



# Committee on Energy Resources and the Environment

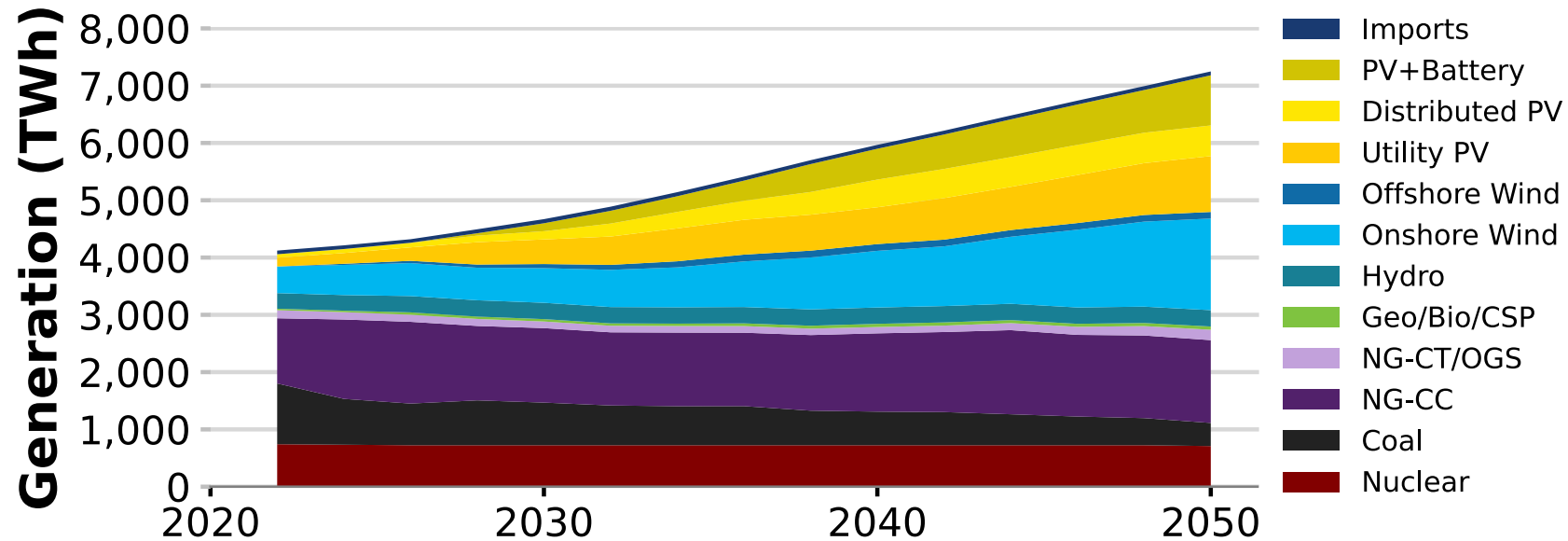
## **Room for One More? A Conversation on Power Systems and Load Growth**

This session will begin at 9:30 a.m.

What does NREL see when  
projecting electrification futures?

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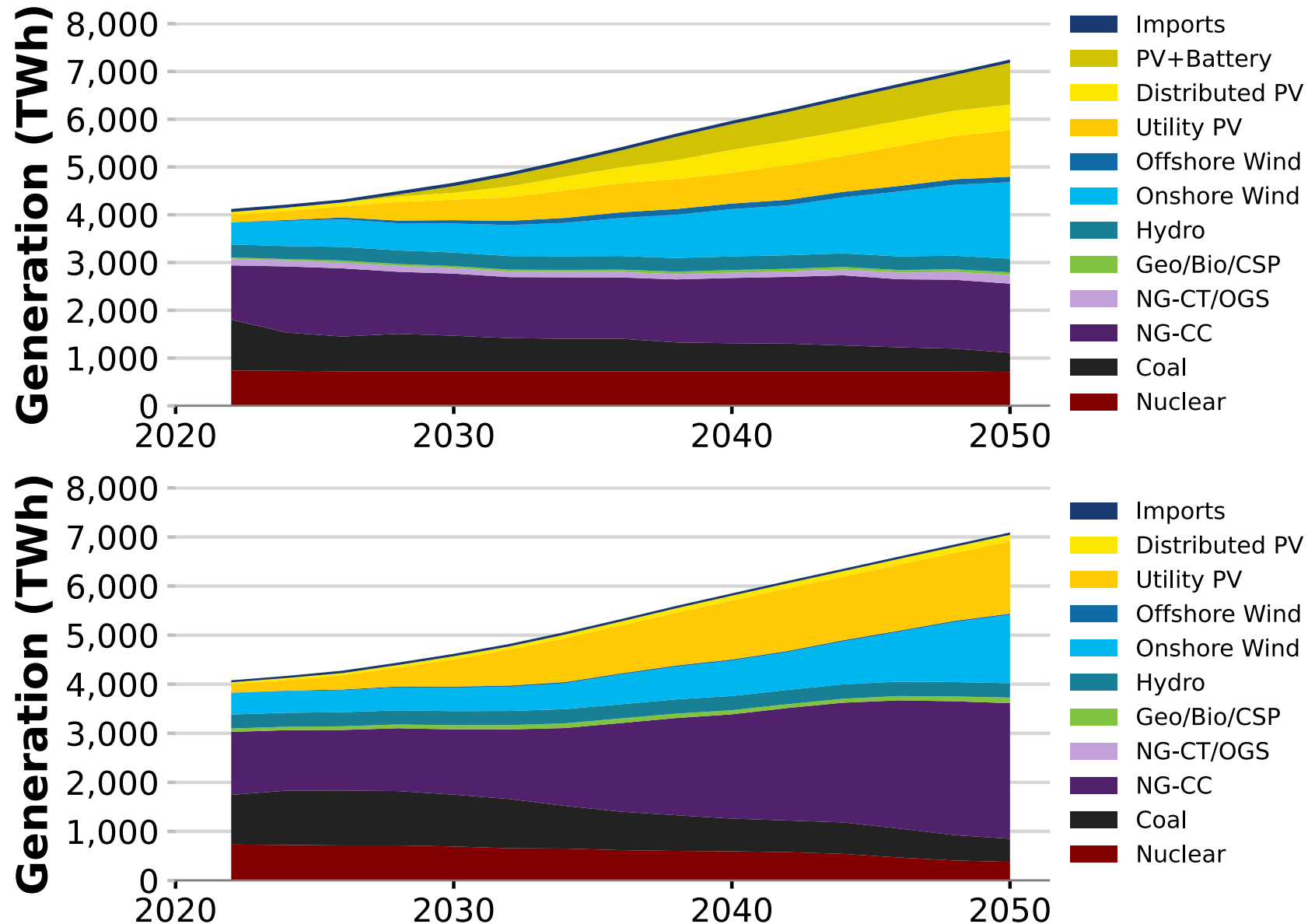
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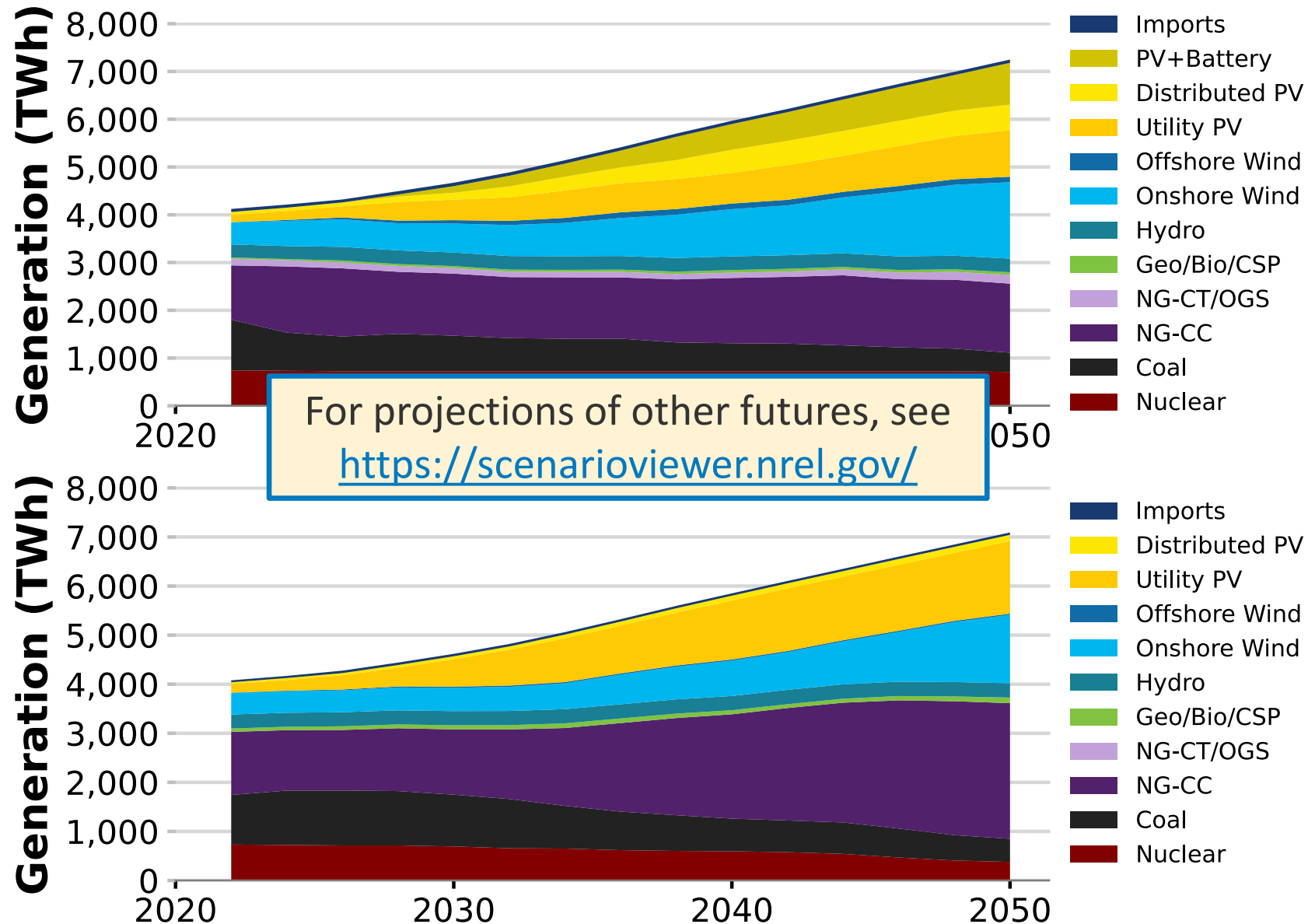
Mid-case with high electrification from NREL's 2021 Standard Scenarios

Least-cost buildout, subject to policy and operational constraints

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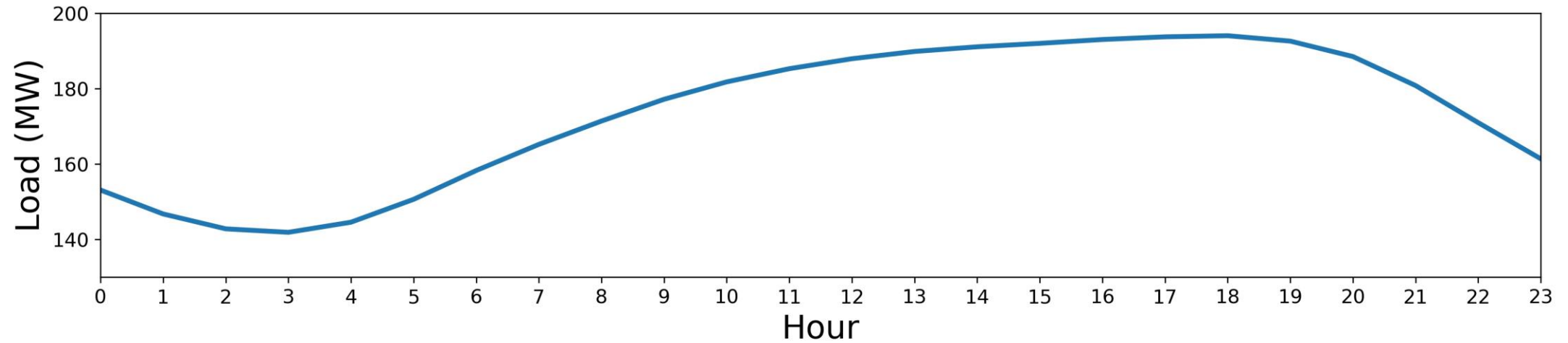
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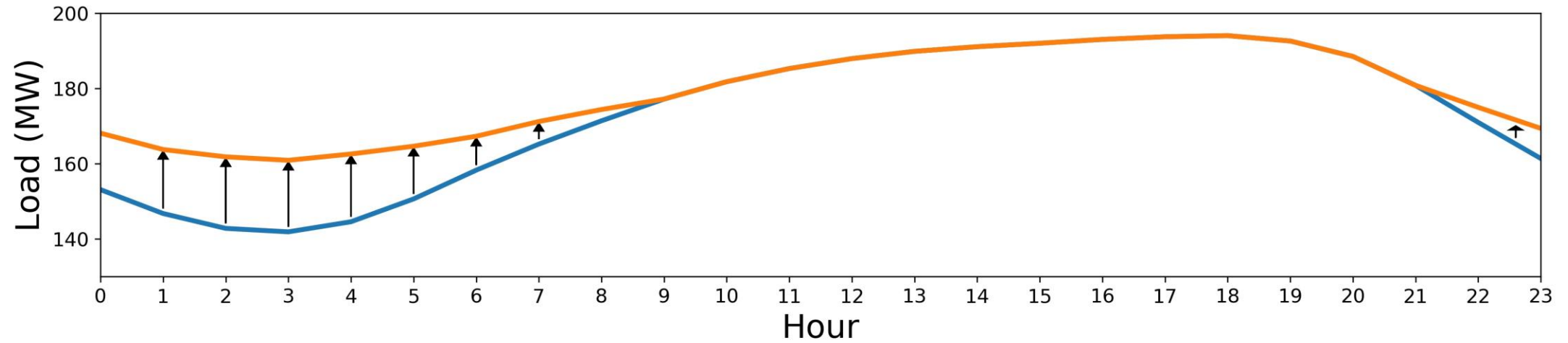
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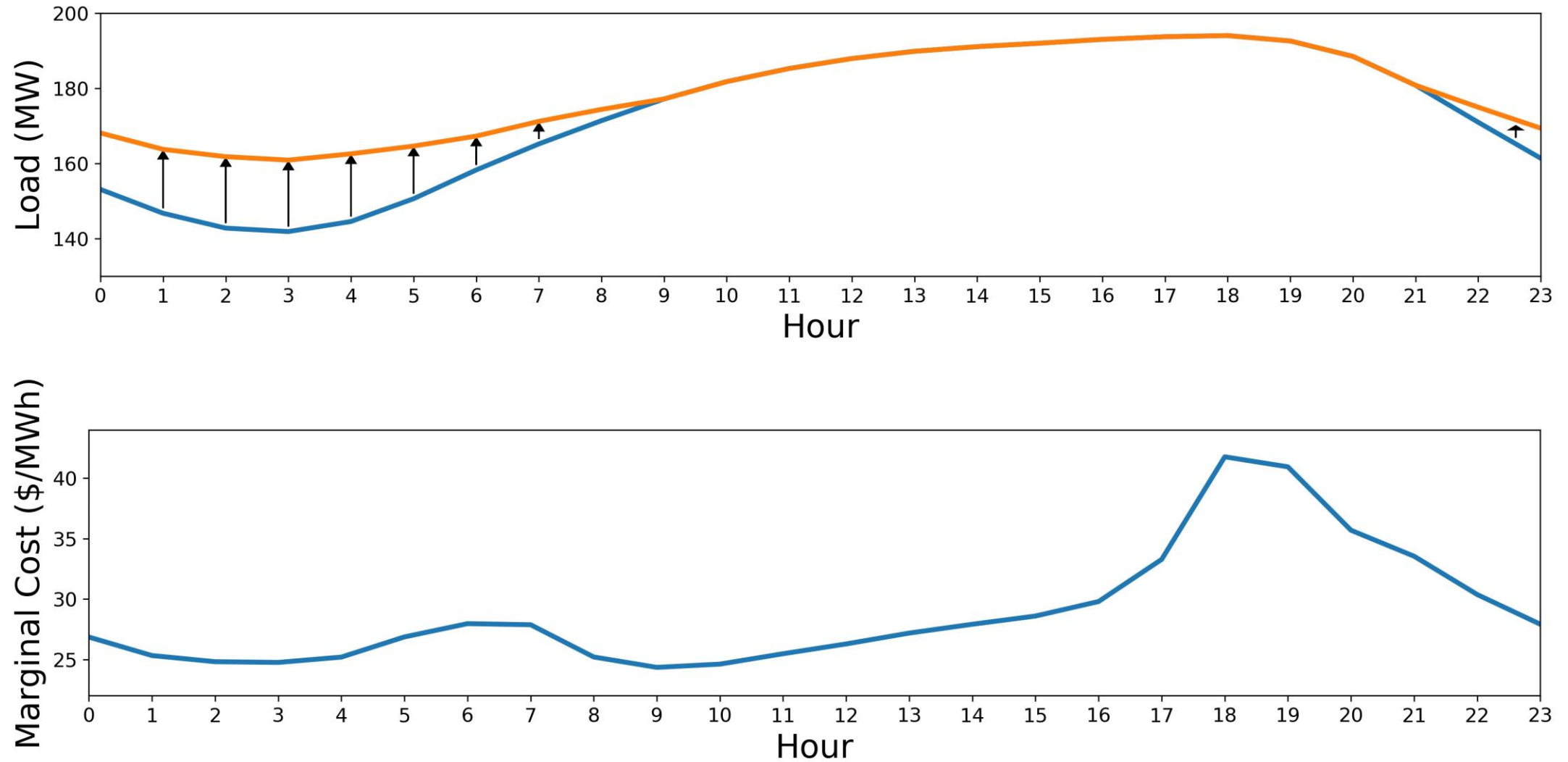


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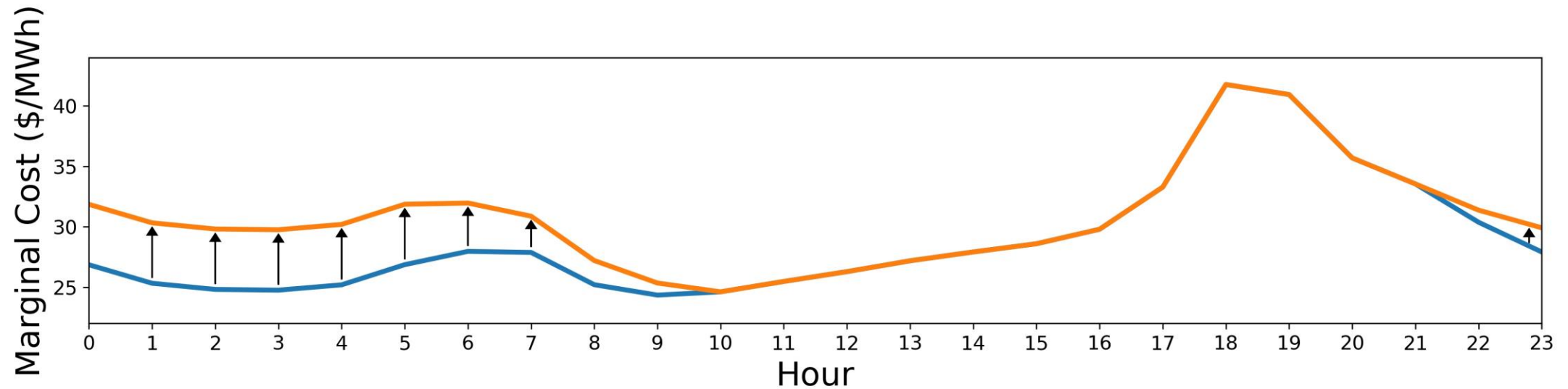
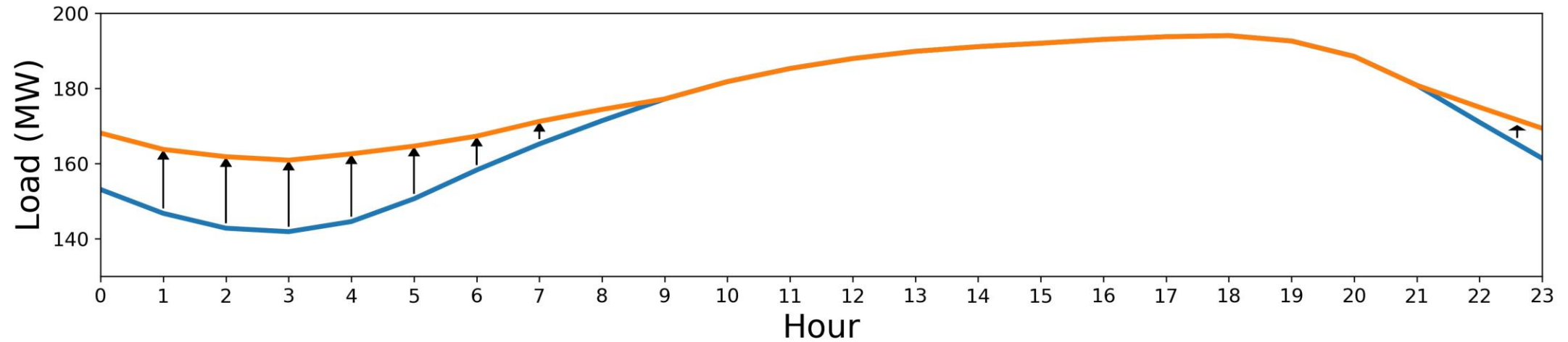




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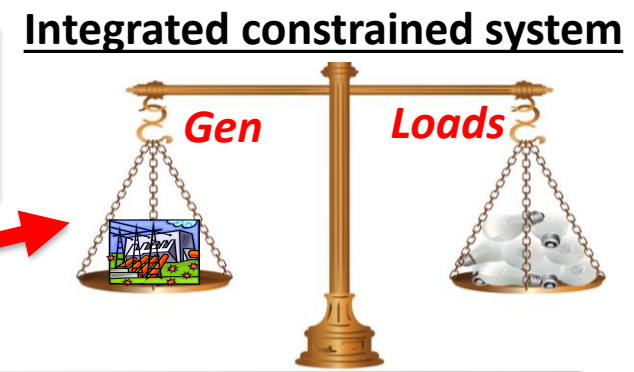
# **Room for One More? A Conversation on Power Systems and Load Growth**

# Electrification Impacts

- Power grid planning, scheduling, and operations
- Long & short run economics

## Balancing Authority

At all times in its footprint

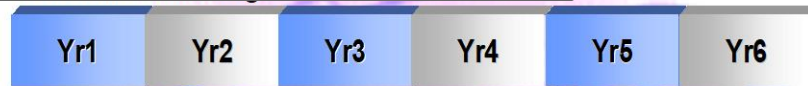


Long-term Integrated Resource Planning



Long Run Costs

Year/month Ahead Planning/Scheduling



Week Ahead Scheduling



Day Ahead Scheduling



Hour Ahead Scheduling



Real Time Dispatch



Short Run Costs

### ❑ Resource adequacy (e.g., reserve margin)

- ✓ Demand projections (*system peak load*)
- ✓ Supply: retirements & additions (*flexibility*)

### ❑ Schedule supply resource availability

- ✓ Planned maintenance outages
- ✓ Manage limited energy supplies (*hydropower*)

### ❑ Plan system production costs/unit scheduling

- ✓ Slow-long start unit commitments (*old steam*)
- ✓ Hydropower/water releases
- ✓ Battery & pump storage schedule (*arbitrage*)

### ❑ Reevaluate schedules (*revised forecasts*)

- ✓ Long-start unit commitments (*steam, comb cycle*)
- ✓ Revise unit-level schedules (*production levels*)

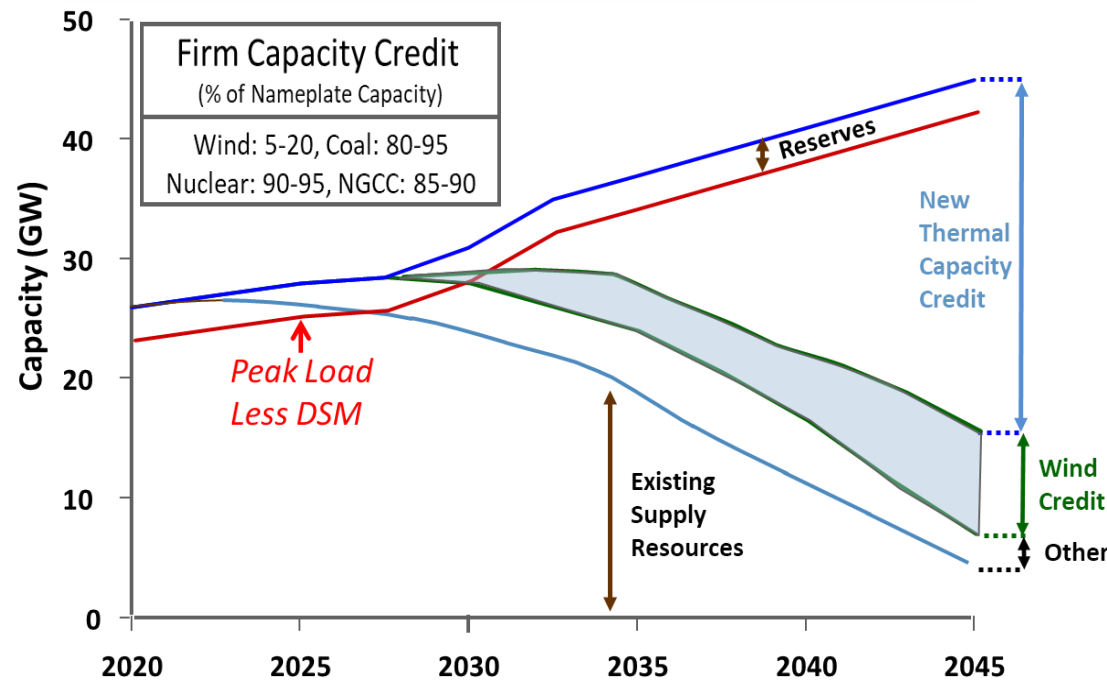
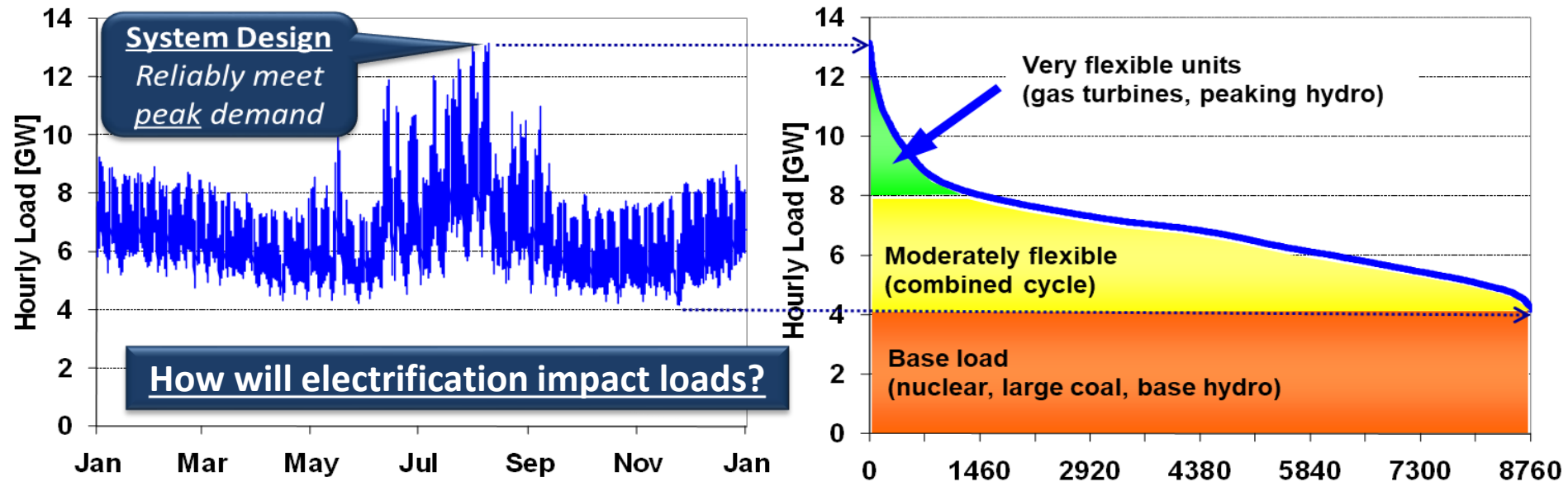
### ❑ Reevaluate schedules (*revised forecast*)

- ✓ Quick-start unit commitments (*gas turbines*)
- ✓ Revise unit-level schedules (*production levels*)

### ❑ Actual system operations (*gen, regulations, etc.*)

- ❑ Response to real time events & forecast error

# Capacity Expansion Requirements (Long-run Economic Costs)



## Technology Attributes

### Economics

- Capital cost
- Fixed & variable O&M costs
- Energy source(s) & prices
- Efficiency profile

### Operations

- Dispatchable
- Response & ramping
- Maximum operations
- Minimum operations
- Reserve capabilities
- Location

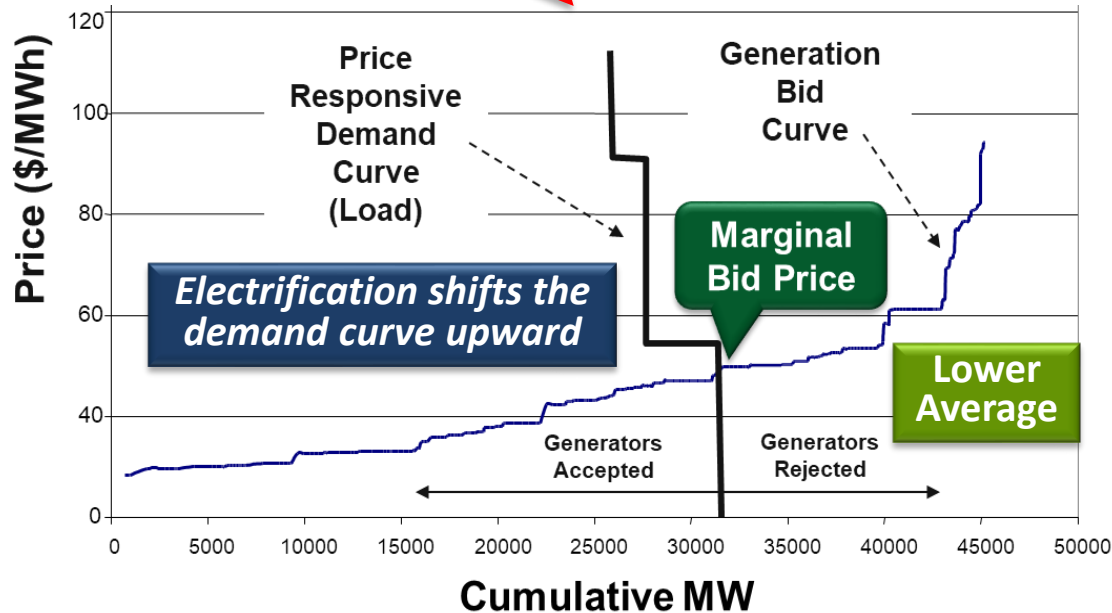
# Locational Marginal Prices (LMPs)

(Short-run Economic Costs - Serve Last/Next MWh of Load)

$$\text{LMP} = \text{Marginal Energy Bid Price} + \text{Transmission Congestion Cost} + \text{Cost of Marginal Losses} + \text{Other (air emissions)}$$

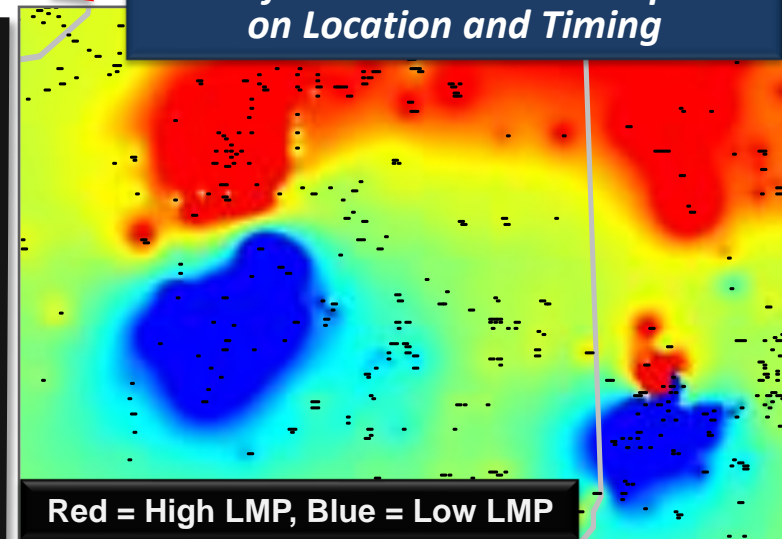
*Most expensive bid accepted*

*Re-dispatch costs to avoid line overloads*



- ✓ Build low cost generation and adequate supply
- ✓ Reduce load
- ✓ Maintain a highly competitive market
  - Many players (*minimize market power*)
- ✓ Effective market rules and monitoring

*Electrification Economics Depends on Location and Timing*



- ✓ Open congested lines
- ✓ Install phase shifters
- ✓ Build transmission capacity/capabilities
- ✓ Build low cost generation in high LMP areas
- ✓ Reduce load in high LMP areas



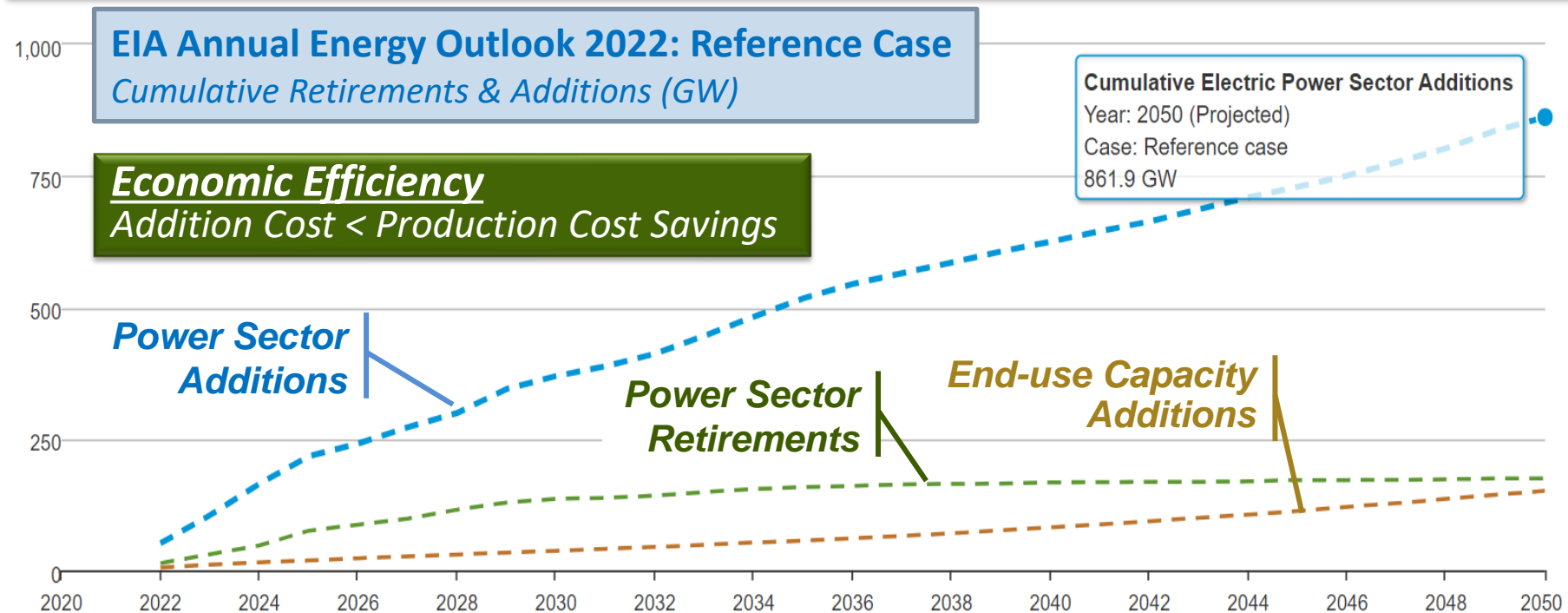
# Spare Capacity: Current and Projected Future

*Some times, in some places, but not always everywhere*

## National Electricity Reliability Council

### *2022 Summer Reliability Assessment*

- **High risk of energy emergencies (*higher load, less capacity, transmission*)**
  - Midcontinent Independent System Operator
- **Elevated risk of energy emergencies (*drought*)**
  - Western Electricity Coordinating Council (*snowpack, transfers, wind/solar output*)
  - Electric Reliability Council of Texas (*extreme heat, reduced output, outages, 7/11/22*)
  - Southwest Power Pool (*cooling water shortages, outages, wind/solar output*)



Thanks for attending.  
The next session begins  
at 10:45 a.m.