power outages in frugal micro-grid systems

Title of the dissertation Reliability and sustainability analyses of frugal solar photovoltaic micro-grid systems in emerging markets

Contents of the dissertation The utilization of solar energy is an important solution to several global environmental problems and could alleviate energy poverty. The use of solar energy is recommended particularly in many global southern countries, where conditions for solar energy exploitation are favorable and hundreds of millions of people live without electricity. Frugal energy innovations could offer qualified energy services affordably and sustainably in these low-income areas.

This thesis contains an analysis of solar-powered micro-grids operated by private energy service companies in India. The frequency of and reasons for power outages was investigated by consumption and production measurements and interviews. The energy users were low-income peasant families in rural India. In addition, the impact of dynamic electricity pricing to the customer behaviour and the grid reliability was studied.

The power outages were due to, especially, problems in technology design and component quality, but above all to a variable set of problems caused by the surrounding poverty, such as difficulties in finding spare parts and skilled maintenance personnel. Power theft and component tampering also caused grid-wide technical disturbances.

It is recommended that special attention is paid to the reliability of service, because the poorest customers did not require the highest service quality. Energy project funders and investors should pay special attention to reliability questions because many developing countries lack quality control requirements for technology, operations and maintenance. A new method for reliability assessment is proposed, taking context-specific challenges of into account and highlighting the locality of solutions in these harsh environments.

Field of the dissertation Engineering Physics, Energy Sciences

Doctoral candidate Sini Numminen, M.Sc.(Tech.)

Time of the defence 10.06.2019 at 12 noon

Place of the defence Aalto University School of Science, lecture hall K216, Otakaari 4, Espoo

Opponent Professor Ewa Wäckelgård, Uppsala University, Sweden

Custos Professor Peter D. Lund, Aalto University School of Science, Department of Applied Physics

Doctoral candidate's contact information Sini Numminen, School of Science, Department of Applied Physics, sini.numminen@aalto.fi, Tel. 0407483607