DEMONSTRATOR

DECENTRALIZED OPTIMIZATION OF ENERGY CONSUMPTION WITH A SWARM OF SMART CONTROLLERS

The demonstrator implements a swarm of low-cost embedded controllers for the de-centralized balancing of energy production and energy consumption (Demand-Side-Management - DSM) in an energy grid. The controllers react to changes in the availability of electricity produced by renewables, thus maximizing the use of PV and wind energy and allowing a significant saving in energy costs.

Electricity production with renewables is highly weather-depend and results in energy peaks and valleys that have to be compensated with expensive backup systems (e.g. diesel generators) or batteries. A cost-efficient alternative is to switch off temporally flexible energy consumers (electric cars, heat pumps, white goods) during the energy valleys and switch them on during the energy peaks.

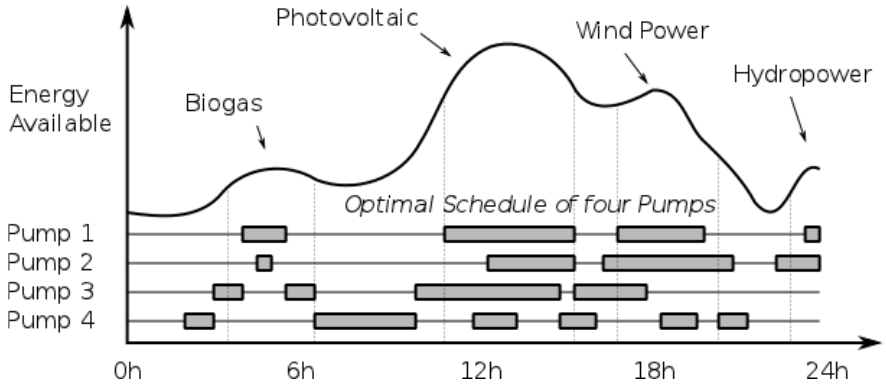

Figure 1: Operating Schedule

The demonstrator simulates a micro grid with four water pumps as flexible energy consumers. The task of the pumps is to keep a specified water level in a reservoir. The demonstrator also simulates the use of conventional energies (like Biogas and Hydropower) and the variability of renewable energy through solar cells and a wind generator.
An ideal operation schedule to maximize this use of renewables is shown in Figure 1.

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To maximize the consumption of electricity from renewables, the SDSO approach uses a swarm of low-cost smart controllers that follow a single price signal. This "balance indicator" indicates the availability of electrical energy in the micro grid. In reaction to a shortage or surplus of electricity in the system, each energy consumer (in this case the pumps) comes to an individual decision whether to increase or decrease energy consumption. The decision is based on the status of the balance indicator, the status of the consumer, the technical properties of the consumer, and process parameters.

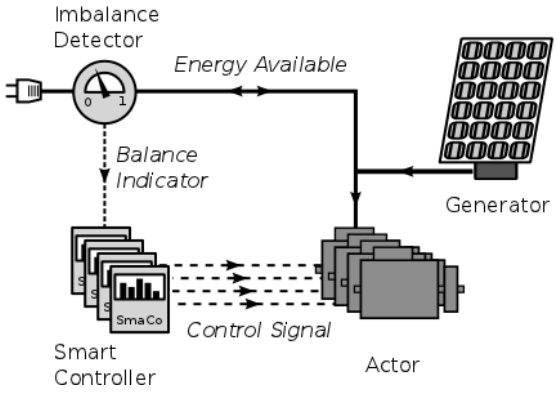

Figure 2: Swarm control

COMPETITIVE ADVANTAGES

PLUG-AND-PLAY	EASY-TO-USE AND INTEGRATE INTO EXISTING SYSTEMS
FAST REACTION	REAL-TIME RESPONSE TO VARIATIONS IN ENERGY SUPPLY (SECONDS)
HIGHLY SCALABLE	LOW INITIAL INVESTMENT, EASY TO SCALE-UP
HIGH RESILIENCY	CAN EASILY COMPENSATE COMMUNICATION ERRORS AND FAILURES OF INDIVIDUAL UNITS
SECURITY BY DESIGN	NO NEED TO DISCLOSE PROCESS DATA; NO OPPORTUNITIES FOR HACKERS

TARGET CUSTOMERS

-ENERGY-INTENSIVE INDUSTRIES

-MANUFACTURERS OF ENERGY-INTENSIVE PRODUCTION MACHINES

-OPERATORS OF GREEN MICRO GRIDS (BUILDINGS, CITY BLOCKS, INDUSTRIAL FACILITIES, MUNICIPALITIES)

-OPERATORS OF GREEN MICRO GRIDS ON ISLAND AND IN REMOTE AREAS

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