Coordinated Markets for the Energy Transition

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Highlights

- United States Electricity Policy Reality
- What is Reliability?
- The Challenges with Markets for Reliability
- The Challenges with Relying on Prices Alone for the Energy Transition
- There is a Role for Policy in the Electricity Sector Beyond “Market Fixing”
- Planning and Market Design Solutions

Two Challenges for the U.S. Energy Transition

- Lack of coordinated policy (federal/state and cross-sector) creates reliability risk.
- In organized markets: LMP is great for managing efficient short-term dispatch, but there are limitations to relying on an LMP *alone* for the energy transition.

Policy Gaps in Electricity

Policy	Gap
State/Federal Decarbonization Targets	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 and EPA recommends that states “reach out to all reliability authorities”	There is no coordinated, regional planning process for this kind of meaningful engagement with reliability authorities, especially for ensuring sufficient balancing resources

Scaling Dispatchable Clean Technologies

Scaling batteries, geothermal, advanced nuclear, long duration storage, hydrogen, or abatement technologies

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

The U.S. Electricity Policy Reality

The uncoordinated policy reality in the U.S. Electricity Markets

RTOs and EIMs (DA/RT) **DO NOT** set electricity policy

- Do not determine type, size, location, timing of resource entry

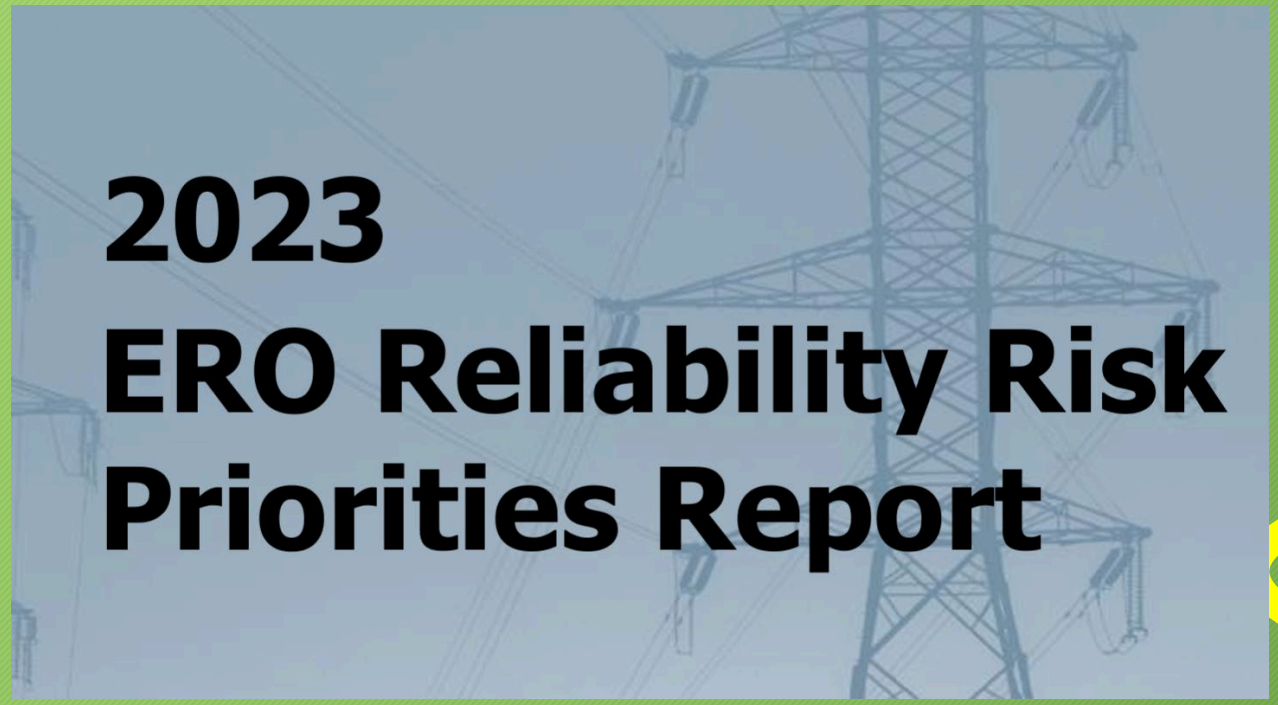
- RTOs and Individual BAs in an EIM are NERC-defined reliability-coordinators

Responsible for Reliable Grid Operations

States **DO** set electricity policy

- States are not NERC-defined reliability-coordinators

NERC Reliability Risk Assessment



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 interde[illegible]se, are becoming increasingly critical. Emerging po[illegible]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. Develop[illegible] of reliability standards and processes recognizes and [illegible] 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.

What is Grid Reliability?

Bulk Electric System Reliability (NERC definition)

(1) **Resource Adequacy**

LOLP Risk Assessments

+

(2) **Operating Reliability**

Withstand sudden disturbances

As sources of uncertainty and risk change, and as the resource mix changes, the growing focus is on OPERATING RELIABILITY

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

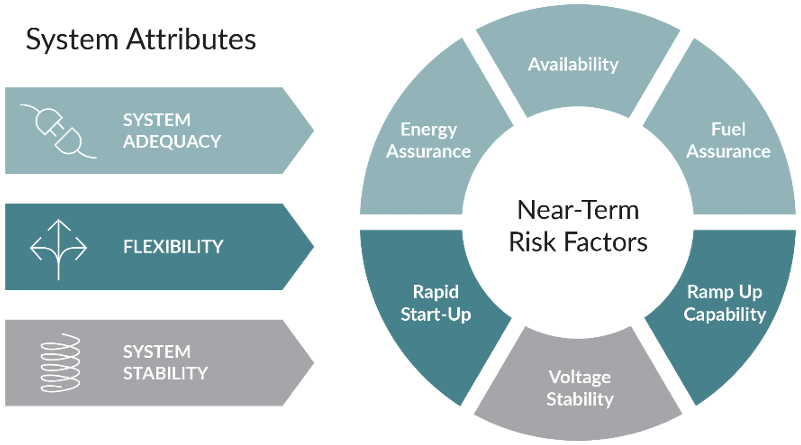


Figure 1: Three priority system reliability attributes and their near-term risk factor focus areas

Source: MISO Attributes Roadmap: A Reliability Imperative Report. 2023.

The Challenges with Markets for Reliability

Why Markets for Resource Adequacy?

- "Deregulating" the electricity sector
- 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, and markets for electricity are just about delivery and hedging delivery and price risk
  - 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	Theory assumes full markets for risk

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.

Challenges with relying on prices alone

Challenge: Not all resource types meet requirements for operating reserves and balancing energy equally at all times

Challenge: Relying on price exposure as a hedging incentive (EO) for residential consumers creates serious equity concerns

Challenge: Various market "fixes" since prices not enough (RA/Operating Reserves)

Challenge: Relying on prices alone for balancing energy in RTOs

Challenge: Coordinating across regulatory silos, jurisdictional divides, and sectors

A Moonshot Mission to Reliably Decarbonize Electricity

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.

Implications of the Electricity Policy Gaps

- Creates **reliability risk**
- Makes it **hard to plan across regulatory silos** (like gas/electricity)
- Makes it **hard to invest** in technologies that may run less over time, but provide critical reliability services when they do
- Makes it **hard to invest** in clean, dispatchable technologies that need additional infrastructure

Acceptable policy in electricity is too limiting: States have a critical role to play

Acceptable policy:

- Correcting for Missing Money and Missing Markets
- Correcting inefficiencies

Markets Alone Focus:

- "Picking winners"
- "Locking in" inefficiency

But policy plays a critical role in technology innovation

- Defines a direction, takes on risk, ensures committed capital beyond R&D *and into deployment*
- Invests in what otherwise would not happen
- Innovation is not something that happens only through the private sector

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. (**TODAY**)

That provide specific grid services

Batteries + Gas with sufficient fuel available.

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

That provide specific grid services

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

State Policy: Direct and Focus IRA Incentives

Technology-neutral IRA incentives need to be focused and directed.

Not all clean energy solutions:

- Provide the same kinds of reliability services.
- All possible in all geological locations
- Some require additional infrastructure to enable their use in electricity (e.g. CCS, Hydrogen)

States as "*innovator of first resort*" can FOCUS INVESTMENT on the types of clean, dispatchable resources that provide essential reliability services required for RTOs to be the "*supplier of last resort*."

A Planning and Policy Coordination Solution

Reliability-Informed State Policy Planning

RTO Studies

- State-determined assumptions

Reliability Implications

- For BOTH RA and Operating Reliability

Reliability-Informed Policy Planning

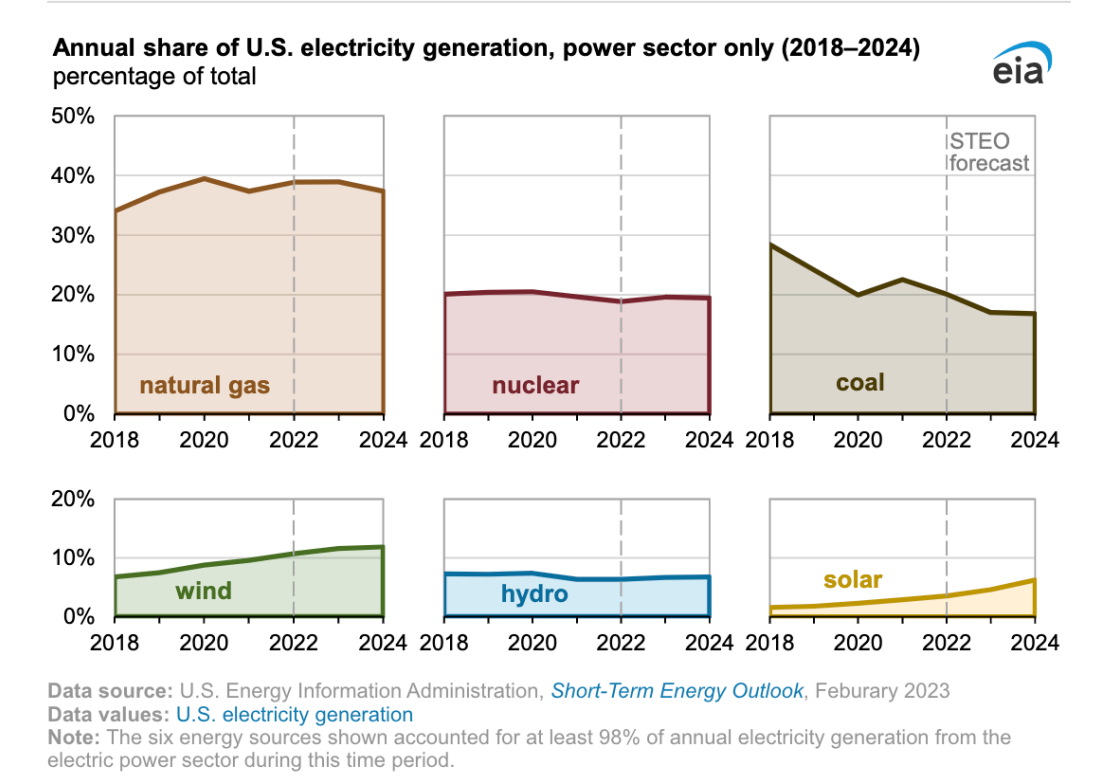
- Inform Resource Selection
- Targeted IRA Incentives

Coordinated, reliability-informed, regional planning for a reliable energy transition. Could include competitive solicitations.

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)*	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)*	Provide regional reliability assessments. These studies would identify reliability needs (resource adequacy and operating reliability) over a defined period.	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.

What will it take to replace natural gas?

Gas Generation and Gas-Electric Coordination Challenges



- Natural Gas = 40% today
- 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)*

What will it take to replace natural gas? Focused Policy

- Markets alone cannot solve gas/electric coordination challenges.
- Markets alone cannot solve decarbonization policy coordination challenges creating reliability and investment risk.
- Markets alone cannot enable technology innovation.

1) Coordinated planning, operation, and reliability standards that support *BOTH* the gas and electric sectors as the resource mix changes.
2) Policy that is focused on the kinds of technology that can replace the reliability services it provides.

Investment Risks for Clean, Dispatchable ("Clean Firm")

- Significant price volatility expected
- Creating investment risk for the "clean firm" resources needed

Uncertainty in policy = uncertainty in the resource mix = when and how often will these prices occur?

Revenue sufficiency for assets that may run less over time, but provide critical reliability services when they do.

Possible Market Design Solutions

That recognize the critical PLANNING needed

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)

Electricity is key to reaching any decarbonization targets.

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

- Types of resources that provide operating reserves and balancing assets are not fungible - especially as increasing sources of uncertainty and variability in daily system operations [variable + ELRs + fuel-limited gas]

Hybrid Market Designs

- Competition “for” the market instead of “in” the market only
  - Keep current short-term dispatch markets PLUS competition “for” the market
- Policy as driver of new entry. Informed by system planning.
- What is needed: Auction designs that avoid lock-in when resources are no longer needed

- Challenge = Most hybrid designs focus FINANCIAL delivery/price risk hedging incentives and EO market construct
- Examples that focus on the need for PHYSICAL may include: Corneli (PRISM); FCEM; Wolak

Strategic Reserves

- 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?

Examples

- Battery storage with dedicated charging resources.
- Gas with storage, firm transportation, that cannot be curtailed.

Regional IRP?

- Competitive Solicitation
- Could consider Hybrid Market options
  - Many parts of the US already separate the STM price from LT investment mechanism
- For Strategic Reserves only?

QUESTIONS? LET’S DISCUSS!