Master Thesis - Analysis of the potential of direct energy market participation and provision of ancillary services by corporate energy systems

(In cooperation with Rudolf Hörmann GmbH & Co. KG)

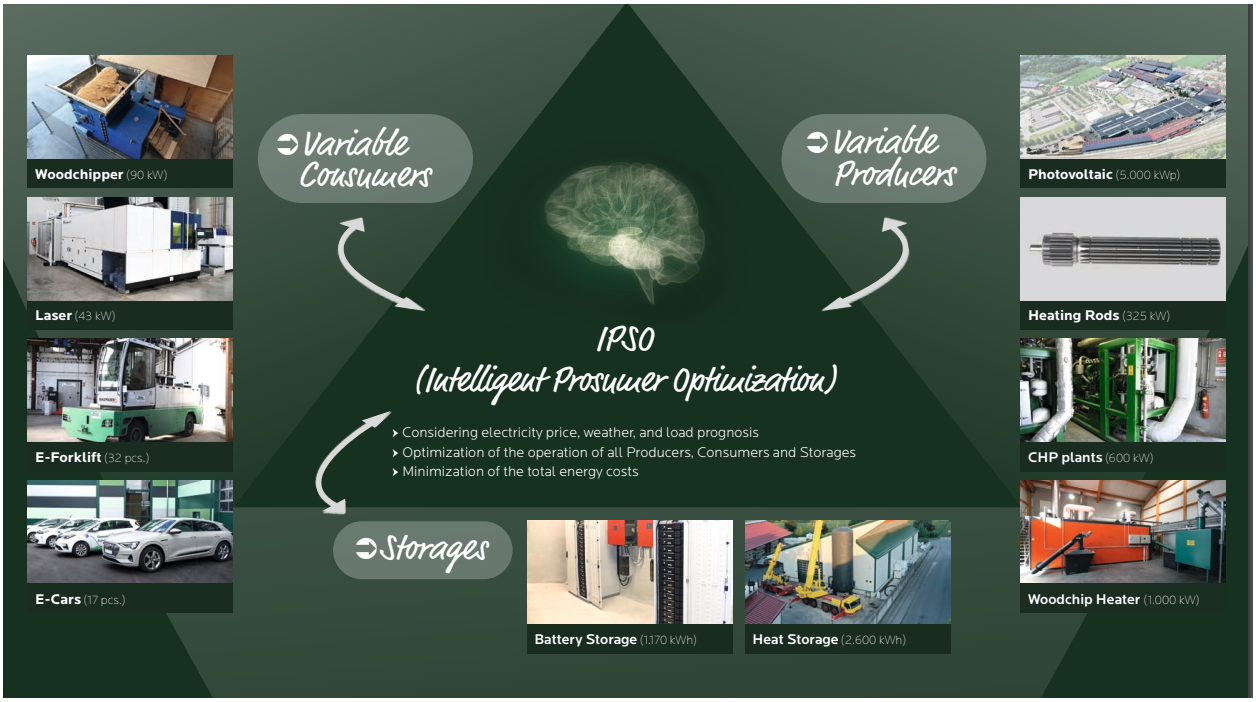

Figure 1: Principle of the IPSO-Program

Motivation

Research in energy transition predominantly focuses on macro-perspective analyses, such as envisaging the future of smart grids and their associated advantages. While the exploration of future potentials in this field is undeniably important, there is a tendency to overlook practical measures that reduce both system and societal costs and can be implemented in the immediate term. To address this disparity, our IPSO (Intelligent Prosumer Optimization) project focuses on optimizing the live operation of existing variable producers and consumers in corporate energy systems using mixed-integer linear programming. The optimization generates benefits through PV self-consumption maximization, electricity/gas procurement cost minimization, peak load mitigation, degradation minimization, and more. Notably, IPSO can be integrated into current energy systems without the necessity for new technical, legislative, or market structure developments. The project specifically targets companies rather than households, mainly due to the straightforward nature and comparatively minor impact of household energy optimization, as well as the disproportionate implementation costs in residential contexts compared to the limited scope for optimization.

The optimization primarily focuses on electricity and heat, considering sector coupling, but it is also adaptable to other commodities such as gas, oil, or wood. The major benefit of optimizing electricity procurement lies in the dual advantage of lowering energy expenses for individual companies and concurrently reducing societal costs. Specifically, the optimization alters the operation of variable prosumers, prompting companies to purchase electricity predominantly during low-price periods. Such a behavior benefits society, as it counteracts further price increases and mitigates additional C02 emissions that occur when electricity is bought during high-price periods.

Companies generally do not participate directly in the day-ahead and intraday markets; instead, they depend on energy providers that offer fixed or variable energy tariffs. However, these energy providers are unable to capitalize on the flexibility of corporate energy systems to engage in market activities. Therefore, your task is to analyze the potential of leveraging the flexibility of corporate energy systems to operate directly in the energy market and also provide ancillary services, such as Frequency Containment Reserve (FCR) and Frequency Restoration Reserve (FRR). The center point and novelty of this research is to directly combine the optimization of an individual corporate energy system with trading in the energy and ancillary service markets in one holistic optimization.

Tasks

- Research and understand trading strategies
- Evaluate whether trading strategies can be directly integrated into the existing IPSO live optimization framework (Option A) or if creating an interface to a trading algorithm would be a more effective solution (Option B)
- Implement Option A and/or B into the IPSO framework
- Validate the feature by testing the IPSO optimization framework first through simulations and then on the real-world energy system of our company

Requirements

- Student of Electrical/Mechanical Engineering, Mathematics, Informatics, or similar
- Courses about modeling and optimization (IPSO is based on Mixed Integer Linear Programming)
- Programming experience (preferably Python)
- Ability to work structured and independently but also a good team player
- Motivation to be a part of the energy transition

As you will be working on a real-world energy system, your presence at our company, Rudolf Hörmann GmbH & Co. KG located in Buchloe (40 min from Munich central station), once a week is beneficial but not mandatory.

Contact

HÖRMANN
Stefan Hörmann
Email: hs@hoermann-info.com

ENS Chair
Anurag Mohapatra
Email: anurag.mohapatra@tum.de