1. Risk Quantification and Trading in Electricity Markets – Prof. Yuri Dvorkin, New York University
Relative to financial markets, current electricity market designs lack sophisticated means of systemic and asset-level risk quantification and trading, thus producing market outcomes incapable of incentivizing cost-efficient risk mitigation. This presentation explores parallels between electricity and financial markets and describes a stochastic market design that allows for (i) explicitly quantifying and limiting the risk of market constraint violations and (ii) introducing such risk-trading instruments as Arrow-Debreu Securities. Taken together, explicit risk quantification and trading make it possible to produce uncertainty- and risk-aware energy and reserve allocations and prices that achieve desirable market design properties (e.g. efficiency, revenue adequacy, cost recovery) in a renewable-rich markets.

2. Risk Trading in Energy Communities – Prof. Jalal Kazempour, Technical University Denmark
Local energy communities are proposed as a regulatory framework to enable the market participation of end-consumers. However, volatile local market-clearing prices and consequently volatile cost give rise to local market participants with generally heterogeneous risk attitudes. To prevent social welfare losses due to conservative trading decisions in the forward stage, i.e. day-ahead market, we propose risk trading in energy communities via financial hedging products, the so-called Arrow-Debreu securities. The conditional value-at-risk serves as our risk measure for players to study different degrees of market completeness for risk. We define a risk-averse Nash game with risk trading and solve it for an incomplete market for risk as an equilibrium problem. We show that this problem reduces to an optimization problem if the market is complete for risk. Numerical findings indicate that a significant community cost saving can be realized when players engage in risk trading and sufficient financial hedging products are available. Moreover, risk trading efficiently protects less risk-averse players from highly risk-averse decision making of rival players.

3. Strategies for Network-Safe Load Control by a Third-Party Aggregator – Prof. Johanna Mathieu, University of Michigan
This talk will explore the impact that load coordination schemes developed to provide transmission-level services can have on the distribution network, such as under/overvoltages and transformer overheating. We will then describe a variety of load coordination architectures and control strategies that can be used to manage distribution network impacts. In particular, we will discuss the issue of utility-aggregator coordination, where a load aggregator wishes to coordinate electric loads to provide ancillary services but does not know the topology/parameters of the distribution network and the utility wishes to protect their network from negative impacts resulting from the actions of the load aggregator. Simulation-based case studies will demonstrate the capabilities and limitations of the various strategies. Joint work with Stephanie Crocker Ross.
4. The variability-flexibility tango: About picking the right partner — planning for dispatchable generation in deep renewable penetration power systems — Prof. François Bouffard, McGill University

We are witnessing an acceleration in the uptake of renewable energy in power systems. Because of the associated variability and uncertainty of renewables, power systems need to have an adequate supply of flexibility to allow for suitable management of short-term operations. So far most of the work in this area has neglected how flexibility needs associated with renewables are fulfilled as part of dispatchable generation capital investments decisions. To address this challenge, we propose an approach to plan the dispatchable generation mix of a power system as needed to counteract variability and uncertainty associated with significant shares of variable renewable generation. To avoid the curse of dimensionality associated with having to represent time-domain variability, we exploit the linear time-invariant feature of variable generation variability using historical phase planes of capacity (in MW) and ramp (in MW/min) to bridge the gap between long-term capacity planning and short-term intra-hour flexibility needs. This approach is much more computationally tractable than other proposals, while also being able to capture adequately short-term operational features like ramping and net load variability.

5. Risks — Prof. Daniel Kirschen, University of Washington

Each stakeholder in a power system not only carries some risk, but also creates risks for others and has the ability to mitigate these risks. For some, these risks are purely financial. For others the major concern is the socio-economic risk of an outage, which is not easily translated in monetary terms. This paper analyzes how the interactions of these participants across a complex physical system affect their risk exposure as well as the benefits they derive from this system. It also argues that, to the largest extent possible, the cost of outage mitigation measures should be charged back to the parties that create this risk because doing so will ultimately reduce it. Finally, it proposes directions for research on how making power system operation more risk-aware would help enhance reliability, control cost and facilitate the integration of variable energy resources.