

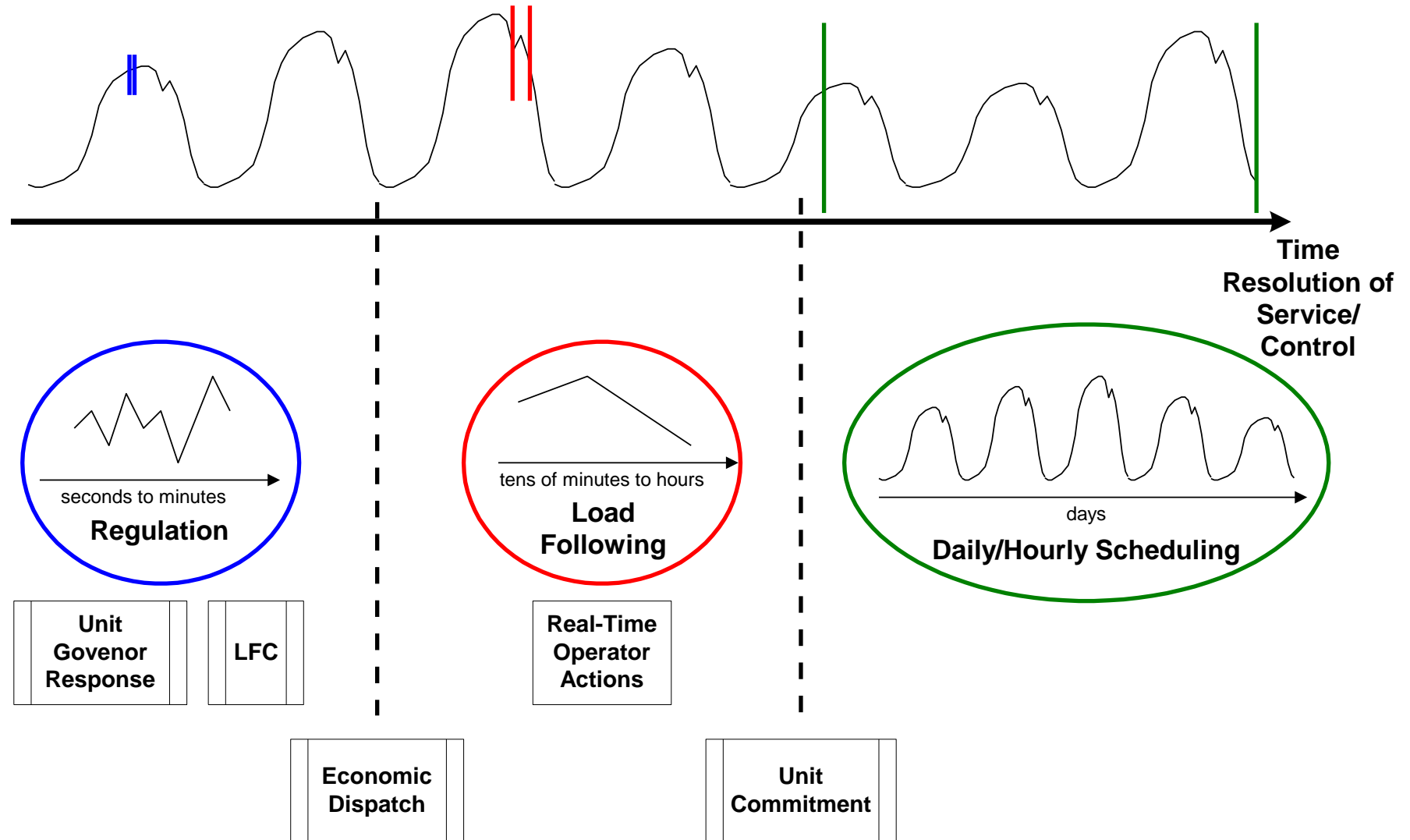
# Tutorial Overview: Incorporating Variable Generation Forecasts into Power System Operational Procedures

June 19, 2019

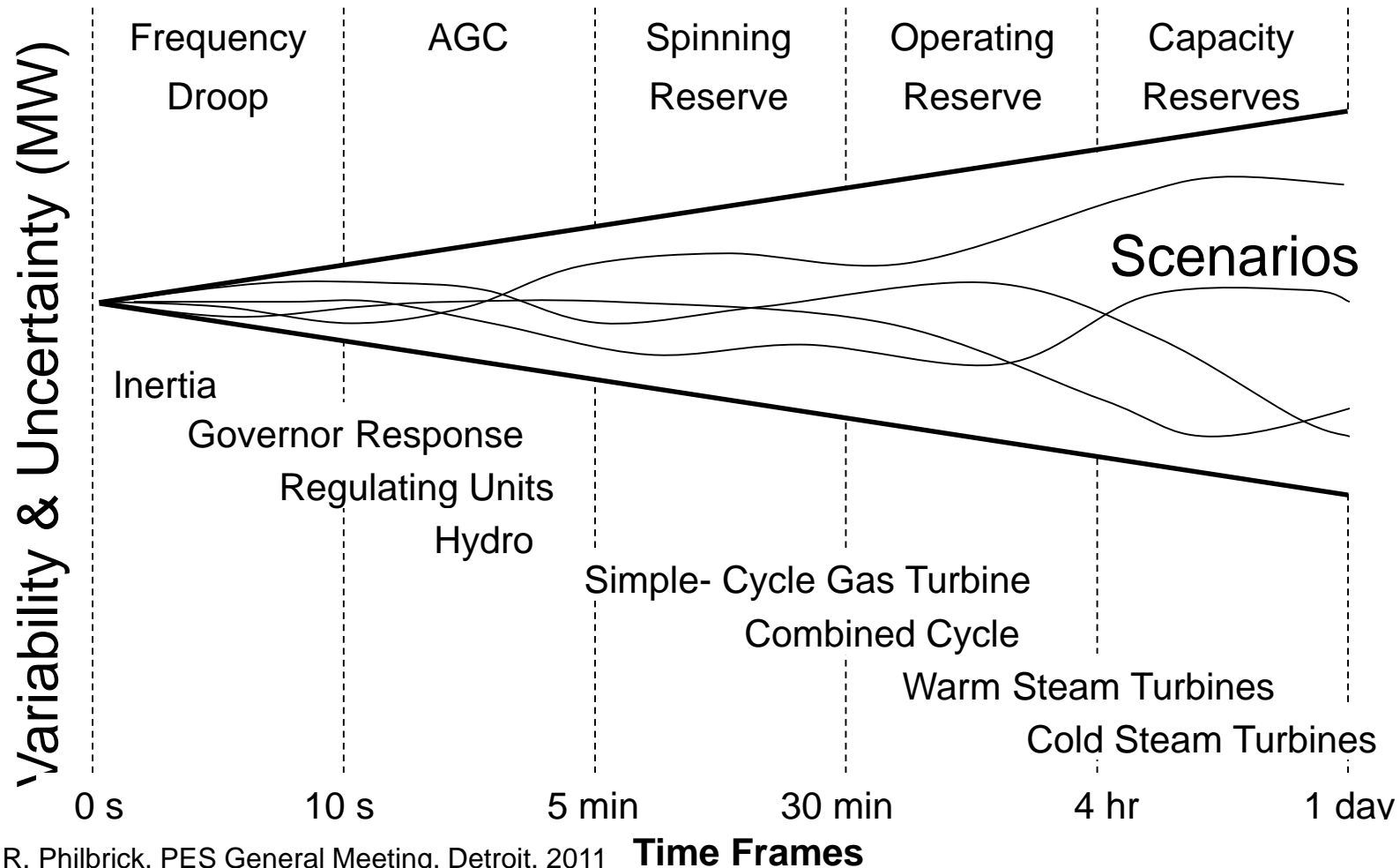
St. Paul, MN



# Timeframes of Operations



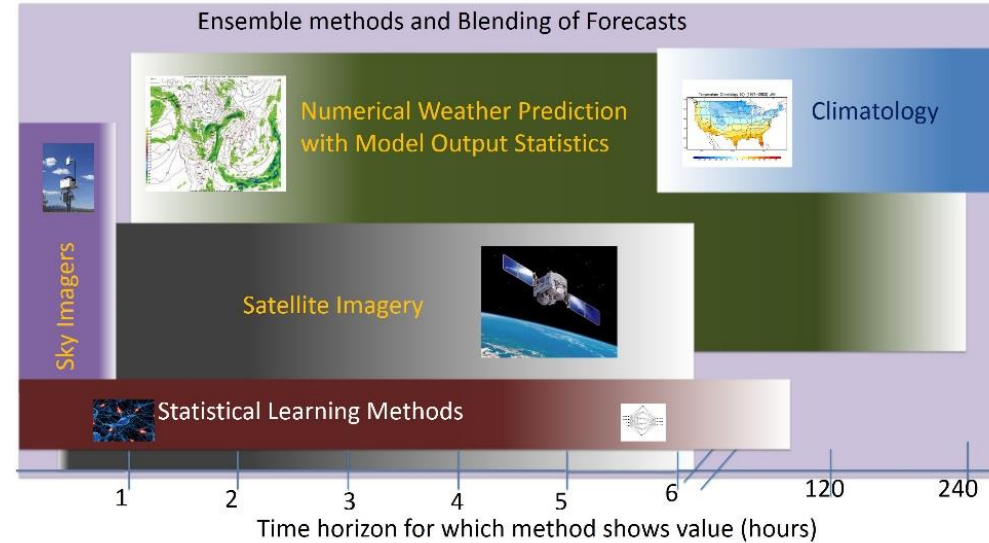
# Scheduling and Dispatch with Variability and Uncertainty



**Need to be able to plan for managing increased variability with uncertainty as to how it occurs → more probabilistic system**

# Who uses forecasts?

- Real time dispatcher
- Day(s) ahead operations
- Market operators
- Market participants
- Trading functions
- Maintenance scheduling
- Hydro scheduling
- Generator owners
- Demand response operators
- Operational planning studies
- Distribution system operations
- Response teams for storm events
- Others....



Solar Forecasts for different horizons

Lots of end users → focus here on how power systems and markets are operated

# Tutorial Overview

## ■ Aims:

- Describe how current markets work in US and European contexts
- Cover different types of markets and system operations and how they use forecasts
- Understand how uncertainty impacts on system operations
- Describe some of the current challenges and research needs

## ■ Some aspects to consider

- Every market is different, but some more similar than others
- Wind and solar may have different impacts, as will distribution versus transmission resources
- Not just electric system, but energy systems in general (gas covered here)
- Markets and system operations continually evolve – physical infrastructure and resources, regulatory and policy choices and consumer preferences will all change over time
- Different market players will have different preferences and needs
- Energy storage is becoming bigger player

# Agenda

- **Daniel Harless**, SPP: Day Ahead and Real Time Operations – A US ISO Point of View
- **Rui Pestana, REN**: Day Ahead and Real Time Operations – A European TSO Point of View
- **Kari (Clark) Hessler**, Xcel Energy – A large utility point of view
- **Nick Steffan** and **Sean Chang**, ERCOT : The Impacts of Variable Generation Forecasting in Determining Reserve Needs and Value
- **Mike Knowland**, ISO-NE: Natural Gas System Forecasting Status and Coordination Opportunities
- **Erik Ela**, EPRI: The Changing Needs of Power System Forecasting on the Evolving Power Grid