# **Sustainable Energy Systems**



The Sustainable Energy Systems research group seeks ways to increase the flexibility, efficiency, sustainability, reliability and social acceptance of increasingly complex and dynamic energy systems, which will be mainly powered by renewable energy sources such as solar energy, wind power or bioenergy. It aims to bridge the gap between existing technologies and globally optimized, smart solutions for the future. In this way, the research group developing ground-breaking solutions for the challenges of future energy systems, allowing for the larger integration of renewable energy, energy storage, the research group will allo work towards storidging entities the house of energy energy assessment and model(data interoperability.

Main EXPERTISE

Percentation indust Sustainable transport and electric mobility Energy efficiency and energy management in buildings Energy markets, economics and regulation Joigtal market-based planning Green economy

Transversal fields

Big Data
Artificial Intelligence (Machine Learning models)
Deep Learning
Cyber-Physical Energy Systems
Software Engineering
Energy Cloud Computing

### Research Challenges

Shifting energy production to renewable and low-carbon sources;
Shifting energy demand from fassil luet to decarbonized electricity, hydrogen or heat;
Developing flexibility systems also the respond to the inherent uncertainty of complex renewable energy systems:
Hostically integrating electricity, gas and heat networks optimally;
Coordinating developments or variable renewable energy systems;
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Coordinating developments or variable renewable energy systems;
Hostically integrating electricity, gas and heat networks optimally;
Locardinating developments or variable renewable energy surves;
flexibility optimation, energy integrating electricity and the integration of the demand.
Increasing system flexibility to match supply and demand dynamics more locally and over multiple time frames (e.g. improving forecasting, shortening decision-making processes, ee
Individing demand response and integrating syntal-scale generation and storage. (mont mersistenial and industrial sectors;
Modernizing energy markets to achieve a fully interconnected market with a level playing field across different energy extors and system levels (from international trade to consum:

#### Application Areas

 Renewable energy systems
Electric network monitoring and operations Electric network monitoring and operati Power system protection Generation and demand forecasting Energy-efficient buildings Electric vehicle charging management Energy communities Energy markets Computational energy intelligence Dynamic optimization and planning

#### Main Assets

#### Equipment

All-sky imager (sky cam) - "EKO ASI-16" - 180" fisheye camera pointing towards the sky to estimate "cloud cover", to identify clouds and clear parts of the sky, to estimate the cloud movements (speed and directi
KEPCO 4-quadrant power supply
NI PXI systems (industrial PC) including several measurement cards
Measurement systems and instruments

#### Selected publications

- Continuel neargy management, in sunst sustainable buildings. A chare-constrained model predictive control approach. H. Nagpal, I. I. Avramidis, F. Capitanescu and P. Heiselberg. 2021. In Energy and Buildings, vol. 248 A <u>Commentensive Multi-Predic Quinnal Power Flow Framework for Somart IV Hetworks</u>. I. I. Avramidis, F. Capitanescu, and G. Deconnick. 2021. In EEET Fransactions on Power Systems, vol. 36, no. 4, pp. 3029-3041 A <u>Storaharit Multi-Brend AC Optimal Format Power Flow Framework for Somart IV Hetworks</u>. I. I. Avramidis, F. Capitanescu, 2021. presented and the IEEE Private Comparison of Power Systems, vol. 36, no. 4, pp. 3029-3041 A <u>Brend Hill-Brend AC Optimal Somar OF Exectional Power Flow Framework for Continuel Somar OF Exectional Power Flow (Private) Approach for Optimal Somar OF Exectional Power Flow (Private) Approach for Optimal Somar OF Exectional Power Flow (Private) Approach for Optimal Somar OF Exectional Power Flow (Private) Approach for Optimal Somar OF Exectional Power Flow (Private) Approach for Optimal Somar OF Exectional Power Flow (Private) Approach for Optimal Somar OF Exectional Power Flow (Private) Approach for Optimal Somar OF Exectional Power Flow (Private) Approach for Optimal Somar OF Exectional Power Flow (Private) Approach (Private) Private) Private) Approach (Private) Private) Private) Approach (Private) Private) Private) Approach (Private) Private) Pr</u>



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