

Introduction to the Markets, Policy, and Analytics Minitrack, Electric Energy Track

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Environmental concerns regarding global warming and the adverse health effects of emissions produced by fossil fuel generation have led to a greater reliance on renewable sources of generation that are inherently variable and uncertain. This trend is accompanied by increased proliferation of distributed resources, storage and smart grid technologies that facilitate demand response and greater observability of the grid. As a result the electric power industry faces new challenges in planning and operation of the power system that require new market mechanisms and computational optimization tools to achieve productive and allocative efficiencies. Flexibility of the conventional generation resource portfolio as well as demand side flexibility are key elements of a new electricity system paradigm that can accommodate massive integration of renewables and distributed resources. Harnessing such flexibility in planning and operations imposes vast computational challenges due to the increased numbers of decision variables and the need to account for uncertainty and respond adaptively to rapidly changing conditions. Hence the central theme of this mini track revolves around identifying requirement and remuneration schemes for flexibility, characterizing market products and public policies that incentivizes flexibility and optimizing resource use to meet flexibility needs so as to assure system reliability in face of uncertainty at least cost.

This minitrack continues a long-standing tradition that evolved over the last two decades since the onset of restructuring the electric power industry in the US. Over that period HICSS has become a leading forum for discussion and outlet for research and developments that focused on the interface between market design for the restructured

electricity industry and computational tools enabling the efficient and reliable operation of a market based power system. The minitrack consists of two thematic sessions focusing on Market Design, Policy analysis and Analytical tools. Over all the minitrack contains six papers as follows:

- *Hierarchical Flexibility Offering Strategy for Integrated Hybrid Resources in Real-time Energy Markets*

This work considers the problem of aggregating the flexible resources while considering distribution system constraints using the deep reinforcement learning (DRL) method. It aims to come up with the flexibility model for a sub-network of resources, which are managed by the so-termed IHR Flexibility Controller (IFC) by learning from historic data using DRL

- *Valuing Technological Flexibility in Low Carbon Electricity Portfolios.*

This paper looks at the impact of technology on future energy scenarios. It frames the energy transition problem as the identification of one near-term investment strategy that is flexible across a wide range of possible future costs, followed by many alternative subsequent investment plans, each of which responds to realized future costs to achieve an aggressive emissions reduction target.

- *Aggregator-Enabled Prosumers' Impact on Strategic Hydro-Thermal Operations*

This paper studies the impact of a growing population of prosumers – represented by aggregator on bulk hydro-thermal producers' ability to strategically 'manipulate' prices so as to increase their profits within a Nash-Cournot competition. To investigate the corresponding research question, The authors build a multi-agent optimization model and solve it by means of complementarity techniques.

- *The Pace of Decarbonization: Can the Power System Transition Meet Climate Policy Goals?*

This paper presents a criticism of some modeling assumptions and in particular a model used in the paper which is highly simplified in both its temporal and spatial level of detail. The issues in the modeling (at a high level) are laid out along with political issues in project implementation. A general discussion of the issues suggests some potential solutions.

- *A Wake-Up Call for the Utility industry: Extreme Weather and Fundamental Lessons from 2021*

The paper discusses the continuing gap between industry planning for extreme weather, as compared to the actual trends in extreme weather events. An apparent lack of preparedness for common mode events (electric power and gas), as well as the severity and frequency of extreme events themselves, is shown to have caused greater harm to society than would be expected given the power industry written reports. The paper presents extensive background research through news/weather reports and industry/government studies on the affect of changing weather on both the power industry infrastructure and outages/damage to customers

- *A Comparison of Strategies for Managing Energy Constraints of Energy Storage Providing Frequency Regulation*

This paper compares different strategies taken by the California Independent System Operator (CAISO) and PJM to control grid-level battery energy storage systems offering frequency regulation to power system operation. The comparisons are done based on signal-following performance, control efforts, and power losses under the strategies taken by CAISO and PJM.