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

MARKETS · RTO/ISO SERIES · EC-WP-402

Capacity Markets & Resource Adequacy

How capacity markets work and what they actually compensate for.

Capacity markets exist because energy and ancillary service revenues alone do not pay for the capacity the grid needs. Resource adequacy is an obligation that predates the markets, and the markets are how that obligation gets settled in dollars. This reference covers the governance of capacity constructs, from statutory authority and accreditation to performance penalties, locational requirements and the correlated failures that keep rewriting the assumptions.

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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 challenge, 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 disguised as content. They come from three decades of doing this work and watching it succeed and fail. I have written them in the same 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

Organized markets buy capacity forward because selling energy and ancillary services does not, by itself, keep enough resources on the system. That design answers a revenue problem; nobody picked it as an ideal. The obligation to have enough resources came first, and it stays where it is no matter how the market settles the bill.

One point of law sits under everything that follows. Section 215 of the Federal Power Act does not let NERC or FERC set and enforce standards for the adequacy of electric facilities or services. Adequacy targets come from state regulators and market operators. NERC assesses adequacy; it does not mandate it. The standards that come closest require analysis, not an adequacy level: a ReliabilityFirst regional standard that requires Planning Coordinators to analyze resource adequacy every year, and a Balancing Authority energy assessment standard that takes effect in April 2027.

- ELCC accreditation is portfolio-sensitive. The same solar resource gets a different value depending on what else is on the grid.
- A capacity payment is compensation for being available. When the resource does not deliver, performance penalties can dwarf the payment.
- Region-wide adequacy does not guarantee reliability at individual locations. Locational capacity requirements exist because the grid is not a copper plate.
- Forced outage rates were modeled as independent. Winter Storm Uri proved they are not. Correlated-failure events have repeatedly forced revisions to that assumption.
- Storage accreditation depends on duration, dispatch, and the rest of the portfolio. A four-hour battery in a portfolio of four-hour batteries clears differently than the first one in.
- Interconnection approval is not deliverability. Projects that confused the two find out at commercial operation.
- The "three years forward" auction is no longer a fixed feature. PJM is working its way back to it, and ISO New England is leaving it for a prompt auction.

1 Statutory Authority and the Emergence of Capacity Constructs

1.1 A Governance View of Capacity

This reference treats capacity markets as a governance question: statutory authority, tariff design, accreditation, oversight, and how pricing allocates reliability risk. Resource adequacy here is a reliability requirement, set and enforced through state regulation, RTO and ISO tariffs, and planning practice; capacity markets are one way to meet it in organized wholesale markets.

1.2 Where the Authority Comes From

The statutory basis for capacity markets is the Federal Power Act. Under Sections 205 and 206, the Federal Energy Regulatory Commission has authority over the rates, terms and conditions of wholesale sales of electric energy in interstate commerce, and those rates must be just and reasonable and not unduly discriminatory. The organized markets run under Commission-approved tariffs that have to meet that test.

Section 215 is a different authority, and the difference matters. It makes NERC Reliability Standards mandatory and enforceable for the bulk-power system. But it says in plain terms that it does not authorize the ERO or the Commission "to order the construction of additional generation or transmission capacity or to set and enforce compliance with standards for adequacy or safety of electric facilities or services." It also preserves state authority to act on the safety, adequacy and reliability of electric service within the state, so long as the action is consistent with the Reliability Standards.

So resource adequacy is not created by a continent-wide NERC standard. NERC's 2025 Long-Term Reliability Assessment says it directly: regulatory authorities or market operators establish resource adequacy targets, and most targets in North America are based on a one-day-in-ten-years loss-of-load criterion. NERC measures the system against those targets and calls out where risk is elevated or high. ReliabilityFirst's regional standard, BAL-502-RF-03, requires the analysis, not the reserve level. Since January 1, 2018, it has required each Planning Coordinator in the region to perform and document an annual resource adequacy analysis against that one-day-in-ten criterion and to identify any gap in planning reserves.

1.3 Why Forward Capacity Constructs Emerged

The early market designs ran into structural problems. Energy-only designs tried to drive investment with energy revenues and scarcity prices. Designers worried, with reason, about the distortion caused by price caps, by demand that does not respond to price at the top of the curve, and by the wild swings in revenue those conditions produce.

Capacity markets were created in parts of the Regional Transmission Organization (RTO) and Independent System Operator (ISO) footprint as a forward procurement tool. In these markets, periodic auctions procure commitments from resources to be available to meet projected peak demand plus the associated reserve requirement, on behalf of Load-Serving Entities (LSEs). FERC, in accepting PJM's Capacity Performance reforms in 2015, described PJM's construct as a three-year forward market that uses an annual auction and subsequent incremental auctions closer to the delivery year.

The Commission has accepted a number of these constructs on the reasoning that structured forward procurement reduces the risk of supply shortfalls and supports price discovery.

Designs differ by market. Some use a centralized forward auction cleared against an administratively set demand curve, such as PJM's Variable Resource Requirement curve. Others lean mainly on bilateral contracts and self-supply, with a central residual or backstop procurement. The institutional details differ. The principle is the same everywhere: give resources an incentive to be there in the amount the system needs to meet its reliability criteria.

1.4 Accreditation and a Design That Keeps Moving

Formal accreditation came with the capacity markets. Accreditation decides how much of a resource's capability counts as reliable capacity during the hours that matter. Early methods leaned on past performance and technology class. As the resource mix diversifies, those methods have to change, and they are changing.

The governance questions do not end once the investment is made. Market design decides what generators must do during emergencies, what they pay when they fall short, and what incentives they face when the system is stressed. Those provisions interact directly with the Reliability Standards that govern Balancing Authorities and with the adequacy obligations set by states and tariffs.

Capacity markets sit on Commission-approved tariffs, layered over the reliability requirements the Electric Reliability Organization enforces. Separating capacity from real-time energy pricing gives buyers forward price certainty for capacity and gives resource owners forward certainty about the revenue for being available.

None of it has stood still. Auction parameters, demand curves, locational constraints and accreditation rules have all changed in response to market developments, court decisions and Commission orders. The construct's legitimacy is argued over constantly in terms of just and reasonable rates and adequate reserves, and in my view it is a running negotiation over price and prudence.

> **End-of-Chapter Summary**
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> Capacity markets are forward procurement mechanisms operating under FERC's Federal Power Act rate authority to address resource adequacy in organized wholesale markets. The adequacy targets they serve come from state regulators and market operators, not from a continent-wide NERC standard; Section 215 withholds that authority. Accreditation methods and performance requirements are where market design and reliability governance meet.

2 Resource Adequacy Obligations and Planning Reserve Constructs

2.1 An Obligation Older Than the Market

Resource adequacy is a reliability obligation, not a market creation. Utilities have long carried the responsibility to plan for enough capacity to meet forecast peak load plus a reserve margin. In organized markets that responsibility is restated in the tariff and in state resource adequacy rules. Within NERC's framework it is assessed rather than mandated. In the ReliabilityFirst region, BAL-502-RF-03 requires the Planning Coordinator to perform the analysis, not to hold a reserve level.

The planning reserve margin covers forced outages, forecast error, and uncertainty in both load and generation. These margins are not set arbitrarily. They come from a decision about how much risk the system will accept, usually expressed as a Loss-of-Load Expectation (LOLE). The long-standing criterion is one day in ten years, an LOLE of 0.1 day per year. BAL-502-RF-03 frames it this way in R1.1: a planning reserve margin that results in "the sum of the probabilities for loss of Load for the integrated peak hour for all days of each planning year analyzed ... being equal to 0.1."

That criterion has always been a planning target, not a guarantee of service quality. NERC's assessments now also report loss-of-load hours and expected unserved energy, because an area can meet the 0.1 day criterion and still show meaningful energy shortfall risk. The 2025 LTRA builds that point into its risk categories: an assessment area is rated Elevated Risk when it meets established resource adequacy targets but does not meet more stringent thresholds of unserved energy and load loss for more extreme weather conditions.

2.2 How Capacity Markets Translate the Obligation

Capacity markets turn the planning requirement into a financial obligation to pay for capacity. The tariff requires LSEs to procure, or be assigned the cost of, enough capacity to cover forecast peak load plus the reserve requirement. An LSE that comes up short faces deficiency charges or has the shortfall procured for it at administratively set terms, depending on the market.

The reliability obligation and the capacity market obligation are linked, but they are not the same thing. The adequacy requirement defines how much resource has to be there. The capacity market is the tariff mechanism that decides who supplies it in a competitive setting. Moving the supply decision into a market does not change the adequacy requirement. Someone still owns the question of whether the total portfolio meets the criteria, and in organized markets that someone is the market operator, under its tariff, with state regulators behind it.

2.3 Assumptions That Age

Reserve margin calculations rest on assumptions about forced outage rates, planned and unplanned outages, load forecast error, and correlated weather.

Renewable resources add spatial and temporal variability. Battery energy storage systems add another layer. A battery's reliability contribution varies with the hours considered, the state-of-charge assumptions, and the dispatch strategy under stress. The capacity market carries these assumptions into the accreditation process, where each resource clears at an estimated capacity value that reflects its contribution during the tightest, highest-risk hours.

Weather volatility, correlated outages by fuel type and geography, and resource performance at peak used to be second-order concerns in adequacy work. They are first-order now. More frequent and more severe cold and heat events have pushed RTOs and ISOs to change how they accredit resources, calculate reserve margins, and define performance obligations.

2.4 Layered Accountability

Balancing Authorities are still the entities on the ground matching supply and demand in real time. Capacity contracted years ahead has to be physically available when the Balancing Authority needs it. In my view the hardest problem on a stressed grid is the gap between capacity that is contracted and capacity that can actually run.

Resource adequacy governance therefore runs in layers. Planners and market operators decide, probabilistically, how much is enough. Market operators procure it through the forward market. Balancing Authorities manage real-time reliability. FERC and state regulators oversee the tariffs and rates.

End-of-Chapter Summary

Resource adequacy rests on planning reserve margins and probabilistic criteria, most often one day in ten years. Capacity markets carry that obligation into the organized market as a forward purchasing commitment. Accreditation, locational analysis and reserve calculations each embed reliability assumptions that flow straight into market prices.

From the Field

Planning reserve margins were calibrated for a different generation mix. With inverter-based resources rising and storage behaving differently from thermal units, the historical reserve calculations are going stale.

A reserve margin that looks adequate on paper can fail in practice when the contingency hits during a tail event. The math has to model the tails, not just the mean.

3 Accreditation Methodologies and Effective Load Carrying Capability

3.1 From Nameplate to Reliability Contribution

Capacity accreditation is the measure of how much capacity a resource is credited with and can sell into a forward capacity market. It translates the physical and probabilistic characteristics of a resource into a quantified reliability contribution. As the generation mix changes, accreditation increasingly decides market outcomes.

Traditional accreditation started from installed nameplate capacity adjusted for forced outages. Conventional synchronous units were rated close to nameplate, with reference to historical availability.

The reliability regime was built when the supply side was mostly conventional. Wind and solar challenge it. Their output moves with the weather, not with load or a dispatch signal. A wind or solar plant can be producing very little during the peak, so its rated capacity says little about its contribution to reliability.

3.2 Effective Load Carrying Capability

Effective Load Carrying Capability (ELCC) is a probabilistic method that measures a resource's contribution to supply reliability. It asks how much additional load the system can serve at the same level of reliability once the resource is added. It expresses the contribution as a reduction in loss-of-load risk, not as a fixed number of megawatts.

ELCC is portfolio-sensitive. A resource's marginal ELCC depends on what is already on the system. Additional solar is worth more in a portfolio with little solar than in one that already has a lot, and as solar penetration grows the risk shifts into the evening hours, which changes the accreditation over time.

Storage follows the same logic. A four-hour battery can provide real value during a short peak but has nothing left to give in a long stress period. Its ELCC therefore depends on discharge duration, state-of-charge assumptions and the dispatch strategy, and on how many other batteries are already serving the same hours.

3.3 Correlation and Method Choices

Accreditation also has to deal with correlated performance. Extreme weather can hit every plant in a region at once, or depress output across several fuel types at the same time. Where availability depends on weather, or plant locations share a climate, an independent forced outage assumption is the wrong one. ELCC modeling tries to capture those systemic risks. MISO's direct loss of load (DLOL) method, accepted by FERC in October 2024 for the

2028/2029 Planning Year, is one example. It measures each resource class's contribution during the risk hours of a probabilistic LOLE simulation built on 30 years of correlated load and weather data.

Approaches in the organized markets are not uniform. PJM accredits resources by ELCC class ratings. MISO today accredits most resources on their availability during the tightest hours of each season, and accredits existing solar on its actual performance during seasonal peak hours. Some designs apply a class-average factor from system-wide modeling, others resource-specific values from metered data. These are trade-offs between administrative simplicity and analytical precision.

The method changes the clearing result. Lower accredited capacity means a resource can sell fewer megawatts into the forward auction, which cuts its revenue and changes the investment signal. Over-accreditation creates latent reliability risk, because the market believes it bought more performance than it did.

3.4 Accreditation as a Governance Question

Regulators are looking harder at accreditation. Market operators are asked to justify their model assumptions, data sets, and estimated inputs such as outage rates and correlation factors. The tension between conservatism and keeping resources economically viable shows up in nearly every stakeholder process on the subject.

Accreditation governance goes beyond market design. Market operators and planners watch how accredited resources actually perform, especially during stress events. When performance departs materially from accredited levels, the methodology changes.

ELCC is an attempt to bridge the real variability of supply and the fixed, forward nature of the capacity commitment. Accreditation decisions are technical and governance decisions at once. They set the effective reliability margin, the investment incentives and, through the clearing price, what consumers pay.

End-of-Chapter Summary

Accreditation converts resource characteristics into reliability contributions in a forward procurement setting. ELCC measures the incremental reliability value of a resource and matters most for variable and energy-limited resources. Accreditation assumptions move prices and reliability margins, and they will be revised several times over the life of a resource commitment as the system and its load shape change.

From the Field

An ELCC value holds only for the portfolio it was calculated against. The same solar resource accredits differently in MISO than in PJM, and the difference is not a calculation error.

Accreditation methodologies are being revised in real time. A project signed under last year's methodology may not clear under this year's. That risk lives with the developer, not the market.

4 Performance Obligations, Non-Performance Risk, and Reliability Accountability

4.1 From Accreditation to Performance

Accreditation decides how much of a resource can be sold into the forward construct. The performance obligation decides what that resource must actually do when the system is stressed. A capacity market's credibility rests less on the commitments it creates than on whether those commitments are met during the hours that count.

Organized capacity constructs define performance assessment periods tied to emergency actions, scarcity conditions or reserve shortfalls. During those periods a resource is expected to deliver energy or reserves consistent with its commitment. Falling short brings non-performance charges.

Performance rules are meant to make the price reflect reliability. If capacity payments flow whether or not the resource is available in real time, the forward contract does nothing to protect reliability. Penalties push the reliability risk back onto the resource owner.

4.2 How the Penalty Structures Changed

Stress events exposed the gap between what capacity contracts said and what resources delivered, and the markets responded by raising the stakes. ISO New England's Pay for Performance design, which FERC largely accepted on May 30, 2014, ties capacity revenue to performance during capacity scarcity conditions. Its Capacity Performance Payment Rate phased in from $2,000/MWh starting June 1, 2018, to $3,500/MWh starting June 1, 2021, and $5,455/MWh starting June 1, 2024.

PJM's Capacity Performance reform, accepted by FERC on June 9, 2015, came out of the January 2014 polar vortex, when PJM's forced outage rate spiked. It created a Capacity Performance product with Non-Performance Charges and Performance Bonus Payments assessed during Performance Assessment Hours, with full implementation planned for the 2018/2019 delivery year and a transition for the two delivery years before it. FERC agreed with PJM that a resource adequacy construct that fails to provide adequate incentives for resource performance can "force consumers to pay for capacity without receiving commensurate reliability benefits."

4.3 Risk by Resource Type

Performance risk varies by resource. Wind and solar output is tied to weather that operators cannot control. Storage is constrained by state-of-charge management over the look-ahead

horizon. Thermal plants face fuel supply risk in extreme weather. Capacity governance tries to account for those differences through accreditation, metering and penalty design.

The link between capacity performance obligations and Reliability Standards is indirect, but it is real. Balancing Authorities keep balancing supply and demand and carrying reserves in real time regardless of what the capacity market did. When capacity resources underperform during stress, the system is worse off, and the operator may have to call on demand response, emergency purchases or controlled load shedding. Those actions can trigger event reporting obligations and expose weaknesses in adequacy planning. Capacity performance has reliability consequences, not just winners and losers in settlement.

4.4 Exemptions, Measurement, and Correlated Outages

Market designs carry force majeure or performance exemptions. How wide the excuse is decides where risk lands. Broad exemptions weaken accountability. Narrow ones can discourage investment in some resource types.

Performance evaluation relies on metered output, demand response baselines and defined reference periods. Measurement and settlement are part of the product. Disputes over performance measurement can shape how regulators read the reliability value of the whole construct.

More frequent extreme weather has put correlated outage risk at the center. In my view, earlier adequacy models generally treated thermal forced outages as independent, because widespread simultaneous failures were rare. The January 2014 polar vortex and Winter Storm Uri in February 2021 broke that assumption. In the February 2021 event, the FERC, NERC and Regional Entity staff report found that freezing issues (44.2 percent) and fuel issues (31.4 percent) caused three quarters of the unplanned generating unit outages, derates and failures to start, and ERCOT shed 20,000 MW of firm load. The governance responses have included mandatory winterization: NERC EOP-012-3, Extreme Cold Weather Preparedness and Operations, effective October 1, 2025, requires Generator Owners to develop and implement cold weather preparedness plans and freeze protection measures for their BES generating units. Markets have also added fuel assurance analysis and revised their penalty structures.

4.5 Penalties Are Not Megawatts

The line between a financial penalty and a reliability consequence needs to be understood. A penalty compensates, in money, for energy that was not delivered. It does not put the missing megawatts back on the system during the stress event. Capacity governance can lower the likelihood of a shortage, but the actual delivery of reliability still rests with the generator, the system operator and the planner.

Performance constructs shape investment in predictable ways. Resources that can hold high output through the most stressful periods of the year are worth more than those that cannot. Short-duration or highly weather-dependent technologies face lower accreditation, higher performance risk, or both.

Electrification is changing the shape and variability of the load curve, which changes when performance assessment hours are likely to occur. The definition of stress periods may need to

move beyond the historical peak so that the hours that actually threaten reliability are the ones measured.

A capacity market stands or falls on the enforceability of its performance obligations and the design of its penalties. If performance risk is not internalized, the forward purchase offers only the illusion of sufficiency. The governance framework has to distribute incentives sensibly across generators, treat resource types fairly, and keep operational reliability requirements in view.

End-of-Chapter Summary

Performance obligations turn forward capacity commitments into binding obligations during stressed conditions. Non-performance penalties tie economic incentives to reliability needs, but they cannot replace operational availability. Performance design, accreditation assumptions and the lessons of a small number of extreme events together make resource adequacy policy in organized markets a moving target.

From the Field

Selling capacity in the forward auction is not the end of the obligation. It is the beginning of one. The performance test comes during the stress event the market was paid to insure against.

Non-performance penalties under capacity performance constructs are designed to hurt. PJM and ISO New England rebuilt their penalty structures precisely because earlier versions did not.

The capacity payment is in the rear-view mirror by the time the system is tested. The performance penalty is what decides whether the participation was profitable.

5 Locational Capacity Requirements and Transmission Constraints

5.1 Why Location Matters

Region-wide adequacy does not guarantee reliability at individual locations. Transmission constraints, stability limits and deliverability restrictions can leave a location exposed even when the aggregate margin says the region is long. The capacity market has to address location so that enough supply sits on the right side of each constraint.

Locational capacity zones come out of transmission studies performed by planners and market operators. Those studies test whether the transmission system can move energy from remote resources into load pockets under peak and contingency conditions. Where it cannot, the market operator may set a minimum capacity requirement for the zone.

The justification for locational constructs is reliability, not redistribution. A constrained urban load center cannot afford to be without backup during peak demand. It needs local generation, local demand response it can count on in advance, or both, and the cost of that assurance belongs in the rates paid by the load it protects.

5.2 Prices, Transmission, and Deliverability

Locational clearing prices can diverge sharply from system-wide prices when supply inside a zone is scarce. The price difference is a risk and an opportunity for resources that can locate where capacity is short.

In this governance model, transmission planning and capacity procurement are bound together. New transmission relieves constraints and narrows zonal price differences. Without it, the market keeps paying for more expensive local resources for longer.

Deliverability testing decides whether a resource counts as capacity in a constrained zone. It tests whether the grid can move the resource's output to load under contingency conditions. A resource that fails deliverability in a zone receives reduced or no capacity credit there.

Distributed energy resources and demand response complicate the picture. Resources inside a constrained pocket can deliver reliability value out of proportion to their size, because reducing net load at peak inside the pocket can relieve the constraint. Capacity markets try to price that value through zonal participation rules.

5.3 Constraints That Move

Siting and environmental policy add to the problem. It is often hardest to build new capacity in the dense areas that need it most. Capacity markets have to meet the reliability requirement while working around land-use and environmental constraints they do not control.

Transmission constraints are not static. Outages, maintenance schedules and changing flow patterns can change deliverability. Capacity constructs rely on forward-looking transmission models that may not reflect conditions during an actual stress event. Severe weather will keep stressing transmission: high ambient temperatures reduce ratings, storms damage facilities, and stability limits tighten, all of which affect the ability to move generation where it is needed. Locational requirements are one way to hedge those risks.

5.4 Getting the Zones Right

The central governance problem is setting zone boundaries and minimum capacity values correctly. Too much granularity brings administrative burden, price distortion and room for rent-seeking in boundary negotiations. Too little hides local constraints inside large zones. Much of the stakeholder debate will keep coming back to boundaries and thresholds.

Locational constructs also influence retirements. Resources in constrained locations earn higher capacity revenue, which can make continued operation more attractive. The retirement of a major local generator can move zonal prices sharply and prompt reliability studies and, sometimes, out-of-market arrangements to keep the unit running.

The connection between locational adequacy and the Reliability Standards is indirect. The transmission planning standards require planners to assess system performance under contingency conditions. Capacity market zones translate the results of that planning into procurement over the forward horizon. Locational capacity governance recognizes that reliable resources exist in particular places, that adequacy is a spatial question as well as a quantity, and that what matters to one load may not matter to another a few hundred miles away.

End-of-Chapter Summary

Locational capacity requirements deal with transmission limits that create local reliability risk even when system-wide reserves exceed the requirement. Zones make the market buy deliverable capacity where transfer limits create the most concern, and they carry transmission planning results into forward procurement. Calibrating those requirements correctly is what keeps market outcomes aligned with the physical transmission system.

From the Field

Capacity in the wrong location is, for reliability purposes, capacity that is not there.

A project sited for capacity revenue without studying the locational constraint is a project at risk of stranded capacity. Treat the constraint analysis as part of the underwriting, done before the money is committed.

6 Market Design Tension and Reliability Risk Allocation

6.1 Efficiency Against Risk Aversion

Capacity markets try to combine competition with mandatory reliability requirements. That forces trade-offs between efficiency and risk aversion, and those trade-offs show up as policy choices built into the constructs. Those choices decide how adequacy risk is split among resource owners, consumers and system operators.

In an energy-only market, scarcity pricing is the signal for new investment. Capacity markets add a forward contract to stabilize that signal and reduce investment uncertainty. The decision to run a centralized capacity auction reflects a policy judgment that energy prices alone will not reflect long-term adequacy risk.

6.2 Who Carries Which Risk

Risk allocation in a capacity construct has several parts:

- LSEs carry the procurement obligation for forecast load and reserves under the tariff.
- Resource owners carry performance risk during stress periods.
- Market operators carry the job of running the auctions and the settlement mechanisms for buying and selling capacity.
- FERC reviews the tariff provisions against the statutory just and reasonable standard.

Consumers pay for all of it through their rates. How much depends on the clearing price, the eligibility rules and other design choices. The balance runs both ways. Excess capacity lowers reliability risk at a higher cost. Too little capacity keeps prices low today and raises the chance of an outage when a major event arrives. Choosing the reserve margin is an exercise in risk and probability that takes human judgment and regulation, not just arithmetic.

6.3 State Policy and Federal Markets

State policy complicates the picture. Resources that receive state support or other out-of-market payments participate in capacity markets alongside resources that do not. That interaction has been litigated hard over price suppression, competitive neutrality and state jurisdiction. Where capacity is treated as a federal tariff construct under the Federal Power Act, the resource adequacy debate runs straight into state authority over generation planning and retail rates. Managing that boundary takes a great deal of institutional effort.

6.4 Accreditation as Risk Allocation

Accreditation assumptions are themselves a form of risk allocation. Conservative accreditation credits less capacity to variable and energy-limited resources, which can mean buying more,

and more expensive, supply. Aggressive accreditation reduces procurement but raises adequacy risk if the assumptions turn out to be optimistic. After recent extreme weather exposed correlated outage risk across fuel types and geography, markets moved quickly to change design rules, strengthen performance incentives, and revise accreditation to reflect that historical outage assumptions no longer hold.

Capacity constructs also shape retirement and investment decisions. Forward prices bear directly on the economics of aging thermal plants. Recent reductions in accreditation for certain technologies could discourage new investment unless other revenue streams fill the gap.

6.5 Reliability Over Market Purity

The governance objective does not change, and it is shared by the wholesale market and the retail regulators: enough deliverable resources to meet the reliability criteria. Market design is a tool for meeting that objective and nothing more. When the capacity market fails to secure enough resources, other tools come into play, such as reliability-must-run arrangements or administrative central procurement.

In my view that is the right order of priority: reliability before market purity. The adequacy criteria do not tolerate a temporary or permanent shortfall in the name of efficiency, and any deviation has to be fixed by regulatory or market action. Economic theory, regulatory language, state energy policy and the Reliability Standards will keep reshaping capacity constructs, and they will decide how long any given design lasts.

> **End-of-Chapter Summary**
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> The debate over capacity market design is part of the broader question of how to keep the lights on through rapid change. Risk allocation among consumers, utilities and resource owners is buried in the demand curve, the auction clearing rules and the performance requirements. The design has to adapt to changing portfolios, state policy and the facts of real stress events so that forward resource planning reflects what reliability actually needs.

7 Extreme Events, Correlated Risk, and Adequacy Recalibration

7.1 The Independence Assumption Breaks

Resource adequacy constructs have long rested on probabilistic models built from decades of operating experience, with forced outages treated as close to independent across resource types and locations. Severe weather has shown that outages can be highly correlated across resource types and across parts of the system.

Recent cold snaps and heat waves have exposed fleet-wide vulnerabilities: fuel supply limits, equipment failures from cold and heat, and thermal performance problems that hit large parts of the fleet at once. These events cut into reserve margins far more sharply than traditional models anticipated.

Correlated risk changes the adequacy answer. If outage probabilities are not independent, the real loss-of-load risk is higher than a model built on independence will show, even when the system looks adequate on paper.

7.2 How the Markets Are Recalibrating

Market operators and planners have been reworking accreditation, reserve margin targets and performance requirements. Accreditation is moving from static, historical forced outage rates toward methods that model outages and weather together; MISO's DLOL method (Chapter 3) is one example. Seasonal accreditation is already in place in MISO, which accredits resources separately for each season because winter and summer carry different risk profiles.

Fuel security has become central. Thermal plants on interruptible fuel face higher outage risk during the very periods when fuel is scarce and demand is high. Some markets have raised penalties for non-performance or added rules aimed at fuel assurance.

NERC is adding an energy lens of its own. BAL-007-1.1, Near-Term Energy Reliability Assessments, is subject to future enforcement with an effective date of April 1, 2027. It requires each Balancing Authority to document and run a process for assessing forecasted Energy Emergencies in the near term, accounting for demand profiles, resource limitations including fuel supply, energy transfers and transmission constraints. It is an operations-planning standard, not a capacity requirement, but it brings fuel-limited and weather-limited energy risk into the compliance world.

The recalibration reaches reserve margin targets as well. A higher planning reserve margin buys more reliability margin at more cost. Where to set it depends on how much risk the regulator and the system are willing to accept.

7.3 Load Is Changing Too

The load profile is changing. As electric vehicles and heat pumps replace gasoline cars and fossil heating, the peak can move to a different part of the day and the system can respond more sharply to temperature swings. The load shapes used in adequacy studies may not capture the most stressful hours anymore.

Extreme events have also shown that operational readiness matters as much as installed capacity. Winterization, maintenance discipline and operational coordination decide how much capacity shows up during stress, and they belong in capacity performance metrics.

7.4 Learning From Each Event

Market monitors examine resource performance after stress events. Each FERC-approved RTO and ISO has a Market Monitoring Unit under its tariff, and those monitors can look at whether accreditation, capacity obligations and penalties reflect the real risk of non-performance when a resource procured ahead of time fails to deliver.

Interconnection-wide learning feeds recalibration. Disturbance and event reviews that identify correlated failures are used to adjust adequacy models.

Correlated renewable output risk is part of the same story. Extended low wind and cloud cover at peak can depress variable generation together. ELCC methods deal with this through the choice of weather years and stochastic modeling.

Adequacy governance has shifted toward a risk framework in which the historical record alone is not enough to describe future stress. The objective has not changed: enough deliverable resources to ride through credible extreme scenarios. What has to adapt is the route, based on what operating experience and analysis reveal about system vulnerabilities.

End-of-Chapter Summary

Correlated performance risk from extreme weather has been a central theme in capacity markets for more than a decade. Extreme events have exposed correlated outages across resource types and invalidated many traditional adequacy assumptions. Markets have responded by changing accreditation, reserve margins and performance requirements, and NERC is adding near-term energy assessments. Keeping probabilistic planning in step with operational reality remains the open problem.

From the Field

In my view, models built on independence understated the risk of correlated stress events.

Correlation is the underestimated variable in capacity adequacy. The reserve margin calculation has to model it.

Extreme events have forced capacity market redesigns in PJM and ISO New England, and accreditation changes in MISO. The lesson travels: model the tails, then model them again.

8 Institutional Boundaries and the Future of Capacity Governance

8.1 Overlapping Jurisdiction

Capacity markets sit inside a layered framework where federal rate authority, ERO reliability authority, regional tariffs and state energy policy meet. Their stability depends on how those boundaries hold. FERC has authority over wholesale market tariffs, including capacity market designs, under Sections 205 and 206 of the Federal Power Act. States keep jurisdiction over generation resource planning, siting and retail rates, and Section 215 expressly preserves their authority over the adequacy of service within their borders. Resource adequacy is a matter of overlapping jurisdiction, not the property of any one regulator.

That boundary has been tested in court. In *Hughes v. Talen Energy Marketing, LLC* (April 19, 2016), the Supreme Court held that a Maryland program guaranteeing a new generator a contract price, conditioned on clearing PJM's capacity auction, was preempted because it disregarded "an interstate wholesale rate required by FERC." Minimum offer price rules, buyer-side mitigation and participation eligibility provisions all reflect the effort to protect competitive outcomes while accommodating state policy. The litigation shows how sensitive adequacy governance is.

8.2 Where the Reliability Standards Fit

The Reliability Standards under Section 215 govern the reliable operation of the bulk-power system: real-time balancing, reserves, emergency operations, transmission planning and, now, cold weather preparedness. They do not set a resource adequacy target. Capacity markets operate alongside those standards, not under one of them. If a tariff construct fails to secure enough resources, the standards still govern how operators manage the resulting emergency, and the adequacy shortfall itself falls back on market operators, state regulators and FERC.

Accountability runs in the layers set out in Section 2.4, and two more belong on that list: Regional Entities monitor and enforce compliance with the Reliability Standards by registered entities, and FERC oversees both the tariffs and the ERO.

8.3 Change Faster Than Process

Significant changes in generation and load are happening inside institutional structures that do not always move at the same speed. Thermal retirements, new modeling of inverter-based resources and the growth of distributed resources all shift adequacy assumptions. Market rules are not always updated as fast as conditions change, and the stakeholder process and FERC filings needed to revise accreditation and performance rules take real time.

Decarbonization policy is reshaping capacity governance. Renewable portfolio standards, carbon reduction targets and electrification policies change how resources are dispatched and how consumption evolves. Capacity designs have to balance those policies with adequate reserves.

The forward horizon itself is in motion. PJM's construct was built on a three-year forward auction, but it is not running on that schedule today. Its 2028/2029 Base Residual Auction results were announced July 14, 2026, at the FERC-approved cap of $325/MW-day, with the 2029/2030 auction set for December as part of PJM's effort to return to a three-year forward cycle. ISO New England is going the other way. FERC accepted its prompt capacity auction design on March 30, 2026 (Docket No. ER26-925-000), moving the auction from three years ahead to shortly before a commitment period scheduled to start June 1, 2028, and ISO New England expects to file a seasonal design in the fourth quarter of 2026. Either way, long-term adequacy planning has to look beyond the auction horizon. Transmission and large generation projects take longer to build than any capacity procurement period, so capacity markets and transmission planning have to be closely linked to avoid a structural mismatch.

New technologies raise their own governance questions. Hybrid plants that combine generation and storage have to be classified within frameworks that were not written for them. Demand response aggregation blurs the line between load and resource. Market design has to handle both without compromising reliability functions.

8.4 Credibility Is the Asset

The likely direction is closer integration of planning and operational analytics, more accurate accreditation and reserve targets through better probabilistic modeling, and high-resolution weather and scenario analysis. The difficulty is getting those analytics into tariffs in a form that can be explained to the customers who pay for them.

Credibility depends on consistency between what the construct promises and what it delivers. If capacity constructs keep failing to deliver the expected reliability during stress events, the framework loses credibility and will be redesigned to win it back. In my view capacity governance will keep evolving in small, successive steps, with accreditation methods, penalty levels and zone boundaries all revised iteratively.

Resource adequacy remains a material reliability obligation. Capacity markets remain one of the ways to secure it in organized wholesale markets. Their continued effectiveness depends on keeping FERC-approved tariffs, state adequacy policy, the Reliability Standards, price signals and system operations in step with each other and with a changing system.

End-of-Chapter Summary

Capacity governance runs through layered federal, regional and state institutions. Tariff-based procurement has to be matched by obligations that can be enforced, and Section 215 leaves the adequacy obligation itself with states and market operators. As portfolios and policy goals change, the rules for accreditation, performance and planning coordination have to change with them so that enough capacity is maintained and regulatory assurance is preserved.

Glossary

Term	Meaning in this paper
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).
Capacity Market	A tariff-based forward procurement mechanism through which an RTO or ISO secures commitments from resources to be available to meet forecast peak demand and the associated reserve requirement on behalf of Load-Serving Entities.
Effective Load Carrying Capability (ELCC)	A probabilistic measure of the additional load a resource allows the system to serve while holding the same level of loss-of-load risk.
Electric Reliability Organization (ERO)	The organization certified by FERC under Section 215 of the Federal Power Act to establish and enforce reliability standards for the bulk-power system, subject to Commission review. NERC is the ERO.
Federal Power Act (FPA)	The federal statute that gives FERC jurisdiction over transmission and wholesale sales of electricity in interstate commerce (Section 201), requires just and reasonable rates (Sections 205 and 206), and establishes mandatory Reliability Standards for the bulk-power system (Section 215).
Firm Demand	That portion of the Demand that a power supplier is obligated to provide except when system reliability is threatened or during emergency conditions (NERC Glossary).
Load-Serving Entity (LSE)	An entity that secures energy and Transmission Service, and related Interconnected Operations Services, to serve the electrical demand and energy requirements of its end-use customers (NERC Glossary). In capacity markets the LSE carries the capacity obligation for its load.
Loss-of-Load Expectation (LOLE)	A probabilistic measure of the expected number of days per year on which available resources fall short of demand. The common planning criterion is 0.1 day per year, or one day in ten years.
Planning Coordinator (PC)	Same as Planning Authority in the NERC Glossary: the responsible entity that coordinates and integrates transmission Facilities and service plans, resource plans, and Protection Systems.
Regional Transmission Organization (RTO)	An entity approved by FERC under 18 CFR 35.34 that is independent of market participants, administers its own transmission tariff and performs the required RTO functions, including operating organized wholesale markets where it has them.

Term	Meaning in this paper
Reliability Standard	A requirement, approved by FERC under Section 215 of the Federal Power Act, to provide for reliable operation of the bulk-power system. It does not include any requirement to enlarge facilities or to construct new transmission or generation capacity.
Reserve Margin	The amount by which available or planned capacity exceeds forecast peak demand, usually expressed as a percentage of demand.
Transmission Constraint	A physical limit of the transmission system that restricts power transfer between two locations.

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 ties what your market desk commits to what your control room carries, including EOP-012-3 and, from April 2027, BAL-007-1.1.

Audit defense and program review

EC provides audit and enforcement support (non-advocacy), audit defense with Notice of Penalty response and settlement posture, mitigation planning and Self-Report development, RSAW production, and data request strategy. Regulator-perspective program reviews and reliability governance and program assessments test whether your program survives real audit questions; compliance program design and improvement, and ongoing program management, follow from the findings.

Narrow scopes, senior throughout

Senior advisory on specific, complex reliability questions; training and executive briefings on reliability frameworks; and industry engagement in standards development and working-group participation. Each engagement is scoped to the entity's role, function, and bulk system impact.

WattOps Compliance

Cold weather plans and freeze protection records should be in order before a stress event tests them. 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

Accreditation and penalties are settled on what your resources did in the tightest hours. RenewOps is EC's renewable operations monitoring and analytics platform, with a Data Center module.

If you have never read your capacity obligations and your compliance program 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
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- AAS, Power Plant Technology, Bismarck State College
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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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