Advanced design, retrofit, operation and maintenance strategies for energy systems

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Challenging sustainability and decarbonization objectives were defined for 2030 and 2050. Energy systems play a crucial role in this context and, in addition, they are showing a huge potential in the development of the current energy and digital transition.

Energy systems are characterized by different technologies, various types of interoperability (e.g., districts) and different energy vectors (e.g., hydrogen, natural gas, and electricity); in addition, transport networks and end-users represent critical actors that have to be considered. Efficiency improvement of energy systems represents a significant target to be tracked in order to guarantee the definition of ad hoc roadmaps for a better future.

Different processes within energy systems play a significant role in the greenhouse gas (GHG) emission, e.g., industries, buildings and transport systems. The emissions are triggering climate change and suitable sustainability and decarbonization strategies must be adopted for climate change mitigation and adaptation.

Complex processes with multi-domain features characterize energy systems; conversion processes, storage systems, sinks and sources have to be handled. Efficiency improvement can be associated to a whole plant, to processes or sub-processes of a plant, to machines, or to devices. Examples of paths for sustainability improvement are carbon mitigation, limited energy use, performance improvement and consumption reduction; in addition, life cycle analysis can be taken into account.

For the new plants, efficiency strategies can be included in the initial design, while retrofit can be adopted for existing plants. In addition, sustainability in daily management of the involved processes requires advanced operation and maintenance methods. Furthermore, suitable Key Performance Indicators (KPIs) have to be defined in order to assess and certificate the performance.

The present Invited Session aims to collect contributions related to advanced design, retrofit, operation and maintenance strategies for energy systems with a focus on sustainability and decarbonization, in order to highlight emerging technologies and best practices. Contributions on digitalization, data, modeling, and forecast are also welcome, due to their massive impact on the topic. The Session will take into consideration research works on field applications and simulations in virtual environments. In addition, research works on methodologies that bridge the gap between simulations and field application are encouraged, together with works on the transition from research to large-scale deployment.

Some examples of specific themes include, but are not limited to:

- Multi-vector energy systems
- Sustainable districts
- HVAC and DHW systems
- Smart/Net Zero/Green buildings

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- Energy management system
- Demand side management
- Demand response
- Multicriteria approaches
- Interoperable tools
- Big Data
- Artificial Intelligence
- Decision Support System
- Advanced Process Control
- Model Predictive Control
- Real-Time Optimization
- Fault Detection/Isolation/Diagnosis
- Predictive Maintenance
- Digital Twin
- Internet of Things
- Benchmark case study
- Technology Readiness Level

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