Systems Thinking for Regulators

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About this Document

The GridWise Architecture Council was formed by the U.S. Department of Energy to promote and enable ***interoperability*** among the many entities that interact with the electric power system. This balanced team of industry representatives proposes principles for the development of interoperability concepts and standards. The Council provides industry guidance and tools that make it an available resource for smart grid implementations. In the spirit of advancing the much-needed large-scale transformation of the grid in a systematic and accelerated manner, this document summarizes the uses and benefits of the practice of Grid Architecture, and introduces few selected Grid Architecture techniques. You are expected to have basic knowledge of grid operations. Those without this technical background should read the *Executive Summary* for a description of the purpose and contents of the document. Other documents, such as checklists, guides, and whitepapers, exist for targeted purposes and audiences. Please see the www.gridwiseac.org website for more products of the Council that may be of interest to you.

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Executive Summary

Today's regulators face a convergence of pressures that would be daunting in isolation: affordability burdens mounting on low- and moderate-income households; load growth returning with force, driven by electrification, reindustrialization, and data center expansion; and resilience imperatives intensified by extreme weather that no longer aligns with historical norms. These challenges arrive simultaneously—and they interact—at precisely the moment the electricity system itself is undergoing structural transformation. Distributed energy resources (DERs), once niche products, have become economically competitive. Customers are adopting rooftop solar, battery storage, electric vehicles, and sophisticated energy management systems at an accelerating pace, reshaping load profiles, introducing bi-directional power flows, and fundamentally altering the relationship between the grid and the people it serves. The system regulators are being asked to govern today is not the system the existing regulatory frameworks were designed for, and the gap between the two is widening.

This paper acknowledges the transformational challenges facing our power system and focuses on how regulators can adopt a new lens for evaluating problems to better develop durable solutions.

The conventional regulatory toolkit was built for *complicated* problems: analytically demanding but ultimately tractable, with sufficient expertise and process. The challenges now confronting regulators are increasingly *complex*: dynamic, nonlinear, emergent, and shaped by the interactions of multiple actors with competing incentives operating across time horizons that rarely align. Treating complex problems as merely complicated ones rarely yields adequate outcomes. It optimizes toward mediocrity and, paradoxically, often amplifies the very complexity it sought to reduce.

Systems thinking offers a more effective path.

Systems thinking is not a philosophy. It is a practical set of analytical tools and habits of mind that help decision-makers see how the parts of a system relate to the whole and where interventions are most likely to produce durable, beneficial outcomes rather than unintended consequences. This paper introduces three core systems thinking tools and demonstrates their application to challenges regulators face today.

The **Iceberg Model** reveals that visible regulatory events—an outage, a rate case, a DER interconnection backlog—are the surface manifestations of deeper structures. Beneath every event lie patterns and trends, structural and institutional arrangements, and, most fundamentally, mental models: the assumptions about how the system works and what outcomes matter. The most powerful regulatory interventions target these deeper layers, not just the symptom at the waterline. When illustratively applied to resilience, the iceberg model reveals that the prevailing mental model, which equates grid reliability with customer service continuity, is no longer adequate. Service resilience requires reconceiving DERs not as grid add-ons but as primary infrastructure. Communities in Vermont, Louisiana, and California's Humboldt County offer examples of where traditional mental models around electric grid resilience are being fundamentally challenged.

Stakeholder Mapping acknowledges that regulatory decisions do not occur in a vacuum. They occur within a complex ecosystem of actors—utilities, customers, aggregators, developers, local governments, first responders, community organizations—each with distinct interests, capabilities, and forms of influence. Making that ecosystem visible is not a procedural courtesy; it is a strategic necessity. The proliferation of distributed energy infrastructure is bringing new actors—zoning officials, neighborhood coalitions, tribal governments—into direct contact with energy decisions for the first time. Regulators

who fail to map and engage these stakeholders will find their proceedings technically complete but politically unworkable, as siting conflicts and community moratoria are already demonstrating.

The **Whole-of-System Perspective** challenges the fragmentation that has historically organized utility regulation into separate silos: generation apart from distribution, reliability apart from affordability, interconnection apart from rate design. This compartmentalization made sense when the system was linear and centrally controlled. It is a liability in a system defined by bi-directional flows, customer-sited generation, and emergent microgrids and virtual power plants. A whole-of-system approach begins not with "How do we solve this problem within our jurisdiction?" but with "How does this problem relate to the system's overall mission?" That reframing leads to different decisions about interconnection standards, DER compensation, distribution planning, and the evolving role of the utility itself.

The central insight of this paper is deceptively simple: The grid is a complex system, not a complicated machine. Regulators who treat it as a machine—adjusting a lever here, expecting a predictable response there—will continue to generate well-intentioned decisions that underperform or backfire. Regulators who approach it as a complex system—attending to feedback loops, leveraging structural interventions, and maintaining explicit awareness of how parts interact to shape the whole—will be better positioned to deliver the affordable, reliable, resilient, and equitable outcomes that their public mandate requires.

Systems thinking does not ask regulators to abandon rigor or expertise. It asks them to apply those capabilities more strategically: to ask better questions before issuing better orders, look beneath events for causes, and design interventions that work with the system's dynamics rather than against them.

The tools are available. The need is urgent. The transformation is already underway in the technologies customers are adopting, in the communities building resilience from the ground up, and in the forward-thinking utilities reconceiving their role. The question is whether regulatory frameworks will evolve quickly enough to shape that transformation in the public interest or lag behind it until the gap becomes irreversible.

This paper is a resource for regulators who intend to lead through complexity.

About the GridWise® Architecture Council

The GridWise vision rests on the premise that information technology will revolutionize planning and operation of the electric power grid, just as it has transformed business, education, and entertainment. Information technology will form the "nervous system" that integrates new distributed technologies—demand response and distributed generation and storage—with traditional grid generation, transmission, and distribution assets. Responsibility for managing the grid will be shared by a "society" of devices and system entities.

The mission of the GridWise Architecture Council ("the Council") is to enable all elements of the electricity system to interact. We are an independent body that believes tomorrow's electricity infrastructure can be made more efficient and secure by integrating information technology and e-commerce with distributed, intelligent networks and devices. To achieve this vision of a transformed electricity system, the Council is defining the principles for interaction among the information systems that will effectively and dynamically operate the grid. The Council, which is supported by the U.S. Department of Energy, includes 13 representatives from electric energy generation and delivery, industrial systems control, building automation, information technology, telecommunications, and economic and regulatory policy.

The GridWise Architecture Council is shaping the guiding principles of a highly intelligent and interactive electricity system—one ripe with decision-making information exchange and market-based opportunities. This high-level perspective provides guidelines for interaction between participants and interoperability between technologies and automation systems. We seek to do the following:

- Develop and promote the policies and practices that will allow electric devices, enterprise systems, and their owners to interact and adapt as full participants in system operations.
- Shape the principles of connectivity for intelligent interactions and interoperability across all automation components of the electricity system, from end-use systems, such as buildings or heating, ventilation, and air conditioning systems, to distribution, transmission, and bulk power generation.
- Address issues of open information exchange, universal grid access, distributed grid communications and control, and the use of modular and extensible technologies that are compatible with the existing infrastructure.

The Council is neither a design team nor a standards-making body. Our role is to bring the right parties together to identify actions, agreements, and standards that enable significant levels of interoperation among automation components. We act as a catalyst to outline a philosophy of inter-system operation that preserves the freedom to innovate, design, implement, and maintain each organization's role and responsibility in the electricity system.

Acronyms and Abbreviations

BTM	behind-the-meter
CDC	Centers for Disease Control
DER	distributed energy resource
DERMS	distributed energy resource management system
DNO	distribution network operator
FOM	front-of-the-meter
GMP	Green Mountain Power
kW	kilowatts
kWh	kilowatt hours
PSPS	Public Safety Power Shutoffs
TSO	transmission system operator
VPP	virtual power plant

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1.0 Introduction + Context

Electric utility regulators confront an unprecedented convergence of challenges that demand fundamentally rethinking how electric systems are planned, operated, and regulated. First, **affordability** pressures are intensifying, causing ratepayers, particularly low- and moderate-income households, to struggle with rising electricity costs that consume an increasing share of strained budgets. Expected investments required for grid modernization, decarbonization, and resilience threaten to drive rates higher still. Second, **load growth** is accelerating vigorously after decades of relative stagnation, propelled by the electrification of transportation and heating, the reshoring of manufacturing, and the explosive expansion of data centers and artificial intelligence computing. Third, **resilience** emerges as an immediate operational imperative. Intensifying wildfires, hurricanes, heat waves, and winter storms are exposing the fragility of infrastructure designed for a bygone era of climate stability. These three forces arrive simultaneously, creating a perfect storm that traditional utility planning approaches and regulatory processes are struggling to navigate.

Yet even as these challenges converge and intensify, a technology revolution is expanding the solution space. Distributed energy resources (DERs)[1]—rooftop and community-scale solar, battery storage, electric vehicles, smart thermostats, heat pumps, and sophisticated microgrids and energy management systems—have crossed the threshold from niche products to cost-effective, high-performing alternatives that deliver multiple values. Solar photovoltaic costs have fallen by nearly 90 percent over the past decade[2] while battery storage costs have fallen by more than 80 percent,[3] making customer-sited generation and storage economically competitive with grid-supplied power in many contexts.[4]

DER performance has improved in lockstep with cost reductions. Modern inverters provide grid services that enhance rather than threaten reliability. Battery systems respond to grid signals in milliseconds. Sophisticated controls, including virtual power plants (VPPs) and DER management systems (DERMSs), orchestrate millions of distributed devices capable of displacing peaking generation and deferring distribution system upgrades. Most consequential for regulators, customer adoption is no longer a hypothetical future scenario but an accelerating reality driven by economics, resilience imperatives, and the appeal of energy autonomy. DER adoption will continue to grow whether regulators embrace, resist, or ignore it, because the underlying economics and customer motivations have fundamentally shifted.

These are not future conditions to be planned for, they are present realities that are already shaping how the grid operates, how customers engage with it, and what regulators are being asked to decide.

The implications for regulators are profound and unavoidable. The trifecta of affordability, load growth, and resilience cannot be adequately addressed through conventional practices that treat each challenge in a separate docket, deploy only utility-owned solutions, or assume customers remain passive recipients of centrally provided kilowatt hours (kWh).

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[1] DER is a broad category of assets that produce, store, use, or manage electricity and are connected to the electricity system either on a customer's premises ("behind the meter" or "BTM") or directly to the utility's electricity distribution system ("front of the meter" or "FOM").

[2] See International Renewable Energy Agency. 2021. *Renewable Power Generation Costs in 2020: Executive Summary*. Available at https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2021/Jun/IRENA_Power_Generation_Costs_2020_Summary.pdf.

[3] See BloombergNEF. 2021. "Battery Pack Prices Fall to an Average of $132/kWh, But Rising Commodity Prices Start to Bite," November 30, 2021. Available at https://about.bnef.com/insights/clean-energy/battery-pack-prices-fall-to-an-average-of-132-kwh-but-rising-commodity-prices-start-to-bite.

[4] See Lazard. 2025. *Levelized Cost of Energy+*. Available at https://www.lazard.com/media/uounhon4/lazards-lcoeplus-june-2025.pdf.

Systems thinking offers regulators a more effective, practical approach. It offers a new lens for viewing and navigating the evolving energy landscape. Systems thinking differs from conventional analysis by shifting how problems are framed and solutions conceived. Where traditional approaches ask, "How do we solve this particular problem within a narrowly defined scope or procedural process?" a systems thinking perspective might ask, "How does this problem relate to the electric system's overall mission and performance?" This subtle but substantial reframing requires commissioners to recognize the likely impacts of decision alternatives on whole-system performance. It requires explicit attention to feedback loops and to how interventions create both intended and unintended consequences. It requires identifying leverage points where relatively modest interventions can catalyze system-wide improvements by modifying fundamental drivers rather than merely treating symptoms. Most fundamentally, a systems thinking perspective recognizes that optimizing parts in isolation often produces suboptimal or even destructive outcomes for the whole, and that, surprisingly, accepting suboptimal performance in individual components can sometimes yield superior system-level results.

Systems thinking can lead to fundamentally different conclusions across everything from interconnection standards to rate design to utility business models because it shifts intervention strategies from optimizing individual regulatory decisions to optimizing the performance of the system that those processes collectively shape.

Systems thinking is about asking better questions before issuing better orders.

This paper builds on the foundational analysis presented in **Bridge to the Future: Crossing the Chasm**, another GWAC report that examines why the electric grid's current transformation differs fundamentally from past periods of incremental change. That paper establishes the structural, operational, and governance challenges now facing regulators; this paper focuses on the cognitive and analytical tools required to navigate them.

2.0 A Regulator's Dilemma: Increasingly Complex Problems

2.1 Understanding the Nature of Problems Before Trying to Solve Them

Most regulatory proceedings start with the question of what to decide, such as approving a tariff, revising an interconnection rule, or initiating a grid modernization plan. But increasingly, the first question for regulators should be "What kind of problem are we actually facing?"

Not all problems are equally challenging. Some are straightforward and require only the application of tried-and-true approaches. Others are complicated but ultimately solvable with the right expertise. And some, especially those now at the heart of grid modernization, resilience planning, DER integration, affordability, and decarbonization, are complex problems, meaning they involve multiple interrelated causal factors and consequences, sometimes with unintended behaviors that emerge from the interactions inherent in complex systems.

Understanding the type of problem informs the type of solution approach (see Table 1). When complex problems are treated as merely complicated ones, such an approach tends to "optimize toward mediocrity," producing technically correct but ultimately inadequate outcomes and paradoxically creating more complexity.

Table 1: The Three Types of Policy Problems in Regulation

Problem Type	Characteristics	Example In Utility Regulation	Appropriate Response
Simple	▪ Clear cause and effect. ▪ Standardized, predictable. ▪ Best practices widely known.	Meter replacement, basic compliance tracking, standard cost recovery accounting.	Use established rules, checklists, standard procedures.
Complicated	▪ Requires expertise, analysis, engineering. ▪ Multiple inputs but ultimately predictable if well executed.	Capacity expansion planning, rate design modeling, interconnection engineering, cost-of-service studies.	Use expert analysis, planning models, structured program design.
Complex	▪ Interactive, dynamic, context-dependent. ▪ Outcomes emerge from relationships and behavior, not static components.	DER market integration, resilience strategies, electrification planning, VPP coordination, performance-based regulation frameworks.	The focus of this paper. Use systems thinking, adaptive policy, iterative stakeholder structures, architectural design.

As discussed in **Bridge to the Future**, modern power systems function as deeply interconnected "systems of systems," in which localized interventions often produce system-wide effects. The distinction between simple, complicated, and complex problems provides a practical lens for understanding why many well-intentioned regulatory actions fail to deliver durable outcomes in this context.

2.2 The Dilemma: We Are Facing Complex Problems Using Tools for Complicated Problems

Many of today's most significant regulatory challenges are complex because they involve the following:

- Multiple actors with different responsibilities and incentives (utilities, aggregators, customers, independent system operators, resource and infrastructure developers, state agencies)
- Uncertain and nonlinear trends (adoption curves, technology costs, growth of large loads, climate volatility)
- Behavioral and institutional feedback loops (inter-dependent behaviors, economic signals, non-economic decision criteria, organizational capabilities)
- Simultaneous technical, economic, and social consequences (affordability, uneven energy burdens and service reliability, market access, resilience, timing, and economic risks).

Yet we are still trying to solve them using tools for complicated problems, such as projection models, cost-allocation formulas, program-specific pilots, incremental tariff changes, or heavily engineered administrative workarounds.

2.3 Systems Thinking and Why It Matters Now

The electric grid is not just a simple machine; it is a complex system that has more in common with natural ecosystems. What was once a linear, one-way delivery system is now a living and evolving network of connected devices, market signals, and human interactions. Regulators today sit at the center

of this transformation. They are not just referees of cost recovery; they are architects of this evolving structure.

As DERs, electrification, and digital controls reshape the grid, traditional, incremental regulatory approaches often struggle to keep pace. Each new rule changes the system's structure and dynamics in subtle ways, altering feedback loops, incentives, and behavior. Without a systems lens, even well-intentioned policies risk producing contradictory outcomes like reliability challenges, stranded investments, and misaligned incentives.

Systems thinking offers a way forward. Systems thinking is an approach to problem-solving and analysis that views challenges as arising from the behavior of interconnected components within a larger whole, rather than from isolated, independent parts. Instead of examining individual elements in isolation, systems thinking focuses on understanding relationships, feedback loops, and patterns of interaction that shape how the entire system functions over time. It recognizes that intervening in one part of a system creates ripple effects throughout other parts, that optimizing individual components can sometimes degrade overall system performance, and that the most effective solutions often require addressing underlying structures and root causes rather than merely treating visible symptoms. Systems thinking helps regulators see the grid not as a collection of isolated mechanisms subject to separate proceedings, but as an integrated system of active agents, relationships, flows, and feedbacks.

2.4 From Linear Logic to Systemic Understanding

Traditional regulation often assumes linear cause and effect: adjust a tariff here, expect a predictable response there. But the grid is full of feedback loops. For example, time-of-use rates change customer behavior, shifting load shapes, altering capacity needs, and, in turn, changing economic signals. Every lever a regulator pulls can impact the performance of the entire ecosystem.

Systems thinking begins by mapping the relationships and interactions among the active agents (e.g., utilities, customers, system and market operators, resource owners and operators) rather than focusing only on the immediate issue at hand. Such a mapping enables regulators to ask the following:

- How does a decision in one part of the system ripple through others?
- What behaviors might this incentive or rule change, reinforce, or suppress?
- Where are the points of tension between affordability and resilience, between innovation and reliability, or between the performance incentives of different actors?

Mapping these interconnections sharpens policy. The famous 1908 "Brandeis Brief" was an early landmark in bringing systems thinking into legal practice and policy making (see Figure 1). Regulators who understand the system's inherent dynamics can design interventions that work with them.



Figure 1: The Brandeis Brief – Systems Thinking and Legal Practice

3.0 Systems Thinking Tools in Practice

Regulators face an increasingly complex landscape in which applying traditional regulation in response to a specific problem often addresses symptoms rather than causes. Systems thinking tools offer a fundamentally different approach, one that investigates why a problem persists and looks beyond the visible problem we see. When regulators embrace systems thinking, they move beyond crisis management to strategic foresight, beyond isolated interventions to integrated solutions. These analytical frameworks enable regulators to understand how utility performance, customer outcomes, and infrastructure resilience are interconnected, revealing leverage points where modest regulatory actions can cause disproportionate improvements across the entire system. Most importantly, systems thinking aligns with the core mission of public utility regulation, ensuring reliable, affordable, and sustainable service not just for today's ratepayers but for future generations.

The tools introduced in this section are intended to support the future-back, system-navigation approach described in **Bridge to the Future**. They are not ends in themselves but practical methods for helping regulators reason across time horizons, institutional boundaries, and interacting system dynamics.

3.1 The Iceberg Model

The iceberg model stands as one of the most powerful tools for guiding systemic thinking, revealing four distinct levels of understanding, three of which lie beneath surface observations (see Figure 2). At the waterline sit **Events**—the visible occurrences that typically trigger reactive responses, such as a service outage or a rate increase request. These events prompt us to react, but they tell us little about causation.

Just below the surface, **Patterns and Trends** emerge when we ask what has been happening over time, allowing us to perceive evolving dynamics and anticipate rather than merely respond. For instance, recognizing recurring seasonal capacity constraints enables proactive planning rather than emergency measures.

Deeper still lie **Underlying Structures**, the policies, regulations, infrastructure configurations, and institutional relationships that influence the patterns we observe. Understanding these structural elements enables regulators to design interventions that reshape system behavior at its roots. At the iceberg's foundation rest **Mental Models**—the prevailing and often implicit assumptions, beliefs, and values about how the system works and what outcomes matter most. These mental models often represent the most powerful yet least visible forces sustaining the status quo, and transforming them unlocks the possibility of fundamental system change. By systematically working through each level of the iceberg, commissioners can trace regulatory challenges from their visible manifestations down to their deepest roots, crafting interventions that address not just what they see but why it exists and where intervention could be most effective.



Figure 2: The Iceberg Model's Four Levels of Understanding

3.1.1 Illustrative Case Study: Applying the Iceberg Model to Resilience

To see the iceberg model in action (see Figure 3), consider the mounting challenge of electric utility resilience: the ability of the system to maintain electric service to customers amid intensifying climate disruption. Begin where most regulatory attention naturally gravitates—the **Events** level. A wildfire tears through drought-stricken terrain, or a severe storm unleashes its fury, and the immediate consequences are widespread outages and downed poles throughout the distribution system. Restoration crews mobilize, mutual aid agreements activate, and the utility's emergency operations center becomes the nexus of round-the-clock recovery efforts. These dramatic events command headlines, public scrutiny, and regulatory investigation. Yet when commissioners confine their analysis to this visible layer, they find themselves managing an endless succession of crises without ever addressing why the crises keep recurring with greater frequency and severity.

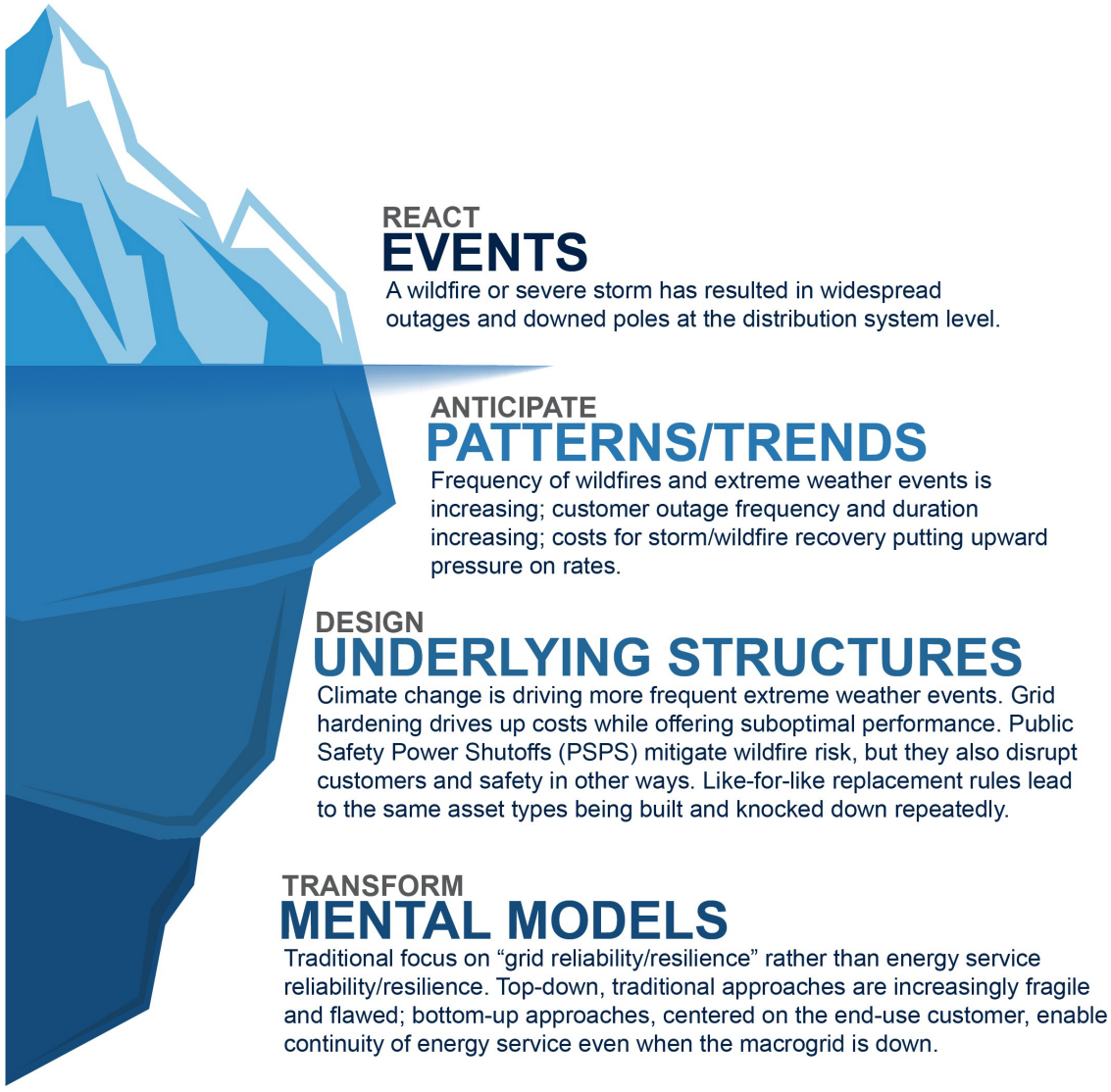


Figure 3: Adapting the Iceberg Model to Resilience

Descending to **Patterns and Trends** shifts the perspective from individual incidents to systemic trajectories that reveal a changing landscape. The data tells an unmistakable story: wildfires and extreme

weather events are occurring more frequently, not as random fluctuations but as a sustained upward trend. Customer outage metrics, both frequency and duration, are deteriorating across multiple utilities and regions. The financial toll of storm and wildfire recovery escalates with each season, creating inexorable upward pressure on rates that threatens affordability for the very customers whose service reliability is declining. These patterns converge to deliver an uncomfortable message: The exceptional has become routine, the emergency has become endemic, and the infrastructure designed for yesterday's climate stability confronts tomorrow's conditions with diminishing effectiveness. Recognizing these patterns enables commissioners to anticipate rather than merely react, to plan strategically rather than respond tactically.

The **Underlying Structures** layer exposes the systemic architecture that generates these troubling patterns. Climate change operates as the primary driver, fundamentally altering the frequency and intensity of extreme weather events in ways that cascade through every aspect of utility operations, and likewise, decisions in forest management and zoning affect how we maintain our wild places and where we build our communities. These are not just utility regulatory functions but need to be understood as an underlying structure of the architecture.

Utilities respond with grid-hardening programs and substantial capital investments to reinforce infrastructure, yet these hardening measures often deliver suboptimal performance, as upgraded equipment still fails when conditions exceed even the enhanced design parameters. PSPS emerge as a controversial structural intervention designed to sever the causal chain between equipment malfunction and wildfire ignition, but these intentional outages create their own constellation of problems, disrupting customers and placing medically vulnerable populations at risk. Meanwhile, like-for-like replacement policies embedded in regulatory frameworks ensure that after each destructive event, utilities rebuild essentially the same infrastructure in the same vulnerable locations, guaranteeing repetition rather than evolution. These structural elements interlock to form a system that expends enormous resources responding to climate impacts while failing to fundamentally adapt to the transformed operating environment.

At the iceberg's foundation rest the **Mental Models**—the largely invisible assumptions and beliefs that shape how stakeholders conceive of the problem and its solutions. The prevailing mental model fixates on grid reliability and resilience, measuring success through the performance of physical infrastructure: poles remain standing, lines stay energized, substations withstand the storm. This infrastructure-centric paradigm has dominated utility thinking for generations, and it frames resilience as fundamentally about the robustness of the centralized grid. But this mental model obscures a more fundamental question: What if grid resilience is not sufficient to achieve the fundamental objective, customer energy service resilience?

The traditional top-down approach treats the macrogrid as the singular path to reliability, yet this assumption grows increasingly tenuous as correlated failures during extreme events demonstrate the inherent vulnerability of centralized systems to widespread, simultaneous disruption and the inability of grid-hardening strategies to anticipate the growing diversity and severity of grid disruptions. The emerging alternative reframes the entire challenge by shifting from infrastructure performance to service continuity, from utility-centric to customer-centric, from centralized to distributed. When commissioners adopt this transformed mental model, they can think of DERs, battery storage, microgrids, and demand flexibility as central elements of resilience strategy, to enable customers to maintain essential energy services even when the macrogrid fails, rather than peripheral, optional, or luxury additions to the system. This represents the deepest level of system change, not just building different infrastructure or adopting different policies but reconceiving the fundamental purpose of the electric utility system and the multiple pathways through which resilience can be achieved. By working through all four levels of the iceberg,

commissioners can trace the visible crisis at the waterline down to its deepest roots and craft interventions that transform the system rather than perpetuate it.

3.1.2 From Theory to Practice: Real-World Examples of Whole-System Resilience

The transformation from infrastructure-centric to service-centric resilience is not merely conceptual; it is already happening in communities across the United States, driven by forward-thinking utilities, grassroots coalitions, and vulnerable populations unwilling to wait for traditional approaches to catch up with accelerating climate realities. These pioneering efforts demonstrate what becomes possible when regulators and stakeholders dig down to the lowest "mental models" layer of the iceberg and fundamentally reconceive resilience as continuity of essential services rather than simply hardening poles and wires. Each example illuminates different dimensions of this paradigm shift, yet all share a common recognition: The most effective resilience strategies combine DERs, community engagement, and equity-centered design to ensure that when the macrogrid fails, people continue to be served.

Green Mountain Power (GMP) in Vermont has undertaken the nation's first comprehensive **Zero Outages Initiative**, committing to deliver an energy system where customers across the state maintain power through 2030 despite intensifying climate-driven storms. This is not hyperbole or marketing; it represents a fundamental reimagining of utility obligations in a climate-changed world. The initiative leverages circuit-level resiliency data, Centers for Disease Control community vulnerability information, geographic topography, and other metrics to determine the optimal resilience approach for each of GMP's 300 circuits, ensuring that both rural and urban customers experience uninterrupted service. The strategy deploys multiple complementary approaches: undergrounding vulnerable lines, deploying residential batteries to remote customers first with an eventual goal of energy storage for all customers, and creating community microgrids and Resiliency Zones. What makes this approach transformative is its explicit recognition that different solutions fit different contexts, and that achieving zero outages requires a portfolio of strategies rather than a one-size-fits-all approach to infrastructure hardening. Critically, GMP frames this not as an additional cost but as superior economics: The money currently spent repairing damage after storms would instead be used to prevent outages before they occur, while distributed storage provides daily value through energy management and grid services. This represents the kind of strategic foresight that systems thinking enables, moving from perpetual emergency response to proactive system redesign.

In Louisiana, where power outages have emerged as the leading cause of disaster-related death, **Together Louisiana** launched the **Community Lighthouse** project in 2022 to create a statewide network of solar-powered disaster response hubs. The initiative aims to build 500 such hubs, "Community Lighthouses," throughout Louisiana, so everyone can be just a short walk from electricity when they need it, starting with communities most at risk. It has already established 15 operating sites, making it the largest renewable energy community resilience hub network in the world. Located in churches, nonprofits, and other trusted community sites, each lighthouse features rooftop solar panels generating electricity stored in backup batteries, supplementing daily energy needs while maintaining ample power accessible during emergencies, even when the local utility grid fails.

During Hurricane Francine in September 2024, all 10 operational lighthouse sites remained fully functional, and about 500 people sought refuge at these locations, receiving access to electricity, refrigeration, shelter, medical services, and other basic needs. But technology alone does not create resilience; people do. Together Louisiana is building teams of "lighthouse keepers" who conduct community outreach, identify residents with electrically dependent medical needs, and create 24-hour call lists for emergency check-ins, deliberately building the social infrastructure that transforms buildings with

batteries into community lifelines. This bottom-up, community-driven approach stands in stark contrast to top-down utility planning, recognizing that resilience emerges from local knowledge, trusted relationships, and neighbor-to-neighbor care. Commissioners should note that this model transcends the regulated utility sector entirely; it represents communities taking resilience into their own hands because traditional infrastructure and institutions have proven inadequate. Yet it also suggests partnership opportunities where forward-thinking utilities and regulators could support and scale community-led resilience rather than viewing it as outside their purview.

In 2018, the **Blue Lake Rancheria**, a federally recognized tribal government in remote Humboldt County, California, developed a pioneering **community microgrid** integrating 420 kilowatts (kW) of solar photovoltaics and a 500 kW/950 kWh battery energy storage system that can operate autonomously from the Pacific Gas and Electric (PG&E) distribution grid. When PG&E enacted PSPS to prevent wildfire ignition during high-wind events in October 2019, the Blue Lake Rancheria microgrid enabled the tribe to keep its casino, hotel, and offices powered while providing hotel rooms for medical patients dependent on electric-powered devices, safe spaces for families to charge phones and access the internet, and even a mobile office for the local newspaper. The tribe estimated it served approximately 10,000 people, about 10 percent of the county's population, during the outage, and county officials estimated the tribe's preparations and microgrid saved four lives during the first utility shutoff. This outcome reveals the profound inadequacy of traditional resilience metrics: From a utility perspective, the PSPS worked as designed by preventing wildfire ignition, yet from a human service perspective, it created a life-threatening emergency that only community-level distributed resources could address. The Blue Lake Rancheria example is particularly instructive for commissioners because it demonstrates that microgrids are not theoretical concepts or pilot projects; they are proven, mature technologies that save lives, reduce costs, and provide daily operational value while standing ready for emergencies. The regulatory question is not whether such solutions work, but rather how to enable their widespread deployment and ensure equitable energy resilience for all communities, not just those with resources to self-fund microgrid development.

These three examples illuminate different pathways to the same destination: energy service resilience that centers on customer needs rather than on grid infrastructure performance alone. GMP demonstrates how a regulated utility can fundamentally transform its approach within the existing regulatory framework when commissioners support comprehensive system redesign. Together Louisiana shows how grassroots community organizing can create resilience infrastructure when traditional institutions fall short, suggesting models for utility-community partnerships. Blue Lake Rancheria proves that distributed resources can provide superior resilience outcomes during the very circumstances, wildfire-prevention shutoffs, where traditional grid hardening offers no solution whatsoever. Collectively, these cases provide commissioners with concrete evidence that the mental model shift from grid resilience to service resilience is not aspirational but achievable, not theoretical but practical, and not optional but essential for fulfilling their fundamental obligation to ensure reliable service in a rapidly changing environment.

3.2 Stakeholder Mapping

Every regulatory decision exists within an ecosystem of actors—utilities, customers, aggregators, developers, local governments, first responders, and community organizations—each with distinct interests, capabilities, constraints, and forms of influence. Stakeholder mapping makes that ecosystem visible. It enables commissioners to understand not just who cares about a decision, but why they care, what power they hold to shape or obstruct change, and how their interests align or conflict with others in the system. Like the iceberg model, stakeholder mapping is not a procedural courtesy; it is a strategic necessity. Regulators who make the stakeholder ecosystem explicit gain the situational awareness needed

to anticipate opposition before it materializes, identify unexpected allies, recognize whose voices have been systematically excluded, and build the coalitions necessary to move outcomes in the public interest.

The need for stakeholder mapping is intensifying. Grid decentralization is bringing new classes of actors—local zoning officials, first responders, tribal governments, neighborhood coalitions, school boards—into direct contact with energy infrastructure decisions for the first time. These actors do not participate in traditional regulatory proceedings. They operate in a separate institutional node that has been typically disconnected from the regulatory process: the local siting and permitting process. Yet their decisions to approve, delay, condition, or block distributed energy infrastructure directly determine whether the resources that regulators plan and utilities procure can ever be built. Failing to map and engage this expanded ecosystem does not keep a proceeding clean and efficient. Quite the opposite, it transfers risk downstream, where it materializes as siting conflicts, community moratoria, and stranded procurement commitments.

3.2.1 Illustrative Case Study: Stakeholder Mapping in Infrastructure Siting and Permitting

The process by which energy resources move from regulatory approval to physical construction involves three sequential steps: 1) planning, in which regulators and utilities determine which resources best fit system needs; 2) acquisition, in which those resources are procured and contracted; and 3) permitting, in which local authorities approve the specific sites where resources will be built. Utility regulators have clear authority over the first two steps. They have historically had no jurisdiction over the third.

That jurisdictional gap creates a structural vulnerability. In today's procurement environment, resource siting decisions are typically made during acquisition and permitting, when a developer selects a site based on lot availability, cost, proximity to existing infrastructure, and engineering feasibility. Those decisions occur without public visibility. By the time local residents are notified, typically through a land-use application filing, they are encountering the project for the first time, with no prior opportunity to influence its design or location. Late-stage notification produces predictable results: distrust of the developer and the process that selected the site, opposition that fuses legitimate safety concerns with broader community grievances, and, increasingly, preemptive moratoria that close the door before any project-specific conversation can begin.

The 2023 Covington, Washington, case illustrates the full cost of this failure. A private developer filed an application to site a 200-megawatt battery storage project on a 14-acre parcel adjacent to a middle school. The local community learned of the application when a neighboring landowner noticed workers on the site and searched the land records. By the time public meetings were convened, residents had organized a robust grassroots opposition campaign. The project was ultimately withdrawn, and the Covington City Council has since enacted a rolling series of six-month moratoria against energy storage development. The developer maintained that the project was technically sound and consistent with state policy and utility need, and on those terms, it likely was. But technical soundness and community trust are not substitutes for one another. By failing to engage the host community before filing, the developer foreclosed the possibility of collaboratively identifying alternative sites or project designs that might have addressed local concerns and produced a viable outcome. The regulatory system approved what it had authority to approve. What it could not see, because no one had mapped it, was the siting node where the project would ultimately fail.

Stakeholder mapping addresses this gap by making the two-node structure of energy infrastructure decisions explicit. Figure 4 illustrates this structure. The regulatory node encompasses the actors familiar to utility regulators: the public utilities commission, the utility, and advocates representing ratepayers,

large customers, environmental interests, and labor. The siting node encompasses the actors who govern local approvals: zoning officials, first responders, third-party developers, host community members, and, depending on the jurisdiction, state officials with concurrent or superseding authority. Currently, the only entity that connects these two nodes is the utility, either as the party seeking local permits for its own projects or as the contracting counterparty to a third-party developer navigating the permitting process. That single point of connection is insufficient, and it places the entire burden of community engagement on an actor whose primary incentive and competence is project completion, not community trust.

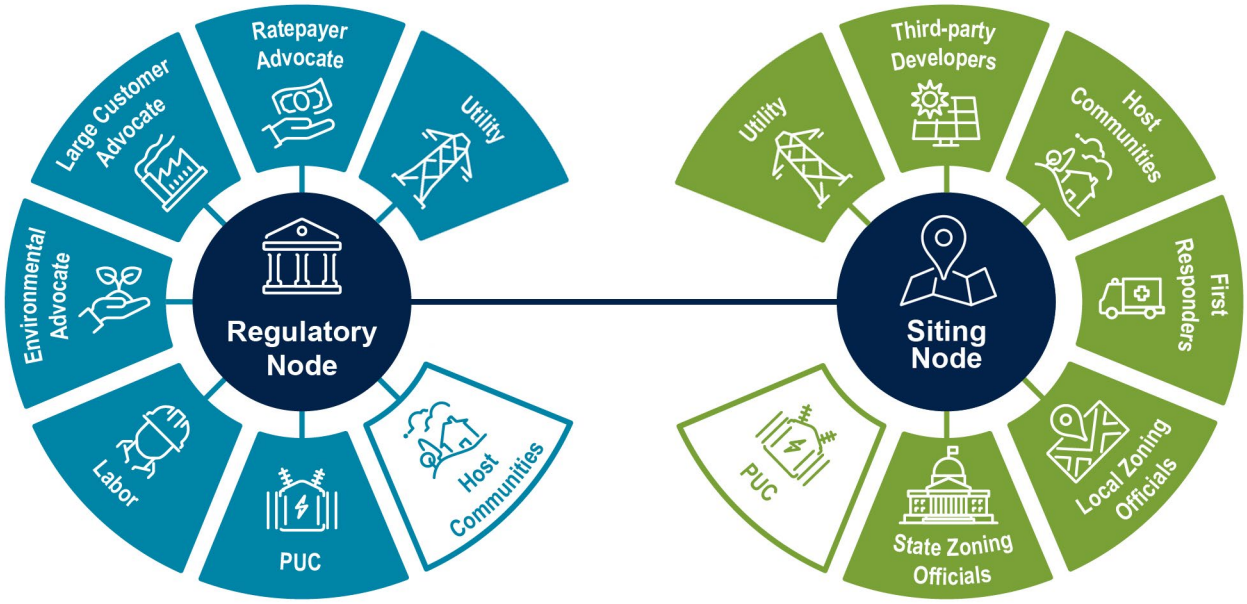


Figure 4: Stakeholder Mapping Two-Node Structure

Utility regulators have practical levers available for closing this gap without asserting jurisdiction they do not hold. Planning approvals, Request for Proposal submissions, and certificates of public convenience and necessity all pass through regulatory review, and each represents an opportunity to attach community engagement requirements as a condition of that approval. Regulators may also initiate rulemaking proceedings specifically designed to establish transparent public engagement requirements for newly constructed or procured distributed energy infrastructure, drafted broadly enough to apply to third-party developers doing business with the utility and not only to the utility itself. Rulemaking proceedings have a particular structural advantage for this purpose: They are inherently participatory, allowing regulators to conduct targeted outreach to siting-node actors—local planning associations, state emergency management agencies, community action organizations, and grassroots groups that have formed as advocates for community needs or in opposition to prior projects—and incorporate their input into the guidance being developed. Groups that have opposed past projects are especially valuable participants; they carry direct knowledge of what went wrong and often have constructive ideas about what better engagement would have looked like.

The process design and substantive content of that engagement guidance matter as much as the requirement to engage. Outreach conducted by utilities and developers as they advance distributed energy infrastructure should be early, initiated before any permit application is filed, so that neighboring communities have a genuine opportunity to influence site selection and project design rather than simply react to decisions already made. It should be contextual, helping communities understand what need the project addresses, what alternatives were evaluated, and why the proposed site was selected. It should be code-grounded, with developers proactively engaging first responders to demonstrate compliance with

applicable fire, electrical, and building codes and to share emergency response plans. It should maximize the convenience and minimize the burdens of participation for local residents, who typically must find time outside their regular jobs to engage with the process. And it should be honest, openly identifying potential impacts on the host community and ultimately committing to specific mitigation strategies, including compensation mechanisms such as bill credits or investments in local infrastructure, documented in a community benefit plan. These are not aspirational standards. They are the minimum conditions for the kind of trust that makes infrastructure siting workable in a decentralized grid.

3.2.2 From Theory to Practice: Stakeholder Mapping as Regulatory Infrastructure

The Covington case and the broader siting challenge it represents are symptoms of a deeper structural condition: The regulatory frameworks governing energy resource procurement were designed for a grid in which consequential infrastructure decisions occurred far from where most people lived and worked. That condition no longer holds. As DERs proliferate and infrastructure moves closer to homes, schools, and community centers, the stakeholder ecosystem that shapes energy outcomes expands well beyond the parties who appear in utility commission proceedings.

Stakeholder mapping is the tool that makes this expanded ecosystem legible. Applied systematically, through rulemaking, procurement conditions, and planning requirements, it transforms community engagement from a project-level afterthought into a structural feature of how the energy system is planned and governed. Regulators who institutionalize this practice will find that their proceedings become not just technically complete but durable, producing decisions that can survive contact with the communities they are meant to serve. In a grid being built from the edges inward, that durability is not a procedural nicety. It is a prerequisite for delivery.

3.3 A Whole-of-System Perspective

Traditional regulatory analysis tends toward compartmentalization, examining generation separately from distribution, considering reliability distinct from affordability, and treating environmental goals as external constraints rather than integral objectives. This fragmented approach reflects organizational structures, jurisdictional boundaries, and professional specializations that carve complex systems into manageable pieces. Yet the most consequential challenges facing utility regulators today—decarbonization, resilience, and affordability—transcend these artificial boundaries. They are inherently systemic, arising from and affecting multiple domains simultaneously. The whole-of-system perspective offers a corrective to this fragmentation, enabling regulators to step back from isolated components to comprehend the system in its entirety by examining how parts interact with and influence one another, how actions in one domain ripple through others, how optimizing individual elements can inadvertently degrade overall system performance, and how solutions that address root causes rather than symptoms often require coordinating changes across multiple subsystems simultaneously.

The whole-of-system perspective offers a corrective. Where traditional approaches ask, “How do we solve this particular problem within our jurisdiction?” a whole-of-system perspective asks, “How does this problem relate to the electric system’s overall mission and performance?” That reframing—subtle but consequential—requires regulators to redefine system boundaries rather than default to customary norms, attend explicitly to feedback loops and unintended consequences, and identify leverage points where modest interventions can catalyze disproportionate system-wide improvements. Most fundamentally, it recognizes that optimizing parts in isolation often degrades the whole, and that accepting suboptimal performance in individual components can sometimes yield superior system-level outcomes.

3.3.1 Illustrative Case Study: DER Integration – Planning, Operations, Markets

The integration of DERs offers a clear illustration of why whole-of-system thinking matters. DERs have been increasing in quantity and diversity in the electricity system, and this trend is expected to continue into the foreseeable future. The big challenge for regulators is to adopt regulations that unlock the greatest benefits of DER growth for customers, the grid, and society at large, while minimizing potential adverse impacts on system operation, reliability, efficiency, and affordability.

The conventional regulatory response tends to fragment this challenge across domains: Interconnection belongs to distribution engineering, compensation to ratemaking, grid impacts to reliability analysis, and equity concerns to social policy. Each domain applies its own analytical frameworks and success metrics, producing siloed solutions that may appear sound in isolation yet collectively fail to serve the system's core mission.

The proliferation of DER is driving a transition from the traditional system structure, in which almost all power generation was connected to the transmission system while the distribution system provided only one-way delivery of energy to end-use customers, to a structure in which supply and storage resources operate at all levels of the system and customer-owned DER can interact with the utility network in diverse ways. This new structure requires substantial new distribution system functional capabilities. The power industry now recognizes that this transition will affect all elements of how the whole electric system functions, including real-time operation, resource and grid planning, markets for energy and ancillary services, regulatory frameworks, and business models.

Moreover, changes to any one of these functional areas will affect the others. It is therefore necessary to assess potential regulatory actions from a whole-system perspective, which in turn requires tools for representing the whole system in a way that reveals the interdependencies among the elements.

The Industry Structure Diagram as an Analytical Tool

An **industry structure diagram** is a visual map of the system's core infrastructure components, active agents, and the interactions among them. Figure 5 presents a highly simplified power industry structure diagram based on the traditional structure before the advent of DERs.

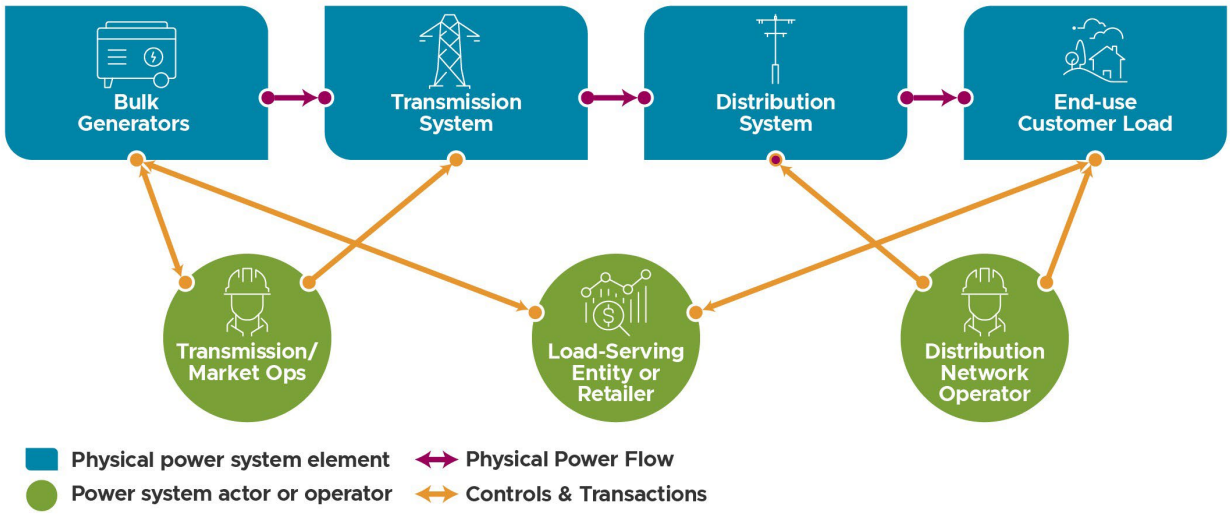


Figure 5: High-Level Power Industry Structure Diagram

The blue components are the main physical components of the system, while the green components are the main actors who perform core functional roles and responsibilities that comprise the system's performance. The pink arrows represent the physical flow of electric power or energy, while the orange arrows indicate interactions among actors and physical components, including operating instructions, congestion management, system balancing, economic transactions, information flows, and financial settlements. In a fully developed structure diagram, these different types of interactions would be designated by different color lines. To keep this example relatively simple, some important actors, most notably regulators, are not shown in this diagram, even though their actions are crucial to determining the performance of the system.

Note the following characteristics of the pre-DER electricity system:

- There is a distinct supply side (bulk generators) and demand side (end-use customers).
- The transmission and distribution systems perform only one-way delivery service, from generators to customers, as indicated by the one-way red arrows.
- End-use customers do not participate actively in the system; they simply consume energy as needed and pay their utility bills.

3.3.2 From Theory to Practice: Whole-of-System Thinking in Regulatory Design

To start, consider how to update the structure diagram to represent the incorporation of DERs into the system, as shown in Figure 6. To keep the diagram relatively simple, the diagram omits interactions involving the retailer, interactions between the transmission operator and the DER, and the existence and interactions of a new type of actor called DER aggregator. A more complete structure diagram would have to include these interactions.

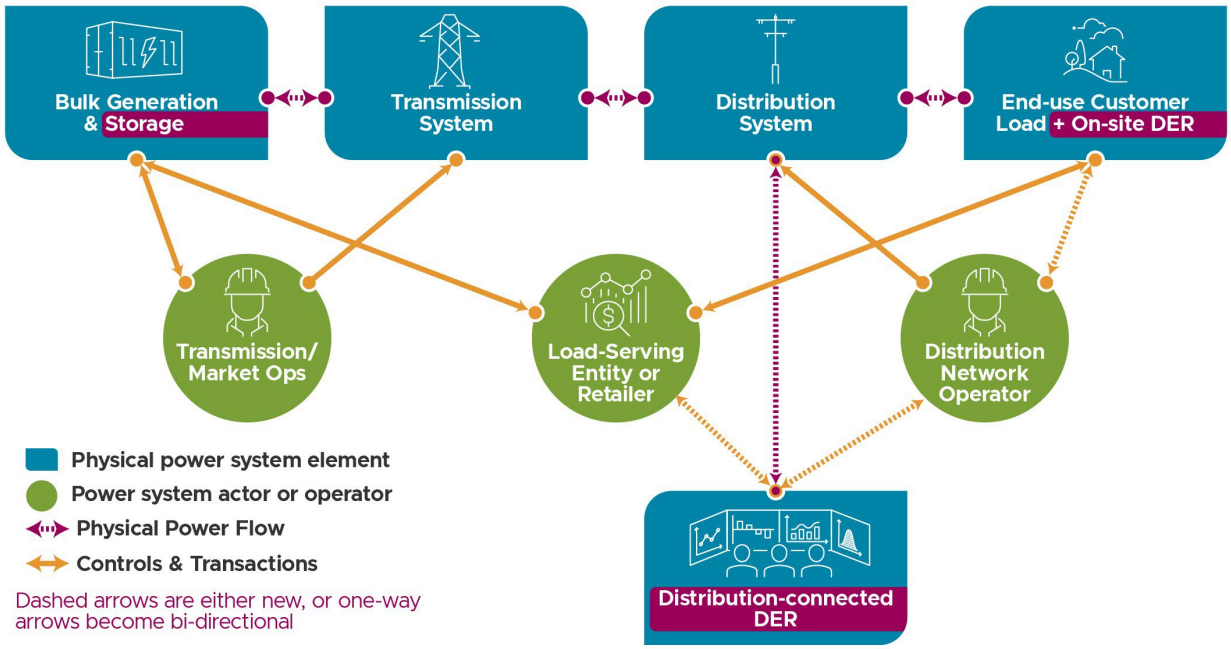


Figure 6: High-Level Power Industry Structure Diagram Incorporating DERs

Note the following characteristics of the DER-integrated system:

- The blue components for distribution-connected (front-of-the-meter [FOM]) DERs and customer on-site (behind-the-meter [BTM]) DERs have orange arrows associated with them, showing that they are part of the physical energy flows.
- Many of the pink arrows are now bi-directional, indicating that power can flow in either direction.
- The pre-DER system's clear separation between the supply side and the demand side no longer exists, now that DER energy supply can be anywhere in the system.
- The distribution network operator (DNO) now has required interactions with both FOM DER and BTM DER.
- A dashed bi-directional arrow is added to represent transmission–distribution interface coordination between the DNO and the transmission operator, a crucial new function required when diverse DERs connect to and may actively participate in the electric system.
- The bulk generation box (top left) now includes bulk storage; this is not a consequence of DERs but is a technology development occurring concurrently with DERs, which is why its red arrow is now bi-directional.

Return now to the objective that started this section: The big challenge for regulators is to adopt regulations that will unlock the greatest benefits of DER growth for customers, for the grid, and for society at large, while minimizing their potential for adverse impacts on system operation, reliability, efficiency, and affordability.

The updated structure diagram reveals several important implications that regulators must consider in assessing potential regulatory decisions.

1. **Advanced grid functions. Integration of DERs will require the DNO to develop functional capabilities that were not required in the pre-DER system.** Beyond providing reliable delivery of kWh from the bulk system to customers, the DNO must maintain reliable, efficient operation with supply resources located throughout the network, on both sides of customer meters, injecting power into the system and frequently reversing the normal flows on distribution circuits.
2. **An increasingly contestable electricity network. On-site DERs compete with the utility grid for customer energy dollars.** Customer adoption of on-site DERs is largely exogenous, driven by customer decisions based on each customer's assessments of its needs, priorities, and financial capabilities. This means, among other things, that customers can dramatically reduce or eliminate entirely their need to procure energy from the grid, a phenomenon known as "load defection" (partial reduction) or "grid defection" (total disconnection from the grid). In other words, the grid is now contestable; it faces competition to retain customers that have the financial capability to reduce purchases of grid-supplied energy. Regulators should seek to understand the factors that drive customer decisions to invest in DERs, which may often be more complex than conventional return on investment, before immediately focusing on the needs of the grid.
3. **Enhanced network flexibility. DERs can offer valuable services to the electric grid, either by modifying customer load or by injecting power into or withdrawing power from the distribution system.** These possibilities introduce new sources of controllable distribution-side performance that can, among other effects, reshape load profiles to reduce peak loads and mitigate short-term load fluctuations, offering the potential to deploy DERs as alternatives to conventional dispatchable generation and transmission and distribution infrastructure upgrades. Meeting the

regulatory challenge to unlock the greatest benefits of DERs should therefore include policies and procedures to utilize and fairly compensate DERs for the value of services they can provide.

4. **Distributed energy supply capacity. The retailer may procure energy supply both from DERs and from bulk generators to serve its customers.** Thus, as load grows over time, it is possible to meet the growth, to some extent, with distribution-side resources instead of relying entirely on bulk-system supply. Conventional resource planning will need to be updated to consider distribution-side resources, and benefit-cost analysis will need to account for non-conventional system benefits, such as avoidance of land-use conflicts, and customer adoption criteria such as energy resilience.
5. **VPPs. Aggregations of coordinated DERs may participate in the wholesale markets operated by the transmission system operator (TSO).** A new type of actor, the DER aggregator (who may also be a retailer), may construct market resources by aggregating multiple DERs to form a VPP. Aggregation activities will add complexity, which would be represented by more blue lines on the structure diagram to denote operating decisions, market bidding, economic transactions, information flows, and coordination with the DNO to enable bulk market participation.

The above observations suggest some new perspectives to be incorporated into the regulatory approach to electric utility regulation for a high-DER system.

First, DER growth will require more refined demand forecasting, both short term for operational purposes and longer term for resource and infrastructure planning and resource adequacy. For operational forecasts, the behavior and performance of DERs on the system will affect the overall system net load shape and the instantaneous variability of net load. This will require an accurate database of DER locations, sizes, types, and performance attributes, including how DERs are being used to provide grid services. For planning forecasts, rates of DER adoption by customers and growth of FOM DERs as supply resources should feed into distribution and transmission planning, as well as the need for bulk-system supply resources.

Second, wholesale market participation by DERs and DER aggregations (VPP) will require reliable and accurate information exchanges for real-time coordination between the DNO, the TSO, and the participating DERs/DER aggregators. For DER participation in the bulk power market to be successful, the TSO must be confident that the DER will fully deliver on market dispatches. The DNO must be confident that it can maintain reliable service to customers while supporting DER market participation. And the participating DERs, which may depend on market revenues to return some of their investment costs, must be confident that DNO curtailments because of distribution system conditions will be infrequent, predictable, and transparent.

The structure diagram is an analytical tool, not an end in itself. Its value lies in what it reveals: the interdependencies that siloed regulatory proceedings cannot see, the new functional requirements that DER integration imposes across the entire system, and the coordination mechanisms that must be designed, not assumed, for the system to perform as intended.

Regulators who apply a whole-of-system perspective to DER integration will find themselves asking different questions at the outset of proceedings. Not “How should we revise the interconnection tariff?” but “How does interconnection policy interact with distribution planning, rate design, and the utility’s evolving operational role?” Not “What is the avoided cost of this DER resource?” but “What is the full portfolio of services this resource can provide, and what compensation structure would unlock that portfolio for the benefit of customers and the system?” These are harder questions. They require broader evidence, more diverse stakeholder input, and greater tolerance for uncertainty. But they are also more

likely to produce regulatory decisions that work with the system's dynamics rather than against them, that enable an increasingly distributed, intelligent, and interactive electricity system.

The whole-of-system perspective does not ask regulators to resolve every interdependency before acting. It asks them to make those interdependencies visible, account for them in their reasoning, and design decisions that remain adaptive as the system continues to evolve. In a grid defined by emergence and feedback, that analytical discipline is not optional; it is foundational.

4.0 Summary and Key Takeaways: Systems Thinking for Regulators



Horizontal and Vertical Whole-System Perspectives

Think across silos (horizontal). Electricity systems span physical assets, market structures, and human behavior. A tariff proceeding, a planning docket, and an interconnection rule are all part of the same system. Seeing them together helps regulators avoid conflicting incentives and misaligned objectives.

Recognizing connections among layers (vertical). Decisions at one layer of the electricity system ripple through others. Resource planning assumptions shape transmission investment, which impacts distribution investment, which determines the options available to DERs and end-use customers. Tracing these dependencies across layers reveals how upstream choices create downstream constraints and where coordination gaps between layers produce outcomes that no single layer intended.



Interconnections and Interfaces Matter

Pay attention to the seams. Reliability issues and policy friction rarely arise within a silo; they occur at the boundaries between systems and core active agents. The transmission–distribution interface, the utility–aggregator handoff, or the customer–data exchange is where coordination and trust either flourish or fail.



Feedback Loops Drive Behavior

What you measure and reward determines how the system behaves. Incentives, metrics, and compliance requirements form feedback loops. Regulators must anticipate how those loops might amplify good behaviors or unintentionally entrench bad ones.



Emergence Happens

Expect the unexpected. When thousands of distributed assets interact, new patterns emerge—VPPs, peer-to-peer trading, or flexible load aggregations. Regulation should be adaptive enough to recognize and enable these emergent capabilities rather than constrain them.



Boundaries Create Clarity

Roles must be defined but flexible. Clear decision rights, who controls what, when, and under which conditions are essential for safety and accountability. Yet boundaries should enable cooperation, not cause isolation. Regulators need to design the connective tissue of the modern grid.



Multiple Perspectives Enrich Solutions

Diversity of perspective equals strength of design. A consumer advocate, a DER provider, and a system operator see the same grid differently, and each is right from their vantage point. Systems thinking honors these perspectives as complementary inputs, not competing narratives.



Time Horizons Matter

Think in trajectories, not snapshots. Policies that optimize today's outcomes can undermine tomorrow's opportunities. Regulators should consider both immediate effects and long-term evolution. In other words, how might short-term incentives influence grid structure, investment patterns, and customer trust over decades?



Leverage Structure, Not Symptoms

Fix the rules, not just the outputs. The most powerful interventions occur at the level of structure: information flows, incentives, and decision rights. Instead of reacting to surface-level program failures, go deeper to change the underlying rules that shape behavior across the system.

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