Balancing, Flexibility, Operations

Introductory Material

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Some basic engagement rules

- Take a positive attitude, learn
- Listen actively to each other
- Ask clarifying questions

Chatham House Rules

Everyone is free to repeat what is said outside this meeting, but not in a way that it can be attributed to any individual or company. This includes all notes taken.

- Be aware of that many terms may have different connotations and be prepared to explain what you mean
- Try to find out where you agree with others
- Agree, to disagree; and then continue listening

Speak for yourself, not your company – and have fun!

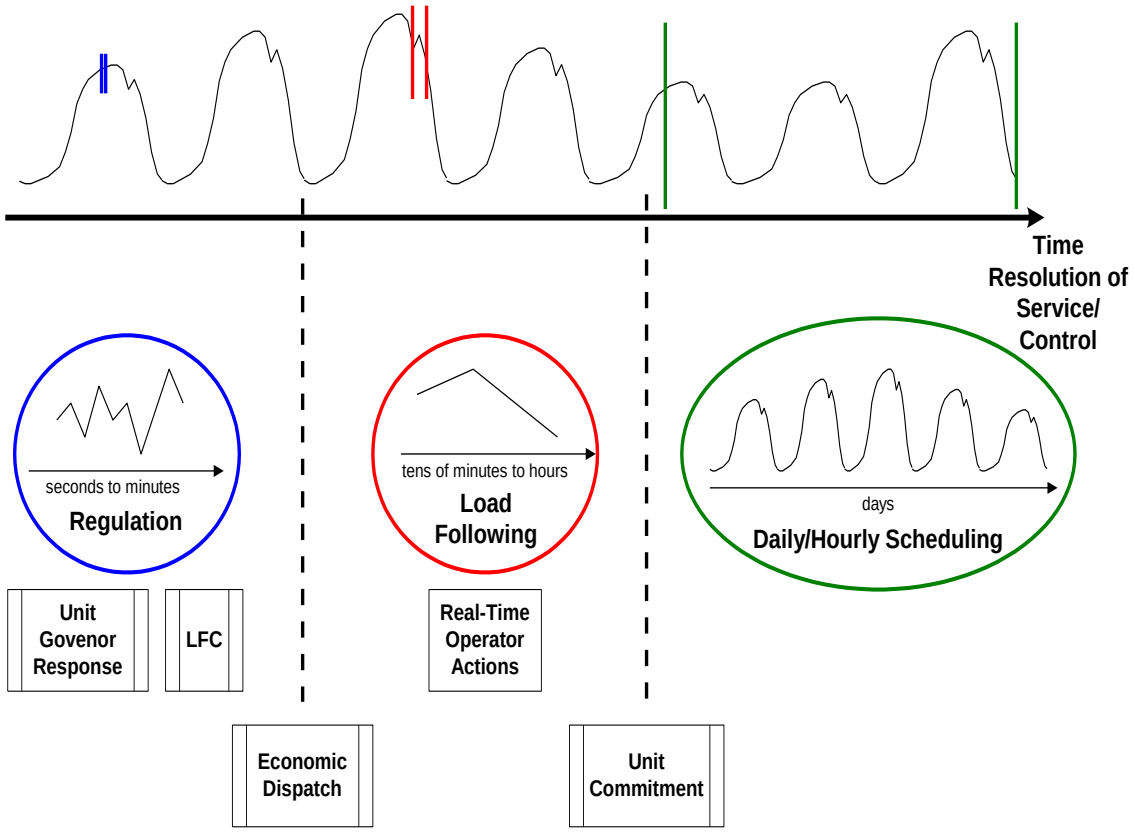
Aim of sessions

- Session 1 (1pm-4.30pm) – Topic Scopes and Issues
  - What is the scope of this area?
  - What is known and unknown about the challenges and solutions?
  - What are the basics of this topic that govern pathways?

- Session 2 (tomorrow, 8.30am-11.30am) – Research Roadmap Outlines
  - Based on the pathways identified, what are the research needs and pathways to get to 100% related to this topic?
  - What analysis work, technology development, regulatory/policy decisions and other decisions are needed to get to the end goal?

- Session 3 (tomorrow, 1.15pm-3.15pm) – Elements of the research roadmap
  - What parallel tasks are needed to get to the end goal of a system with low carbon?
  - How do these tasks relate to each other, and to tasks/roadmaps in other topic areas?

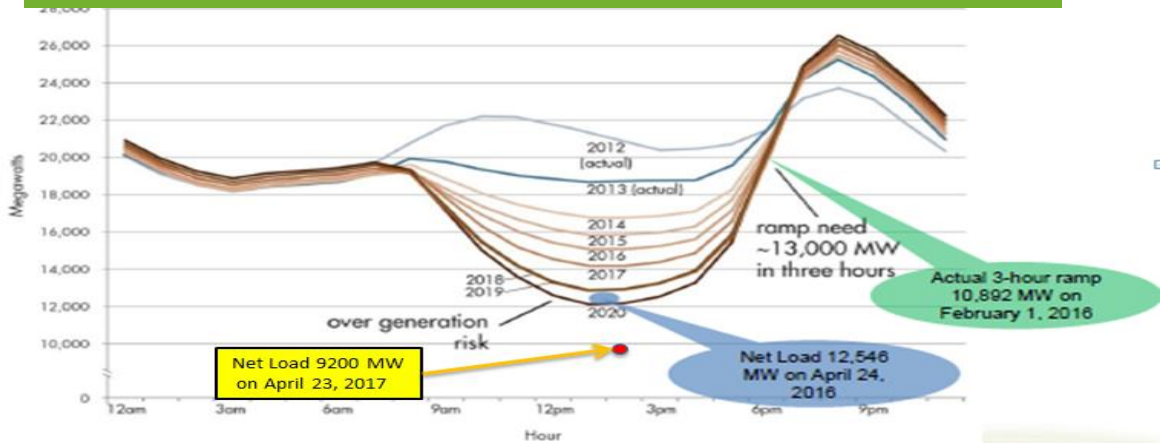
What is the focus here?



- From smaller scale balancing areas (islands) to large interconnections with multiple balancing areas and various degrees of coordination
- Electricity system is focus but interactions with gas, heat, transport, water and other networks also possible and important to consider

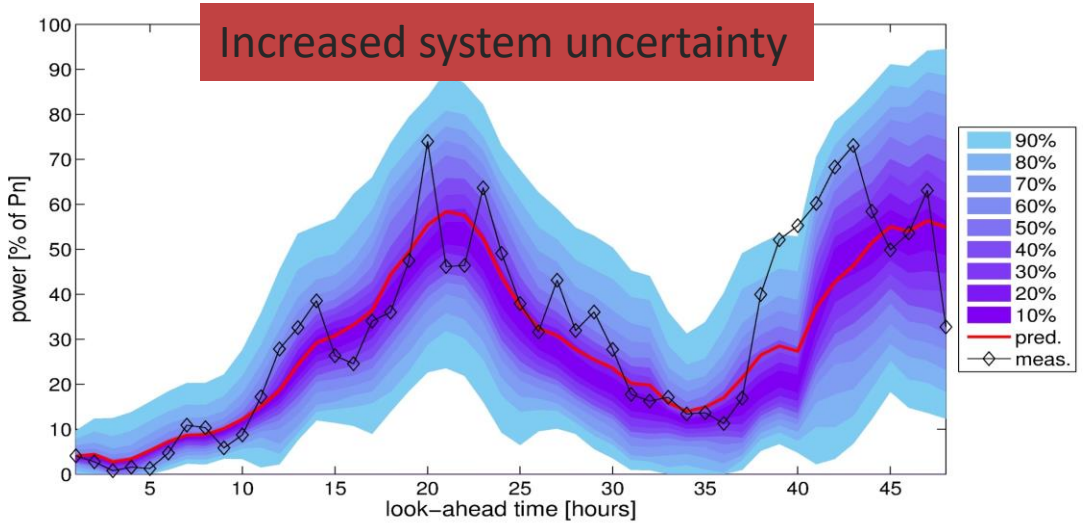
What are the challenges

Increased variability of supply side and uncertainty

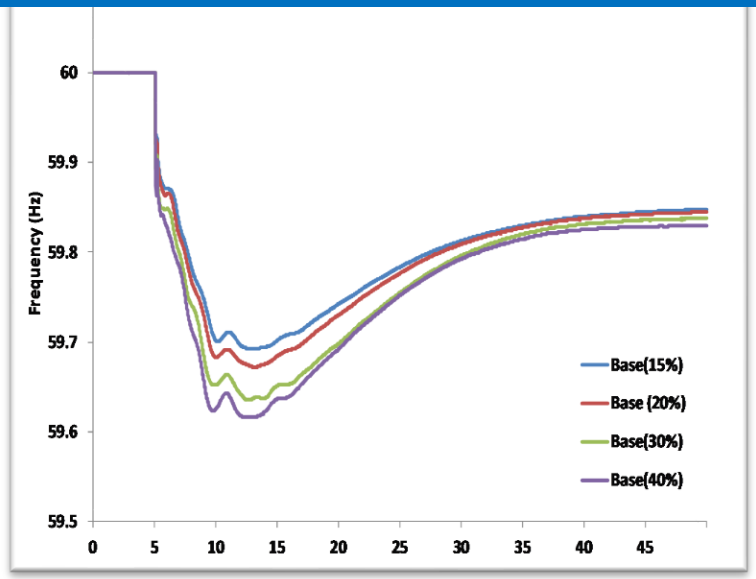


Transition to decentralized system

Increased system uncertainty



High penetration of inverter based resources



Questions identified in preparation

- How will operating practices and paradigms evolve as systems operate with very high renewable penetration?

- How will operating constraints on other energy systems impact on the electric system, and vice versa, and what can be done to reduce the impact of such constraints?

Questions identified in preparation

- How does forecasting and knowledge about weather based renewables impact on operations, and what does that imply for new and improved operational practices?
- What changes to system operating practices are required as we move to a more decentralized environment?
- What opportunities emerge with cost-effective storage and interaction with other energy vectors?

Envisioning Future States and Pathways to Get There

- For deep decarbonization scenarios relying on large shares of renewable resources, the balancing and flexibility functions and resources will be provided by *(what resources)*? And they will be operated by *(who?)* using *(what?)* tools to operate
  - No one answer will be optimal in all places and times

- This will require various pathways that need to be identified → this will help identify gaps
  - Technologies, policies, people, organizations, interactions, etc. are all potential means to the ends identified above
  - What is crucial and what is nice to have? Can we do it all now?

Potential levers and practices to lean upon

- Improving models and tools used to operate the system
  - Increasing resolution – temporal and/or spatial
  - Better representation of uncertainty
  - Improved representation of neighboring regions and systems

- Improved forecasting, real-time visibility, analysis and optimization
  - Increasing emphasis on ‘big data’, machine learning, etc.
  - Digitalization of energy system providing more control and information

- Increasing emphasis on demand side integration
  - Demand side becomes increasingly important
  - Decentralized control and new system architectures possible

- Energy systems integration

- Storage and shifting of energy

Together...Shaping the Future of Electricity

Track description

- This track will discuss the balancing-related functions of the system at very high levels of renewables, where the **variability and uncertainty** in their output will be a crucial important factor in determining *operating strategies* and leveraging the use of **new and existing balancing resources**, including those from the ***demand side*** and that lean on other ***energy systems*** to provide power system flexibility.

- The track will identify how different sources of flexibility can be used to **support supply/demand balancing**, and understand what that means for operating systems that vary between **periods when supply is met solely by renewables and periods with other resources also contributing**. In this regard, there is a need to contrast requirements for **short term** balancing with **long-duration (seasonal)** resource deficiency

Where are overlaps with other tasks

- Strong overlap with markets – how to incentivize the operational practices discussed here
- Strong overlap with demand side – if assumption is that demand side is used to provide significant portion of balancing
- Overlap with adequacy – adequacy may be moving more towards provision of flexibility as much as capacity
- Overlap with volts and amps – aim may be to provide the grid forming convertors with right signals to ensure balancing, which may be done on shorter time frame

- Overlap is OK – we just need to identify and iterate, while not straying too far into those task areas