ENERGY COMPLIANCE, INC. | *Field Reference for Organized Markets*

MARKETS · RTO/ISO SERIES · EC-WP-401

How Organized Wholesale Markets Work

Wholesale market constructs and their alignment with reliability obligations.

Wholesale markets get framed economically, and that framing misses half the picture. Organized markets exist to serve reliability as much as price discovery. This reference explains how energy, capacity and ancillary service constructs translate reliability needs into market results, where the market's authority ends, and why market participation and reliability compliance are never the same thing.

energycomplianceinc.com **OCTOBER 2026**

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Foreword

This professional reference is one of a series Energy Compliance, Inc. publishes for registered entities and the people who run their compliance programs.

I have spent more than thirty years on every side of the bulk electric system. I have operated control centers as a Reliability Coordinator, Transmission Operator, and Power System Operator. I have audited grid facilities and signed off on findings as a senior compliance auditor. I have worked enforcement matters from inside the regulator's process. For the last several years I have advised registered entities directly through the firm I founded.

The entities that do reliability well share a habit. They take the standards seriously without confusing them with reliability itself. A NERC Reliability Standard is a floor, not a ceiling. Compliance is something an auditor evaluates; reliability is something a system either delivers or does not. So these entities prepare for audits by building programs that survive real questions, not binders that look thick.

That is the perspective these references try to share. Each one takes a single topic, whether a standard family, an operational function, a regulatory framework, or an emerging industry problem, and walks through how it actually works.

They are written for the compliance manager who wants to understand the system and not just memorize requirements. For the legal counsel who has to brief a board honestly. For the senior operator who has been told that compliance and reliability are

the same thing and suspects they are not. And for the new compliance hire who was handed a binder and told good luck.

These references are not marketing material dressed up as content. They come from three decades of doing this work and watching it succeed and fail. I have written them in the voice I use in a control room or in front of a Regional Entity audit team: direct, grounded in evidence, and honest about what the standards do and do not require.

Energy Compliance exists because much of the consulting offered to registered entities today is structured for billable hours rather than for outcomes. Every engagement is overseen by a senior practitioner. We do not bring five people to a meeting that needs one. We automate the work that should be automated and apply senior judgment to the work that requires it. If that is what you want in a compliance partner, the back of this reference has our contact information.

If not, the reference still belongs to you. Take what is useful and apply it well. And remember the only test that ultimately matters: when the system needs to perform, does it?

Rob Smith

Founder and Principal, Energy Compliance, Inc.

Executive Summary

Wholesale markets get framed economically. That framing misses half the picture. Organized markets exist to serve reliability as much as price discovery, and their energy, capacity and ancillary service constructs are the mechanism that turns reliability needs into market results. A market that produces efficient prices but undermines reliability cannot be sustained.

This reference walks through how the organized markets are built, what each construct is for, where the market's reach stops and the reliability authority takes over, and how governance keeps the two aligned as the system changes. The points I want a reader to carry away:

- Market participation and reliability compliance are not the same thing. Treating them as one creates audit risk in both directions.
- Day-ahead and real-time markets settle in dollars. Reliability standards settle in megawatts and seconds. Compliance lives at the intersection.
- Capacity markets fill a gap that energy and ancillary services do not cover. The gap is structural, and the market is one mechanism for closing it, not the only one.
- A capacity payment is compensation for being available, not for being dispatched. Confusing the two misframes participation strategy.
- Market behavior tuned for revenue and inattentive to reliability creates exposure. Market Monitoring Units watch market behavior and refer suspected Market Violations to FERC's Office of Enforcement.
- When the system is under stress, the reliability authority overrides the market schedule. That is the design working, not a market failure.
- Every market mechanism allocates risk somewhere. Knowing where it sits tells you who absorbs the cost when conditions change.

1 Institutional Purpose of Organized Wholesale Electric Markets

1.1 Why Organized Markets Exist

This reference looks through the economic overlay of the organized wholesale markets to their underlying relationship with the grid. The goal is simple: give the people who run compliance programs a working picture of the role these markets play in keeping the bulk power system reliable, and of where that role ends.

Wholesale electricity markets were not set up as commerce for its own sake. Their institutional form answers an operating problem: how to run a wide-area transmission system in real time when the generation, the load and the wires are owned by many independent parties. The market is the medium that translates system requirements into the behavior of resources on the grid, while the system operator keeps real-time control.

Three physical facts drive the design. Most electricity has to be produced the instant it is consumed. The system has to be balanced continuously. And power flows according to physical law, along every available path, not according to the contract that sold it. A delivery from one point to another depends on conditions that neither the seller nor the buyer controls. Leave production and consumption to bilateral deals alone and the results will, sooner or later, be inconsistent with what the system can physically do. Something has to coordinate the parties so that each one behaves consistently with the constraints of the whole. In the regions that have them, the organized market is that coordinating mechanism.

The scale is significant. FERC lists seven RTO and ISO markets in the United States (CAISO, ERCOT, ISO-NE, MISO, NYISO, PJM and SPP; ERCOT's market is overseen by the Public Utility Commission of Texas, see 7.1) and reports that two-thirds of the nation's electricity load is served in RTO regions. Traditional wholesale markets, without an RTO or ISO, remain the model primarily in the Southeast, Southwest and Northwest.

1.2 Standardization and Reliability Built Into the Clearing

Standardization is the core institutional logic. Organized markets define the products, set the rules for membership and fix the procedures for settling transactions. That cuts the complexity of bilateral negotiation among thousands of possible counterparties to something manageable. It also helps reliability: the system operator can rely on a known set of parameters about how resources will offer, respond and settle, and can work out in real time how those resources fit within the operating limits of the network. Seen this way, a market is more a coordination mechanism than a marketplace.

Reliability is designed into the clearing process itself. Transmission limits, reserve requirements and contingency criteria all go into the market clearing algorithm so that the scheduled

generation and demand are physically deliverable. The optimization runs inside the boundary set by technical and operating requirements. The schedule that comes out reflects both the economic preferences of the participants and the reliability constraints of the system.

Markets also set priorities by rule. Without a market, the choice of which resources answer a change in system conditions is a bilateral or operational judgment call. In an organized market it is specified in advance, which makes the response to system changes predictable and uniform.

1.3 Markets Under Stress and the Accountability They Create

Markets do useful work in normal operations, but they matter most to reliability during stress. Scarcity pricing, reserve procurement and uplift payments signal how tight supply is relative to demand and how much capacity and reserve the system needs. These are administrative signals as much as economic ones; they do not always reflect the true value of scarcity. They still change the behavior of every participant, and they do it without the operator having to take direct control of each resource.

It is a mistake to confuse the institutional role of markets with the turbulent effects market outcomes sometimes produce. Controversy and politics come with the territory. People tend to read volatile or unpopular market outcomes as proof that markets do not work. The short-term effects are fair game for debate. The underlying constraints and costs the market reveals were there all along.

Everything an organized market does builds a framework of accountability. Because the rules are transparent and the outcomes observable, regulators, the reliability organizations and others can check whether system requirements are being met and whether the market design remains consistent with reliability requirements. The commercial and reliability functions stay distinct, and each is accountable on its own terms.

Understanding this institutional purpose comes before analyzing any individual design feature. The rules for trading energy, capacity and ancillary services each serve a reliability goal. Knowing that explains why the design features look the way they do, and why markets have a role in reliability governance that goes beyond economics.

> **Chapter Summary**
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> Economic theory treats wholesale electricity markets as price-setting arenas. Their institutional role is broader. Participation is governed by rules that decide who takes part and how, system constraints are built into the clearing, and supply and demand are shaped to reflect what the system needs. That makes the organized market a coordination mechanism in support of reliability, and that role is the yardstick for evaluating each part of its design.

2 Energy Market Constructs and Reliability Alignment

2.1 What the Energy Market Actually Does

The energy market is the most visible part of the wholesale market. Its obvious function is price formation and trading. From a reliability standpoint it does something more important: it marshals the resources needed ahead of time and in real time, in a way that respects system constraints and operating procedures.

Energy market constructs turn system conditions into dispatch through scheduling and trading. They take load forecasts, resource offers and network constraints and produce a schedule that is both economical and technically feasible. Reliability is a built-in feature. Operating conditions, contingency requirements and security constraints act as hard boundaries on the market outcome.

2.2 Day-Ahead, Real-Time, and the Information in Price

The energy market is organized around reliability time frames. The day-ahead market is the predictive step. Resources are committed and schedules built against projected real-time conditions, which lets the operator plan around expected constraints, prepare for contingencies and manage uncertainty before it arrives. The real-time market then adjusts the day-ahead schedule to actual conditions to keep supply and demand in balance.

Energy prices carry reliability information as well as economic information. Locational price differences reflect transmission constraints and periods of system stress, and they point to places that deserve closer monitoring. The price does not create the constraint. It makes the constraint visible to participants and regulators alike.

The energy market also does not operate apart from operational authority. If reliability requires it, the system operator can intervene in real time and take actions that differ from the market result. The energy market is a tool that supports operating decisions made under the reliability standards. It is not a substitute for them.

2.3 The Long-Term Signal and the Link to Other Markets

Energy market outcomes have an indirect effect on long-term reliability. Prices that stay low for long periods, or spike for short ones, show where the grid is constrained or resources are short. That information feeds planning models and market design discussions. The energy market is not built to deliver resource adequacy, but it is an important source of information for reliability and governance decisions.

The alignment between energy markets and reliability is deliberate. Market design embeds knowledge of system constraints and operating procedures in a transparent, predictable form. When that alignment holds, an energy market can coordinate the behavior of many independently owned resources across a wide area without central ownership or control of those assets.

Understanding the energy market from a reliability perspective is the foundation for understanding the rest. Capacity and ancillary service markets exist to cover reliability needs the energy market cannot address alone. They build on the coordination framework the energy market establishes.

Chapter Summary

Energy market design supports reliability by scheduling supply and demand across several time frames, with system constraints and operating requirements built into pricing and scheduling. A market that matches supply and demand at every planning stage, without diminishing the operator's control of the grid, is the core of reliability through market design.

3 Capacity Market Constructs and Resource Adequacy Context

3.1 Resource Adequacy Is a Different Problem

Capacity markets deal with an aspect of reliability other than real-time balance and short-term scheduling. Their purpose is resource adequacy: making sure enough capacity will exist to serve peak load under stressed conditions, years from now. Those are timing and investment problems the energy market cannot solve on its own.

Resource adequacy generally means the ability of an area's generation and transmission resources to serve forecast load and reserve requirements over a future planning period. It concerns problems that may arise on some future date. Operational reliability concerns the problems in front of the operator now. Capacity products create an obligation, an incentive or both that ties those future needs to specific commitments.

Because capacity is typically procured against requirements set well ahead of the delivery period, procurement is not tied to individual operating hours. That separation in time between the capacity market and the reliability events it is meant to prevent matters for policy. It shows how resources and their reliability contribution are accounted for well before any actual shortage.

The starting point is the load forecast and the capacity requirement needed to keep an adequate reliability margin. With those in hand, planners can assess whether the capacity expected to be available will cover the load, with allowance for uncertain resource performance.

3.2 Paying for Availability, Not Energy

The reliability function of a capacity construct rests on availability rather than energy production. A capacity product measures a resource's commitment to be available during the system's peak hours, regardless of how often it is called on to produce energy in normal conditions. In my view, the reason is that some low-frequency reliability events carry very high value to customers, and the energy market alone does not fully price that value.

Capacity resources also carry performance obligations meant to align the provider's incentives with the system's needs during high demand. Designs vary from region to region. The underlying concept is consistent: the capacity counted toward adequacy must actually be available when it is needed.

3.3 Capacity Markets Do Not Replace Planning

Capacity markets do not supplant planner judgment or the reliability standards. In my view this is the single most important point about them. They sit on top of the deterministic and

probabilistic planning analyses that assess resource adequacy against engineering criteria. The auction uses a market mechanism to procure the capacity that the assessment says is needed. Who defines resource adequacy and the acceptable level of risk? The planning world does, not the auction.

Capacity constructs are also a product of institutional and regulatory choices. Where a state or a vertically integrated utility carries the obligation to provide adequate supply, a capacity market may not be needed at all. Elsewhere, a centralized capacity auction is a way to coordinate many market participants across several states. Capacity markets are therefore not a natural feature of every market. They are the result of specific governance decisions.

They have real strengths and real limits. On the plus side, they give visibility into forecast reserve margins and flag when supply is likely to be tight. On the minus side, they are complex, rest on many uncertain parameters that change over time, and give only an approximate picture of where and when supply and demand might fail to meet. That is why capacity markets need to be designed in step with planning metrics, performance requirements and monitoring.

Seen in context, a capacity market is one way of handling long-term adequacy where the costs and risks of providing reliability are spread widely rather than borne directly by individual customers or resources. It does not diminish the role of the standards-based and planning-based resource adequacy regime in the North American system.

Chapter Summary

Capacity products support long-term resource adequacy by securing commitments that capacity will be available under high-demand conditions. They complement planning analysis by matching committed capacity to the shortfalls that planning identifies. Their effect is bounded by the design choices of regulators and market operators and by the wider reliability performance of the grid.

4 Ancillary Service Constructs and Operational Reliability

4.1 Why Ancillary Services Exist

Ancillary services answer reliability needs created by the dynamic, real-time nature of the system. Energy and capacity constructs supply electricity and capacity over defined periods. Ancillary services provide something different: continuous support for frequency, voltage, stability and contingency response. Ancillary service constructs turn those needs, as defined by reliability analysis, into a set of products that can be procured and managed.

NERC's Glossary defines Ancillary Service, in language taken from FERC Order No. 888-A, as the services necessary to support the transmission of capacity and energy from resources to loads while maintaining reliable operation of the Transmission Service Provider's transmission system in accordance with good utility practice. FERC's RTO rule requires each Regional Transmission Organization to serve as the provider of last resort for all ancillary services required by Order No. 888 and subsequent orders.

The need comes from the physics. Frequency has to be held within narrow limits. Voltage has to stay within margins that allow real power to move and keep lines and transformers within their thermal limits. And the system has to respond immediately to the unexpected loss of a generator or a transmission facility. Those needs are permanent, and they exist whatever market policy a region adopts. The amounts required are set by system design and operating criteria under the reliability rules and operating procedures, not by the market.

4.2 Products That Define Reliability Needs

Ancillary service products create a formal way to procure reliability services before they are needed. A product is simply a definition of the characteristics a service must have, such as ramp capability or restoration capability. Market designers did not invent these characteristics in a vacuum. The products are an attempt to state real-time reliability requirements in concrete, measurable terms.

From an institutional standpoint, ancillary service markets disclose what the system needs to operate reliably. They require the quantities to be stated explicitly and compensate the resources that provide them, replacing informal arrangements and assumptions about supply. That disclosure helps the operator understand what capability is available to handle expected conditions. Demand-side resources can also provide ancillary services; FERC's rules require RTOs and ISOs that run competitive ancillary service markets to accept bids from demand response resources on a basis comparable to other resources.

Resources that provide ancillary services carry specific response requirements and are not necessarily dispatched in energy merit order. Because these services must be held ready or

deployed under particular conditions, they need their own market constructs, and the operator still needs room for discretion when conditions call for it.

4.3 Ancillary Services, Energy, and Oversight

The relationship between ancillary services and energy shows the layering that supports reliability. The energy market sets the base schedule. Ancillary services provide the flexibility and response around that schedule. The point of the ancillary service construct is to make sure reliability does not depend on chance or on whatever resources choose to do voluntarily. It is built into the market structure.

Oversight is central to ancillary service design. Because these services directly affect reliability, their definitions, quantities and performance criteria get close scrutiny from regulators and reliability organizations.

As system conditions change, so does the need for ancillary services. Shifts in resource mix, load characteristics and interregional flows can all change the type and quantity required. Ancillary service constructs let the market adapt to those changes without altering the underlying reliability rules. That is where system physics and market design meet most directly. Ancillary services are reliability products and an integral part of the organized market's infrastructure.

Chapter Summary

Ancillary service constructs secure operational reliability by translating stability, frequency, voltage and reserve requirements into defined market products. They make those requirements transparent, set priorities among them and integrate them with the energy market, while preserving the operator's freedom to act and its responsibility for the outcome.

5 Interaction Between Market Constructs and Real-Time Operations

5.1 Markets Set Expectations; Real Time Tests Them

How market constructs interact with real-time operations is central to understanding how markets support reliable operation while the system operator keeps independent control of the grid. The energy, capacity and ancillary service markets establish a set of expectations about how the system will perform. Real time frequently departs from those expectations. How the operator handles the gap determines how much reliability the system actually delivers.

Market constructs reach real time through predefined rules and a fixed schedule of events. Some are simple, like the day-ahead energy schedule or capacity commitments. Some are complex, like the rules for deploying ancillary services. Whatever the form, the purpose is the same: bring the system into real time already coordinated, so that the uncertainty from changing conditions, variable generation and load, and known constraints and contingencies is reduced from the start.

That advance coordination is necessary for reliability but not sufficient. Markets handle known and predicted differences between supply and demand. Real-time operation is inherently uncertain, and some volatility, even predictable volatility, cannot be fully captured in market processes. Each of the following requires some level of operational response:

- changes in peak demand or in the shape of the load curve
- unexpected failures of generation or transmission
- plant outages for maintenance
- severe weather and other external events
- unforeseen interactions between new facilities and the existing system

5.2 When the Operator Departs From the Market

Once the operator exercises its authority under the reliability standards to address one of these events, the market outcome is no longer what governs. Actions taken to manage real-time conditions, including departures from merit order, reassignment of resources and deployment of reserves, may not match the market schedule. In an organized market, security constraints set the priority order.

FERC's RTO rule makes this explicit. A Regional Transmission Organization must have exclusive authority for maintaining the short-term reliability of the grid it operates, including the right to order redispatch of any generator connected to transmission facilities it operates if that is necessary for reliable operation.

A generator operator should never have to choose between following market instructions and following an operator's reliability directive, because operating procedures settle which one governs. The ability to depart from market results belongs in well-understood operating procedures, governed by defined accountability.

The interaction between markets and operations shows the limits of economic optimization. The clearing algorithm finds the best solution within the constraints it is given, but not every operating issue or emerging condition can be written as a constraint. Operational judgment, grounded in situational awareness and reliability criteria, corrects and supplements what the market rules can express. That is why, within an RTO or ISO, the market function and the operating function sit in the same organization but the operator's reliability authority stands apart from the market result.

5.3 Recording Deviations and Learning From Them

Market constructs shape real-time operations. The energy schedule determines the baseline set of resources. Ancillary service schedules determine how much control action is available. Capacity definitions shape what spare resources are likely to exist. But operating decisions are still made in real time, in response to current conditions.

Transparency and accountability manage this relationship. Deviations from the market outcome caused by reliability actions are recorded and handled through established procedures. A reliability action taken to manage volatility should not leave a resource carrying financial consequences for a deviation the operator directed.

Over time, the interaction between markets and operations shapes how the markets develop. Frequent intervention or recurring operating constraints can signal that some part of the market design no longer matches what the system needs. RTOs and ISOs bring that operating experience into market design discussions and planning assessments so the markets keep evolving in a way that is compatible with real-time operation of the grid.

This is why market performance cannot be the only measure of a market. A market has to fit within the framework of operational reliability management. It has to handle uncertainty, respect security priorities, keep the need for intervention low, and leave the operator's freedom intact when intervention is necessary.

Chapter Summary

Market constructs and real-time operations form a hierarchy with reliability of supply at the top. Markets coordinate schedules and forecasts. Operators make decisions on current conditions, so that the market never obstructs reliable operation, even under the most complex and uncertain conditions.

6 Reliability Risks, Limitations, and Market Exposure

6.1 Markets Reveal Risk; They Do Not Remove It

Wholesale markets are usually judged on efficiency, prices and participant behavior. Their reliability significance, and their limits, get less attention. The core point of this chapter is that wholesale markets disclose reliability risk. They do not mitigate it. Understanding those limits is essential to seeing how markets fit within a wider reliability framework.

The first limit is abstraction. A market has to translate the physical system into commercial terms, and physics does not leave much room for argument about definitions. Energy, capacity and ancillary service products are, at best, approximations of more detailed physical requirements. They allow efficient coordination at the margin, but the definitions, rules and prices may miss locational detail, unusual conditions and interactions that cannot be quantified easily or cheaply. That is where real reliability risk remains.

The second is timing. The market works in discrete intervals and planning horizons. Reliability events can develop over seconds or over years. Cascading outages and severe weather can move faster than any market process can respond. In those cases the system depends on real-time operating action.

6.2 Performance Assumptions and Transmission Limits

The third limit is performance. A market assumes that resources will perform as described. Capacity constructs assume the committed resources will be available when needed. Ancillary service constructs assume actual response will match modeled response. When those assumptions fail, reliability risk follows, and the assumptions fail most often under stress, when outages correlate and performance degrades. The market's exposure to that risk sits on the surface. It points to the underlying risk without doing anything to reduce it.

Transmission constraints are a fourth area where market effectiveness is regularly tested. The market uses transmission limits drawn from transfer analysis and security-constrained power flow, but actual conditions can differ because of planned or forced outages, derates, or flows above expected levels. Congestion pricing manages transmission constraints economically. It does not relieve them physically. When generators follow price signals into a pattern that puts the grid at risk, reliability action may be needed to address the local problem.

6.3 Behavior, Perception, and the Boundaries of the Tool

Participant behavior complicates the picture further. Participants respond to the incentives built into the market, and those incentives will not line up with reliability objectives under every condition. Oversight exists to catch problem behavior, but reliance on economic incentives

creates exposure to strategic behavior that has to be managed through governance and regulation, not operational control alone.

Market exposure also shapes public and policy perception. Occasional price spikes and shortages put a spotlight on parts of the power system that are normally invisible. Because these problems surface in markets rather than being absorbed quietly inside a regulated rate, they are often described as symptoms of deregulation or as problems caused by the market. What gets lost is that the market brought to the surface a problem that was already present in the system. The market reveals periodic stress. It does not create it.

None of this makes markets less useful. It defines the boundaries within which operators, regulators and others can use them effectively, alongside reliability standards, planning criteria and operating authority. Reliability governance starts from the assumption that no single tool manages all the risk on the grid. After every rule of an organized market has done its work of coordination, transparency and incentive alignment, risks remain that have to be managed in parallel. A market's value as a reliability resource depends on the reliability framework around it.

Chapter Summary

Organized wholesale markets expose reliability risks and constraints rather than eliminate them. The constraints come from abstraction, timing mismatch, performance assumptions, transmission limits and participant behavior. Understanding them shows that markets are coordination mechanisms that work within well-defined boundaries, not a general remedy for the reliability risks inherent in power systems.

7 Governance, Oversight, and Accountability in Market Environments

7.1 Tariffs, FERC and the Filed Rules

Organized wholesale markets operate inside a governance and regulatory framework that has to balance price-responsive service to customers against reliability and accountability. What happens in the wholesale market affects the reliability of the bulk power system, and the market itself is regulated. Governance is what keeps market design and operating rules consistent with reliability requirements.

For the FERC-jurisdictional RTOs and ISOs, market governance rests on tariffs filed with and accepted by the Commission. Under Federal Power Act section 205, rates and charges for jurisdictional transmission and wholesale sales, and the rules and regulations affecting them, must be just and reasonable, and changes require notice filed with the Commission, sixty days ahead unless the Commission orders otherwise. Market rules, product definitions, settlement procedures and mitigation provisions live in those tariffs. The RTO or ISO administers them and proposes changes to them through its stakeholder process and a filing with FERC. It cannot simply depart from the filed rules on its own. FERC's RTO rule sets four minimum characteristics (independence, scope and regional configuration, operational authority, and short-term reliability) and eight minimum functions, beginning with tariff administration and design.

ERCOT is the exception to this pattern. It operates as an independent system operator subject to oversight by the Public Utility Commission of Texas and the Texas Legislature, and its market rules are governed through that framework rather than through a FERC market tariff. Reliability Standards still apply. Under Federal Power Act section 215, all users, owners and operators of the bulk-power system must comply with the Reliability Standards that take effect under that section.

7.2 Market Monitoring and Parallel Reliability Oversight

Market monitoring reinforces oversight. FERC requires each Commission-approved RTO and ISO to provide for a Market Monitoring Unit. Its core functions are set in FERC's regulations: evaluate existing and proposed market rules and recommend changes, review and report on market performance at least quarterly with a more comprehensive annual state of the market report, and identify and notify FERC's Office of Enforcement staff of behavior that may require investigation, including suspected Market Violations. The RTO or ISO may not alter the Market

Monitoring Unit's reports or dictate its conclusions. Monitoring complements the Commission's enforcement authority by supplying the information regulators need.

Reliability oversight runs in parallel through the standards-based regime administered by NERC and the Regional Entities under FPA section 215. Market participation does not change a registered entity's reliability obligations. The Reliability Standards apply the same way whether a generator's output is sold in the market or not, and compliance monitoring evaluates performance against defined requirements, not against market results. Parallel oversight keeps the market from eroding reliability accountability.

Governance gets complicated where market outcomes meet state policy. State choices about resources, incentives and regulation can change market dynamics without changing the market rules. The organized market has to remain a neutral administrator of its filed rules while operating alongside those policies. The governance process gives the region a forum to deal with the unintended consequences that result, without handing policy functions to the market participants.

7.3 Transparency and Distributed Accountability

Transparency is a basic principle of market governance. Published prices, schedules, monitoring reports and planning assessments let outsiders verify how the market performs and whether its reliability aspects match what is observed. That transparency supports accountability to regulators, customers, reliability organizations and other parties, who can watch how the market works under different supply and demand conditions and check the outcomes against the stated objectives.

Accountability is distributed rather than concentrated in a single entity. Each RTO and ISO is accountable for its operational responsibilities under the market rules, and other registered entities are accountable for theirs. Market participants are directly accountable for following the tariff and the Reliability Standards. Regulators are responsible for making sure all of them meet their obligations. That follows from a simple fact: reliability and market performance come from the interaction of many parties, not from the actions of any one of them.

Governance also explains why markets change incrementally. Changing a market structure can require stakeholder approval, regulatory filings and reliability studies, sometimes before more than one regulator. The slow pace frustrates people. It exists so that a market rule change does not put the reliability of critical infrastructure at risk.

Chapter Summary

Governance and oversight shape how organized wholesale markets behave and limit the potential for abuse. Filed tariffs, market monitoring, standards-based reliability oversight and transparency together maintain accountability in a decentralized system where no single entity carries complete responsibility.

8 Market Evolution, System Change, and Reliability Adaptation

8.1 Why Markets Have to Change

Organized wholesale markets operate in a changing system. Resource and load characteristics shift, technology advances and policy requirements change, and each of these tests the original design of the market and the reliability performance that goes with it. In this environment, market evolution is a condition of using wholesale markets as a reliability tool at all.

Change becomes necessary when the assumptions built into a market construct no longer fit the system. New resources may differ in availability, responsiveness and performance under stress. Load may change in its peaks, its variability or its sensitivity to price and weather. The market has to accommodate those changes while keeping the reliability-based design elements at its core.

Evolution means adjusting product definitions, trading granularity and settlement mechanisms. The aim is not economic optimization for its own sake. It is to align the market with the actual characteristics of the power system and the performance it requires, which the original assumptions may not have captured. A market is a model of a power system, and a model has to be updated when the system changes.

8.2 When Risk Moves Faster Than Redesign

The pace of change creates tension in the governance process. Reliability risks can emerge faster than a market can be redesigned. In those cases, operating procedures and business practices serve as interim measures while longer-term market changes are developed. That is another place where the relationship between the market and operational authority shows.

Several factors limit how fast a market can change. New rules typically pass through long stakeholder and approval processes that involve political and social trade-offs and layers of oversight. Those layers guard against poorly considered changes, but they also widen the gap between when a change is needed and when it takes effect. That gap shapes how well a market can absorb lessons from operating experience.

8.3 Planning as the Starting Point

The connection between market development and planning matters. Planning studies identify reliability needs that the existing market structure may not meet. Those findings should be a starting point for market design, so that the adequacy and operating capability the future system needs are provided through a market structure built for them. Markets are dynamic tools informed by planning, not static guarantees of reliability.

Regional markets are not converging on a single optimal design. Market changes are shaped by system characteristics, regulation and public policy, all of which differ from region to region. The reliability goals are the same everywhere. The approaches differ. That heterogeneity is a feature of a system that is unified without being uniform.

Seeing market evolution as reliability adaptation changes the terms of the debate. Problems and redesigns are not proof of market failure. They are the ongoing work of keeping market rules matched to a changing system. A market design is effective for reliability if it supports reliability accountability while still producing transparent price signals.

Chapter Summary

Organized wholesale markets must keep adjusting to changing grid conditions to stay useful as reliability tools. The adjustment matches market rules to how the grid actually operates, through a governance process informed by transmission planning and operating experience. The need to evolve reflects the interdependence of grid and market, not a fixed design waiting to be finished.

9 Boundaries Between Markets and Reliability Authority

9.1 Market Results Are Not Reliability Directives

A defining feature of an organized wholesale market is the line between market administration and reliability functions. That line was present, more or less, in older institutional arrangements. It has since been drawn deliberately and formally to protect system reliability. Understanding it is important in its own right, and it is essential to understanding how organized markets work inside a reliability framework.

Every market works through products that turn what the system needs into an economic signal. Energy schedules, capacity commitments and ancillary service awards come out of rules-based processes that use participant offers and forecasts of system conditions. Those results tell the system what to expect from resources. They are not reliability directives. Every market result is contingent on the assumptions built into the process that produced it.

9.2 Where Reliability Authority Comes From

Reliability authority comes from the functions an entity performs under the Reliability Standards and its operating agreements. NERC registers entities in its Compliance Registry by functional type, such as Balancing Authority, Transmission Operator and Reliability Coordinator, based on the functions they actually perform. That authority rests on the Reliability Standards and system security requirements, not on the market. The NERC Glossary describes the Reliability Coordinator as the highest level of authority responsible for the Reliable Operation of the Bulk Electric System, with the authority to prevent or mitigate emergency operating situations in both next-day analysis and real-time operations. When reliability is threatened, the entities holding that authority take the actions needed to protect the system, whatever the market consequences.

The boundary is most visible under stress. When supply does not match forecast demand, when resources fail or when an event disrupts real-time operations, reliability functions take precedence over the market schedule. Committing additional resources to restore balance, shedding firm load in specific areas, redispatching resources away from their scheduled positions and deploying reserves all reflect the same overriding principle: the system has to stay reliable when reality departs from the market plan.

The boundary reflects a basic fact of a complex physical system: different coordination mechanisms are needed at different times. Markets are meant to reduce how often reliability authority has to be exercised and how far, not to eliminate it.

9.3 Keeping the Boundary Clear

Accountability mechanisms enforce the boundary. Reliability actions are subject to after-the-fact review and to compliance monitoring against the applicable standards. Those mechanisms make the exercise of reliability authority observable and justifiable. The settlement rules in each RTO and ISO tariff are designed to keep resources that followed the operator's direction from being penalized financially for it.

Confusion about the boundary causes real problems. Put too much inside the market and people start expecting every delivery problem to be solved through price, rather than through operating authority and agreements. Treat reliability measures as something outside and opposed to the market and you overlook that those measures were chosen deliberately, to deliver a level and quality of supply the market alone would not provide at an affordable cost. Either way, it becomes much harder to judge how well the market or the reliability rules are performing.

The boundary also shapes design choices. Market designs have to account for their limits and for their links to operating functions. Reliability institutions, in turn, have to take market structures into account in their standards and practices, without relying on markets for the non-economic parts of reliability. Understanding where each side's authority stops is the key to making them work together.

Preserving the boundary keeps the rules of the game intact: markets enable reliable operation, but they do not control it. That is what makes market outcomes legitimate and reliability actions credible as objective. In a market-based system built on high-voltage grids engineered to operate reliably, keeping market governance and grid reliability governance distinct protects both economic efficiency and reliability.

Chapter Summary

Organized wholesale markets and the reliability authority both operate under rules, and those rules set an order of precedence. Markets establish coordinated expectations. The reliability authority acts in real time under mandatory standards and overrides the market when it must. Preserving that boundary is central to accountability, to real-time coordination among many participants, and to the reliability of the system as a whole.

10 Energy, Adequacy, and Operational Services as Distinct Reliability Functions

10.1 Three Problems, Not One

The vocabulary of organized wholesale markets is familiar and widely accepted. It can also hide something important. Energy scheduling, forward capacity products and operational services each address a very different reliability problem. Calling all of them "constructs" obscures how different their purposes are.

Energy scheduling deals with continuous balancing. Its main reliability contribution is coordination. It produces a consistent regional schedule for generators and grid resources based on forecasts of load, capacity and transmission constraints. The reliability value lies in the process of reaching a feasible schedule more than in the price. The energy market keeps thousands of independent decisions from adding up to an infeasible or unstable system state.

Forward adequacy is a different risk. It is the risk of not having enough generation and storage capacity to cover peak demand days. Unlike real-time reserves, it is a planning and investment problem. Its reliability value is in addressing future shortages at the planning and investment stage, before they become real-time shortfalls that the operator has to manage at the last minute.

Operational services deal with urgency and immediate response. Frequency control, contingency response and voltage support come from the dynamics of the grid, not from exposure to price volatility. Even a perfectly scheduled system experiences short-term deviations. The contribution of these services is protective: they keep the grid stable through rapid change.

10.2 Why No Single Product Secures Reliability

Viewed as distinct functions, it becomes clear why no single market product can secure reliability on its own. Coordination without sufficient resources does not prevent scarcity. Sufficient resources without the ability to respond do not prevent disturbances. And response capability alone does not avoid unnecessary use of emergency measures. The organized market uses different sets of rules, tailored to different time frames, to secure each property.

How each product is defined also sets the performance expected of it. Failure to follow a schedule, unavailability at peak and failure to respond in a contingency are three different reliability risks, and different organizations measure them in different ways.

10.3 Separating the Functions for Better Governance

Keeping the functions separate is essential to disciplined market rule changes. Solving an adequacy problem does not solve an operational one. Operational improvements will not fix a lasting resource adequacy shortfall. Good market design practice requires participants and authorities to know which aspect of reliability a change addresses and which it does not.

Separating energy scheduling, adequacy and operational support also improves communication with the reliability standards bodies. The Reliability Standards define expected outcomes for each function, using different criteria, time frames and assignments of responsibility. Market rules do not supersede those standards, and it matters to be clear about that, because a market rule that satisfies the tariff does not by itself satisfy any Reliability Standard requirement.

Analyzing the functions separately allows more accurate assessment of organized markets. Each element is judged against criteria suited to the risk it was built to control, not against a single common yardstick.

Chapter Summary

The reliability of an organized wholesale market rests on separate institutional arrangements for separate risks: energy scheduling to coordinate supply and demand, adequacy mechanisms to secure enough supply, and operational services to keep supply reliable through disturbances. Keeping them separate shows what design, incentives and market mechanisms each contribute to system reliability.

11 Reliability Outcomes, Measurement, and Institutional Feedback

11.1 Reliability Is Measured Against Standards, Not Prices

Reliability performance in an organized market is not the same as market outcomes or price behavior. Reliability outcomes come from the interaction of markets, grid operations, planning and the Reliability Standards. This chapter looks at how reliability performance should be measured in a market setting, and at how those measurements feed back into the design and operation of the market.

Reliability is measured against established standards and criteria, not economic ones. Performance on loss of load, operating limits, frequency and disturbance response is the basis for the security measures tracked through reliability studies, event analysis and monitoring. Those measurements are largely independent of market transactions. The market influences them only indirectly.

Market regions use real-time market data in assessing grid reliability, but that data does not replace reliability assessment. Schedules, reserve levels and voltage control data show the state of the grid before an incident. After an event, they support reviews of whether the market rules reflected system conditions accurately. That review is diagnostic, done after the fact to learn, and distinct from compliance enforcement.

11.2 The Feedback Loop

Institutional feedback runs through several channels. Event reviews under reliability oversight identify performance gaps and coordination failures. Planning assessments carry operating experience forward; at the continental level, NERC publishes a Long-Term Reliability Assessment and seasonal summer and winter reliability assessments. Market monitoring examines whether the market rules created incentives or outcomes that worsened or revealed reliability risk. Each channel works separately. Together they are the basis for institutional learning.

That loop lets markets and reliability organizations stay separate while still adapting. A market will not correct reliability problems by itself. Findings feed the planning and governance processes that change rules, operating procedures and plans. The changes are then based on what actually happened in the system rather than on what the designers expected.

11.3 Measurement Limits and Transparency

Measurement has limits. Some risks, such as correlated degradation of resource performance and extreme weather effects, may not be fully captured in current metrics. An organized market may make those effects visible under stress, but characterizing them properly takes new measurement methods. Feedback also depends on being able to tell a single event from a systemic problem.

Transparency matters here. Reliability assessments, market performance reviews and event analyses are often public, which allows scrutiny and debate. Their main purpose is independent verification of what happened, what it affected and how the system was managed, so that the picture of reliability outcomes is not shaped by how well the market performed in the quiet periods between disruptions.

Why do markets evolve piecemeal? Institutional feedback explains much of it. Market change is the result of accumulated learning rather than a reaction to each unexpected event. That keeps reliability rules and market incentives aligned over time. Measurement and feedback are the link between the real world of power system operation and the design of market rules. The markets supply the data and the exposure. The reliability frameworks supply the tools to assess the performance of the system and its generation and transmission. Governance turns the findings into controlled, disciplined change. The organized market functions as one subsystem within a larger architecture built around reliability.

Chapter Summary

In an organized market, reliability performance is measured against reliability and operating standards and indicators, not market outcomes. Feedback from reliability studies, planning analysis and oversight reviews shapes the direction of the market while keeping market outcomes and reliability performance distinct. That supports continuing accountability and keeps the market aligned with reliability goals.

12 Organized Markets as Coordination Institutions Rather Than Control Systems

12.1 Coordination, Not Command

Wholesale electricity markets are often described in language that implies top-down control, optimization and predictability. That language obscures what markets actually do. A market does not operate assets or deliver specific quantities of energy in the operating sense. Its job is to coordinate a system with many owners and many decision-makers so that it can be operated reliably without central control of each resource.

Chapter 1 covered why that coordination is needed and how standardization delivers it: markets coordinate by alignment rather than by command.

12.2 The Operator Still Holds Control

The system operator remains responsible for stability and for responding to disturbances. That role has deliberate limits on both sides. The market cannot compel the physical system, and it cannot act instantly when something goes wrong. Those limits exist so that the entities responsible for reliability under the mandatory Reliability Standards keep operational control when they need it to respond to stability or security threats. The market influences behavior. The operator's decisions about the network rest on established reliability criteria.

The difference between coordination and control matters most under stress. Scarcity, a constraint or an imbalance in the market is not an operating order. The operator uses its authority to correct the condition. The market provides information about the state of the system and aligns individual incentives. It is not a source of operating direction.

12.3 What the Coordination View Means for Design and Accountability

Viewing the market as a coordination institution also clarifies accountability. Primary accountability stays distributed among the individual participants and the functions they perform. The market operator is accountable for administering the market rules and for how well its coordination mechanisms work. That allocation is consistent with the standards-based view of reliability and with shared accountability.

This view matters in design debates. Proposals to direct resource decisions through markets from the planning table, or to turn every policy decision into a market product rather than administering it, stretch markets beyond what they can do as a governance mechanism. Good

market design accounts for the limits of market coordination and focuses on aligning prices with the goals they can serve, leaving to central authority the judgments that simple rules cannot capture.

The coordination view is a steadying lens for judging market performance. A market succeeds when it reduces friction, increases transparency and helps participants act predictably within a reliability-centered framework, not when it attempts command.

Chapter Summary

Wholesale electricity markets are best understood as institutions that coordinate decentralized decisions in a highly decentralized system, not as control devices. Market rules and prices align behavior with established grid requirements and support reliability, while rules-based central authority and shared accountability among participants remain in place.

13 Persistent Tensions Between Economic Signals and Reliability Objectives

13.1 Relative Prices, Absolute Limits

The interaction between market institutions and reliability rules creates a lasting tension that refinement of the details cannot fully remove. Prices and reliability criteria rest on different principles, work on different time scales and use different measures of performance. Organizing the market through centralized institutions does not resolve the conflict. It makes it visible.

Economic information is relative and marginal. Prices express scarcity, opportunity cost and quantity at a particular time and place. Reliability limits are fixed. Keeping a system secure means holding certain conditions within bounds regardless of cost, and regardless of whether the resulting trades are profitable. Because the two work from different premises, they cannot be fully reconciled.

The tension is most obvious under stress. A high price signals higher risk, but it does not by itself trigger reliability action. What drives the operator is how close the system is to its operating limits.

13.2 Administrative Interventions and Competing Views

Managing that tension is part of building the institution. Administrative interventions such as uplift payments and reliability must-run arrangements address situations where the market cannot be relied on to produce the outcome system security requires. They are often called market-distorting. In practice they reflect the fact that security constraints cannot always be reduced to a market-determined contract.

The tension shows up in stakeholder positions. Participants who bear the cost of reliability measures, especially in the short term, argue that the measures undermine efficiency. Reliability organizations argue that markets do not adequately protect customers and supply under vulnerable conditions. The governance of an organized market exists to resolve those competing views through formal processes rather than through unilateral action.

13.3 Tension Managed, Not Eliminated

Over time, the recurring misalignment between economic objectives and reliability leads to changes in products, transactions, procurement rules or pricing. Those changes are the normal readjustment that keeps reliability management effective as the system changes.

Tension does not mean incompatibility. Markets and reliability frameworks can and should coexist, because each meets a need the other cannot meet alone. Prices guide efficient, transparent planning and trading. Reliability criteria mark the boundaries the system cannot cross. The goal is a stable relationship between the two, not a single equilibrium point.

Seeing the tension as a permanent property of organized markets clarifies the reform debate. Good governance is less about designing the most efficient market and more about making markets transparent, accountable and correctable when performance drifts. An organized market works when it keeps the tension visible and manageable.

Chapter Summary

Organized wholesale markets make visible the built-in conflict between price signals and reliability objectives. The conflict comes from different purposes, time horizons and performance measures, and market design alone cannot fully reconcile them. What governance can do is manage the adjustments that the conflict makes necessary.

14 Organized Markets Within Interconnection-Scale Reliability

14.1 Reliability Is Interconnection-Wide

Reliability in North America is delivered at the scale of the Interconnection, whatever the institutional structure. The NERC Glossary describes the four major Interconnections in North America as the Eastern, Western, ERCOT and Quebec Interconnections, each synchronized so that a failure in one part may affect operators elsewhere in the same Interconnection. An organized market covers a defined region, but its effect on reliability reaches beyond its borders through shared transmission, flows across seams and mutual exposure to contingencies. Understanding the market's role means looking at how regional design and operation interact with interconnection-wide reliability.

Power flows do not respect market boundaries. A transaction inside one market can drive flows through a neighboring system, especially when margins are thin. Coordinated planning, interchange scheduling and reliability agreements account for those interactions, each with limits set by market and institutional boundaries. FERC's RTO rule recognizes this directly: interregional coordination is one of the required functions of an RTO, which must ensure the integration of reliability practices within an interconnection and market interface practices among regions. Markets provide the interface, but they do not fully capture the effects one system has on another.

14.2 Wide-Area Assessment and Wide-Area Events

Interconnection-wide reliability assessment counterbalances the regional market view. NERC's seasonal and long-term reliability assessments, along with disturbance analysis, examine risk at scales larger than any single market. They identify risks from correlated resource performance, extreme weather and wide-area transmission issues that may not be visible from inside one region. Market regions contribute data and operating insight to those assessments while keeping their regional focus.

In a wide-area disturbance, coordinated operating action, operating procedures and real-time situational awareness matter far more than the economic interests of any subregion. Market schedules may have to be adjusted or set aside. That again shows that markets operate within the reliability authority of the grid.

Market regions also differ at their seams. Market time frames, reserve practices and operating coordination are not the same from one region to the next. Those differences come from history, regulation and policy more than from different reliability requirements. Coordination across the differences, rather than uniformity, is what keeps a federated market system working.

14.3 Markets as One Layer Among Many

Wide-area events also shape market development. Lessons from major disturbances inform the Reliability Standards and feed market rule discussions. Markets may be adjusted to reflect observed interconnection dependencies, but those changes preserve regional control and accountability, and they tend to come in small, incremental steps based on lessons from actual events.

In the interconnection context, organized markets are regional tools for supporting reliability within their footprint. RTO and ISO functions support coordination across the high-voltage network, but risks that originate outside a region are managed through interregional coordination and planning. The reliability of the whole depends more on how the regions work together than on any one region alone.

From this perspective, an organized market is one reliability resource among many in a layered system. Its value lies in coordinating resources efficiently within its region and in complementing the wide-area reliability authorities that step in when grid security requires it.

Chapter Summary

Each organized wholesale market covers a region, but reliability effects cross regional boundaries within the Interconnection. Understanding how a market interacts with interconnection-wide studies, real-time tools and coordinated wide-area responses places its regional coordination role within the broader reliability framework.

15 Executive Perspective on Markets as Reliability Infrastructure

15.1 Markets as Infrastructure

For executives and boards, an organized wholesale market is best viewed as institutional infrastructure rather than as a particular design or rule book. Like transmission facilities and Reliability Standards, markets are part of the structural framework through which reliability is achieved. That puts market design in the category of long-term structural integrity, accountability and consistency, not short-term attention to prices or operating metrics.

Markets function as infrastructure by providing durable coordination that persists through changes in leadership, policy and conditions. Their rules, timetables and institutional relationships give stability to the coordination of a system that is itself constantly changing. That stability supports reliability because it reduces the need for improvised crisis management.

The executive view asks different questions. It focuses on how the market supports operation and coordination during transitions and during potential shortages. The core question is whether the market design provides enough transparency into system operation, and enough planning and coordination among participants, that operators can still take corrective action when a reliability problem is coming. In my view, economic efficiency has to be subordinate to that requirement under every foreseeable scenario.

15.2 Accountability and Governance Interfaces

Infrastructure is judged differently. The question is not whether it ever comes under strain but how it performs under load. A sudden price spike from scarcity pricing or a regulatory intervention does not by itself mean the infrastructure failed. It may mean the system is exposing a vulnerability in a transparent, coordinated way. Management's job is to work out whether the problem reflects a structural weakness or a normal risk of the system.

Governance complexity is another reason the infrastructure model fits. As Chapter 7 described, the industry operates under federal oversight, the reliability organizations, state commissions and a wide range of stakeholders. Executives have to be careful not to confuse running the business with meeting regulatory obligations and complying with the Reliability Standards. Managing the interfaces among those dimensions well prevents overreach and misunderstanding.

15.3 Keep the Market Within Its Limits

Treating markets as reliability infrastructure has consequences for both near-term operations and long-term planning and policy. Resource development, transmission expansion and demand growth all happen in a market context. Markets do not cause those decisions, but they

shape how the associated effects are absorbed by the power system. The infrastructure frame helps assess more rigorously the reliability effects of events that originate outside the market.

An organized market is effective only while it stays within its role of providing information and carrying signals among independent operators. That limit has to be preserved so that operators and authorities keep the flexibility to make sound decisions in the rare situations the market cannot resolve.

Senior leaders should understand markets, organized or bilateral, as not sufficient for reliability on their own. They are a required piece of infrastructure, like a transmission line or a generating unit, that has to be operated, maintained and controlled reliably. Their purpose on the grid is structural coordination, not delivery of a particular level of supply and demand.

Chapter Summary

From a management standpoint, organized wholesale markets are reliability infrastructure that provides lasting coordination, not lasting control. Treating them as infrastructure puts the emphasis on reliability, accountability and fit with the larger system, and positions markets as one component of a multi-layer reliability structure.

16 Limits of Market Expansion as a Reliability Strategy

16.1 More Market Is Not Always More Reliability

As organized markets have evolved, expanding the market has become a routine answer to emerging reliability problems. New products, new incentives and finer price granularity are proposed to fill each new gap. Markets can and should be adjusted when conditions change. But expanding a market does not automatically improve reliability, and it can create new risks.

Markets work well where needs are well defined and can be described, quantified and met commercially through established structures. Complex reliability relationships that require higher-order judgment and nonlinear modeling do not reduce easily to market products. Trying to turn every reliability issue into a market oversimplifies it, and the real understanding of cause and effect gets lost in the translation.

Expansion also multiplies the assumptions built into the design. More products and more incentives require more predictions about system behavior, customer response, transient performance and many other variables. Each prediction is another place where expectations and actual performance can diverge. Reliability governance has to weigh whether another layer of market truly reduces risk or only moves it somewhere less visible.

16.2 Governance and Operational Costs of Expansion

Expansion affects governance too. As markets widen to accommodate new participants and practices, the relationships defined in earlier structures can weaken, and oversight suffers when more activity happens outside those structures. Markets are increasingly described not as one part of power system governance, coordinated through the RTO or ISO, but as the main mechanism for reliability. If governance rules are relaxed to make room for new entrants or perceived needs, clear accountability becomes harder to define and enforce.

Operational considerations matter as well. Real-time security depends on speed, clear instructions and timely decisions. Market rules and settlement processes form a fixed framework that may not respond quickly to unforeseen events. Over-reliance on markets for additional reliability can obscure the point at which other operating measures or non-market solutions are needed.

16.3 Refinement With a Reliability Test

In my experience, the fix usually lands in planning, transmission, operating procedures or the standards, even when the problem was first approached through a market enhancement. Markets can signal the need for those actions, but they do not satisfy the reliability need on their

own. Treating the market as the first resort rather than one tool among several risks underinvesting in the other reliability work.

That does not mean markets should be static. Continuous refinement is needed to keep the market matched to system conditions, and it has to be guided by reliability targets as well as market constraints. Expansion is not justified by itself, or by outside pressure, unless the added products and links are properly assessed through reliability analysis and market studies.

The discipline comes from knowing where the market should grow and where it should not, so that the reliability plan fits the institution. Markets are useful only to the extent they support, rather than conflict with, operating authority, planning and technical standards. Reliability comes from the interplay of all of them.

Chapter Summary

Expanding the scope of organized markets does not necessarily improve reliability. Markets coordinate activity, but complex reliability problems cannot always be expressed or solved through them. Good governance knows when a market improvement will produce real reliability improvement and when the answer lies in operations, planning or the standards.

17 Long-Term Reliability Governance in Market-Based Systems

17.1 Keeping Roles Clear Over Time

Reliability governance in a market-based system is a long-term undertaking and cannot be driven by short-term operating or market considerations. It is about sustaining the roles, mechanisms and processes that keep the grid reliable as system conditions, resource mix and regulatory requirements change. The organized market is part of that governance system, not separate from it.

Long-term governance is, at bottom, about keeping roles clear over time. Markets shape economic behavior. Reliability organizations set performance expectations. Operators take real-time action. Holding those roles steady prevents mission drift. When a new problem appears, the temptation is to give the market another job, because market outcomes are observable and measurable and so look effective. Long-term governance resists that while still respecting what markets, reliability organizations and operators each do well.

Accountability is what makes market reforms durable. Mandatory Reliability Standards provide stable minimum performance levels that are not subject to short-term politics or market volatility. The market operates within those standards, not the other way around. That stability is essential, because it keeps the standards binding even as market design evolves.

17.2 Institutional Memory and the Planning Link

Reliability risks are increasingly complex and are best managed by preserving institutional memory and lessons learned. Many risks develop over years and are understood only after long operating experience and several significant events. Good governance preserves the knowledge, tools, information and cross-functional expertise involved, and recognizes emerging trends early enough to act before a failure. Markets provide a great deal of the information behind reliability decisions. Governance practices make sure that information is understood and acted on.

The link between markets and planning matters most over the long term. Planning studies identify trends, such as load growth, resource performance and transmission capacity, that market signals may not reflect well. Long-term governance makes sure planning insights shape market evolution and that short-term market outcomes do not displace dedicated adequacy and resilience analysis.

17.3 Policy Change, Isolated Events and Institutional Humility

Policy change is a major challenge for long-term planning. Different state and federal policies on resources can significantly change development patterns and the way resources enter the

market. An organized market should stay as neutral as it can in its operational management of security, supply and demand balance and peak demand, to limit the effect of those shifts on reliability. Governance structures have to address the reliability effects of policy change in a nonpolitical way.

Long-term governance also requires restraint in the face of isolated incidents. Market-based systems will see fluctuations that sometimes have dramatic consequences. Durable governance recognizes when a disturbance is part of the normal risk of the system and does not call for structural change. Overreacting to isolated events can disrupt the coordination that long-term reliability depends on.

Above all, long-term reliability governance in a market environment requires institutional humility. No single redundancy or mitigation approach can cover every uncertainty about future supply and demand. The market, the regulatory framework, the standards, operations and planning have to stay integrated, each within its own bounds. Only by recognizing those limits will the grid sustain reliability through decades of significant change.

Chapter Summary

Long-term reliability governance in a market environment depends on defined roles and responsibilities, stable measurement, communication and knowledge retention, and controlled change. Organized markets provide coordination and transparency. Lasting reliability comes from the governance of the standards, from knowledge of future load conditions, and from governance structures able to respond to change.

18 Synthesis of Market Function and Reliability Responsibility

18.1 Interwoven Functions

Understanding the organized market's role in reliability requires putting the pieces back together: energy scheduling, adequacy, operational services, governance and the operating functions of the system operator. These functions are not a stack of cards laid one on another. They are interwoven, and reliability is the outcome of the whole.

Markets affect reliability by shaping expectations. Participants form expectations about how reliable a component, system or service is, how important each one is and how well it will perform. Thousands of individual decisions are made on those expectations, and together they meet the market's needs. The expectations reduce uncertainty and allow risk to be managed. Reliability depends largely on keeping those expectations consistent with the physical reality of the assets and their operation.

18.2 Responsibility Follows Function, Not Participation

Reliability responsibility follows function, not market participation. Entities are held accountable against the Reliability Standards for the functions they perform, not for their market results. That shields reliability judgments from price and commercial pressure when transmission security is at stake. Markets shape the context for those judgments, not the responsibility behind them.

The relationship between market expectations and reliability responsibility is not static. Experience shows where expectations and reality diverge. Planning and operating experience reveal where market expectations are not being met. Events occur that the market design did not anticipate. That experience goes into the governance process, which corrects and adapts coordination arrangements without reopening the underlying assignment of responsibility.

No organized market can be judged simply as a success or a failure. A market can work as intended while reliability risk rises because of external factors such as severe weather, policy change, commodity price volatility or physical constraints on the grid. Reliability can also hold up through market volatility and controversy. What matters is whether coordination of resources and activities is preserved and whether the market design and rules still hold participants accountable for their actions.

18.3 Institutional Discipline

That balance depends on institutional discipline. If market performance is allowed to set reliability levels, accountability disappears. If reliability is handled through administrative action instead of rules, coordination disappears. Keeping coordination and accountability clearly

separate, while allowing fact-based adjustment where they meet, is the key to long-term reliability.

That synthesis is a basis for sound decisions as the system keeps changing. Future changes to market design, planning standards and operating procedures should be judged by their effect on consistency across institutions, not only on their individual merits. The reliability of the planning processes, the key coordination elements, the governance arrangements and the operating authorities should all be preserved.

Chapter Summary

Reliability outcomes in organized markets depend on how market design meets the standards of responsibility. Market design shapes what participants expect of each other and how much they disclose, and it shapes the enforcement mechanisms behind each function. What matters for grid reliability is that these elements remain compatible, without mistaking market coordination for control.

19 Closing Perspective on Markets as Reliability-Supporting Institutions

19.1 What Organized Markets Are For

The role of organized wholesale markets can only be fully understood in relation to system operation as a whole. They were not designed to solve reliability problems directly. They are an institutional mechanism for handling the complexity of keeping a large, highly interconnected and widely dispersed system reliable. Markets support reliability through structure: they impose a disciplined framework that aligns interests across the system, rather than compelling particular outcomes or controlling performance in detail. That gives a more informed basis for judging what an organized market is worth.

A market exists for a basic reason. Central ownership and control of nearly every part of the North American grid is neither economically nor physically practical. At the same time, a large number of independent utilities and resource owners cannot effectively coordinate real-time operation of the system on an uncoordinated basis. The organized market fills the gap between what can be centralized and what cannot. Competing entities enter the market and trade under rules every participant accepts, rules consistent with reliable grid performance. Reliability products and services come out of that rule framework. The marketplace itself does not supply them.

Every market discussed in this reference reveals underlying system conditions, aligns expectations and improves visibility over short and long horizons. Markets expose system tensions and constraints and make uncertainty and interdependence visible. That can be uncomfortable: sudden price moves unsettle people and constraints look like bottlenecks. But reliable, controllable energy supply depends on a clear understanding of those dynamics.

19.2 What Markets Do Not Do

Just as important is what markets do not do. They do not:

- define reliability requirements
- enforce performance obligations
- exercise operational control

Those belong to the Reliability Standards, to functional accountability and to real-time operational authority. Keeping these distinctions clear is essential to visibility, integrity and enforceability as the system changes.

A growing number of factors outside market rules and design now influence reliability: severe weather, the condition of transmission and distribution infrastructure, policies that drive resource choices, and changes in end-use load. The market reflects these influences economically and

through its rules, but in the end they have to be managed through coordination among planning, operations and governance.

19.3 Governance Decides the Outcome

From an oversight and executive perspective, disciplined restraint is in order. Responding to every new need by widening the market's footprint would dilute its focus and its usefulness. Reliability is better served by defining the market's role deliberately and, within those boundaries, letting operational knowledge and reliability analysis guide action.

The long-term contribution of organized markets to grid reliability will be decided more by the quality of governance than by the details of market design. Markets that remain venues for coordination, transparency and price alignment will continue to support reliable operation as conditions change. In my view, markets that are expected to replace regulation, operator discretion or accountability will not deliver.

Wholesale markets are a reliability management tool. They are not a reliability guarantee. The chapters of this reference all point to the same conclusion: wholesale markets work well inside grids that operate under mandatory standards and follow sound planning and operating rules. Where the market design leaves those safeguards intact, reliability has the safeguards it needs.

Chapter Summary

Organized wholesale markets are part of a system built to deliver reliability through structured coordination and visibility in a system that would otherwise be uncoordinated and opaque. Markets do not enforce or regulate reliability. They work within standards-based mechanisms for accountability and operational control. Reliable supply depends on firm governance that respects institutional boundaries while leaving operators room to respond to conditions as they find them.

Glossary

Term	Meaning in this paper
Ancillary Service	Those services that are necessary to support the transmission of capacity and energy from resources to loads while maintaining reliable operation of the Transmission Service Provider's transmission system in accordance with good utility practice. (NERC Glossary, from FERC Order No. 888-A.)
Balancing Authority (BA)	The responsible entity that integrates resource plans ahead of time, maintains Demand and resource balance within a Balancing Authority Area, and supports Interconnection frequency in real time. (NERC Glossary.)
Bulk Electric System (BES)	Unless modified by the inclusions and exclusions listed in the definition, all Transmission Elements operated at 100 kV or higher and Real Power and Reactive Power resources connected at 100 kV or higher. It does not include facilities used in the local distribution of electric energy. (NERC Glossary, summarized; see the full definition for inclusions I1 to I5 and exclusions E1 to E4.)
Capacity	In market usage, a resource's commitment to be available to produce energy or reduce demand when called on, typically during peak periods, as distinct from the energy it actually delivers. (EC description.)
Capacity market	A centralized procurement mechanism, used in some organized markets, that secures capacity commitments ahead of a future delivery period to support resource adequacy. (EC description.)
Contingency	The unexpected failure or outage of a system component, such as a generator, transmission line, circuit breaker, switch or other electrical element. (NERC Glossary.)
Day-ahead market	The forward market in which resources are committed and schedules are set for the next operating day against forecast conditions. (EC description.)
Economic Dispatch	The allocation of demand to individual generating units on line to effect the most economical production of electricity. (NERC Glossary.)
Energy	Electrical work delivered over time, expressed in megawatt-hours. (EC description.)
Independent System Operator (ISO)	An independent entity that operates the transmission system and administers the organized wholesale market in its region. (EC description.)
Interconnection	When capitalized, any one of the four major electric system networks in North America: Eastern, Western, ERCOT and Quebec. (NERC Glossary, excerpt.)

Term	Meaning in this paper
Market Monitoring Unit	The person or entity responsible for carrying out the market monitoring functions that the Commission has ordered Commission-approved independent system operators and regional transmission organizations to perform. (18 CFR 35.28(b).)
Operating reserve shortage	A period when the amount of available supply falls short of demand plus the operating reserve requirement. (18 CFR 35.28(b).)
Real-time market	The market that adjusts day-ahead schedules to actual conditions and sets prices for energy delivered in each operating interval. (EC description.)
Regional Transmission Organization (RTO)	An entity that satisfies the minimum characteristics, performs the required functions and accommodates the open architecture condition set out in FERC's regulations. (18 CFR 35.34(b), paraphrased.)
Reliability Coordinator (RC)	The entity that is the highest level of authority who is responsible for the Reliable Operation of the Bulk Electric System, has the Wide Area view of the Bulk Electric System, and has the operating tools, processes and procedures, including the authority to prevent or mitigate emergency operating situations in both next-day analysis and real-time operations. (NERC Glossary, excerpt.)
Resource adequacy	The ability of an area's resources to serve forecast load and reserve requirements over a future planning period. (EC description.)
Transmission Operator (TOP)	The entity responsible for the reliability of its "local" transmission system, and that operates or directs the operations of the transmission Facilities. (NERC Glossary.)
Uplift	Payments made outside market clearing prices, typically to resources committed or dispatched for reliability whose costs the market price did not cover. (EC description.)

Entries marked NERC Glossary are quoted or excerpted from the NERC Glossary of Terms Used in NERC Reliability Standards as posted at the time of this review; entries marked 18 CFR come from FERC's regulations; entries marked EC description are plain-language explanations by Energy Compliance, Inc. Consult the official NERC Glossary and the Code of Federal Regulations for the authoritative text.

How Energy Compliance Can Help

Registration, applicability and the market-reliability boundary

EC provides registration and applicability analysis, NERC reliability and compliance advisory support, and NERC compliance program support, interpretation, and audit preparation. Operational and engineering reliability alignment closes the gap between what your market desk does and what your control room is accountable for under the standards.

Audit defense and audit preparation

EC provides audit and enforcement support (non-advocacy), audit defense with Notice of Penalty response and settlement posture, and mitigation planning and Self-Report development. EC also provides RSAW production and data request strategy.

Senior review of the program you have

A regulator-perspective program review tells an entity whether its program would survive real audit questions. Reliability governance and program assessments ask the same question at the governance level, including how market decisions and reliability obligations are kept apart. Compliance program design and improvement, and ongoing compliance program management, follow from the findings.

Narrow scopes, senior throughout

EC also takes defined scopes: senior advisory on specific, complex reliability questions; training and executive briefings on reliability frameworks, including the market-reliability boundary this reference describes; and industry engagement in standards development and working-group participation.

WattOps Compliance

WattOps Compliance is EC's NERC compliance evidence platform (wattopscompliance.com). EC will run one standard at one facility through WattOps at no cost (CIP standards excluded).

RenewOps

RenewOps is EC's renewable operations monitoring and analytics platform, with a Data Center module.

If your market strategy and compliance program have never been read side by side, start there.

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About the Author

Rob Smith is the Founder and Principal of Energy Compliance, Inc., with more than thirty years in the industry on every side of the system. He began in control-room operations as a Reliability Coordinator, Transmission Operator, and Power System Operator across RTO/ISO and utility control centers. On the regulator side, he was a senior compliance auditor and subject matter expert for NERC Reliability Standards. He audited grid facilities, evaluated mitigation adequacy, participated in risk-based oversight of utility mitigation activities, and supported the development of violation notifications and settlements in FERC-directed enforcement actions. He conducted a regulatory audit in the Sultanate of Oman against the Sultanate's Sector Law and Grid Code.

He founded Energy Compliance, Inc. to deliver senior regulator-side compliance authority without the layered staffing and billable-hour overhead of larger firms.

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- MBA, Energy Management, University of Mary
- MSL, Compliance Law, Fordham Law University
- BAS, Energy Management, Bismarck State College
- BAS, Mechanical Engineering, Metallurgy minor, University of Florida
- BAS, Criminology, St. Petersburg College (State Law Enforcement Certification)
- AAS, Power Plant Technology, Bismarck State College
- AAS, Electrical Transmission System Technology, Bismarck State College

Certifications: NERC Lead Auditor training; previously NERC-certified at the Reliability Coordinator level; 1st Class A Boiler Engineer License, Minnesota.

About Energy Compliance, Inc.

Energy Compliance, Inc. is an independent consulting and advisory firm based in Bloomington, Minnesota, focused exclusively on electric reliability, cybersecurity reliability, and regulatory compliance for organizations connected to the North American Bulk Electric System.

We support registered entities, including Generator Owners and Operators, Transmission Owners and Operators, Reliability Coordinators, Balancing Authorities, and Distribution Providers. Our work spans NERC Reliability Standards, FERC orders, RTO/ISO market participation rules, Regional Entity oversight, and state regulatory frameworks.

We do this work differently than larger consulting firms. A senior practitioner with regulator-side experience oversees every engagement. We staff for outcomes, not billable hours. Our deliverables are written to be operationally executable and audit-defensible, structured for the auditor's question rather than the consultant's binder. Where automation can replace manual work, we build the automation. Where senior judgment is required, the senior is in the room.

Energy Compliance is not affiliated with, sponsored by, or endorsed by the North American Electric Reliability Corporation, the Federal Energy Regulatory Commission, or any Regional Entity.

Learn more at energycomplianceinc.com.

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