Energy and Emergency Planning Integration Crosswalk (EEPIC)

Prepared for the Midwestern Governors Association by Converge Strategies

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About this Material

The effort to create this framework stems from the Midwestern Governors Association (MGA) recognizing a need for enhanced state coordination and alignment in emergency planning, particularly in response to grid events. MGA aimed to develop a resource that encompasses existing state plans and policies addressing these challenges. This effort builds off the success of the MID-GRID initiative that sought to unify and enhance state energy resilience efforts.

This framework was created over the course of two years by pooling expertise from Midwestern states, including state energy offices, electric sector representatives, and emergency management authorities, who advised on the content and challenges that should be addressed. Their input was provided during meetings and workshops convened over the course of a year.

The goal of this effort is to align policy and regulatory and operational strategies into a framework that supports energy security, maximizes the impact of energy policies, enhances resilience, and promotes development in the Midwestern region.

ABOUT MIDWESTERN GOVERNORS ASSOCIATION

The Midwestern Governors Association (MGA) is a non-profit, bipartisan organization that brings together governors and their staff to address public policy issues of significance to the region. The MGA provides governors and state staff with the opportunity to foster regional development and exchange best practices.

Learn more about MGA at https://midwesterngovernors.org/.

ABOUT CONVERGE STRATEGIES, LLC

Converge Strategies, LLC (CSL) is a consulting company focused on the intersection of energy, resilience, and national security. CSL works with civilian and military partners to develop new approaches to energy resilience policy and planning in the face of rapidly evolving threats, vulnerable infrastructure, and determined adversaries.

Learn more about CSL at www.convergestrategies.com.

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NAVIGATION | While each module can stand on its own, or be reviewed in sequential order, users must work through the User Guide and Implementation Plan prior to beginning work in any module.

INSTRUCTIONS | Use this framework as a way to orient yourself with state, utility, and grid operator protocols. While it will not address all the unique roles and responsibilities of every stakeholder, the framework will help readers understand different types of organizations and their decision making processes.

List of Abbreviations

Abbreviation	Definition
BES	Bulk Electric System
BtM	Behind-the-Meter
CESER	Office of Cybersecurity, Energy Security, and Emergency Response
COG	Continuity of Government
DER	Distributed Energy Resource
DHS	Department of Homeland Security
DOE	Department of Energy
DOT	Department of Transportation
EEPIC	Emergency and Emergency Planning Integration Crosswalk
EM	Emergency Management
EMA	State Emergency Management Agency
EOP	Emergency Operations Plan
ETR	Estimated Time of Restoration
FEMA	Federal Emergency Management Agency
FERC	Federal Energy Regulatory Commission
IBR	Inverter-Based Resource
IOUs	Investor-Owned Utilities
IPP	Independent Power Producer

IRA	Inherent Risk Assessment
IRP	Integrated Resource Plan
ISO	Independent System Operator
LEO	Law Enforcement Officer
LTE	Long-Term Evolution
MGA	Midwestern Governors Association
NARUC	National Association of Regulatory Utility Commissioners
NERC	North American Electric Reliability Corporation
POIA	Power Outage Incident Annex
PSAP	Public Safety Answering Point
PUC/PSC	Public Utilities/Service Commission
RSC	Regional State Committee
RTO	Regional Transmission Organization
SCADA	Supervisory Control and Data Acquisition
SEO	State Energy Office
SEP	State Energy Plan
SESP	State Energy Security Plan
T&D	Transmission and Distribution
THIRA	Threat and Hazard Identification and Risk Assessment
VPP	Virtual Power Plant
VRA	Vulnerability and Risk Assessment

Introduction

EXECUTIVE SUMMARY

The rapid transformation of the electric grid, combined with a growing number of threats, requires a more sophisticated approach to energy security. MGA created the State Energy and Emergency Planning Coordination project to improve emergency planning and preparedness for regional grid emergencies.

This product – the Energy and Emergency Planning Integration Framework (EEPIC) – is designed to support multi-stakeholder planning and increase energy security at the state and regional scales, not to replace existing plans required for state agencies or utilities under statute or regulation. It provides a structured approach for developing new state energy strategies and for aligning existing planning processes with policy priorities.

Objectives

SUPPORT ALIGNMENT

Align Governors' policy, regulatory, planning, operational, and legislative capabilities to support state energy strategy.

MAXIMIZE IMPACT

Improve energy policy decision-making to support energy resilience, equity, and economic development.

BUILD CAPABILITY

Improve interregional resource planning to accelerate investment in priority infrastructure and reduce grid vulnerabilities.

PURPOSE

KEY TERM: ENERGY SECURITY. Defined by the International Energy Agency as "uninterrupted access to energy at affordable prices," and rests on the three pillars: reliability, the ability of the energy supply to meet the power requirements of all sectors; resilience, the ability to mitigate and respond to interruptions; and efficiency, using just enough energy to power any process.

The Midwest electric grid is facing unprecedented electricity demand growth, increasingly frequent and severe weather, and the growing threat of physical and cyber attacks.

Energy security planning requires a collaborative and integrated approach to mitigate the breadth of risks confronting the electric grid that no single entity can fully address. Building a complete understanding of current grid conditions and future risk projections requires improved visibility into a variety of planning processes that currently reside in multiple public and private sector organizations. Utilities and energy service companies provide electricity to consumers, regional grid operators maintain the reliability of the bulk power system, and states have responsibility for public health and safety and for electricity sector regulation and policy.

The purpose of the EEPIC Framework is to enable states to align their policy goals through a more collaborative and holistic approach to state energy security policy and emergency operations planning. Each module of the framework is designed to guide users through a specific aspect of energy security with the goal of creating tailored but scalable approaches to planning.

User Guide

Review Existing Plans and Map Stakeholders

EXISTING PLANS | The EEPIC Framework builds on plans, policies, and procedures developed by state utility commissions, energy offices, and emergency management agencies **(See Annex C)**. Users should identify and review current documents to ensure alignment.

STAKEHOLDERS | There are many public and private sector organizations that influence energy security planning **(See Annex B)**. Users should identify the stakeholders that require sustained engagement and partnership as part of the planning and integration process.

Navigating the Framework

STEP 1	STEP 2	STEP 3	STEP 4
Energy Strategy Crosswalk	**Module Selection**	**Planning Review**	**Integrated Planning**
Before proceeding to individual modules, users should develop a State Energy Security Strategy utilizing the provided **Crosswalk.** The Strategy should set priorities and guide planning decisions for each of the modules to follow.	Each of the four planning modules can function as a stand-alone guide, or they can be used together to develop a consolidated energy security resource. Interpret the module(s) using your chosen Strategy as a guide.	Reference existing plans and policies while navigating the modules to identify areas of alignment and gaps based on users' interpretation of the modules and the chosen Strategy. This can result in new or updated plans or policies.	The completed framework module should serve as a guide for future efforts related to mid- and long-term infrastructure planning, state energy policy development, and emergency response planning.

Special Considerations

Sector-Focused

Energy security includes considerations for infrastructure, assets, and integrated systems that extend beyond electricity, such as natural gas, liquid fuels (e.g., LNG, propane, etc.) and oil. For the purpose of this framework, the planning and analysis will be limited to the electricity sector, with consideration given to other infrastructure sectors as part of the **Interdependency Planning Module**.

Data Sharing

Several planning modules in the EEPIC benefit from planners having access to information that is not publicly available because it is proprietary or protected from disclosure. While this information would be beneficial to the analysis, it is not required. Users should engage through existing processes or use resources such as the **NARUC Grid Data Sharing Playbook** to share information that would advance energy security planning.

Resource Adequacy

Resource adequacy is defined as, "the ability of the electric grid to satisfy the end-user demand at any time" This Framework doesn't include a resource adequacy module since there are multiple well-established methods and processes to assess it. However, each module will identify the resource adequacy impacts of each topic area.

State Energy Strategy

State Priorities

Given the complex nature of the electricity grid and the diversity of public and private stakeholders, it is essential to determine what guiding principle will drive legislation, policy, regulation, planning, operations, and the allocation of scarce financial resources. Below are three strategies, each with specific benefits to all stakeholders, that can be applied to the energy security planning process to serve as a driver for the grid transformation. While most states will select a single strategy to guide the framework, these strategies are not mutually exclusive; a state can weight elements of more than one where its priorities call for it. Modules are written per-strategy for clarity, so states blending strategies should apply the relevant guidance from each rather than treating any one module's strategy framing as exhaustive.

Strategy Descriptions

Diversification	Using diversification as the primary driver of an energy security strategy reduces dependence on any single energy source, thereby enhancing the stability, resilience, sustainability, and reliability of energy infrastructure. The presence of multiple energy sources on a system mitigates multiple levels of risks, especially those associated with supply chain, price volatility, and regulatory changes.
Economics	Economics as a driver of energy security leverages the financial perspective for risk mitigation by prioritizing investment in infrastructure and specific energy sources. This approach may stem from communities that rely on a particular energy asset, or the private or public sector priorities.
Resilience	Resilience promotes an energy security strategy that leverages the innovative use of technologies, tools, and processes to reduce risk and enhance the security of the system. The level of resilience and the methods needed to achieve it are determined through analysis of current vulnerabilities and future threats, as driven by infrastructure needs, laws, or regulatory requirements.

STATE GUIDANCE | Review existing variables highlighted below to understand what drives decisions.

Policies	Plans	Stakeholders	Funding
The state policies, legislation, and that regulations govern electric grid operations.	Local, state, and regional planning resources and processes.	Public and private entities and personnel needed to build and operate the grid.	Investment from ratepayers, private organizations, and government sources.

EEPIC Framework Modules

OVERVIEW

Given the many facets of energy security and energy emergencies, the EEPIC Framework focuses on specific challenges associated with the subsets of plans, procedures, and activities. The MGA State Energy and Emergency Planning Coordination Group identified four specific topic areas that are central to state planning where improved alignment could maximize the effectiveness of the framework. The four modules below are designed to address each topic.

PLANNING MODULES

MODULE 1: Design and Integration

Design and integration refers to the ability of the infrastructure planning process to align between state policy, regulatory requirements, utility design, and independent system/regional transmission operators (ISO/RTO) priorities. This can shape properly scaled transmission and distribution infrastructure design and performance requirements. The framework will provide guidelines for building uniform infrastructure design criteria that consider multiple organizational priorities and processes.

MODULE 2: Energy Risk and Criticality

Energy risk and criticality is the potential for energy infrastructure to be impacted by a broad range of hazards, as well as the relative importance of assets to the reliable operation of the grid. This includes susceptibility to hazards, impacts of a disruption on connected systems, presence or lack of redundancy, and the asset's historical performance. The framework will suggest how organizations can develop shared, standardized assessment methods to address system-level risk.

MODULE 3: Restoration Prioritization

Restoration priorities determine how, when, and to whom energy will be restored, considering the availability of capacity, resources, and infrastructure. States, RTOs, and utilities have different prioritization and response plans, some of which depend on one another. Additionally, organizations may not be aware of how these priorities and plans affect them. This framework will share insights for building an energy security prioritization method, incorporating successful resource planning and emergency response.

MODULE 4: Interdependency Planning

Interdependency planning helps regions develop robust emergency response plans, as energy is crucial to other critical lifelines (e.g., natural gas, water, communications, transportation). Understanding how these sectors interact is key to achieving regional resilience. This framework will help users establish requirements within their organization and suggest methods for interdependency mapping with external partners and systems.

Strategy: Diversification

STATE OBJECTIVES

SPREAD OUT RISK	CLEAN ENERGY	SYSTEM OF SYSTEMS
Increase redundancy of the energy system through scaled, balanced investment to reduce the risk of state dependence on a single energy source, fuel type, or physical asset, that, if left unaddressed, could become a single point of failure in a system.	Provide legislative, regulatory, or economic incentives to drive investment in clean energy resources as a means of building optionality into the capacity portfolio. Effective Implementation should include multiple resource types.	Adopt a "tactical" approach to segment energy systems through the deployment of microgrids, behind-the-meter generation, long duration energy storage, and flexible power, such as vehicle-to-grid technology, for transportation electrification.

Advantages. Opportunity for carbon reduction, community-scale projects and improved reliability.

Drawbacks. Fewer energy market incentives and more complex deployment with utilities.

POLICY LEVERS

State Energy Office	State Legislation	Emergency Mgmt	Regulators	Owner/ Operator
Integration of redundancy and balancing of the capacity resource mix into the State Energy Security Plan (SESP).	Provide grant funding and tax incentives for distributed energy resource deployment and permitting.	Explore diverse technical solutions for risk mitigation and deployment of behind the meter (BtM) assets supporting critical loads.	Support regulation to simplify the deployment of a wider variety of energy resources to inform rate-based investment.	Develop Integrated Resource Plans (IRP) that focus on infrastructure diversification and deployment of distributed energy resources (DER).

MODULE NAVIGATION

Design and Integration. Create and implement criteria for microgrid design and DER integration.

Energy Risk and Criticality Module. Identify risks that are directly addressable through added redundancy, as well as identifying critical assets to support.

Restoration Prioritization. Look for opportunities to co-locate new energy resources with critical loads.

Interdependency. Seek ways to reduce dependencies on bulk fuel infrastructure (i.e., oil or natural gas).

Strategy: Economics

STATE OBJECTIVES

LOW COST OF ENERGY	LARGE LOAD CUSTOMERS	LARGE SCALE INVESTMENT
Leverage energy and wholesale market competition to keep the cost of electricity as low as possible in order to minimize financial impacts to consumers and incentivize business investments in the state.	Position the state to receive a larger share of projected load growth in business sectors, including data centers and manufacturing, by maximizing the amount of energy available to current and future customers.	Drive additional public and private investment in infrastructure in order to successfully implement the strategy at scale. Lowest cost of energy delivery model will require balanced investment.

Advantages. Lower overall cost to consumers can drive population and business growth.

Drawbacks. Less incentive for reliability and resilience. Diminished investor-owned utilities (IOUs) due to increased market competition.

POLICY LEVERS

State Energy Office

Increase emphasis on transmission and bulk fuel delivery capabilities in the State Energy Security Plan (SESP).

State Legislation

Focus on expediting siting and permitting of Bulk Electric System (BES) assets to accelerate and scale development.

Emergency Mgmt

Integrate large energy loads and capacity resources into risk planning to support effective restoration prioritization.

Regulators

Align regulations with organized markets for large-scale energy deployment and minimal impact to ratepayers.

Owner/ Operator

Utilize integrated resource plans (IRPs) to align utility transmission and generation to ISO planning for cost effectiveness.

MODULE NAVIGATION

Design and Integration. Maximize the use of grid enhancing technologies to harness energy from existing infrastructure at lower costs.

Energy Risk and Criticality Module. Identify and emphasize the risks to bulk fuel delivery systems (i.e. natural gas, storage) and large capacity resources.

Restoration Prioritization. Incorporate key economic loads into planning for major events to limit business disruptions and incentivize reserve margins.

Interdependency. Improve joint planning for gas/electric system coordination and interregional transmission connections.

Strategy: Resilience

STATE OBJECTIVES

ALL HAZARDS	CRITICAL LIFELINES	ASSET HARDENING
Improve the survivability of the electric grid to a full range of natural and man made threats. Tight integration of security systems and protocols between public and private sector, with special consideration for state-specific threats.	Identify and integrate the specific community lifelines that will reduce the human toll of energy emergencies (i.e. public health, public safety) to support disaster response operations and planning form the city level to the state level.	Upgrade current assets and construct additional infrastructure designed for the purpose of withstanding the impacts of severe weather events and targeted cyber and physical attacks on essential systems.

Advantages. Higher system reliability and much lower risk of widespread, long-duration grid outage.

Drawbacks. Market structures don't currently incentivize resilience and costs can be higher.

POLICY LEVERS

State Energy Office

Use Vulnerability and Risk Assessment (VRA) as a targeting mechanism for infrastructure investment.

State Legislation

Leverage state funding and grant programs to defray the costs of resilient infrastructure investments and balance benefits.

Emergency Mgmt

Provide insight to community lifeline planning methods and support capture of federal grants for infrastructure.

Regulators

Enable ideas such as performance - based regulation to support reliability and resilience outcomes and investment.

Owner/ Operator

Develop Integrated Resource Plans (IRP) that emphasize system survivability and support of state security priorities.

MODULE NAVIGATION

Design and Integration. Develop enhanced infrastructure requirements for threat-specific risks.

Energy Risk and Criticality Module. Make concrete connections between risk and investment, including reducing the criticality of assets through hardening.

Restoration Prioritization. Identify energy loads and customer types that support public health and safety.

Interdependency. Emphasize connections between systems with the greatest human impact (i.e. water/wastewater, communications).

Energy and Emergency Planning Integration Crosswalk (EEPIC)

Design & Integration

Design & Integration

MODULE OVERVIEW

Design and integration focuses on how energy stakeholders-states, grid operators, and federal partners-can align their priorities for energy planning and policy to support infrastructure development. This module helps translate grid design decisions from a purely technical exercise to one that incorporates shared processes on risk assessment, policy objectives, and long-term system needs.

This module is organized to help users understand stakeholders that shape grid design and infrastructure planning. It examines how each Energy Security Strategy (Diversification, Economic, and Resilience) translates into specific design priorities and planning considerations. This module does not prescribe a path for technical implementation, but is rather meant to help build shared understanding of infrastructure needs.

Outline

HOW TO USE THIS MODULE

This module is designed as a flexible reference that explains how each Energy Security Strategy translates into grid design decisions. It is not intended to be read in sequence, as each section is written to stand alone. The module is organized around the full arch of grid design decision-making, from understanding other states' successes to identifying key stakeholders, and the design implications of each strategy.

Step 1 — **Case Studies**. Explore real examples of how states have implemented each Energy Security Strategy through policy and infrastructure decisions.

Step 2 — **Stakeholder Mapping**. Identify the key stakeholders involved in grid design, understand their roles, and know how the state can engage with them.

Step 3 — **Implementation Strategy**. Understand the planning cycle through which states can advance their Energy Security Strategy.

Step 4 — **Strategy Approach**. Example of how each Energy Security Strategy shapes grid design priorities at the distribution, transmission, and generation levels.

Step 5 — **Resource Adequacy Nexus**. Analyze how the Energy Security Strategy addresses resource adequacy challenges and what levers are available to close adequacy gaps.

Design & Integration

OPPORTUNITY STATEMENT

Design and integration refers to the ability of the infrastructure planning process to align between state policy, regulatory requirements, utility design, and independent system/regional transmission operators (ISO/RTO) priorities and shape properly scaled transmission and distribution (T&D) infrastructure design and performance requirements. Specifically, this can be accomplished through shared understanding of state and federal codes, regulations, and policies; state energy risks and hazards-based performance needs; and utility and ISO/RTO infrastructure design processes. This module provides guidance for translating the Energy Security Strategy into design criteria that reflects both the state's goals and the priorities of other stakeholders, enabling states to move towards actionable design decisions.

GAPS

How Policy Impacts Infrastructure Design	State infrastructure planning is largely driven by informal standards and policies, such as carbon emissions standards or social legislation. However, these are enforceable goals, not design criteria, and they have little impact on grid performance or design at a technical level. This complicates planning for utilities, whose ability to meet these goals is dependent upon their ownership structure, capabilities, and if they operate across state lines. This results in inconsistent infrastructure design and system outcomes both within states and across state lines.
Stakeholders Have Different Grid Planning Priorities	Infrastructure planning decisions are shaped by differing priorities across energy stakeholders, often leading to misalignment. States tend to prioritize long-term policy outcomes and virtues (e.g., using clean energy to reduce emissions), whereas utilities focus on cost and cost recovery, reliability metrics, and operational feasibility. Utilities face the constant decision of "building back" (i.e., replacing) or "building back better" (i.e., building better replacements) after disasters or disruptions. These differing ideals result in fragmented planning and delayed infrastructure and investments.

MODULE GOALS

Help state offices achieve their energy goals through improved infrastructure planning processes.	Build understanding of who shapes grid design decisions and how to engage them effectively to advance the state energy security strategy.
Connect energy security strategy selection to concrete grid design priorities, understanding what implantation looks like in practice.	Translate each energy security strategy into specific design priorities across the system: distribution, transmission, and generation.

Design & Integration

CASE STUDIES: SUCCESSFUL GRID DESIGN POLICIES

Diversification Strategy

California

The *Electric Rule 21* establishes technical and procedural criteria for connecting inverter-based resources (IBRs) through regulated investor-owned utilities (IOUs). The regulation lowers interconnection barriers, enabling a wider variety of distributed energy resources (e.g., solar) to become part of the energy mix.

Virginia

The Clean Energy Economy Act set a goal of 100% clean energy by 2050 and a renewable portfolio standard, and required the retirement of fossil fuel generation. The policy creates pressure on integrating new resource types, preventing risk of concentration around single fuels.

Economic Strategy

Arizona

The Governor used executive action to establish the Arizona Energy Promise Taskforce, which delivered recommendations on lowering energy costs, easing project timelines, providing frameworks for large loads to protect ratepayers from cost shifts, and promoting opportunities for emerging energy technologies like nuclear.

Texas

Texas enacted PUC Rule 25.55 and Rule 25.62, requiring weatherization of generators and transmission facilities. It also requires utilities to submit resilience plans and allows for cost recovery for resilience improvements. The economic framing of these regulations demonstrate that upfront prevention costs are justified to avoid greater system failures.

Resilience Strategy

New Jersey

After Hurricane Sandy exposed fuel supply vulnerabilities, the state implemented the Retail Fuel Station Program grant to help gas stations install backup power (e.g., permanent generators and transfer switches). It later enacted requirements for gas stations to have transfer switches. This program focuses on the survivability of a critical cross-sector dependency.

Florida

The Senate Bill 796 builds on previous laws for IOUs to develop 10-year storm protection plans to harden infrastructure and establishes a separate cost recovery mechanism for storm protection activities. By doing so, the state incentivizes utilities to invest in large-scale infrastructure and improve long-term planning.

Grid Designer Roles

STAKEHOLDER MAPPING

Advancing an energy security strategy requires coordinating across a range of stakeholders, each with distinct authority, resources, and responsibilities in the grid design process. Understanding who these stakeholders are and how to engage with them is critical to translating policy goals into infrastructure outcomes. These stakeholder groups are state agencies and offices; federal partners; ISOs/RTOs; and utilities. The diagram below maps each key stakeholder group, their roles in grid design, and the primary ways to engage with them. This page discusses state agencies and offices and federal partners; the following page details the ISO/RTOs and utilities.

Stakeholders	Role in Grid Design	How State Offices Can Engage
State Agencies & Offices Set strategic direction and policy goals related to design, and coordinate across agencies to align energy and infrastructure priorities		
State Energy Office (SEO)	Leads energy security planning; Manages federal grants; Coordinates across agencies on infrastructure goals	Drive Energy Security Strategy through SEP/SESP development; Coordinate priorities with utilities and federal partners
Public Utilities/Service Commissions (PUC/PSC)	Regulates utilities; Sets enforceable performance and design standards; Approves utility planning documents	Align regulatory requirements with Energy Security Strategy goals through integrated resource plan (IRP) approval and other criteria
Emergency Management (EM)	Consequence management for energy emergencies and hazard mitigation	Coordinate to align grid infrastructure priorities with state hazard profiles
Governor's Office	Sets energy policy through EOs and legislative guidance	Advocate for and advise on incorporating energy goals into law, programs, etc.
Federal Partners Establish regulatory frameworks, standards, and funding programs that shape what grid designs, resources, and approaches can be used		
Department of Energy (DOE)	Provides technical assistance, research, and funding for grid modernization, resilience, and cybersecurity	Access grid modernization grants, funding, and guidances aligned with the Energy Security Strategy
Federal Energy Regulatory Commission (FERC)	Regulates interstate and wholesale markets; Issues transmission planning rules and interconnection standards	Monitor FERC orders to understand federal requirements and identify where state authorities can align
Federal Emergency Mgmt Agency (FEMA)	Provides hazard-based awareness and their impacts on energy infrastructure	Reference FEMA hazard plans to address energy infrastructure vulnerabilities

Grid Designer Roles

STAKEHOLDER MAPPING

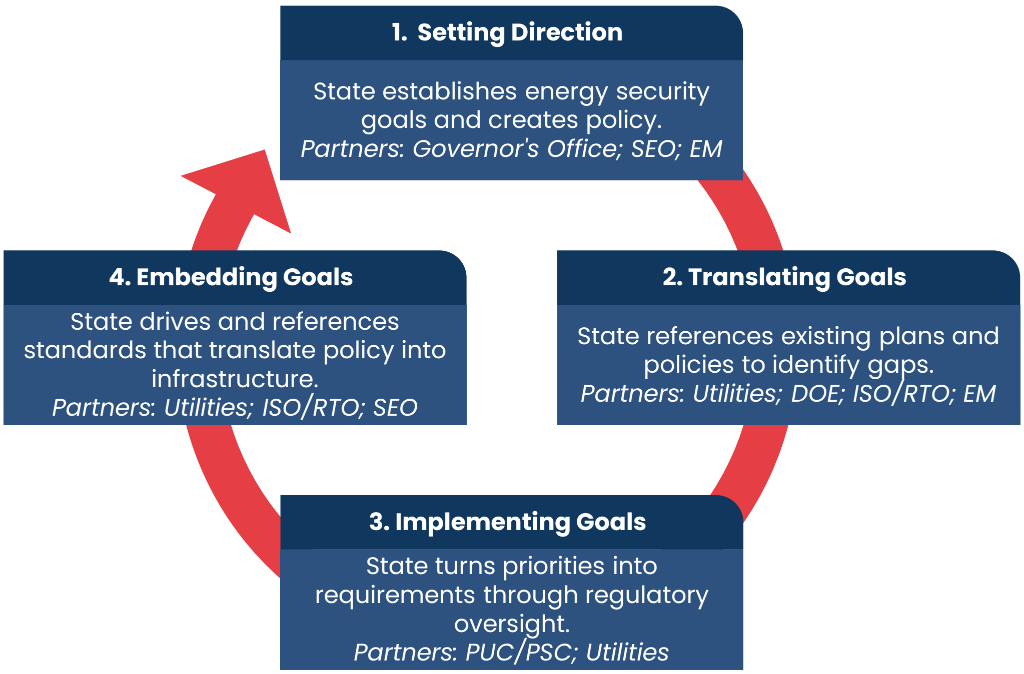
While government stakeholders like state agencies and federal partners establish the regulatory, policy, and funding environment needed for grid design, private partners like ISO/RTOs and utilities are responsible for the operations and planning and infrastructure decisions that ultimately determine whether state energy goals are realized in practice. These private stakeholders require different engagement approaches. For example, states lack direct oversight of ISO/RTOs, but have regulatory oversight over certain types of utilities. The diagram below maps each key stakeholder group, their roles in grid design, and the primary ways to engage with them.

Stakeholders	Role in Grid Design	How State Offices Can Engage
ISO/RTOs Manage bulk system by integrating regional priorities, market needs, regulation, and transmission planning considerations into grid design		
Regional State Committees (RSC)	Group of state PUC and appointed representatives in an RTO region, tasked to act as united voice and influence RTO priorities on transmission planning and operations	Coordinate with the state RSC representative to align on state Energy Security Strategy priorities and/or energy policy to ensure your state's position is reflected to the RTO
Utilities Design, build, and maintain grid infrastructure according to regulatory requirements, mandatory standards, market tariffs, and state/federal policy		
Investor-Owned Utilities (IOUs)	Own and operate transmission, distribution, and generation infrastructure; Develop IRPs for PUC approval; Regulated by state agencies	Work with government/state affairs representatives to achieve policy alignment; Engage technical and planning staff to ensure Energy Security Strategy Priorities are reflected in IRP submissions and utility planning and infrastructure design criteria
Electric Cooperatives & Municipal Utilities	Operate energy infrastructure (e.g., transmission, distribution, and generation assets) in rural or municipal areas; Not subjected to state regulation or oversight authority	Engage executive leaders and operations staff to understand organization's operational capacity and constraints to offer targeted support to help them execute state energy goals
Specialized Energy Partners (e.g., Joint Agencies, Green Banks, etc.)	Operate in the space between utilities and grid operators; Pools resources to purchase power, finance grid infrastructure projects, etc.	Coordinate with stakeholders to align partners' decisions with state energy goals; Identify funding opportunities for partners that support state priorities

Implementation Strategy

ADVANCING GRID DESIGN

Regardless of the energy security strategy a state pursues, the tools for advancing that strategy are the same. States work through four levers: policies, plans, regulations, and standards. Rather than thinking of these levers in isolation, they are best understood as a continuous cycle of planning and implementation, with flexible entry points, each phase building on the last, and infrastructure outcomes feeding back into setting direction. For each phase, the sections below describe the specific levers available, state actions in the phase, and key partners involved.



1. Setting Direction

Levers: *Legislative Policies; Plans (e.g., SEP/SESP)*

Role:
- Use existing risk assessments to identify high risk assets or areas to focus design efforts.
- Use SESP/SEPs or legislation to translate policies to planning priorities.
- Advise on legislation establishing energy goals.

2. Translating Goals

Levers: *Plans (e.g, IRPs, hazard mitigation plans); Federal programs or policies*

Role:
- Reference IRPs to identify where plans diverge from state goals.
- Use hazard mitigation plans to align grid design with risk priorities.

3. Implementing Goals

Levers: *Regulations (PUC/PSC); Plans (utility IRP & filings)*

Role:
- Review utility filings to identify where state direction can strengthen decisions.
- Work with PUC to codify priorities into requirements, explicitly or with incentives (e.g., grants).

4. Embedding Goals

Levers: *Standards (e.g., NERC, federal policies, utility frameworks)*

Role:
- Establish reporting requirements for utilities that surface instructure gaps and inform future planning.
- Adopt or reference federal or industry standards as the floor, or use to strengthen state guidelines.

Diversification Strategy Approach

OVERVIEW

Diversification focuses on reducing system-wide risk by incorporating a mix of generation sources, fuel types, and technologies. Pursuing this strategy requires balancing its objectives with operational realities, including fuel availability, resource costs (e.g., cost of natural gas or constructing utility-scale solar PV), and technical limits of the transmission and distribution system. Further, a diverse energy mix increases reliance on supporting systems and sectors, like communications. Therefore, it is important for states to account for these dependencies when planning, as diversification can shift or reduce risk, but not eliminate it. From a design perspective, diversification is less about adding indiscriminate capacity and more about maintaining options and flexibility for resources that help the grid run when certain assets or fuels are disrupted.

This section translates diversification into specific priorities across three levels of the grid: distribution, transmission, and capacity/generation. At each level, design criteria are shaped by the strategy's goals and advanced through the levers available to state offices. Refer to the examples in the diagram below to understand what implementing diversification looks like in practice and how your levers can be used at each level.

Distribution

- Set interconnection standards that make it easier for a variety of distributed resources to connect to the grid, reducing resource dependence.
- Use state policies (e.g., energy, emergency planning, etc.) to justify investment or support for critical facilities to have backup generation capability (e.g., rooftop solar, backup generator, microgrid) to ensure optionality in grid operations.

Transmission

- Require utilities to specifically demonstrate how their transmission plans account for growing resource diversity and locations of assets.
- Coordinate with ISO/RTOs and RSCs to reference regional transmission plans to identify where transmission constraints are limiting the ability to deliver or receive power; can also use findings to justify state investment or requirement setting at utilities.

Capacity/ Generation

- Use legislation or executive action (e.g., clean energy laws) to set measurable targets that require utilities to diversify their generation mix.
- Review utility IRPs requirements and PUC approval criteria to ensure that new generation assets increase both capacity and resource diversity on the system.

Economic Strategy Approach

OVERVIEW

The economic strategy approach prioritizes investment in infrastructure and specific energy sources, and ensures they are integrated into the system in a cost-effective manner. Economic stability depends on communications, energy, and transportation sectors, making cross-sector coordination essential to any effective strategy. From a design perspective, the strategy emphasizes investments in areas of the system where economic value can be maximized, such as connecting available and sufficiently-sized generators, supporting economically-critical loads (e.g., large loads, industry), and enabling deferment of more expensive projects. While this approach can accelerate the deployment of infrastructure, it can potentially defer risks to the future and reduce resilience capabilities.

This section translates economics into specific priorities across three levels of the grid: distribution, transmission, and capacity/generation. At each level, design criteria are shaped by the strategy's goals and advanced through the levers available to state offices. Refer to the examples in the diagram below to understand what implementing economics looks like in practice and how your levers can be used at each level.

Distribution

- Reference state economic development policies alongside existing PUC requirements to direct utility investment towards high-value loads (e.g., dense commercial areas) where outages can carry high economic costs.
- Use the VRA to identify the highest impact hazards and advise on cost-effective infrastructure upgrades (e.g., grid enhancing technologies) that can mitigate these hazards.

Transmission

- Establish cost recovery mechanisms or other financial offsets to make efficiency projects, like hardening infrastructure (e.g., undergrounding lines prone to storms), financially viable for utilities.
- Provide guidelines to utilities on performing comprehensive economic justification (e.g., avoided costs of future risks or projects) as part of planning processes.
- Work with ISO/RTOs to advocate for smoother interconnection processes to unlock lower-cost resources.

Capacity/ Generation

- Use state and federal incentive programs (e.g., tax credits, grants) to lower the cost of preferred generation types and make their investment feasible and attractive to utilities and independent power producer (IPPs).
- Use IRP approval authority to require utilities to demonstrate that generation additions are adequately sized to accommodate future projected load growth.

Resilience Strategy Approach

OVERVIEW

The resilience strategy approach treats resilience as a system-wide objective that transcends planned physical infrastructure by implementing innovative use of technologies, tools, and processes. The goal is not only to reduce the likelihood of disruptions, but also to assess hazard exposure, cross-sector interdependencies, and operational flexibility to limit the duration and consequences of disruptions when they occur by. However, a key risk of this strategy is the use of technology, which can introduce secondary risks, such as cyber and physical security risks. States should engage federal partners, particularly DOE, when assessing and mitigating these cyber and physical security risks using the tools and processes developed for risk assessment. Under the design framework, resilience emphasizes grid survivability when conditions are degraded and prioritizes capabilities that enable operations during these times. This section translates resilience into specific priorities across three levels of the grid: distribution, transmission, and capacity/generation. At each level, design criteria are shaped by the strategy's goals and advanced through the levers available to state offices. Refer to the examples in the diagram below to understand what implementing resilience looks like in practice and how your levers can be used at each level.

Distribution

- Reference state emergency plans (e.g., hazard mitigation plans, SESPs) to identify which areas face the greatest risk from specific hazards and use findings to direct where standards or hardening requirements should apply to first, or be designed to address.
- Use PUC or state legislation to require asset hardening and redundancy measures (e.g., hazard-based infrastructure design like construction standards) at critical facilities so they can operate during degraded conditions.

Transmission

- Adopt federal or third-party (e.g., NERC) reliability standards as state minimums for transmission design, and either expand them in areas where vulnerability and risk assessments (VRAs) or other state plans identify greater hazard exposure or target investment in those areas.
- Review and tie design standards to current hazard profiles (e.g., wildfire, flood risk) to ensure assets can withstand state-specific disruptions.

Capacity/ Generation

- Reference DOE technical assistance or research resources to identify appropriate advanced technologies that can be used as IRP approval criteria to enhance system management capabilities.
- Require or advise utilities to include resilience analysis (e.g., model generation performance under extended disruptions, fuel supply constraints, winterization) in IRPs or other planning submissions to ensure resource adequacy accounts for survivability.

Resource Adequacy Nexus

GRID DESIGN & RESOURCE ADEQUACY

Resource Adequacy is a fundamental challenge in grid planning. It's not just about having enough capacity; it's also about whether the right resources are available, in the right place, at the right time. A grid that looks perfect under normal operating conditions can quickly fall short in the face of fuel supply chain disruptions or transmission constraints.

From a design perspective, resource adequacy appears as an outcome of the design decisions made by states and utilities. Because the generation mix, transmission infrastructure, and distribution systems all determine whether the system can meet demand, all design standards, planning requirements, and investment decisions become adequacy decisions. The Energy Security Strategy pursued further shapes how adequacy is defined and addressed, with each Security Strategy leading to different design priorities and levers for addressing gaps. This section examines how resource adequacy is shaped by each Energy Security Strategy: what adequacy challenges the strategy exposes, and what design levers or actions are available to dress them.

	Adequacy Challenges	Actions & Levers
Diversification	• Diverse energy mixes increase system complexity and shift risk; managing multiple resources creates coordination challenges for supply management. • Utilities may not be meeting diversification goals in practice (i.e., uses low capacity assets).	• Use IRP approval criteria to require utilities to demonstrate how their assets perform under stress. • Use design standards to ensure diversified resources are adequately sized to serve current demand, and are scalable/planned to address future load growth.
Economics	• Transmission is underinvested in, creating uneconomic cost constraints due to congestion and reducing access to cheap energy. • Economics favors large-scale assets, so any fuel supply or operational disruptions can cause cascading impacts to the system.	• Use PUC mechanisms (e.,g plans approvals, rate incentives) to ensure transmission plans account for redundancy and/or efficiency. • Explore regulatory authority over economic risk mitigation tools (e.g., require winterization) and use authority to reduce asset exposure that can cause economic harm.
Resilience	• Cross-sector dependencies have naturally occurring risks that might not be planned for (e.g., comms outages affecting system monitoring). • Adequacy isn't inherently resilient; having capacity for normal demand isn't always applicable to prolonged, disrupted operations.	• Require utilities to outline how their plans address prolonged disruptions and can sustain critical functions during cross-sector issues (e.g., degraded comms). • Through IRP requirements, utilities must demonstrate their capacity can perform under state-specific hazard scenarios.

Energy and Emergency Planning and Integration Crosswalk (EEPIC)

Energy Risk and Criticality

Energy Risk and Criticality

OVERVIEW

Energy risk and criticality is the potential for energy infrastructure assets to be impacted by natural and man-made hazards, due to asset susceptibility to hazards, impacts of disruption on connected systems, presence or lack of redundancy, and the asset's historical performance.

Understanding energy risk and criticality is important because natural or human-made risks to energy infrastructure affect security, reliability, and resilience. If these risks are determined in disparate, poorly communicated ways, that can cause gaps in planning and resources for many stakeholders. This section aims to enable better communication between government and private stakeholders by suggesting a standardized method for assessing system-level risk.

Outline

HOW TO USE THIS FRAMEWORK SECTION

This module suggests a method of addressing the lack of uniformity in risk assessment methods using a resources called the Consolidated Risk Spectrum. The Consolidated Risk Spectrum, as previewed below, is a four-step process that enables users to build a shared understanding of risk that considers multiple disparate assessment processes. Users are able to use results of Steps 2-4 to assess or understand the best choice for Step 1. Alternatively, the choice in Step 1 can be used to heavily influence decision-making in Steps 2-4.

Step 1 — **Communicating Criticality:** Understand how the Energy Security Strategy chosen in the User Guide affects how you address and communicate energy criticality.

Step 2 — **Risk Assessment:** Consider multiple aspects of risk, such as probability and tolerance, and analyze outcomes of existing risk assessment processes.

Step 3 — **Dimensions of Energy Risk:** Analyze the effects these risks will have on the system.

Step 4 — **Criticality Matrix:** Determine how critical an asset is based on the Dimensions of Energy Risk.

Energy Risk and Criticality

OPPORTUNITY STATEMENT

There is no uniform method for determining risk or the certainty of of energy infrastructure assets. If this alignment were achieved, it would help organizations build a general understanding of how specific circumstances might impact what is considered essential.

To address this challenge, this section will enable users to develop a Consolidated Risk Spectrum. The Consolidated Risk Spectrum is a multi-step process integrating various stakeholder resources. It is focused on defining risk as a strategic concept rather than conducting discrete risk assessments, providing a shared framework to align stakeholder planning efforts and improve translation of state-level priorities into utility risk assessments and their outputs.

GAPS

No Single Method for Assessing Risk	Different organizations—both state agencies and utilities—define and assess risk differently, leading to inconsistent planning approaches and standards across the state. These differences are driven by varying decision-making frameworks, including how organizations prioritize risk (e.g., based on likelihood and impact or the relative cost of mitigation and consequences). Organizational capabilities also shape these approaches, as technical, operational, and financial constraints influence how risks are understood and addressed.
Uncertainty of Service for Critical Functions	The lack of uniform risk assessment methods is further challenged by the lack of clarity regarding service for critical functions. More specifically, there's no uniform method to determine or communicate what makes an asset "critical." This distinction is important because how risk is determined and mitigated directly affects the measure of asset criticality.

MODULE GOALS

Share ideas on what organizations can do after assessing critical infrastructure risk.	Understand the differences between system-level vs. individual risks.
Explain how organizations can define risk for their own critical infrastructure.	Navigate various risk tolerances across multiple entities and assets.
Recommend ways organizations can work together to create a standardized risk assessment process.	Improve methods of identifying and mitigating risk, especially regarding interregional connections.

STEP 1

Communicating Criticality

ENERGY STRATEGY AND CRITICALITY NEXUS

It's important for state officials to understand how their chosen Energy Strategy addresses system criticality and how their decision-making processes might differ from that of infrastructure owner/operators. It's normal for the state to address criticality issues through policy measures, regardless of the chosen energy strategy. Sometimes, this may differ from infrastructure owner/operators and other state offices, who may choose actions that don't fully accomplish state goals. The table below analyzes how how criticality is addressed and implemented through each Energy Strategy.

As suggested in the User Guide, officials are encouraged to choose their energy strategy prior to beginning the Consolidated Risk Spectrum. By doing so, the risk calculation created by the Consolidated Risk Spectrum will be better understood as a result of the desired strategy. However, the strategy can be chosen after conducting the Consolidated Risk Spectrum by analyzing which strategy is the best fit for the results.

Energy Strategy	Definition	How Criticality Is Addressed	Implementation
Diversification	Increase the redundancy of the energy system through scaled, balanced investment to reduce the risk of state dependence on a single energy source, fuel type, or physical asset, that, if left unaddressed, could become a single point of failure in a system.	Ensuring one type of energy source or asset that is susceptible to a particular risk type doesn't dominate system generation capacity by promoting buildout of excess generation assets through financial or regulatory policy initiatives.	Infrastructure owner/operators internally implement renewable energy build out in IRPs to be in compliance with state regulations or supports developers in interconnection processes.
Economics	Prioritizing risk mitigation of certain energy types, assets, or system nodes based on economic contribution.	Identification of nodes or assets that need to be strengthened or hardened due to economic importance (e.g., large loads); or, providing subsidies for an energy type due to its economic/quality of life importance to a community.	Infrastructure owner/operators increase generation capacity, in line with state policies and incentives, to serve and protect new/increased load such as a data center.
Resilience	Strengthening an energy system through the innovative use of technologies, tools, and processes.	Protect the system, assets, or loads from hazards by instituting specific policy measures (e.g., requiring battery storage be paired with all upcoming solar energy projects over a certain megawatt).	Infrastructure owner/operators manage demand challenges on system by implementing demand response measures for energy efficiency.

STEP 2

Risk Assessment

HOLISTIC RISK

This Risk Assessment process builds off existing resources to help users consider multiple aspects of risk, including determining what risks to prioritize as a function of likelihood and impact, identifying the thresholds of acceptable risk to establish mitigation targets, and integrating current government and private sector plans to maximize compatibility. This process focuses on understanding and aligning existing definitions and outcomes, rather than conducting a new or standalone risk assessment.

The type of outage, whether controlled (the deliberate loss of assets) or uncontrolled (the unintended loss of assets), and its cause, such as cold weather, derechos, or floods, can affect risk calculations based on relative severity and asset impacts. These factors shouldn't drive decision-making because the risks themselves are inherently uncontrollable and their mitigation falls primarily to infrastructure owners and operators. State officials should instead focus on what they can control: determining what risks exist, and using policy, regulation, or financial assistance to help identify and communicate them. It is also worth noting that risk may be defined differently across state resources and infrastructure owner planning processes. Users should analyze these differences to identify commonalities that can shape a shared interpretation of risk.

This process requires gathering and analyzing key documents from state offices, including the Threat and Hazard Identification and Risk Assessment (THIRA), State Energy Security Plan (SESP), and others that address infrastructure risk. The following page outlines how to best maximize the Risk Assessment process, including how to best utilize these documents and key factors and questions to consider when analyzing them.

Probability vs. Impact Matrix	+	Risk Tolerance Level	+	Vulnerability and Risk Assessment Outputs	=	Holistic Risk
Integrate risk assessment processes from gov't and private sector to determine what vulnerabilities drive risk (i.e. THIRA, North American Electric Reliability Corporation (NERC) Reliability Assessments).	+	Consider the thresholds for risk mitigation relative to the availability and performance of energy infrastructure and service delivery to meet state energy security priorities.	+	Identify and incorporate the results of current SESPs and Vulnerability and Risk Assessments (VRA) to ensure alignment.	=	Determine how critical an asset is through an understanding of its characteristics.

STEP 2

Risk Assessment

OPTIMIZING THE PROCESS

Components Of The Risk Assessment	How This Informs The Risk Assessment Process	Considerations	Guiding Questions
Probability vs. Impact Matrix	• Resources like the THIRA identify what the state has already highlighted as hazards and can be used to determine impacts to a specific asset. • NERC Reliability Assessments examine overall potential risks and impacts to the system and can be used to better inform analysis of risk probability and impacts to assets.	• How assets are affected by varying risks (e.g., asset is vulnerable to fuel supply challenges but not floods). • The extent to which future risk is considered in present-day assessments. • How impacts of a risk effect interpretation. • How to reconcile resources that identify or interpret risks differently.	• Are there other resources you can use to determine risk or analyze additional ones? • Which is more important: the probability or the impact of a risk?
Risk Tolerance Level	• Influences how individual risks are evaluated and prioritized. • Essentially defines "risk" (i.e., risk threshold is amount of risk you're willing to accept).	• How future potential risk impacts present-day tolerance levels. • Impacts to infrastructure (e.g., resource/fuel availability, lifecycle, etc.). • How risk manifests (e.g., degradation or destruction of system).	• How high can risk tolerance be before system operations are severely degraded? • How might this decision impact asset performance and availability standards in the future? • How is tolerance varying by risk type?
Vulnerability And Risk Assessment Outputs	• SESPs can be used to validate or further analyze results and findings from previous components (e.g., provides risk/hazard profiles and assessment, mitigation measures, etc.).	• How to reconcile different results between SESPs and other resources like THIRA. • Cross-sector impacts.	• What does it mean if a risk is presented multiple times across or within documents? • What if a particular asset (type) is repeatedly affected?

STEP 3

Dimensions of Energy Risk

DRIVERS AND VARIABLES OF RISK

The Dimensions of Energy Risk analyzes the effects four different risk variables can have on the energy system. To conduct this analysis, users will need to understand demographics and asset-specific information, such as its location in the system and (inter)dependencies, much of which can be sourced from utility partners and their planning resources. This will support defining risk, enabling states to better interpret and influence how utilities assess and prioritize risk. This step complements the likelihood-based analysis in Risk Assessment. States must weigh not just how likely a vulnerability is, but also its consequences if realized: a low-probability event with severe consequences can warrant more attention than a frequent one with minimal impact.

The first two risk variables are ***geographic scale*** and ***duration***, which evaluate impacts at a higher level. The second set of variables are ***societal change*** and ***cross sector impact***, which help assess how disruptions affect communities and interconnected systems. Together, they provide a structured way to understand priorities and guide planning decisions. It is important to recognize that risk levels shift depending on context: an outage that is low impact under normal conditions may become high risk during periods of increased demand, and monetary or economic considerations, such as the costs of disruption, can further elevate the severity of certain impacts.

To better aid users in their analysis of what drives risk across their energy system, the following pages detail each of the variables and their characteristics. The variable's risk levels are color-coded in green, yellow, and red to denote low (1), medium (2), and high (3) risk, respectively. The overall risk level is the average of all four variable scores, where low risk is ≤1.5; medium is between 1.51 and 2.4; and high is ≥2.5. These color designations, seen below, will be useful in analyzing the results of the Consolidated Risk Spectrum.

Variable #1: Geographic Scale

Evaluate how the impacts of risk increase in proportion to the scale of the energy systems impacted in an event.

Variable #2: Duration

Assess thresholds for time-driven disruptions that result in cascading impacts to people and interdependent systems.

Variable #3: Societal Change

Understand the severity of impact based on three tiers:
1) Population Vulnerability
2) Public Health/Safety
3) Potential for Permanent Relocation

Variable #4: Cross Sector Impact

Crosswalk the FEMA Community Lifelines to assess the extent of multi-sector impacts due to asset or system degradation, disruption, or destruction.

Low Risk	Medium Risk	High Risk

STEP 3

Dimensions of Energy Risk

VARIABLE 1: GEOGRAPHIC SCALE

Risks to infrastructure impact the energy system differently depending on the level of the system the asset lies on. Understanding these risks allows for better determination of the actions that should be taken to mitigate them. There are three main levels of scale along the energy system to consider: local (distribution infrastructure), state (transmission and generation), and multi-jurisdictional (regional bulk electric system (BES)).

The table below provides examples of how low, medium, and high risks to assets can impact the system at each grid level. Each risk level provides further examples of what types of risk exist and the ways in which they impact energy systems. Note that while low levels of risk have little effect on the energy system, particularly at the local level, high risk levels can drive increased costs, losses, and resource demands.

	Asset Risk Level		
System Level	**Low** *Maintenance issues, localized outages, slight changes in supply and demand, supply chain delays, accidents.*	**Medium** *Critical equipment failure, environmental events, regional demand spikes, cybersecurity, policy change.*	**High** *Large-scale environmental events, cybersecurity or physical attacks, resource scarcity, safety incidents, significant policy change.*
Local	Brief, localized outages impact community lifelines and functions. Delays in maintenance; may cause significant issues over time.	Harm businesses and quality of life. Little to no redundancy if asset becomes inoperable; can stress wider system.	Devastation of communities, particularly over long periods (e.g., blackouts, damage, hazards like pipeline explosion).
State	Frequent/repeating issues on individual assets may impact compliance and overall cost for operators.	Physical harm to people and equipment. Needs for replacements and upgrades cause serious disruptions to energy delivery.	Widespread outages and economic loss. Impedes emergency response and impacts other infrastructure systems.
Multi-jurisdictional	Minimal impact, even when aggregated, due to size and interconnectedness of systems.	Reliance on interregional transfers, assuming connections work or exist. Cost/price volatility.	Stress to regional and national grid can impede interregional transfers and economics (e.g., factories can't produce export goods).

STEP 3

Dimensions of Energy Risk

VARIABLE 2: DURATION

The length of time a grid asset is inoperable can seriously impact the performance of other grid assets within a connected system, including the energy customers the asset serves. Longer duration outage events can significantly increase economic and societal consequences as performance degrades over time. The minimum acceptable duration of an asset being inoperable represents its criticality to the system.

Duration is broken into three timeblocks: 6-24 hours; 24-72 hours; and over 72 hours. Each time frame carries its own set of corresponding impacts to people, operations, and physical infrastructure as a result of the extended power outage. While there may be common themes between the timeblocks, the severity of the effects and impacts increase with the outage duration.

Utilize the diagram below to analyze and understand the risk of an extended outage. Consider:

- What energy customers and connected infrastructure depend on that asset's operation, and what happens to them when electricity service is lost?
- How do these timelines affect state priorities for energy emergency response planning?
- How are compounding financial impacts affecting the risk level?

	Effects	Impacts to Infrastructure
6-24 Hours	Common timeframe primarily impacting quality of life (e.g., loss of home energy, businesses). Minor health & safety concerns (e.g., food spoilage, electrical medical equipment).	Backup battery on communications towers last ~8 hours, restricting time for power restoration. Reliance on backup generation, if equipped.
24-72+ Hours	Moderate impacts to health & safety, economics, and infrastructure (e.g., certain functions cease due to lack of power, loss of communications). Extended planning/resources may be required to protect and provide for the population.	Typical stored fuel for backup generation is only enough for ~72 hours and may begin to run out, depending on use. Long term impacts to non-operating infrastructure (e.g., bacteria at wastewater treatment plant die if not "fed").
72+ Hours	Severe impacts to population health & safety and economics (e.g., businesses close, slow/no transportation, poor/low medical care access). Property damage due to lack of heating/cooling.	Outages over this timeframe are eligible for federal assistance. Requires extensive coordination across sectors and organizations to restore the system safely.

STEP 3

Dimensions of Energy Risk

VARIABLE 3: SOCIETAL IMPACT

Energy is one of the most important tools we have to sustain societal functions. While numerous modeling tools exist to help us understand the technical underpinnings of losing a grid asset, **Societal Impact** helps interpret how the loss of electrical service can affect the essential services people rely on. **Societal Impact** is divided into the three categories below: Population Vulnerability, which primarily deals with quality of life; Public Health and Safety; and Permanent Relocation/Mass Migration, which describes the longer-lasting socioeconomic impacts of outages.

This variable should be used to interpret how asset loss translates into broader societal risk, enabling users to poritoritize planning efforts. Notice below how the severity increases across these categories, demonstrating how disruptions can escalate from immediate service impacts to long-term societal consequences. This progression helps users evaluate both direct effects and their impacts over time.

Population Vulnerability

Endangers public safety through slow or absent transit options. Safety enforcement resources, like law enforcement officers (LEOs), may be engaged in other activities.

Impacted quality of life (e.g., economic well being, loss of electricity for food storage, medical supplies, essential services).

Public Health & Safety

Disruptions to medical facilities including hospitals, nursing homes, and pharmacies can result in poor quality medical care or the complete loss of services.

Water infrastructure may also be affected, leading to reduced access to potable water, causing the spread of infectious diseases.

Permanent Relocation/Mass Migration

Businesses closing due to extended power outages undercuts financial stability, resulting in job losses for the local population and long-term losses of tax revenue for governments.

Long and/or recurring outages cause pre-existing business to permanently close and deter future investment in communities.

STEP 3

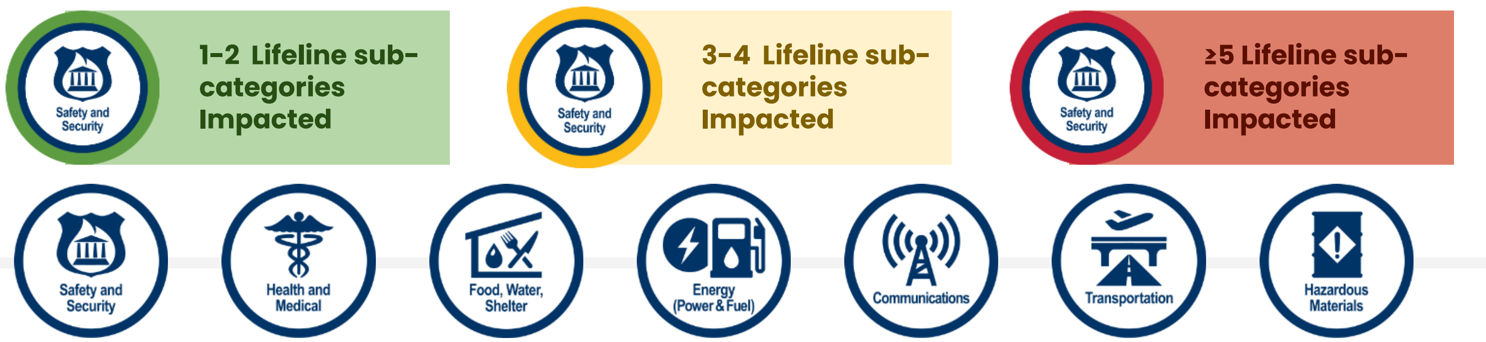
Dimensions of Energy Risk

VARIABLE 4: CROSS SECTOR IMPACTS

As previously discussed, energy is utilized is almost every aspect of our daily lives, and numerous critical systems (e.g., transportation, communication, and health) are dependent on energy. When the loss of an asset prevents energy transmission, the effects reverberate across multiple sectors.

The final variable of the Dimensions of Energy Risk analyzes cross sector impacts **Cross Sector Impacts** using the FEMA Community Lifelines to understand the cross sector role of an asset and its effects on communities and the system. Below, the diagram shows the increasing severity of risk when more than one Lifeline is affected. Note that this section is agnostic to which specific lifeline is affected. However, outside of this process, users are encouraged to conduct further analysis of the subcategories in each lifeline to gain full understanding of the risks to other sectors.

Users should refer to Annex A for the full list of the FEMA Community Lifelines.



EXAMPLE: DETERMINING DRIVERS OF RISK

Step 3 of the Consolidated Risk Spectrum identifies what is driving the state's risk calculations. The table to the left demonstrates how to interpret the results using the example of an asset operating in cold weather. Each variable's risk is scored on a three-point scale-high (3), medium (2), or low (1)- with the overall risk level being the average of all four scores.

The primary risk driver is the regional scale of impact from the loss of this asset (high). While the outage duration is relatively short-term (medium), few people and critical sectors are affected (low). Per the average of these scores (1.75), this asset's overall risk level is medium (2).

Scenario: Cold Snap

Scale	Local T&D	BES	Regional
Duration	<24 Hours	24-72 Hours	72+ Hours
Population	Vulnerable	Health & Safety	Mass Migration
Cross-Sector	1-2 Lifelines	3-4 Lifelines	≥5 Lifelines

Risk Level: Medium

STEP 4

Criticality Matrix

INTEGRATING RISK METHODS

The Criticality Matrix is the final step in the Consolidated Risk Spectrum. Here, users determine how critical an energy asset is relative to other infrastructure by identifying and assessing its overall risk and performance as part of the larger energy system. This calculation is not solely about scoring assets, but about determining the contributing factors in forming a risk definition. To best complete this matrix, users may need to work with infrastructure owner/operators to gather data on resources and historical performance of assets. The process described in the following pages is not prescriptive and users should feel welcome to adjust the process to suit their needs.

The first step of the matrix is to gather findings and external resources from the Consolidated Risk Matrix, to be used as inputs to the matrix. Then, using the example questions below, analyze the findings from both the Risk Assessment (Step 2) and Dimensions of Energy Risk (Step 3). Finally, using data regarding infrastructure performance and resources, analyze the performance of the asset.

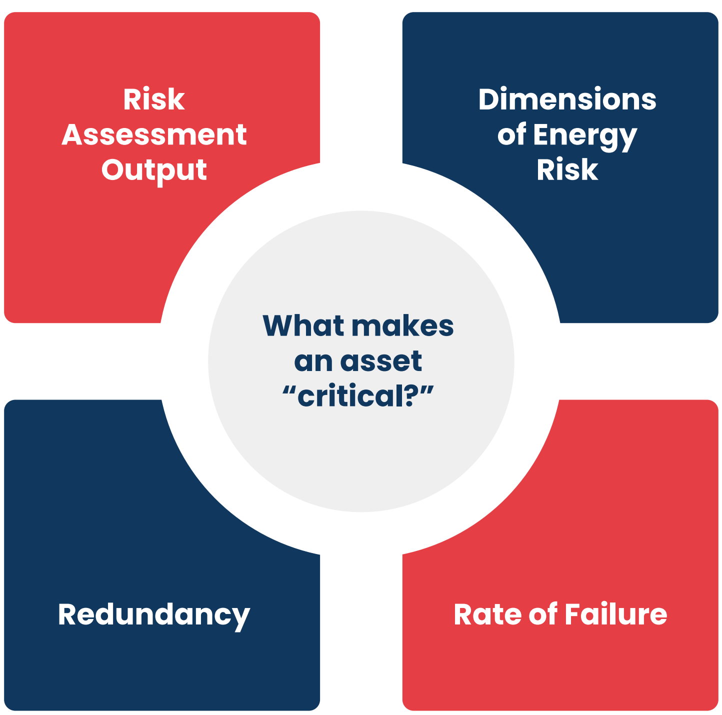
The Criticality Matrix utilizes a three-point system, symbolizing low (1), medium (2), or high (3) risk, which is used to rank the findings of each category, and includes the previous risk level of the Dimensions of Energy Risk. Using this scoring system, a high-capacity generation asset with limited or no comparable asset would indicate a high redundancy risk score (3). The points for each category should be added together to determine the criticality of the asset, with a score limit of 12. These scores should be interpreted as indicators of how risk is defined and prioritized, rather than a precise measurement. In general, an asset is Critical if the total score is 10 or more. The following page provides a table for calculating risk levels across each category.

Susceptibility to Risk

What was the outcome of the risk assessment? An asset with a high likelihood of experiencing a risk that you can't reasonably tolerate should be rated as highly critical.

Risk Drivers

What is the primary aspect of risk? Does the asset serve a densely populated area? Is it an important regional asset? Would it take a long time to repair or replace?



Single Point of Failure

Can the functions on this asset be supplemented or replaced by another resource, asset, or capability with minimal impact?

Historical Performance

What is this asset's historical performance? What stage of lifecycle is this asset in? Think about what risks an aged asset poses to system operations.

STEP 4

Criticality Matrix

USING THE CRITICALITY MATRIX

Below is the scoring method for understanding the results of the Criticality Matrix for both individual assets (based on the average score created in Step 3) and the overall score (the total of the four scores).

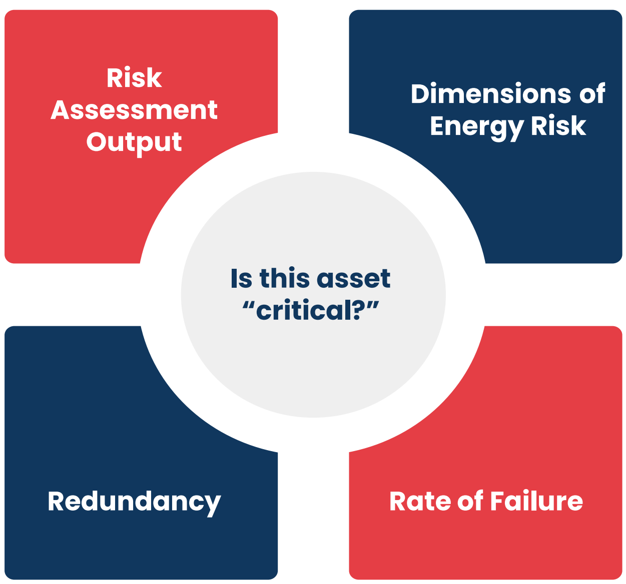
Individual Asset Score (Dimensions of Energy Risk)	Low Risk *(1)*		Medium Risk *(2)*		High Risk *(3)*
Criticality Score (Total Added)	Low *(4-5)*	Medium *(6-7)*	Moderate *(8-9)*	*Critical* *(10-12)*	

EXAMPLE: DETERMINING CRITICALITY

Below is an example of how to best conduct the Criticality Matrix using the example of a large solar farm built for the primary benefit of supporting a new data center campus.

The solar farm is inherently variable. If lost, the data center can use back-up generation. However, the loss of the solar farm can have other effects for meeting demand across the system.

The loss of the solar farm can impact multiple communities. An extended outage can increase reliance on backup and other system resources to meet demand and disrupt digital services.



This is a high capacity asset with a high capacity factor. If lost, utilities may need to dispatch higher-cost resources or shift system priorities to maintain reliability.

This asset is fairly new and has never failed.

	Risk Assessment Output	Dimensions of Energy Risk	Redundancy	Rate of Failure	Criticality Score
Score	2	3	2	1	8

Result

This asset criticality score is "moderate" due to its medium risk assessment score, the existence of unfavorable but redundant assets, and nonexistent rate of failure. **However,** it is still critical and poses a high risk to the system due to its risk drivers, particularly its extensive cross sector and geographical scale impact.

STEP 4

Consolidated Risk Spectrum

UNDERSTANDING THE CONSOLIDATED RISK SPECTRUM

The final step of the Consolidated Risk Spectrum is to analyze and interpret the inputs of each step to understand the results of the overall risk assessment. This will allow officials to do two things. First, this process produces a common understanding of what ***risk*** means and how it is defined. Secondly, this new definition can be used to communicate to utilities what energy issues the state is concerned about and how it wants to address them. The table below helps officials better interpret the meaning behind the inputs in each step of the Consolidated Risk Spectrum process. However, this table is not prescriptive and should be used as a guiding tool during and after the analysis and scoring process.

	Risk Level		
Consolidated Risk Spectrum	**Low**	**Medium**	**High**
Energy Security Strategy	Chosen strategy existed in policy prior to conducting module and is already implemented or in progress; Further efforts will improve existing plans and likely will not require significant, new resources.	Chosen strategy existed in policy to some degree prior to conducting module and is partially implemented or in progress; Further efforts will improve plans or take new direction, likely requiring new resources.	Chosen strategy did not exist prior to module; All efforts to achieve the strategy will require significant resources.
Risk Assessment	Common definition of ***risk*** exists between state and utilities; low probability of risk, or risks are known and already mitigated (e.g., state is prone to flooding and regs. already exist); Risk tolerance is appropriate for existing vulnerabilities.	Some common definition of ***risk*** exists; several risk types aren't mitigated, leaving asset(s) vulnerable; General lack of alignment between different risk assessment processes; Risk tolerance may need to lower across key vulnerabilities.	Disparate definitions of ***risk*** exist across state, utilities, and risk assessment processes; Existing risks are not or are inadequately mitigated; Risk tolerance is higher than appropriate for existing vulnerabilities.
Dimensions of Energy Risk	Low/minimal risks to the system that are either easily mitigated or are already mitigated through existing policy or regulation; Further efforts to protect system will be based on improvements.	Notable risks to the system are identified, and mitigations will need to be identified or strengthened through existing policy or regulation.	Severe risks to the system that are not currently or thoroughly mitigated; Concentrated efforts in policy and regulation are needed to address challenges.
Criticality Matrix	Asset(s) deemed not critical due to low risks identified across all categories.	Asset(s) deemed critical due to moderate to severe risks across at least 1-2 categories; Requires stakeholder engagement and some policy or regulatory changes.	Asset(s) deemed critical due to high level of risk across at least 3 categories; Requires extensive stakeholder engagement and policy or regulatory changes.

Resource Adequacy Nexus

RISK-DRIVEN PLANNING

Energy risk and criticality and resource adequacy are closely related issues that can significantly impact the performance of the energy system. To mitigate these risks, effective resource planning is essential to ensure that load demands can be met. This approach not only improves the performance of assets but also increases the diversity of generation resources and redundancy. The risk assessment conducted in this module aids in identifying which of the assets require further attention.

A key aspect of understanding an asset's criticality is to determine its historical performance and the presence of backups that can match its generation contribution to the system. If an asset is failing in these attributes, then conversations around resource adequacy become crucial. In particular, you should address how to incentivize infrastructure owner/operators to replace or perform maintenance on the asset, which mitigates the risk this asset poses to the system.

During conversations about resource adequacy, many officials and infrastructure owner/operators point to interregional transfers and transmission as the best solution to managing energy supply and demand needs. However, it's important that assets which play major roles in the bulk electric and/or regional systems are thoroughly assessed for any risks they may pose or be affected by.

For example, an aging fossil fuel power plant located in a storm-prone area and serves several critical loads, including a military base—it is a high risk and a critical asset. If weather challenges caused it to fail without sufficient backups, there would be detrimental cascading impacts across the system. This module is designed to help identify these kinds of issues and communicate the need for appropriate resource planning to make the system less reliant on these kinds of assets.

What does it look like in practice?

Identification of Problem

An aging, outage prone natural gas plant exists in the central but rural part of the state. The closer it gets to full capacity, the more it breaks. Meanwhile, several assets (fossil fuels and DER) are either in utility connection queues across the state or are being built.

Solutions Brainstorming

Two problems exist: a poorly maintained asset and a large generation queue. It's determined that state policy should support prioritizing assets in queue that'll serve critical loads/nodes, particularly the one in question, and allow for rate increase to support the cost of maintenance on the natural gas plant.

Impact on Systems & Policy

State mitigates risks to the energy system, both broadly and to the natural gas plant itself, by ensuring generation assets can access and provide service to the grid.

While this example leans towards a ***resilience*** strategy, more work can be done by users to ensure methods validate the chosen security strategy.

Energy and Emergency Planning Integration Crosswalk (EEPIC)

Restoration Prioritization

Restoration Prioritization

MODULE OVERVIEW

The order electricity customers are restored determines the extent of a grid outage impact. The longer an outage persists-or the order power is restored-for any individual energy load, the more public health, safety, and economic well being are threatened. Utilities have restoration plans that are not well-understood by the state, leaving an unclear picture of how decisions are made. Building a prioritization model closes that gap by clarifying how and why specific electric loads are selected for restoration based on grid conditions, contractual agreements, and their function in support of community lifelines. When the state and utilities determine this priority load criteria, both sides have a shared basis of understanding that sets expectations, expedites restoration, and streamlines decision-making during energy disruptions.

HOW TO USE THIS MODULE

This module helps states align utilities with their energy strategy and priorities by providing a means to determine how critical electricity loads and customers are identified and selected for priority restoration. Users will begin with an understanding of gaps in current planning, which create disparities in how electricity customers within the same state are impacted differently by the order in which their service is restored. This will support users in navigating Step 2 and the concepts of defined *tiers* of energy customers, which generally reflect the function of the energy customer (i.e. a hospital), or it's importance to supporting grid systems (i.e. telecommunications). The final two steps will guide users to apply multiple frameworks to generate their own priorities.

Step 1 — **Communicating Priorities:** Know the roles and responsibilities of various stakeholders in setting and executing priorities.

Step 2 — **Prioritization Tiers:** Understand the physical and operational characteristics of the grid that affect decisions.

Step 3 — **Prioritization Crosswalk:** Identify the existing plans and policies that impact this process to find alignment.

Step 4 — **Strategy Integration:** Apply the State Energy Security Strategy to identify the electricity customer types that support your goals.

Restoration Prioritization

OPPORTUNITY STATEMENT

Restoration prioritization is a process most states don't formally do, and the consequences show. When Winter Storm Uri struck in 2021, the absence of clear, shared criteria for determining which loads to restore first when the energy shortfall exceeded planned load shedding thresholds, the result was critical loads without power. The hallmarks of grid disruptions include complex technical challenges, workforce and equipment gaps, inaccurate information regarding the extent of impact, and conflicting goals between government and private sector stakeholders. As policy setters, states influence how utilities prepare for and respond to energy emergencies. This module enables users to develop the Prioritization Crosswalk, a multi-step process that incorporates the State Energy Strategies and integrates a variety of planning methods to anticipate essential decision points encountered by utilities and government leaders during a grid outage, thereby helping to establish state-level criteria for identifying the types of energy loads that align with a State Energy Strategy. While energy emergencies will always create unexpected, event-driven impacts, many challenges can be predicted and addressed through detailed planning.

GAPS

Differences in Authority & Roles In Setting Priorities	Electric utilities are responsible for determining the order customers' power is restored following disruptions, based on their own internal calculus. However, government leaders at the local, state, and federal level have unique authorities during emergencies; where utilities are government-owned and operated, as with municipal or public power utilities, that role is direct. These different bases of authority can produce competing priorities that can sometimes complicate overall response.
Unknown Priorities in Utility Plans, Policies, & Procedures	Each utility has a formal or informal restoration prioritization plan that identifies which segments of their system will be restored first, written from the individual customers, or at the feeder or substation level, and are based on a variety of factors including grid stability (i.e. critical substation), community needs (i.e. police station), or contractual obligations. These plans are developed unilaterally by the utility, without state input into how the priorities are determined.

MODULE GOALS

Identify the plans, policies, and resources available that enable decision-making across public and private sector stakeholders.	Understand grid functions and limitations to develop effective restoration priorities that reduce the impact of grid outages.
Learn how to apply your State Energy Strategy to determine restoration priorities.	Develop an integrated, state-level method for identifying and communicating priorities to utilities.

Restoration Prioritization

ROLES AND RESPONSIBILITIES

No single organization or unit of government has sole authority to direct every aspect of power restoration following a grid outage. Operational decision-making is a reflection of several formal and informal processes designed to reflect the priorities of all stakeholders impacted by the event. However, it is important to understand these roles in context. The diagram below identifies the types of priorities most directly influenced by each stakeholder based on their responsibilities.

Utility

Makes decisions based on available assets, personnel, infrastructure, and grid conditions immediately following an event.

Elected Officials

Elected officials can intervene in grid restoration efforts based on authorities granted in laws or based on public influence.

Emergency Mgmt

As the primary response authority for disasters, EM can direct the efforts of resources essential to grid restoration.

Regulators

State regulators can dictate some aspects of customer prioritization (i.e. natural gas goes to home heating first).

State Energy Office

The State Energy Security Plan (SESP) identities critical grid energy assets, including energy loads to inform restoration.

Grid Survivability Priorities

The assets and infrastructure essential for the stable operation of the grid. Loss of these loads or facilities can result in additional outages.

+

Strategy-Focused Priorities

Energy loads identified by the State Energy Strategy that limit impacts to specific sectors or customers (i.e. wastewater facilities for resilience).

+

Event-Specific Priorities

Customers and facilitates that are uniquely important to the nature of the outage based on the operating conditions (i.e. cooling centers during heat wave).

=

Integrated Restoration

Consolidating the needs from each prioritization type to mitigate the aggregated impact of an energy outage event.

Communicating Priorities. The restoration process works best when stakeholders develop their lists together rather than in isolation. Each party should understand not just what others have prioritized, but how they arrived at those priorities. Without that context, conflicting lists can undermine restoration efforts rather than coordinate them. Openly sharing methodology across roles builds the common understanding needed to move from competing priority lists to an integrated restoration plan that's grounded in shared principles and the State Energy Strategy.

Step 1

Prioritization Tiers

INFRASTRUCTURE AND RESOURCE LIMITATIONS

Identifying every customer on a grid system for prioritization is infeasible. Instead, priorities should be categorized by tiers, which identify customers of a certain type or function. Multiple, ranked tiers are needed to provide enough structure to ensure strategy alignment while providing the flexibility needed in a dynamic operating environment. However, the decision to prioritize one electricity customer over another is not made in a vacuum. Furthermore, it is not solely a reflection of authority or policy. Energy emergencies create constraints on physical assets and operational systems that may inhibit or eliminate the choices of utilities or government authorities. This idea relates to two important aspects of the grid:

Balance must be sustained. Energy supply and energy demand must always remain in balance. Periods of imbalance, depending on their severity, can trigger a “cascading outage” that is beyond the control of the utility to prevent.

The grid is a series of building blocks. Electricity cannot “jump” from one location to another, it must be carried on physical wires to the user, and no portion of the grid can be re-energized without direct access to capacity resources. This also means load prioritization is bound by the system's physical configuration.

Constraint	Definition	Impact on Restoration	Prioritization
T&D Infrastructure	The vast majority of outages are caused by disruptions to distribution lines; however, damage to transmission is responsible for wider spread, longer duration outages.	Connectivity between segments of the grid and capacity resources is essential for restoration. Without the connection, priorities cannot be executed.	Planning methods need to account for the highest priority tier that is available, indicating the T&D assets needed to deliver the energy are intact.
Capacity Availability	The amount of electricity being actively generated and ready for consumption. This fulfills the supply side of the aforementioned need for sustained balance on the grid.	The forecasted and real-time availability of generation is an essential aspect of restoration, as no new loads will be added until capacity is available to match it.	During events when capacity is severely limited, prioritization is even more vital and cannot follow a method of “the most customers restored in the least amount of time.”
Operational Limitations	The finite availability of trained personnel and equipment needed to execute the restoration.	The logistical requirements of restoration are extensive and their availability will determine the pace and scale of the restoration.	The accessibility of roads, functionality of communications, and safety of personnel all must be factored into how many loads are targeted for restoration.

Step 1

Prioritization Tiers

ENERGY LOAD THRESHOLDS FOR OUTAGE DURATION

While the Energy Risk and Criticality module examines how critical an asset's function is to the grid, this section focuses on how the duration of an outage changes the nature and severity of a disruption. These are distinct considerations, as a facility can be both critical to the grid or a community but still have the ability to self-sustain for extended periods without electric service.

The consequences of an outage vary based on duration and the facility's ability to function without power. A facility that loses essential function within hours carries a different risk profile than one that can self sustain for days. Understanding where a facility sits in those thresholds tells you how urgently it needs to be restored and helps calibrate decisions and priorities when new information is available, like when Estimated Times of Restoration (ETR) are issued by utilities. For example, a 48-hour ETR is manageable for a facility that can self-sustain for 72+ hours.

The table below defines three duration-based tiers. Use these tiers to assess time-sensitive consequences for energy customers and inform where they fall on the restoration prioritization list.

	Description	Prioritization Tier
72 + Hours	Low impacts to health and safety, economics, and infrastructure. Facilities can maintain function for ≥72 hours using operating capabilities or backup systems, but stored fuel for backups may begin to run out depending on use.	**Low. Loss of power is an inconvenience, but it does not have broader community impacts.** **Example.** Individual homes (weather dependent) and commercial customers with the ability to curtail service.
24-72 Hours	Moderate impacts to health and safety, economics, and infrastructure (e.g., certain functions cease due to lack of power, loss of communications). Facility can operate in a degraded mode that doesn't require off-site electricity.	**Medium. Customer has moderate ability to self-sustain, failure is not imminent.** **Example.** Nearly all hospitals have backup generators and have protocols for operating without grid electricity (must have water).
1-24 Hours	Severe and rapid impacts to population health and safety and economics (e.g., businesses close, slow/no transportation, poor/low medical care access). Near immediate loss of essential facility functions when grid disruptions occur.	**High. An outage lasting a day has near-immediate impacts to facility functions and the community.** **Example.** Only half of water/wastewater facilities have backup power and they are very difficult to restart.

Step 1

Prioritization Tiers

DETERMINING YOUR TIERS

Assigning energy loads to tiers should integrate each of the variables outlined in Step 1 of the Module. A customer that rates high in the Priority Type (i.e. an asset essential for grid survivability) will place high unless there is an additional constraint that reduces its relative importance (i.e. there is sufficient capacity available even if the asset were brought back online).

Prioritization Tier	Type	Constraint	Duration
Tier 1	❑ Survivability ❑ State Strategy ❑ Event-Specific	❑ T&D Infrastructure ❑ Capacity Availability ❑ Operational Limitations	❑ 1-24 Hours ❑ 24-72 Hours ❑ 72+ Hours
Tier 2	❑ Survivability ❑ State Strategy ❑ Event-Specific	❑ T&D Infrastructure ❑ Capacity Availability ❑ Operational Limitations	❑ 1-24 Hours ❑ 24-72 Hours ❑ 72+ Hours
Tier 3	❑ Survivability ❑ State Strategy ❑ Event-Specific	❑ T&D Infrastructure ❑ Capacity Availability ❑ Operational Limitations	❑ 1-24 Hours ❑ 24-72 Hours ❑ 72+ Hours

Example. A water treatment facility serving a city of 115,000 people experiences an outage due to a derecho during a period of extreme heat. Your state strategy is **Resilience,** the region is experiencing a **Capacity Shortfall,** and the facility has backup generators with **24 hours** of fuel on-site.

Priority Type:

Survivability > No
Strategy > Yes
Event > Yes

Constraint:

T&D > No
Capacity > Yes
Operational > No

Duration:

24 hours:
HIGH

Tier Identification:

TIER 1

Step 2

Prioritization Crosswalk

PRIORITIZATION IMPACTS

Organization	Title	Description	Impact on Prioritization
State Emergency Management Agency (EMA)	Threat and Hazard Identification and Risk Assessment (THIRA)	Describes various types of risks state has identified to inform vulnerability and risk assessment process.	• State Emergency Management/homeland security has visibility into Department of Homeland Security (DHS) Critical Infrastructure databases that can inform decisions. • The state can provide resources (transportation, security, generators, etc) to support utility restoration efforts. • The identified plans contain information on Continuity of Government (COG) with a corresponding list of critical government facilities.
	Emergency Operations Plan (EOP)	A comprehensive, all-hazards framework for preparedness, response, and recovery, establishing lines of authority and coordination to ensure an effective response to reduce negative impacts.	
	Power Outage Incident Annex (POIA)	A detailed plan or section within the EOP that specifically addresses the coordination, response, and recovery efforts for a prolonged power outage.	
State Energy Office (SEO)	State Energy Security Plans (SESP)	Help understand state energy resilience priorities and risks as a function of pre-identified state-level hazards to infrastructure.	• The VRA includes the identification of critical assets and sites that support energy infrastructure systems. • The SESP contains listings of priorities for the state to address through planning and investment.
	Vulnerability and Risk Assessments (VRA)	Informed by THIRAs to help understand susceptibility to risks and hazards.	

Step 2

Prioritization Crosswalk

PRIORITIZATION IMPACTS

<table>
<tr><th>Organization</th><th>Title</th><th>Description</th><th>Impact on Prioritization</th></tr>
<tr><td rowspan="2">State Strategy</td><td>Inherent Risk Assessment (IRA) Guide</td><td>Helps NERC identify compliance measures using a common risk assessment method.</td><td>• How can system vs individual-level risks be differentiated?</td></tr>
<tr><td>Energy System Resilience</td><td>Provides methodologies for assessing resilience postures and building quantifiable frameworks to model resilience metrics.</td><td>• How can renewable energy, sustainability measures, and efficiency planning be used to mitigate disaster planning?</td></tr>
<tr><td rowspan="2">Utilities</td><td>Internal Prioritization Process</td><td>Varies by company, but identifies priorities down to the distribution feeder level.</td><td rowspan="2">• Detailed planning and information on grid asset criticality and vulnerability to better understand the Survivability Tier.
• Real-time visibility into system status
• What risks have seen growth in frequency?</td></tr>
<tr><td>Black Start Plans</td><td>NERC-mandated planning for BES critical loads and designated generators.</td></tr>
</table>

Step 3

Strategy Implementation

DIVERSIFICATION

The State Energy Strategy helps develop priorities and inform decision-making processes. In some instances, this thought paradigm may differ from that of infrastructure owner/operators. Decisions will need to be made regarding the order in which customers are restored, regardless of the outage cause. As described in the introduction to this module, first priority must go to any assets essential to the continued operation of the grid. Such sites can include critical substations, generation facilities that require external power for startup, or infrastructure that supports grid operation (i.e. control centers). When it comes to identifying electricity customer types that align with the state strategy, it is important to consider how the strategy translates to action. Diversification, which emphasises technologies like DER and microgrids, would place a priority on these areas of impact:

COMMUNITY ASSETS	DISTRIBUTED LOADS	INTERCONNECTIVITY
Facilities that are essential to sustaining the essential functions of communities including access to food and water, sheltering during extreme weather conditions, and energy systems needed for mobility.	The deployment of distributed energy resources will also require the restoration of loads necessary to maintain system balance during recovery. That includes facilities that provide balancing "ties" between capacity resources.	Data and communications connectivity are needed to sustain the remote grid visibility and dispatchability needed for flexible resources deployed across service territories, placing an emphasis on communications.

EXAMPLE: DIVERSIFICATION

Utilizing the FEMA Community Lifelines framework **(Annex A),** emphasis can be placed on energy customers that reflect state priorities. The flowchart below analyzes how how prioritization is addressed and implemented through a Diversification Strategy:

Communications

Critical Facilities - Communications. Sites that provide direct support to data and cellular communications including **wireless towers, fiber optic relay facilities, Long-Term Evolution (LTE) switching sites, and repeater stations.**

Food, Water, Shelter

Critical Facilities - Food, Water, Shelter. Sites within this category such as **water/wastewater treatment, heating or cooling centers, and grocery stores** often have backup generation, but require restoration within 24 hours to avoid disruptions that will cause community impacts.

Energy (Power & Fuel)

Critical Facilities - Energy. The accessibility of diverse and distributed capacity resources requires the rapid restoration of **transmission substations,** and the recharging of **grid scale storage** for load "smoothing" during restoration.

Step 3

Strategy Implementation

ECONOMICS

The State Energy Strategy helps develop priorities and inform decision-making processes. In some instances, this thought paradigm may differ from that of infrastructure owner/operators. Decisions will need to be made regarding the order in which customers are restored regardless of the outage cause. As described in the introduction to this module, first priority must go to any assets essential to the continued operation of the grid. Such sites can include critical substations, generation facilities that require external power for startup, or infrastructure that supports grid operation (i.e. control centers). When it comes to identifying electricity customer types that align with the state strategy, it is important to consider how the strategy translates to action. Economics, which emphasises large-scale energy deployment, would place a priority on these areas of impact:

ENABLING INFRASTRUCTURE	RAPID SCALING	FIRM SERVICE CUSTOMERS
The continued functionality of businesses is reliant on access to essential infrastructure systems, specifically communications and transportation, to support the stability and operation of financial systems.	Many of the facilities vital to economics are also large-load customers, requiring substantial amounts of electricity. This includes data centers, manufacturing facilities, product distribution, and cold storage.	Customers with the ability and willingness to provide financial incentive for prioritization and serve as load “anchors” for nearby restoration efforts so other key sites in the vicinity can benefit from the presence of crews.

EXAMPLE: ECONOMICS

Utilizing the FEMA Community Lifelines framework **(Annex A),** emphasis can be placed on energy customers that reflect state priorities. The flowchart below analyzes how how prioritization is addressed and implemented through a Economics Strategy:

Communications

Critical Facilities - Communications. Sites the provide direct support to data and cellular communications including **wireless towers, fiber optic relay facilities, LTE switching sites, and repeater stations.**

Transportation

Critical Facilities - Transportation. Multi-modal transportation to support economic activity, including **airports, seaports, train yards, traffic control systems,** and **electrified public transportation.**

Energy (Power & Fuel)

Critical Facilities - Energy. Rapid load scaling and large-load customers will require the restoration of **transmission assets, large capacity resources,** and grid operations facilities.

Step 3

Strategy Implementation

RESILIENCE

The State Energy Strategy helps develop priorities and inform decision-making processes. In some instances, this thought paradigm may differ from that of infrastructure owner/operators. Decisions will need to be made regarding the order in which customers are restored regardless of the outage cause. As described in the introduction to this module, first priority must go to any assets essential to the continued operation of the grid. Such sites can include critical substations, generation facilities that require external power for startup, or infrastructure that supports grid operation (i.e. control centers). When it comes to identifying electricity customer types that align with the state strategy, it is important to consider how the strategy translates to action. Resilience, which emphasises the survivability of life support systems, would place a priority on these areas :

ESSENTIAL INFRASTRUCTURE	EMERGENCY SERVICES	VULNERABLE POPULATIONS
Life support systems, which underpin the ability of communities to sustain essential services, provide the necessary stability to avoid a worst-case outcome for impacted populations following a disaster.	The ability to provide for basic needs—including public safety, access to emergency medical services, and short-term sheltering for impacted populations—bridge the long-term restoration off full services.	Addressing life-saving and life-sustaining needs of underserved communities, functional needs, and elderly populations through an emphasis on critical care and shelter-in-place needs.

EXAMPLE: RESILIENCE

Utilizing the FEMA Community Lifelines framework **(Annex A),** emphasis can be placed on energy customers that reflect state priorities. The flowchart below analyzes how how prioritization is addressed and implemented through a Resilience Strategy:

Safety and Security

Critical Facilities - Safety and Security. Continuity of operations for essential services including **police stations, fire stations,** and **government buildings** supports the basic needs of impacted communities.

Food, Water, Shelter

Critical Facilities - Food, Water, Shelter. Access to potable water requires support of **water/wastewater treatment, grocery stores** for food distribution, and short-term **shelter locations** for temporary housing.

Health and Medical

Critical Facilities - Health and Medical. Reducing injuries and fatalities during outages requires prioritizing **hospitals, medical clinics, nursing homes,** and access to daily medicines at **pharmacies.**

The Resource Adequacy Nexus

A BUILDING-BLOCKS APPROACH

Successful prioritization of energy loads for restoration requires a coordinated effort to minimize the *Capacity Availability* constraint described earlier in the module. This will require a more intentional assessment of prioritized loads to understand their unique requirements. For example, determining that public safety facilities are a priority is not enough to fully inform discussions related to resource adequacy. These electricity loads must be identified, aggregated, and categorized based on their energy usage. The steps below outline how to assess priority lods and their impact on capacity availability.

Step 1 — **Facility types and average loads.** Build a comprehensive list of the facilities that meet your strategy-driven criteria for priority loads.

Step 2 — **Service Requirements:** Is the energy load of these facilities constant? Does it change based on time of day or have high demand peaks?

Step 3 — **Consolidate for scale:** How much load is it when it's all combined? How does this align with capacity procurement or reserved margins?

Step 4 — **Planning integration:** Do the results align with IRPs, market-driven capacity procurement, and policy priorities?

IMPLEMENTATION

Identify Priority Loads

Define the priority load categories (i.e. facility types), their individual and aggregated power needs, and their specific energy needs based on capacity performance including ramp time, run time, fuel availability, and load-following capability to determine their compatibility with different resource types.

Infrastructure Alignment

Having adequate capacity to meet priority demand is insufficient without the associated infrastructure to deliver it to the priority facilities. Knowing whether capacity needs to be co-located (for zero downtime facilities) or time-phased approaches will help inform investment and siting of generation.

Impact on Systems & Policy

States can create tiers of resource adequacy that better reflect their energy security priorities. Each set of priorities (survivability, strategy, and event specific) will each have an associated resource adequacy requirement that helps utilities and policy makers better understand requirements for system planning.

Module Stakeholder List

Organization	Title	Description	Questions to consider
Emergency Management	Threat and Hazard Identification and Risk Assessment (THIRA)	Describes various types of risks state has identified to inform vulnerability and risk assessment process.	How can standardized risk calculation language be used to inform common planning and assessment processes?
	Vulnerability and Risk Assessments (VRA)	Informed by THIRAs to help understand susceptibility to risks and hazards.	How do varying circumstances affect the definition of "risk"?
State Energy Office	State Energy Security Plans (SESP)	Help understand state energy resilience priorities and risks as a function of pre-identified state-level hazards to infrastructure.	How did prioritization of assets affect the risk assessments? What perspectives/drivers are evident throughout the SESP assessment? How are stakeholders' inputs incorporated into the process?
Department of Energy	State and Regional Energy Risk Profiles	Identifies regional and state level risks to energy infrastructure.	How can we adapt the risk quantification scales for threat probability, duration, and consequence?
	Office of Cybersecurity Energy Security, and Emergency Response (CESER) Risk Assessment Essentials for state Energy Security Plans	Used as aid to develop SESPs.	What energy sectors are most affected in our state? Are they the most dominate? What risks have seen growth in frequency?
North American Electric Reliability (NERC)	Inherent Risk Assessment (IRA) Guide	Helps NERC identify compliance measures using a common risk assessment method.	How can system vs individual-level risks be differentiated?
	Energy System Resilience	Provides methodologies for assessing resilience postures and building quantifiable frameworks to model resilience metrics.	How can renewable energy, sustainability measures, and efficiency planning be used to mitigate disaster planning?

Energy and Emergency Planning Integration Crosswalk (EEPIC)

Interdependency Planning

Interdependency Planning

MODULE OVERVIEW

Interdependency planning involves developing a state energy strategy that recognizes the relationships between critical infrastructure sectors. This module will specifically address interdependencies that directly impact grid operations and infrastructure to understand the risk of cascading impacts.

This module analyzes electric grid impacts through the lens of three FEMA Critical Lifelines (referred to as 'sectors' throughout the module): communications, energy, and transportation. These sectors were chosen due to their essential support to grid operations and their potential for cascading impacts if degraded or disrupted. They also require a specialized understanding of their capabilities to improve cross-sector coordination efforts.

Outline

HOW TO USE THIS MODULE

The module is split into three independent sections, each discussing sector-specific assets, their potential impact on grid operations, and how planning for the sector is impacted by the state's chosen Energy Security Strategy. The module, including the sections themselves, is written as a flexible reference and not intended to be prescriptive or used in sequence. Feel free to navigate this module in any order that suits your planning needs.

Step 1 — **Sector Overview**. Define the Critical Lifeline based on the Energy Security Strategies and understand how its loss impacts grid operations.

Step 2 — **Sector Asset Analysis**. Analyze 3-4 infrastructure asset types within the sector that are essential for grid operations.

Step 3 — **Grid Operations Impact**. Understand how outage duration within a sector impacts operations and examine how asset outages impact grid operability.

Step 4 — **Engagement Questions**. Provide examples and guidance on the questions to ask sector owners/operators to improve joint planning and coordination efforts.

Step 5 — **Strategy Implications**. Determine how each Energy Security Strategy shapes planning priorities and decision-making within the sector.

Interdependency Planning

OPPORTUNITY STATEMENT

Interdependency planning helps develop more robust and realistic emergency response plans by recognizing the crucial linkage between grid operations and the critical sectors it depends on, including communications, energy, and transportation. The grid provides the energy necessary to operate assets within these sectors that are critical to grid operations and their loss can have serious consequences for reliable operations. For example, the loss of fiber communication lines can disrupt remote visibility and control of grid assets by severing data links for Supervisory Control and Data Acquisition (SCADA) systems. State offices are well positioned guide stakeholders in surfacing these connections, where dependence on energy may not be obvious. Not every vulnerability can be fully resolved; the goal is to reduce the most consequential risks.This module examines operational dependencies and highlights opportunities to improve planning and coordination efforts.

GAPS

All Critical Lifeline Sectors Require the Grid, and Codependency varies	All critical lifeline sectors (i.e., safety and security; food, water, shelter; health and medical; energy; communications; transportation; and hazardous materials) depend on the grid to operate. However, many of these sectors do not directly enable grid operations. For example, a hospital needs electricity to run its machines but provides no benefits *to* the grid. This framework accounts for these sector-specific services and constraints to help users analyze dependencies that have direct impacts to the electric grid and response operations.
Visibility and Understanding of Sector-specific Assets	While evaluating which sectors are most essential to grid operations is challenging, there is the added problem of understanding the specific capabilities and relevant assets within those sectors. Stakeholders may be unaware of specific functions due to regulatory or technical reasons (e.g., data protection, or lack of specific software to view information). Additionally, the opaque nature of dependencies can make it difficult to pinpoint or recognize critical assets until a real-world failure occurs.

MODULE GOALS

Evaluate the interdependency planning concerns of critical lifeline sectors based on their importance to the grid.	Improve visibility and shared understanding of sector capabilities for state energy stakeholders.
Understand how power outages along critical lifeline sectors impact grid operations.	Support cross-sector emergency planning and coordination.

Sector Overview

SECTOR ORIENTATION

This module addresses the interdependencies between grid operations and the infrastructure that supports it. Specifically, it analyzes grid impacts through the lens of three FEMA Critical Lifelines—communications, energy, and transportation—identifying the assets within each that are most consequential to grid operations, rather than providing a comprehensive sector-wide analysis.

Each sector is covered in detail in the following pages. The descriptions below are intended to orient users to what this module covers for each sector. Use the individual sector sections for full asset definitions, analysis, planning considerations, and strategy alignment.

	Sector Definition
Communications	The communications sector underpins grid reliability by keeping operators connected to their systems and to each other. Its assets enable real-time monitoring, coordination, and data exchange that grid operators depend on during disruptions. This section specifically focuses on physical infrastructure (e.g., switching facilities), connectivity assets (e.g., cell towers), and dispatch and alerting assets (e.g., public safety answering points, or PSAPs).
Energy	The energy sector encompasses the interconnected network of power and fuel infrastructure that supports the function of all other sectors. Its assets are responsible for fuel availability and electric generation. This section specifically focuses on liquid fuels (diesel, oil, and propane) and natural gas. Energy programs and technologies that support electricity generation and management, such as demand response and virtual power plants, are growing in importance. However, they operate more as processes than fixed assets. Therefore, they do not fit within the asset-based analysis conducted in this module and are not discussed.
Transportation	The transportation sector connects the people, equipment, and materials needed for grid operations. Its assets span multiple jurisdictions and ownership structures, requiring early and constant coordination between stakeholders. This section specifically focuses on modal transportation: roadways (e.g., highways), rail systems (e.g., rail cars), and maritime assets (e.g., ports and barges).

Interdependency Planning

Communications Sector

Communications Sector Overview

SECTOR DEFINITION

The communication sector is foundational to grid reliability and resilience, enabling both system control and effective field operations. For the system, communications enables remote and real-time monitoring of grid assets and provides the data necessary for capacity monitoring and dispatching. On the field operations side, it enables coordination and connectivity with work crews, incident response stakeholders like law enforcement, and issuing public notifications to customers. Without reliable voice and data communications, whether lost to a power outage or a cybersecurity challenge, utilities lose system visibility and coordination efforts degrade, hindering restoration operations and exacerbating the impacts of grid disruptions to other sectors. Therefore, the main goal of assets in this sector is to maintain connectivity before, during, and after incidents.

STRATEGY ALIGNMENT OVERVIEW

Diversification	Economics	Resilience
Plan for increased dependency on small comms nodes that come with greater use of microgrids, DERs, Virtual Power Plants (VPPs), and inverter-based resources, incorporating comms nodes into microgrid planning and evaluating where co-location of assets may be required to maintain reliable operations.	Direct planning and investment effort towards BES-supporting communications infrastructure where data reliability underpins economically important areas, assets, and capabilities to protect or prioritize their operations during emergencies or restoration.	Work with emergency response stakeholders to identify and prioritize communications energy loads that support public safety, public health, and command-and-control during emergencies to support essential life-saving and life-sustaining functions.

GRID OPERATIONS OVERVIEW

Physical Infrastructure	Connectivity	Dispatch & Alerts
Physical communications assets, such as fiber optic relay sites, switching stations, and control centers, enable secure data exchange and facilitate remote management between field assets and system operators. These assets have the most impact for grid operations.	Assets that enable voice communication, such as Wi-Fi and cellular/telephone service, support real-time coordination between field crews and devices and external partners. If degraded, short-term backups are available, but effective alternative processes must be included in emergency plans.	Assets such as PSAPs and law enforcement stations enable incident reporting, information flow, and coordinated emergency response across jurisdictions. While they can provide key information for security, their loss has minimal impact to the grid's operation.

Asset Analysis

ASSET OVERVIEW

The connectivity and dispatch and alerting assets and capabilities provided by the communications sector allows stakeholders to maintain visibility and control of the grid. Theys are also important for effective response and coordination. When considering the grid more specifically, the importance of the services provided by these assets is also shaped by their load size and distribution across the system. The table below analyzes specific communications assets value to grid operations as a function of the services they provide and their energy loads.

Asset	Grid Service	Load Assessment	Evaluation
Backbone Facilities (Fiber Networks, Switching and Optical Relay Stations)	*Physical Infrastructure*: Connects comm. lines to transmit data between users and/or systems.	*Large, Centralized Loads*: Singular, central meeting point for multiple network lines, comms. providers, and data to be disseminated from.	These are high risk assets, serving multiple sectors and providers simultaneously and in a centralized location. Assets have battery or other backup, but risk increases as disruption duration extends past backup capability, having cascading impacts. More considerations are required for restoration (e.g., facility access, location).
Cellular Towers	*Connectivity*: Facilitates information exchange across distances and organizations.	*Small, Distributed Loads*: Location and availability mostly depends on network provider. Provides cellular coverage to a specific radius, so many are used to reach across a region.	These are a medium risk asset, used as primary capability to communicate with stakeholders or assets in different locations (e.g., field crews). They have backup generators, but risk can increase if fuel resources deplete and power is not restored. The number of assets requires significant logistics, complicating coordination and outage impacts.
PSAPs	*Dispatch & Alerts*: Facilitate incident reporting and info., coordination, and security across multiple jurisdictions.	*Medium, Distributed Loads*: Few are needed to serve large regions or communities. Acts as a main entry point for public safety and security information.	Low risk, indirect grid-providing asset that helps manage response efforts related to grid operations. By law, has 24 hours of backup capability. Having backup and fewer loads makes it easier to restore power for utilities and mitigates the need for contingency operations.

Grid Operations Impact

IMPACT OVERVIEW

A power outage affecting the communications sector can have profound impacts for grid operations. The impact is determined by three components: an asset's operational constraints (i.e., the ability for the asset to have power or operations restored quickly by the utility); the ability of the asset to operate in degraded conditions (e.g., backup platforms, systems, or processes); and the criticality of service provided by the asset to the grid. The table below outlines the impacts that the loss of each critical communications asset type has on grid operations at various outage durations.

Duration	Duration Analysis	Grid Impacts
≤6-12 Hours	Manageable duration that prompts switching to contingency procedures, backup communications platforms, or a form of manual operations. Noticeable impacts for grid operation and coordination efforts as backup power capabilities are strained or become inoperable.	***Cellular Towers*** Impacts depend on tower location, as each has varying criticality depending on the area they serve (e.g., critical facilities in area vs rural residences), services provided, and priority for restoration. Loss forces use of contingency comms platforms and procedures (e.g., radio, satellite phones) which can be strained over extended periods.
≥12-24 Hours	Certain contingency systems become degraded due to extended duration (e.g., backup power depleted). Connectivity losses complicate dispatching, field comms., and real-time information sharing. Slowed response activities due to reduced comms., working hours for crews, etc.	***PSAPs*** No direct grid impact, but response coordination can be degraded. Loss of power at 24+ hours can trigger gov't. involvement in response efforts. Impacts information flow and coordination for public safety and security needs allocated between stakeholders.
24+ Hours	Represents the highest risk for grid operations, with strained external coordination. Severely degrades dispatching, field comms., and real-time information sharing/monitoring. Increased risk of cascading failures, safety incidents, and response timelines.	***Backbone Facilities*** Backup power for these facilities begins to deplete after 24 hours, so coordination of additional fuel supply or restoring grid power is needed. Loss in general connectivity (i.e., voice, data, etc.) over large areas, due to aggregated service lines.

Engagement Questions

KEY IDEAS

Effective interdependency planning in the communications sector requires state stakeholders to actively engage energy and communications providers, emergency management agencies, and other partners (e.g., state and federal agencies) to understand how communications assets support grid operations and where gaps in understanding their capabilities and impacts of their loss exists.

The questions below are designed to prompt structured dialogue about emergency planning that improves visibility, clarifies roles, and aligns priorities across organizations. By addressing concerns such as operational limitations, stakeholders can improve their asset awareness and strengthen their ability to plan for incidents and implement resilience measures.

Existing Partners & Programs

Which comms providers and public agencies are essential to grid operations and emergency coordination, and how are they integrated into planning and response?

What info-sharing agreements or mechanisms are needed?

Investment Gaps

Which assets or capabilities would improve system visibility and control during outages (e.g., backup power, redundant paths)?

Where could joint investments between utilities and comms providers reduce shared vulnerabilities?

Policy & Regulatory Guidance

What barriers limit coordination, joint prioritization, or data sharing between utilities and comms providers?

Where would state guidance improve alignment on comms and emergency response priorities?

Operational Capabilities & Limitations

How long can critical comms systems operate under degraded conditions before operations are significantly affected?

How are cybersecurity vulnerabilities being planned for and mitigated? What impacts are likely?

Resource & Technical Needs

What resources are required to sustain comms capabilities during extended outages or degraded environments?

What additional tools, data, or analyses are needed to better understand comms dependencies and operational limits?

Strategy Implications

STRATEGY - LIFELINE PLANNING CRITERIA

This section uses criteria-based evaluation to understand what implementing the Energy Security Strategies in planning would look like in practice with the communications sector. Rather than prescribe a single approach, it provides a structured framework for comparing how each strategy changes planning priorities, operational requirements, and the assets or capabilities needed to support grid operations. The table below highlights some key planning considerations and guiding questions that help evaluate how each strategy influences planning and decision-making within the communications sector.

Strategy	Considerations	Guiding Questions
Diversification	• Assess whether comms systems provide sufficient capability to monitor diverse energy portfolios (e.g., DER, IBR, conventional gen.). • Determine where additional comms nodes, redundant paths, or co-located systems are needed to maintain ops.	• What (additional) comms capabilities are needed to maintain system visibility and dispatch during both normal operations and disruptions? • How does our energy mix impact comms needs (e.g., geographic dispersion, dispatchability, etc.)?
Economics	• Work with comms and grid asset owner/operators to align comms capabilities and asset upgrades (e.g., new tech) with grid infrastructure projects. • Evaluate where improved data reliability and system visibility provide the greatest operational value.	• Where would improved comms visibility and control enhance support to large loads and critical facilities? • What is the appropriate, economical level of investment that will provide the most benefit to grid operation?
Resilience	• Identify comms assets/sites whose loss would significantly impair grid operations or emergency response capabilities. • Determine the best standards or methods for strengthening assets (e.g., infrastructure hardening, back-up power duration limits, etc.).	• What potential cyber or physical security risks could advanced technologies expose the system to? • How do we identify the most vulnerable and most critical comms assets/facilities? How can the risks to these be mitigated?
Resource Adequacy Nexus	• Evaluate whether backup or redundant comms systems and emergency comms plans (e.g., PACE plans) can support operations in degraded environments. • Identify and mitigate constraints that prevent comms asset improvement (e.g., provide financial incentive to comms providers to build infrastructure).	• What comms gaps could reduce system monitoring, delay response operations, or prevent other grid operations? • Do we have sufficient technical and procedural comms capabilities to support grid operations under normal and degraded conditions?

Interdependency Planning

Energy Sector

Energy
(Power & Fuel)

Energy Sector Overview

Energy (Power & Fuel)

SECTOR DEFINITION

The energy sector consists of the entire inter/intrastate, connected network of electricity, oil, natural gas, and liquid fuels assets throughout the U.S. The main goal of assets in this sector is to facilitate the availability of fuel and its management for electricity generation. The sector has a crucial role in planning because it crosses state lines, enables the function of all other sectors, and depends on other sectors for its function, potentially amplifying the effects of energy sector supply disruptions. Also, the ability of the sector to reliably perform has a direct impact on the economic wellbeing and public safety outcomes of communities in the region.

Therefore, effective planning in this sector is necessary to avoid cascading challenges that erode regional resilience. This section analyzes the key assets and capabilities of liquid fuels (i.e., oil, propane, and diesel) and natural gas.

STRATEGY ALIGNMENT OVERVIEW

Diversification	Economics	Resilience
Flexibility of power sources is the main goal. There should be a strong mix of generation sources and fuel types (i.e., thermal and renewable) to prevent reliance on and cascading impacts stemming from disruptions in a specific fuel source.	Focus investment on infrastructure and resources that support cost-effective, large-scale energy generation and delivery. Planning decisions are heavily influenced by market signals, policy priorities, and regional economic conditions.	Mitigate vulnerabilities across generation, distribution, and transmission systems of all energy types by implementing advanced technologies or processes (e.g., alternate fuels for backup generation, asset hardening) to ensure grid survivability.

GRID OPERATIONS OVERVIEW

Liquid Fuels	Natural Gas
Liquid fuels (e.g., oil, propane, and diesel) and distillates are critical for routine energy operations and emergency support. They can be distributed across state lines and help provide backup generation when the BES is disrupted, supply fuel for (peaking) power plants and homes, and have direct uses in sectors such as transportation.	Natural gas is a critical resource in electricity generation, providing base load power and peaking capacity to support grid stability. It also has uses for heating and industrial processes. The sector relies on many specific components to function, including pipelines, gate stations, and terminals.

Asset Analysis

ASSET OVERVIEW

The assets necessary for grid operations in the energy sector focus on fuel availability and managed allocation of the fuel. It is important to note that disruptions can create a vulnerability feedback loop, where the loss of fuel limits generation and backup power capabilities, which has further impacts on grid operations. Additionally, the importance of the services provided by these assets is also shaped by their load size and distribution across the system. The table below analyzes the value of specific energy assets to grid operations, as a function of the services they provide and their energy loads.

Asset	Grid Service	Load Assessment	Evaluation
Liquid Fuels	*Production* The extraction or preparation of fuels	*Small, Distributed Loads* Sites serve specific functions to producing usable fuel and are located in various places.	Limited short-term impact unless multiple sites are simultaneously affected and for long periods. Provides fuel in a useable state to end users.
	Distribution & Storage (Refineries, Point of Delivery Stations) Movement and storage of fuel to end use/users	*Large, Centralized Loads* Aggregates fuel from multiple sources in a single location and serves many users (can receive, store, or distribute).	High operational load with many buildings. Provides BES-level generation fuel, backup capabilities, and other end use.
Natural Gas (NG)	*Management (Control Systems/Centers)* Facilitates all operations of the system, from production to end use	*Large, Centralized Loads* Single control center, managing large parts of network (e.g., flow, distribution).	Manages NG movement and (for gas utilities) monitors system. Loss can limit remote visibility, forcing manual ops for localized operators and utilities.
	Production, Transmission, Distribution, and Storage The NG system, from refinement to end use	*Small, Distributed Loads* Assets (e.g., city gate stations) spread across the system, controlling specific parts and movement of NG.	Each load type and subcomponents has varied operational criticality and use (e.g., control pressure vs move supply). Number of assets and location complicates response timelines.
	Transit Hub (Terminals) Areas for maintaining supplies of NG	*Large, Centralized Loads* Specific facilities with high operational load (can receive, store, and distribute NG).	Backbone for fuel availability No direct grid service; impacts appear after supply *from* hubs stops (after extended period.)

Grid Operations Impact

IMPACT OVERVIEW

The impact of disruptions to liquid fuel and natural gas assets is shaped by how long an outage persists, how central the affected asset is to managing the fuel's supply and system controls, and the asset's operational constraints. Generally, these assets can withstand short-term disruptions by using supply storage and operational capabilities (e.g., manual operations, flexible service contracts, mutual aid); however, their ability to support electricity generation degrades as outages extend and their own operations are impacted. The table below outlines the impacts that the loss of each critical energy asset type has on grid operations at various outage duration.

Duration	Duration Analysis	Grid Impacts
≤24 Hours	Manageable duration; ability to rely on storage supplies and contingency capabilities (e.g., manual operations). Coordination may be complicated if other dependencies are degraded (e.g., comms.), there are extenuating circumstances, or partnerships do not exist.	**Point of Delivery & Refinery Facilities** In short term, loss of a single site can be mitigated through storage use, alternate supply chain sources, or alternate fuel sources for power generation. Loss of asset operation limits the ability to replenish storage and move/produce fuel, and can constrain future fuel availability after disruptions end.
≥24-72+ Hours	Significant operational constraints (e.g., system pressure, field crew management). Requires increased coordination between operators, regulators, local/state/federal agencies, and dependent sectors to repair or mitigate impacts. Noticeable impacts for fuel end users may begin (e.g., flexible service contracts, storage depletion).	**City Gate Stations, Storage Facilities, & Gas Stations** Loss of an asset causes reduced fuel supply at the local/small region level for end-uses (e.g., homes, generators, backups), directly reinforcing the vulnerability feedback loop. Operators, emergency managers, and critical facilities may rely on stored fuel supplies that are depleting.
72+ Hours	Normal mitigation measures become ineffective or exhausted. Impacts cascade through the sector (fuel shortages reduce gen. capacity), and begin to have significant effects across the grid and other sectors, limiting total capabilities. Coordination enters multilateral or regional level to be effective.	**Terminals** Do not provide direct grid services. If supplies to and from terminals stop, after an extended amount of time, generation, storage, and backup capabilities degrade significantly. Loss of asset operations has impacts for the wider geographic area.

Engagement Questions

KEY IDEAS

Interdependency planning in the energy sector requires engagements across fuel producers and managers, utilities, state/federal regulators, and emergency management partners. The questions below are designed to help state energy stakeholders better understand how energy sector assets operate under stress, where coordination can be improved, and how planning, investment, and policy-related decisions can influence the impacts of disruptions across other dependent sectors.

By addressing concerns such as operational limitations, stakeholders can improve their asset awareness and strengthen their ability to plan for incidents and implement resilience measures.

Existing Partners & Programs

What existing planning forums, agreements, or coordination processes can be leveraged to improve visibility into energy sector challenges?

What orgs. control sector functions most critical to grid ops?

Investment Gaps

Which assets or capabilities would reduce the risk of prolonged outages or cascading failures if targeted for investment?

Where are current investment priorities not addressing fuel deliverability, backup generation, or resource flexibility needs?

Policy & Regulatory Guidance

What existing policies, regulations, or rules most influence fuel availability, restoration activities, and contingency operations?

How could state-led action remove barriers to energy sector operations and cross-sector coordination?

Operational Capabilities & Limitations

How do operational constraints (e.g., fuel shortage, equipment failures, etc.) affect grid operations as outage duration extends?

At what point do degraded operations at crucial assets begin to significantly impact system reliability and wider response?

Resource & Technical Needs

In what ways do state or energy sector stakeholders lack situational awareness during disruptions?

What info is needed to define thresholds where degraded conditions of energy sector assets affect grid operations?

Strategy Implications

STRATEGY - LIFELINE PLANNING CRITERIA

This section uses criteria-based evaluation to understand what implementing the Energy Security Strategies in planning would look like in practice with the energy sector. Rather than prescribe a single approach, it provides a structured framework for comparing how each strategy changes planning priorities, operational requirements, and the assets or capabilities needed to support grid operations. The table below highlights some key planning considerations and guiding questions that help evaluate how each strategy influences planning and decision-making within the energy sector.

Strategy	Considerations	Guiding Questions
Diversification	• Consider where over-dependence on a fuel source currently exists and where alternatives would improve operational flexibility. • Evaluate how different resource/fuel combinations affect dispatch and back-up flexibility.	• What combinations of fuels and/or power generation technologies most effectively diversify the system? • How do existing economic or external barriers (e.g., cost-to-build, geographical limits, etc.) impact diversification planning?
Economics	• Consider whether economically attractive investments increase dependence on specific fuels, technologies, or nodes over time. • Evaluate which projects or (regulatory) standards enable capacity, economic, and/or load growth.	• What policies or investments are needed to promote least-cost/most-benefit large-scale infrastructure construction? • What risks to resilience or reliability are being accepted in pursuit of this strategy? Has our risk tolerance been reached?
Resilience	• Mitigate potential financial costs from resilience measures by incorporating diversification and economic strategy goals/considerations in planning. • Assess how back-up gen/systems, storage capabilities, or DERs can be used to sustain critical functions.	• What parameters around operating procedures and technologies should we set for resilience measures (e.g. islanding capabilities, tax incentives for DERs, etc.)?
Resource Adequacy Nexus	• Assess whether fuel availability (i.e., transmission/transportation and fuel supplies for gens and backup uses) is sufficient for normal and degraded operations. • Identify potential issues, such as capacity shortfalls, fuel limitations, and management or deliverability challenges.	• What cross-sector dependencies exist that could prevent the delivery and use of liquid fuels and natural gas? • What does 'resource adequacy' mean, capacity-wise, for our fuel or technology types?

Interdependency Planning

Transportation Sector

Transportation

Transportation Sector Overview

SECTOR DEFINITION

The transportation sector is a network of several, independent modes of transit that move goods and passengers; the assets or nodes can be publicly or privately owned. The main goal of assets in this sector is to connect resources to distributed users by enabling the movement of fuel, equipment, personnel, and materials necessary to operate the grid. Effective planning in this sector is essential because transit systems underpin every aspect of grid and emergency response operations. Additionally, planning or response in this section is heavily influenced by the efforts of state or federal partners. This section analyzes the key assets within road, rail, and maritime transport.

STRATEGY ALIGNMENT OVERVIEW

Diversification	Economics	Resilience
Consider the different supply chains and concerns (e.g., obtaining, installing and repairing grid-related equipment) when planning for diversified resources, as alternative transit and supply capabilities may be needed to withstand disruptions.	Direct planning and investment priorities to transportation hubs and corridors that support the most critical energy assets or operations, in order to enable cost-effective and timely movement of fuel, equipment, and personnel.	Work with utility and transportation stakeholders to determine the access, delivery, and response coordination needed during emergencies, particularly around critical grid assets. Build or reinforce existing plans to ensure adequate transit planning.

GRID OPERATIONS OVERVIEW

Roadways	Rail Systems	Maritime
Roadways (e.g., roads, highways, interstates) are the primary way utilities access energy infrastructure. They enable movement of crews, equipment, and fuels needed for generation and response activities. These assets are managed at the state-level, and are crucial in facilitating response and access needs.	Rail systems are a major part of the energy supply chain, allowing for inter/intrastate movement of materials that cannot be transported by road, such as fuels and large equipment like transformers. Rail operations require coordination across jurisdictions, making pre-event planning essential.	Maritime assets (e.g., port access and barge traffic) are foundational to grid operations by supporting supply chain movement over waterways. They enable delivery of bulk fuels like coal and major grid components. These systems involve state, federal, and private stakeholders, requiring coordinated planning.

Asset Analysis

ASSET OVERVIEW

This section analyzes transportation assets based on their load characteristics and the impacts these assets have on grid operations and emergency management. It is important to mind the differences of this sector compared to communications and energy assets. First, transportation assets are owned by a wider set of state, federal, and private stakeholders, limiting utility's direct ability to impact response efforts and necessitating broader coordination efforts. Second, assets are more directly impacted by *prolonged* disruptions, as delays in fuel and material movement pile up. Lastly, the state has a major, primary role in enabling utilities' movement during disruptions (e.g., security, route clearance on highways, etc.). The table below analyzes specific transit assets value to grid operations, as a function of the services they provide and their loads.

Asset	Grid Service	Load Assessment	Impact Evaluation
Roads, Highways, & Interstates	*Roadways* Facilitate movement of small volume grid assets and fuels via truck	*Small, Distributed Loads* Road networks create redundant/flexible routes for utilities and emergency responders to reach assets.	Management and ownership of specific roads lies with state and local transit authorities. Critical for physical access to assets and movement of small fuel/component supplies; final layer for other transit assets (i.e., you still need to move by road sometimes). Roads have varying importance and priority for resources (e.g., interstates have more traffic).
Rail Cars	*Rail Systems* Facilitates movement of goods over long distances and across state lines via rail cars	*Medium, Centralized Loads* High capacity, cost-effective option for bulk fuels and heavy grid components across long distances to centralized railyards.	Rail cars and tracks cross jurisdictions, but railyards are concentrated and sometimes privately owned, requiring planning across stakeholders. "Last Mile" Problem for some end users that may still need to use roads/ports for delivery can create prioritization conflict. Fuel/equipment deliveries to grid operators using this method may be delayed, prolonging outages.
Port Access & Barge Traffic	*Maritime* Supports delivery of bulk fuels and heavy equipment over waterways using barges and ships	*Large, Centralized Loads* Supports movement of imported materials like coal and grid components to a few ports located on major navigable waterways.	Redundancy, routing goods through alternative ports, is possible but limited by whether those ports have the capacity to absorb the additional volumes. High operational load (i.e., receiving and distributing materials on various modes) for ports and barge traffic. Needed for strategic, long-term movement of supplies; has lowest risk to grid operations (in the short-term).

Grid Operations Impact

IMPACT OVERVIEW

The impact of transportation disruptions on grid operations is heavily influenced by the size and multi-jurisdictional, multi-stakeholder nature of its key assets, particularly in regards to planning and coordination priorities. Unlike assets directly managed or owned by single entities, transportation systems depend on disparate local and state agencies, private operators, and authorities with different priorities and capabilities. As disruptions persist, coordination across these organizations becomes more complex, impacting movement of fuel and grid components. The table below outlines the impacts that the loss of each critical transportation asset type has on grid operations at various outage duration.

Duration	Duration Analysis	Grid Impacts
≤6-12 Hours	Disruptions stem from traffic control or access restrictions (e.g., debris on roads). Disruptions are well managed by state-level stakeholders, like law enforcement or Department of Transportation (DOT), but working hours may become problematic over time. Has more immediate impacts for localized fuel or supply distribution.	**Roads, Highways, & Interstates** Restoration and response operations (e.g., fuel delivery, crew access for repairs) are degraded by poor road access. Local and state DOT stakeholders may need to prioritize which roads to manage (e.g., traffic, tree removal which is not done by utilities), affecting which assets are restored first.
≥12-24 Hours	Noticeable impacts for rail and maritime operations begin and compound (e.g., degraded or lost ability to load and move rail cars, barges, and ships); fuel deliveries slow or are paused. Response and coordination efforts become challenging as impacted, multi-jurisdiction stakeholders increase.	**Rail Cars** Sustaining generation or backup capabilities and repairing equipment becomes difficult as fuel and equipment deliveries are disrupted. Possibility of switching to alternative transit modes may be limited by the ability to move supplies by new mode (e.g., by road) or if other modes are disrupted.
24+ Hours	Significant backup of grid fuels and components occur as goods are unable to move from their entry or distribution point. Transportation challenges become a primary constraint of grid recovery and response operations.	**Port Access & Barge Traffic** Supply backlogs begin to cause regional fuel availability issues. Limited flexibility in sending goods elsewhere or using other transit modes. Coordination challenges escalate, with grid and transit operators, port authorities, state, and federal stakeholders all being involved.

Engagement Questions

KEY IDEAS

The transportation sector enables the movement of crews, fuels, and equipment essential to maintaining grid operations; disruptions can shift sector assets from a supporting function to a limiting factor. Effective interdependency planning in the sector requires state stakeholders to actively engage energy and transportation providers, emergency management agencies, and other partners (e.g., state and federal agencies) to understand how transportation assets support grid operations and where gaps in understanding their capabilities and impacts of their loss exists.

The questions below are designed to guide structured dialogue between stakeholders and help identify transportation-related planning risk and constraints.

Existing Partners & Programs	What agreements exist with stakeholders to support fuel deliveries, personnel movements, etc. during disruptions? How are transportation stakeholders incorporated into state and utility emergency operations and plans?
Investment Gaps	Where do current capabilities create logistical bottlenecks for moving resources for critical grid operations? Which improvements (e.g., port enhancements, alternate routes) would reduce delays in supporting grid operations?
Policy & Regulatory Guidance	Where do existing transportation rules create uncertainty about who can authorize movements and resource support? How should the state define and communicate priorities for state resource support during multi-sector disruptions?
Operational Capabilities & Limitations	How will the state prioritize support (e.g., security, escorts, etc) to utilities and transportation stakeholders during disruptions? What contingency procedures exist to manage transportation disruptions?
Resource & Technical Needs	How long can critical transportation assets and functions operate under degraded conditions, and what thresholds signal that constraints are beginning to affect grid operations and response efforts?

Strategy Implications

STRATEGY - LIFELINE PLANNING CRITERIA

This section uses criteria-based evaluation to understand what implementing the Energy Security Strategies in planning would look like in practice with the transportation sector. Rather than prescribe a single approach, it provides a structured framework for comparing how each strategy changes planning priorities, operational requirements, and the assets or capabilities needed to support grid operations. The table below highlights some key planning considerations and guiding questions to help evaluate how each strategy influences planning and decision-making within the transportation sector.

Strategy	Considerations	Guiding Questions
Diversification	• Develop or support contingency operations (e.g., alt routes, modal options, etc.) that maintain grid operations when primary methods are disrupted. • Assess potential impact of geographically dispersed infrastructure or multiple fuel types on transportation planning.	• Are contingency logistics capabilities plans sufficient to support response and grid operations under degraded (prolonged) conditions?
Economics	• Prioritize investments in transportation assets and capabilities that increase fuel throughput and reduce delivery constraints for gen assets and major customers. • Evaluate whether transportation planning is aligned with demand growth, generation needs, and fuel supply shifts.	• What important or critical routes or assets are being overlooked for investment because they do not offer the greatest economic return? • How can investments be better allocated to improve transportation nodes while avoiding creating single points of failure?
Resilience	• Integrate utility and transportation stakeholder response plans to establish shared access procedures and resource allocation protocols. • Develop decision criteria for allocating state resource to transportation assets that sustain grid operations.	• What measures—procedural or technological—would best support grid operations during disruptions? • How can we balance differences in ownership and authority over assets among stakeholders and account for them in the planning process?
Resource Adequacy Nexus	• Work with transportation and utility stakeholders to build shared understanding of needs in emergency plans, like resource needs and timeline constraints. • Establish guidelines for providing state resources and assistance to utilities during disruptions (e.g., clearing hwys).	• Where does logistics capacity (i.e., timeliness of deliveries) become the limiting factor in maintaining or restoring grid operations? • How will the state prioritize and coordinate transportation assistance to utilities?