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MULTI-ENERGY AND MULTI-SECTOR SYSTEMS AS A TOOL TO IMPROVE THE STABILITY, RELIABILITY AND RESILIENCE OF THE ELECTRIC POWER SYSTEMS

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Over the last decades, an ever-growing concern about energy transition fostered a massive use of renewable energy systems, provided the electrification of conventional means of transportation, enhanced the use of energy storage from residential to industrial, tertiary and utility level applications.

Furthermore, a new set of technologies and techniques, from ICT to AI, together with the large-scale adoption of distributed energy systems, sector coupling and demand flexibility, enabled a new realm of possibilities for the management and control of networks.

The energy transition requires the definition of a new model of energy and social organization based on production and consumption of energy from renewable sources. Of fundamental importance in the governance of energy transition is the correct definition of the contributions and integration (sector-coupling) of the various energy chains to meet needs. Solar, wind or hydraulic energy, the energy transition relies on renewable energies. Faced with the widespread adoption of this type of energy, which is intermittent and therefore difficult to predict, the use of other energy carriers and other non-energy sectors (e.g. mobility) appears to be a flexible and competitive solution. With the rise of renewable energy, capping and storing excess electricity are becoming major challenges for grid operators. In this contest the objective is to define management models and smart digital and technological solutions such as smart interoperable platforms for the hybridization of different forms of energy storage systems (from the battery to thermal and hydrogen based – Power to X) and the optimization of the distribution of electricity produced from renewable energies.

This special issue will focus on the key technologies enabling energy transition in future multi-energy and multi-sector systems as a tool to improve the stability, reliability and resilience of the electric power systems. It is widely recognized the ever-growing importance of exploiting synergies among different energy networks, namely electric, natural gas, district heating and cooling, and, to a wider extent, to other "networks" such as e-mobility and water. When dealing with integrated and flexible multi-energy systems (micro and nanogrids), a holistic approach should be used.

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Technologies enabling interactions among networks (polygeneration, heat pumps…), optimal management and control strategies, energy storages (EES, TES, power-to-X,) and ICT tools will play a pivotal role to fully exploit the potential flexibility required when increasing the share of energy production from non-programmable renewables sources.

In this context, authors are requested to submit their original research works focusing on the energy transition towards a cleaner future.

The topics of interest include, but are not limited to

- operation and advanced control of grids, microgrids and nanogrids
- optimal sizing and operation of multi-energy and multi-sector systems,
- modern demand-side response and demand-side management strategies,
- digitalization and resilience of energy networks,
- market and economic issues in multi-energy and multi-sector systems,
- grid-integration of renewables and hydrogen,
- power to X: power-to-hydrogen, power-to-gas, power to heat
- distributed generation and energy storage
- key enabling smart technologies

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