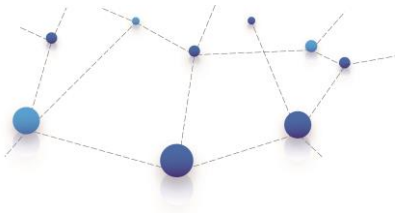
How to optimize the overproduction of photovoltaic electricity into the grid with the utilization of ICT infrastructure

OBJECTIVES



The OrPHEuS project elaborates hybrid energy network control strategies for smart cities implementing novel cooperative local grid and inter grid control strategies for the optimal interactions between multiple energy grids.

The OrPHEuS project aims at optimising the synergies between multiple energy grids by enabling simultaneous optimization for individual response requirements, energy efficiencies and energy savings.

Stability and efficiency across multi domain energy grids are crucial. Although multi-dimensial synergies are increasingly apparent, they neither have been comprehensively investigated so far.

IMPLEMENTATION

The project investigates the implementation of the control strategies on specific use cases scenario in two demonstration sites located in the City of Skellefteå in Sweden and in the City of Ulm in Germany. The operational focus of the project is the cross-domain coupling of energy infrastructures in order to increase energy efficiency through energy transformation and grid coupling. With respect to the hybrid energy characteristics, both demonstration sites are quite distinct.

Demonstration sites	
City of Skellefteå, Sweden	City of Ulm, Germany
The reduction of vertical production (driven unsustainable with fossil fuel) is in the centre of the targeted control strategies.	The major issue is the balancing of the high penetration of solar Photovoltaic (PV) generation under today's operation with a pre-dominant operational challenge for PV control. The key focus is to define control strategies to increase the intake of the energy supply from PV on the roof generation into the grid while maximizing the benefits for the low voltage power grid.

The project will optimize the PV electricity production at the Ulm testing site, which presents, at the test demonstration site area Einsingen, an over production, without self-consumption, of PV electricity of 230 MWh annually on an average annual electrical consumption of 1000 MWh. The Test Area Einsingen covers the area of one low voltage grid transformer in the village Einsingen.

Airborne image of the test area Einsingen in Ulm (Germany) with the position of the PV systems (sun symbol) and the transformer.

The test site contains a single secondary substation transformer with a nominal power of 630 kVA (10 kV/0.4 kV).

137 houses are connected via eight feeder lines to this transformer. The houses are single family houses or multi-family houses as well as a couple of agriculture estates with living house and estate building.

At the moment 20 PV systems with a summarized nominal power of 233 kWp are installed. The single system powers range from 2.2 kWp to 47.84 kWp. This equals to a penetration rate of 37 % of the transformer nominal power.

CONCLUSIONS

The OrPHEuS project investigates the challenges of complex communication coupling for hybrid energy grids towards new opportunities for increasing PV integration and researches control strategies embedded over networked communication and control system facilitating distributed system intelligence across coupled smart grids. This will result in a higher integration of renewable energy sources such as PV into the energy grids, in a reduction of CO_2 emissions, in energy savings and security of energy supply which will provide economic, social and environmental benefits to the communities where the OrPHEuS control strategies will be implemented.

PARTNERS

WIP · TU Wien – Technische Universität Wien, Vienna University of Technology · Energy Economics Group · Hochschule Ulm – University of Applied Sciences · AIT Austrian Institute of Technology – Tomorrow Today · SWU · DLR · NEC · Luleå University of Technology · Skellefteå kraft

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