INFORMS2020. Special Session ‘Local Energy Trading and Communities’

Session chairs: Zacharie De Grève (University of Mons, Belgium), François Vallée (University of Mons, Belgium)

Title	**Cooperative Frameworks For A Fair And Efficient Allocation Of Resources Within LV Electricity Communities**
Author Information	**Martin Hupez**, Jean-François Toubeau, Zacharie De Grève, François Vallée, University of Mons, Mons, Belgium.
Abstract	The presentation aims at highlighting various collaborative frameworks for power exchanges within LV electricity communities enhancing sharing mechanisms. These frameworks feature billing schemes leading to cost allocations reflecting the truth cost incurred by the electric system. In this respect, the flexibility of prosumers including excess storage capacity, unused local generation and shiftable load, is properly coordinated. More particularly, the global optimization across the whole community and the generalized Nash Equilibrium approaches used for a day-ahead scheduling are put into perspective in terms of efficiency, fairness and implementation.

Title	**Peer-to-peer Energy Trading Without Revealing Sensitive Information**
Author Information	**Geert Deconinck**[1], Fairouz Zobiri[1], Yinjie Wang[1], Mustafa A. Mustafa[2], Svetla Petkova-Nikova[1], [1]KU Leuven, Leuven, Belgium; [2]University Manchester, Manchester, United Kingdom.
Abstract	Several envisioned implementations of the EU's Citizen Energy Communities will allow community members to trade their green electricity or their demand flexibility directly with their peers, putting suppliers (or retailers) in a secondary role. In order to engage customers in such a peer-to-peer energy trading application, their privacy needs to be preserved. Cryptographic techniques -such as computations-over-encrypted-data- allow to clear such peer-to-peer energy markets without having to share individual flexibility data. This presentation will detail how local electricity trading can be designed in such an context, simultaneously minimising the energy costs in a time-of-use tariff scenario and minimising the energy exchange with the main grid.

Title	**Learning Nash Equilibria With Applications To Electricity Markets**
Author Information	**Maryam Kamgarpour**, ETH Zurich, Switzerland.
Abstract	A challenge in control of large-scale systems such as the power grid and the transportation network is to address autonomous decision making of interacting agents while ensuring global system safety and performance. In this setting, a Nash equilibrium is a stable solution in the sense that no agent finds it profitable to unilaterally deviate from her decision. Due to geographic distance, privacy concerns or simply the scale of these systems, each agent can only base her decision on local information. I present our results on distributed algorithms for learning Nash equilibria in convex and non-convex games.

Title **Heterogeneous Ambiguity Aversion In Energy Communities**

Author Information **Niklas Vespermann**[1], Jalal Kazempour[2], Thomas Hamacher[1], [1]Technical University of Munich, Munich, Germany; [2]Technical University of Denmark, Kgs Lyngby, Denmark.

Abstract Individual confidence in empirical data describing the probability distribution of uncertainty related to community imbalances gives rise to heterogeneous ambiguity aversion of community members. Ambiguity-averse decision makers tend to make conservative decisions to reduce potential disbenefits at a future stage. To study implications of ambiguity aversion in energy communities we formulate the decision process of each local market participant by a distributionally robust optimization problem with a Wasserstein ambiguity set. For heterogeneous ambiguity aversion we use a Walras tâtonnement solved by dual decomposition to compute the market equilibrium, while relying on optimization for the special case of homogeneous ambiguity aversion. Results indicate that community cost significantly increases as ambiguity aversion differs among community members.

Title **Local Energy Markets: From Real-time Monitoring Data To An Invoice**

Author Information **Bertrand Cornélusse**, University of Liège, Belgium.

Abstract We consider a local energy community as a set of members attached to a distribution system. Members can exchange energy among them through a local market and exchange with the public market. This work investigates ways to construct the invoice for the community members based on real-time metered data, to be compatible with usual invoicing practices in distribution systems. The local market design attempts to maximize members' benefits by favoring local energy usage, while ensuring that no member loses with respect to a position where he has access only to the public grid. It thus amounts to sharing locally produced energy among the members and determining local market prices.