Coordinated Planning for the Energy Transition

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ESIG October 2024

100% Clean Electricity Markets Task Force Workshop

Highlights

- United States Electricity Policy Reality
- What is Reliability?
- Gas and Electric Interdependency
- The Challenges with Relying on Market Prices Alone for the Energy Transition
- A Planning and Policy Coordination Solution for an Orderly and Reliable Transition
- Markets within a Planning Framework

The U.S. Electricity Policy Reality

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Two Challenges for the U.S Energy Transition

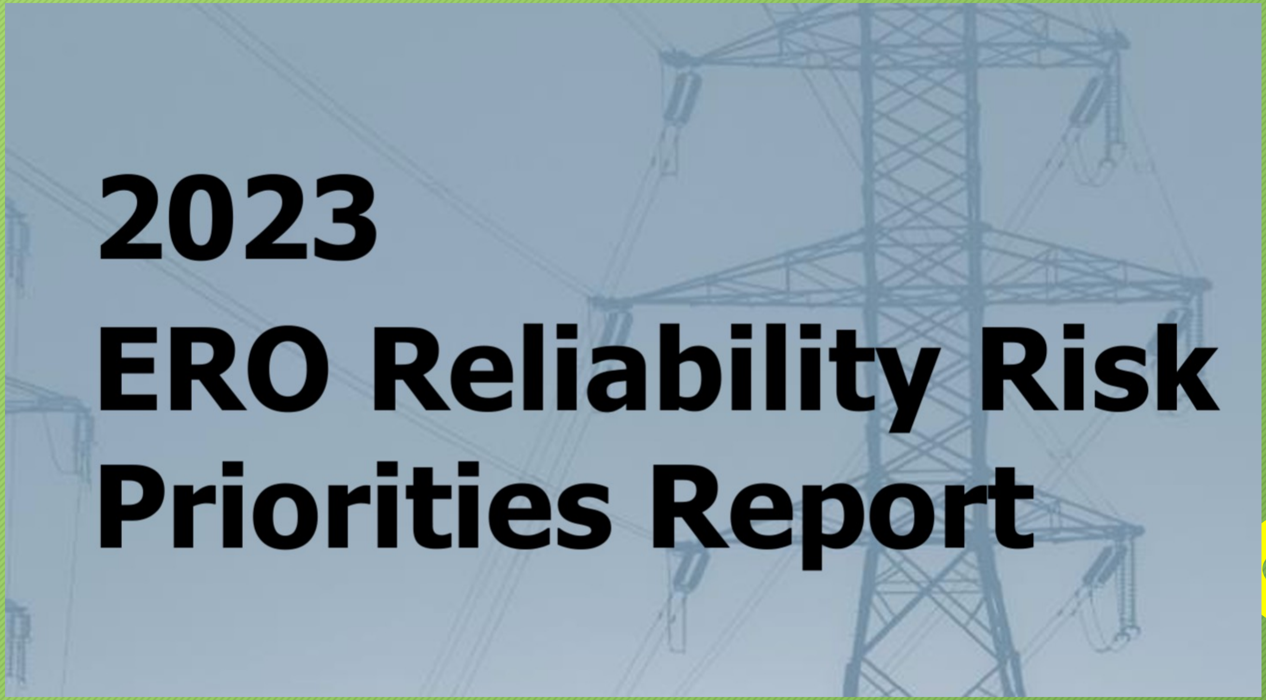
- Lack of coordinated policy (federal/state and cross-sector) creates reliability and investment risk.

- In organized markets: Prices are great for managing efficient short-term dispatch, but there are limitations to relying on prices (an "LMP") *alone* for the energy transition.

Policy Gaps in Electricity

Policy	**Gap**
State/Federal Decarbonization Target Setting	No one setting targets at state/federal level also has grid reliability responsibilities
IRA Technology-Neutral Incentives	A *specific* technical mix of resources is needed for reliable grid operations
EPA carbon pollution standards require meaningful community engagement in state compliance plans, including “reaching out to reliability authorities”	There is no coordinated, regional planning process for this kind of meaningful engagement with reliability authorities

Policy Gaps Create Reliability Risk



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Reliability Impacts of Energy Policy

Policy as a Reliability Risk Factor

Energy Policy can drive changes in the planning and operation of the BPS. Accordingly, policy can affect BPS reliability and resilience and could present risks to its reliable operation. Ensuring reliability during and after policy driven transitions should be a key consideration in setting Energy Policy. The implementation of policy decisions can significantly affect the reliability and resilience of the BPS. Decarbonization, decentralization, and electrification have been active policy areas. Implementation of policies in these areas is accelerating, and, with changes in the resource mix, extreme weather events, and physical and cyber security challenges, reliability implications are emerging. Demonstrated risks, such as energy sufficiency as well as natural gas and electric interdependence, are becoming increasingly critical. Emerging potential risks, such as aggregate DERs, are increasingly concerning. Due to the interdependency of critical infrastructures (i.e., electricity, natural gas, water, transportation, and communications), potential reliability risks are magnified when cross industry segments and agencies act independently to create or implement policy. Development of reliability standards and processes recognizes and respects the jurisdictional authorities setting and implementing policy decisions. It will take strong collaboration and partnerships across a multitude of boundaries to mitigate the emerging risks we face today – state, federal, provincial and private – ensuring reliability of the grid is a prioritized tenet of critical infrastructure.

Policy Gaps Make it Hard to Focus Investment

Scaling Dispatchable Clean Technologies

Batteries, geothermal, advanced nuclear, long duration storage, hydrogen, bioenergy, or abatement technologies

- Technology-neutral incentives need to be focused and directed.
- Not all of technologies are possible in all geological locations
- Some require investment in additional infrastructure to scale and enable their use in electricity
  - Pipelines for CCS or Hydrogen
  - Storage for spent fuel rods

What is Grid Reliability?

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Bulk Electric System Reliability (NERC definition)

(1) **Resource Adequacy** (2) **Operating Reliability**

+

LOLP Risk Assessments Withstand sudden disturbances

(3) **Energy Adequacy**

Resources that produce when dispatched

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Operating Reliability: Real-Time Power System Operations

- Meeting mandatory and enforceable reliability standards
- Managing to contingencies
- Respond to changes in grid frequency or voltage stability
- Supply/Demand Balance
- Maintain transmission lines within rated limits

"Essential Reliability Services"/"Grid Attributes"/"Ancillary Services"

Challenges as the Resource Mix Changes

- Resources that can produce at all times
- Meeting “Net” Load
- Flexible, Dispatchable Resources that are Quick-Start and Fast-Ramping

Growing sources of uncertainty

- Generation output (Renewable, Energy-Limited Storage, Fuel-Limited Gas)
- Electrification Targets (heating + transportation)
- Changing and extreme weather
- Customer-sited generation (not visible to bulk grid operators)

Reliable Grid Operations ("Grid Attributes")

- **Balancing Energy**
  - Flexible Generation Resources
  - Fast-Start
  - Quick-Ramping
- **Operating Reserves**
  - Produce within 10 min/30 min
  - Once deployed, must be replaced within 60-90 min

Today provided by batteries and gas generators…

And both are limited

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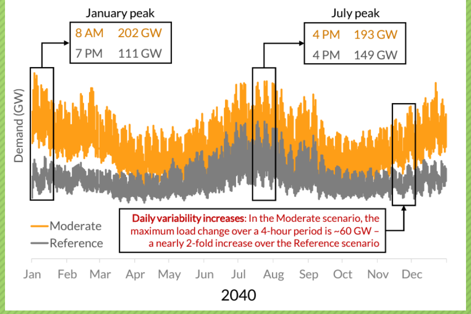
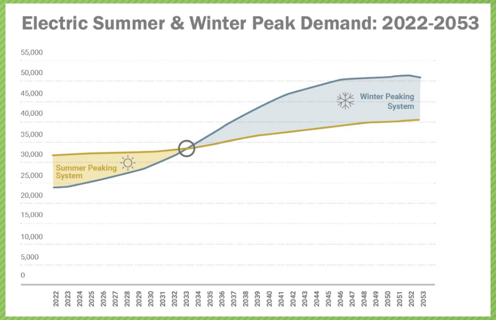
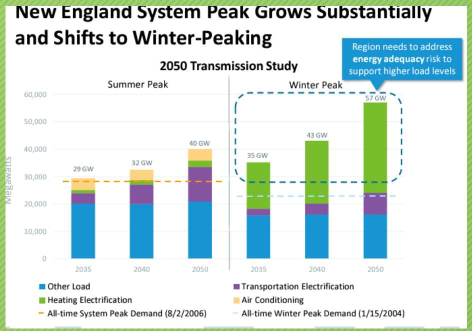
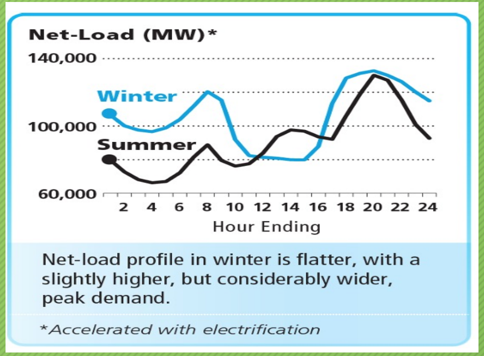
Gas-Electric Interdependency









Systems become winter peaking…with significant ramping needs

- Natural Gas = 40% today (EIA)
- Increasingly used to provide balancing energy (NERC 2023)
- Challenge in the U.S.:
  - Bring on clean, flexible resources while ensuring the natural gas system is capable of supporting electric system needs throughout the transition *(see FERC 2023; NAESB 2023; RTO Blueprint 2024)*
  - May require strategic gas storage reserves/pipelines *(NAESB 2023)*
  - States set heating decarbonization targets without considering bulk electric system reliability needs *(Joseph 2024)*

Challenges with Relying on Market Prices *Alone* for the Energy Transition

Economic Theory for the Deregulation Paradigm

- **Prices coordinate resource investment**
  - The LMP that enables short-term market operation efficiency would also be the only entry/exit signal.
- **Scarcity pricing especially important**
  - Symbiotic investment: Generators and Consumers
- **Electricity is a commodity**
  - Markets for electricity are about hedging delivery and price risk
  - Resources are fungible: It doesn't matter which resource delivers energy, only that energy is delivered (Hogan and Harvey 2022)

The reality…
Scarcity Price/LMP Alone Challenges

Missing Money	Missing Markets
Price Caps/Market Power	Insufficient markets for risk
Operator Actions	Insufficient incentives for hedging
Inelastic Demand and "can't target deficient LSEs" (Also raises serious equity concerns)	Always have default/bankruptcy option
Non-Convexity	Hard to forecast scarcity/discount these hours
Reliability Standards > CBA Economic Investment	

Scarcity pricing has never been a sufficient investment signal to meet reliability targets.

An LMP is important, helpful, useful, and necessary for efficient ST operations, but relying on an LMP alone for sufficient investment in the resources that enable reliable system operations has always been a challenge.

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Investment Risks for Clean, Dispatchable (“Clean Firm”/”DEFR”) Resources

- Significant price volatility expected

- How forecast revenues?
  Uncertainty in policy = uncertainty in the resource mix

- How ensure revenue sufficiency?
  For assets that may run less over time, but provide critical reliability services when they do.

- How ensure associated infrastructure that can enable innovative technologies to deploy and scale?

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A Moonshot Mission to Decarbonize the Electricity Sector

- Markets are always incomplete and imperfect. Instead of the constant focus on how to fix market gaps, we should ask: "What needs to be done?" (Mazzucato)

- We need reliability-informed policy and markets that meet changing reliability needs throughout the transition.

A Planning and Policy Coordination Solution

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Policy should focus on two timelines

1) Need resources that meet operating reliability needs in all hours and all seasons as more renewable resources come online. (**<u>TODAY</u>**)

That provide specific grid services

Natural Gas with sufficient fuel available + Batteries

2) Targeted incentives for the kinds of resources that can replace fossil assets. (**<u>FUTURE</u>**)

That provide specific grid services

Examples: Geothermal, Advanced Nuclear, Hydrogen, Bioenergy, Long-Duration (Multi-day) storage, Fossil with Carbon Removal ("abated")

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A Policy and Planning Coordination Framework

Entity	Role	Activities
States	Provide study assumptions	Study assumptions based on integrated Resource Plans (IRPs), state policy targets, and/or federal policy requirements and state plans (e.g., the EPA.)
Reliability Coordinator *In some regions this is the Regional Transmission Organization (RTO) or Independent System Operator (ISO). In other regions, coordination with Balancing Authorities may be needed.*	Consensus Building	Regional system planning study (with agreed-upon scenarios) based on state and federal policy (e.g., types of generation, timing, locations, electrification targets, EPA regulations, etc.)
Reliability Coordinator *In some regions this is the Regional Transmission Organization (RTO) or Independent System Operator (ISO). In other regions, coordination with Balancing Authorities may be needed.*	Provide regional reliability assessments. These studies would identify reliability needs (resource adequacy and operating reliability) over a defined period.	Provide assessments over defined timelines: Short-term (1-5 years) Medium-term (5-10 years) Longer-term (10-20 years)
States	Consider studies and scenarios for reliability-informed policy planning.	Targeted incentives for technology types that meet policy and system reliability needs.
States	Coordinated regional planning for generation and infrastructure that meet identified reliability needs.	Could include mechanisms to consider regional planning and coordinated procurement of needed resources and infrastructure.

Market Design Solutions

That recognize the importance of **SYSTEM PLANNING**

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Market design solutions

- Hybrid Markets
  - Competition “for” the market instead of “in” the market. Replace voluntary with mandatory contracting.
  - Recognizing policy as driver of new entry. Informed by system planning.
  - Auction designs that avoid lock-in when resources are no longer needed?
- Strategic Reserves (a form of hybrid market)
  - All pay the cost of resources needed to maintain reliable grid operations
  - Could still have competitive solicitation…which could enable new assets types that can fully replace fossil when commercially available
- Regional IRP for specific asset types (a form of hybrid market)
  - Could still have competitive solicitation…which could enable new assets types that can fully replace fossil when commercially available

Concluding Thoughts

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Bulk Electric System Reliability is a Public Good

- RTOs = The **supplier of last resort** for the **essential reliability services** needed to maintain reliability and prevent network system collapse. (Order 2000)

- What grid operators do to prevent network collapse is both non-exclusive and non-rivalrous. (Report to Congress on Electricity Market Competition 2007)

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Electricity is too important, too critical, too essential

- Reliability throughout the transition depends on having a **SPECIFIC TECHNICAL MIX** of resources that meet:
  - Policy targets + Balancing needs (load following, ramping, quick-start) + Operating reserve requirements.

- The transition must be orderly **AND** reliable
  - Gas system must be capable of responding to rapidly changing electricity needs
  - Transitioning away from natural gas requires focused and coordinated policy and planning.

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QUESTIONS? LET’S DISCUSS!