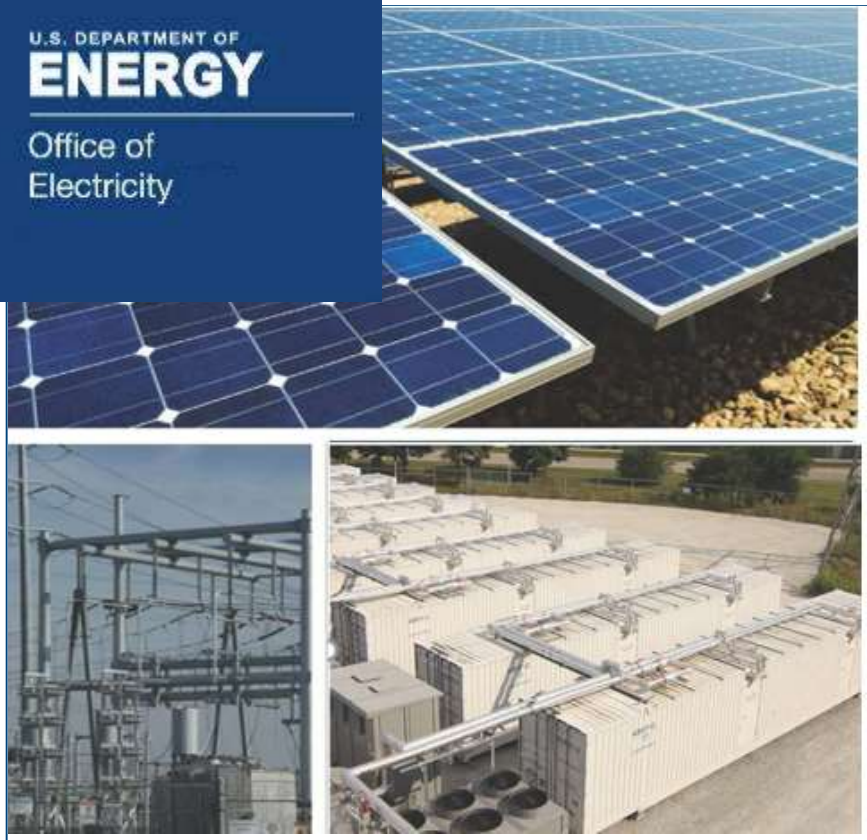
U.S. DEPARTMENT OF ENERGY
Office of Electricity



Resilience Planning

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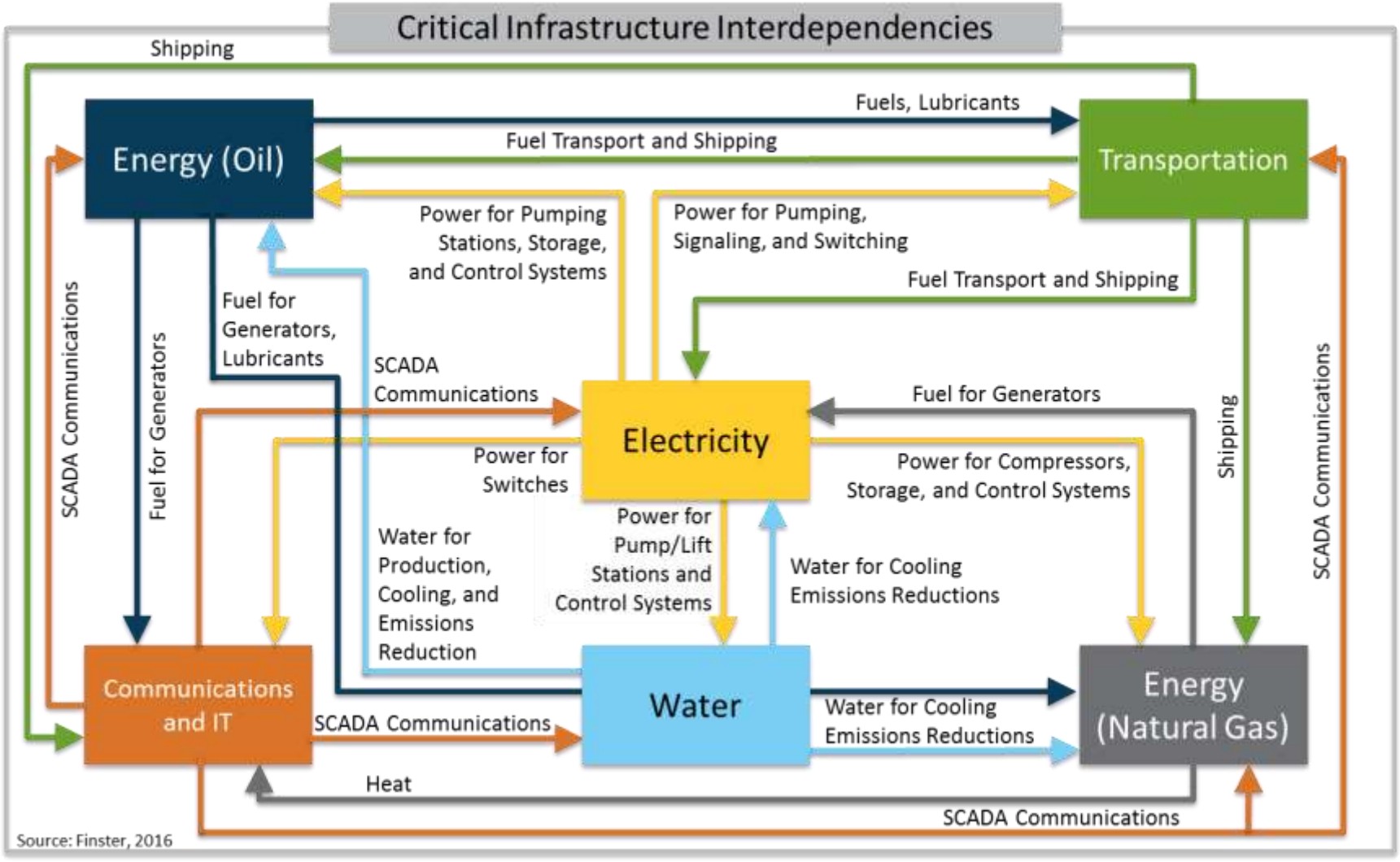
Problem Statement

There is not a systematic way to think about how to incorporate resilience into planning processes that aligns technology investment strategies with state goals and objectives

Data and analytical processes are needed to guide efforts that are proactive so that we can withstand or reduce the impact of disruptions when they occur

US Critical Infrastructure Depends on Electricity



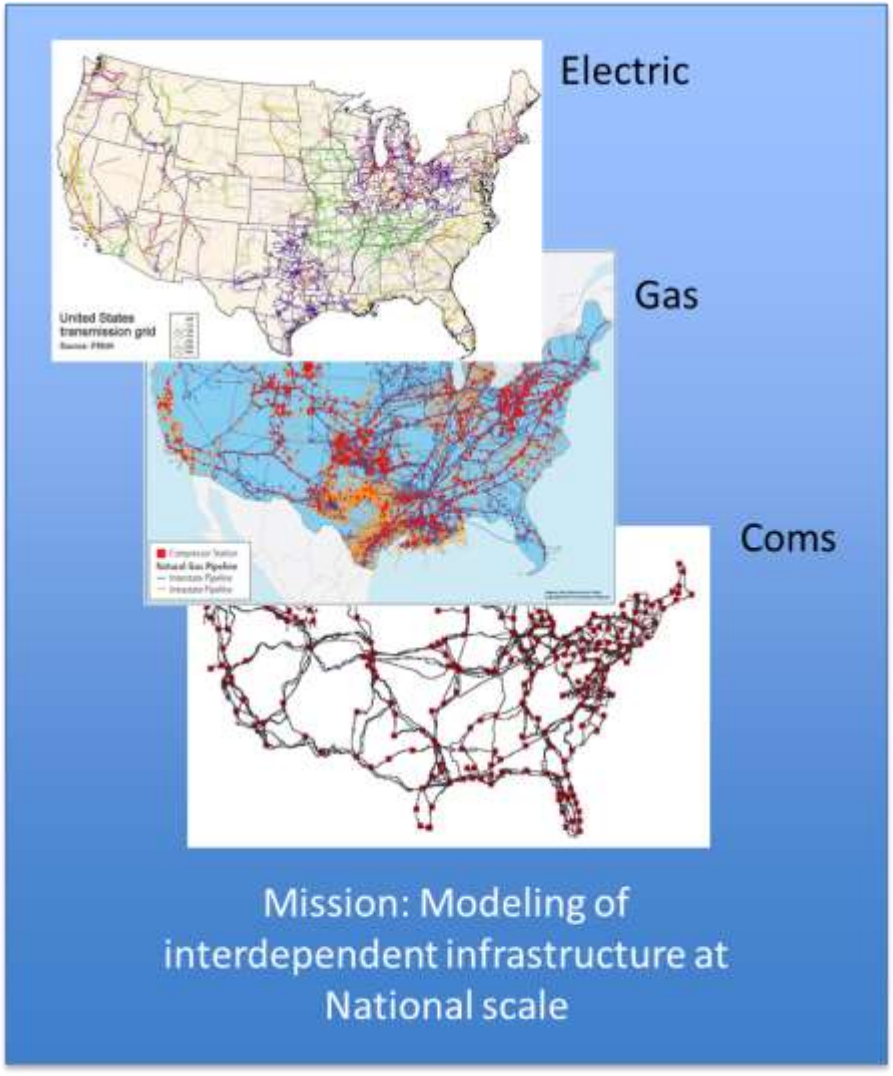
Protecting US Infrastructure Through Modeling

Vision

Rapidly predict consequences of known and emerging threats to national energy infrastructure.

Prioritize investments in resilience to include hardening, research development, and fuel supply.

Support accurate and holistic analyses for decision makers to prepare, respond, and mitigate threats.



North American Energy Resilience Model

Components

Modeling and simulation tools (elect, gas, coms, econ/metrics)

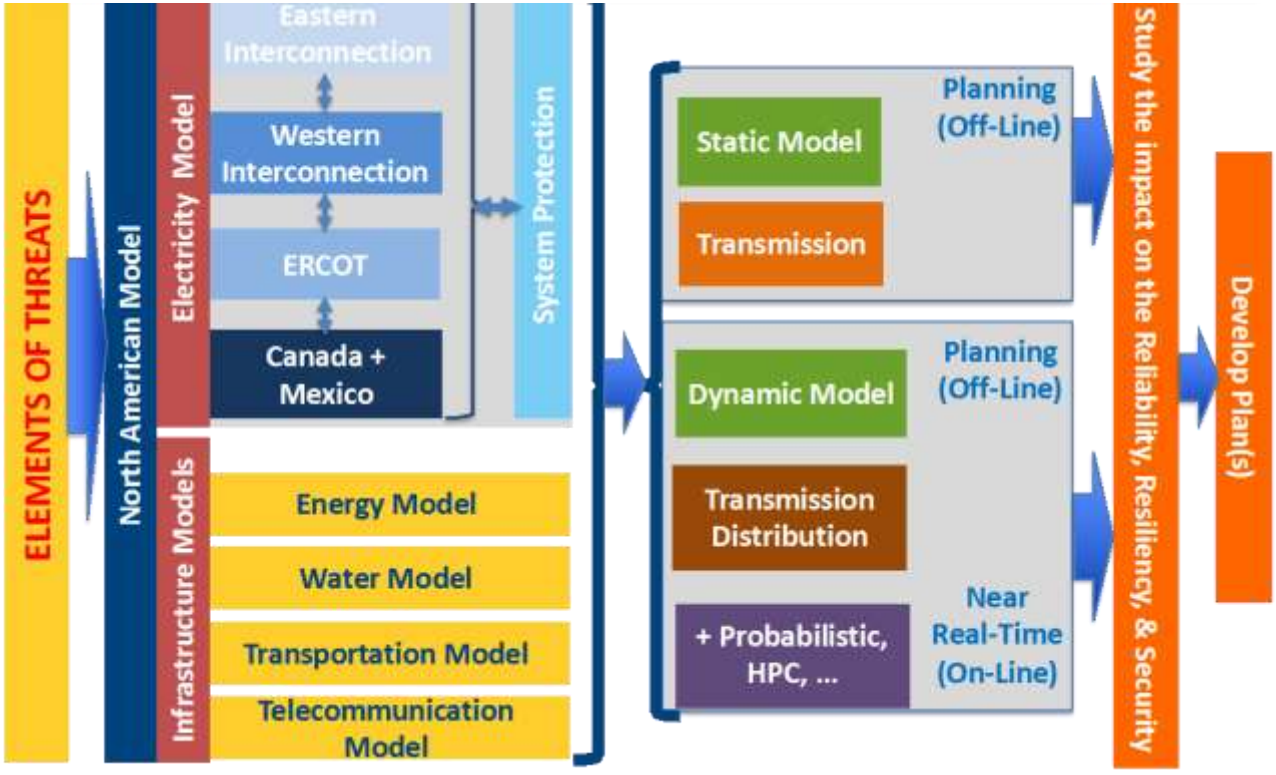
Databases to store model inputs and data streams

Secure computer and storage systems

User environments to enable analyses

Processes used to obtain & feed data and model inputs into system

Conceptual NAERM Workflow Concept



Natural Gas/Electric Grid Use Case

Strategic Problem:

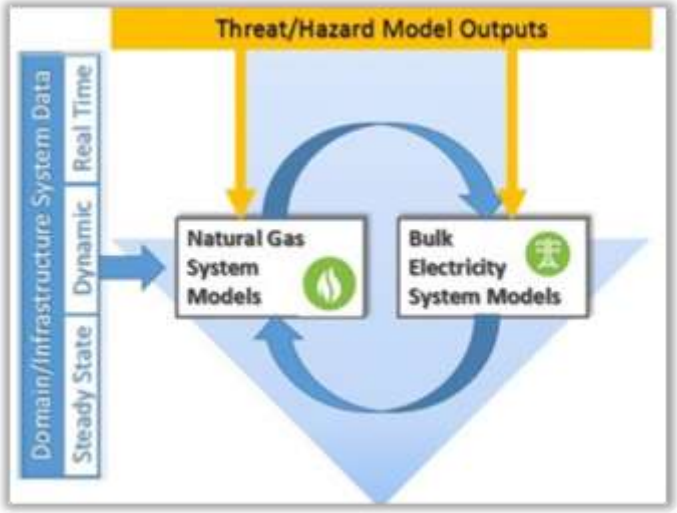
- Natural gas contingencies pose N-k risks to Bulk Electric System (BES) due to increase in gas fired plants

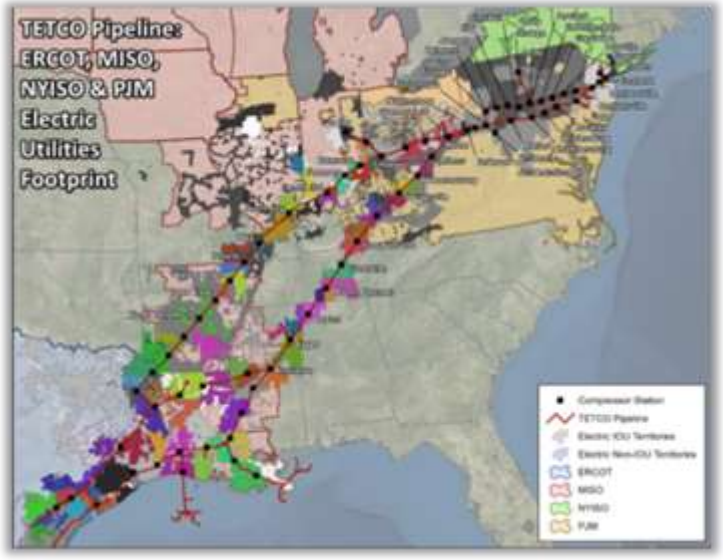
Modeling Scenario:

- Model and demonstrate an N-1 real event (hurricane, polar vortex) on a regional scale (single interstate pipeline, ~10 electric utilities)
- Scenario examines impact outages in gas transmission pipeline on BES and feedback into natural gas system

Approach:

- Leverage experience in mining data from sources such as EIA, FERC 567, HSIP, Platts and industry relationships to develop steady state and dynamic datasets
- Utilize existing modeling capabilities such as lab code NGFast, commercial codes PSSE, and lab High Performance Computing (HPC) systems
- New capabilities include coupled electric-gas models using HELICS (*Hierarchical Engine for Large-scale Infrastructure Co-Simulation*) co-simulation framework, new APIs, and new methodologies to validate models





Resilience Framework for States

Logical Consistency

State Policy Makers

Legislatures and Governors

- **Develop policy goals and objectives** (e.g., wildfire mitigation)
- **Require plans** (ex: CA utility wildfire mitigation plans)
- **Fund improvements** (ex: CA utility **cost recovery** standards & practices)
- **Require utility coordination and oversight** (ex: coordination & data-sharing among state agencies, eg, sharing cybersecurity information and practices, and conducting independent evaluations)
- **Facilitate specific risk mitigation strategies** (ex: microgrid development and application of NAERM findings)
- **Develop further recommendations** (ex: establishing commissions, boards and state offices with specific charges)

State Policy Implementers

Utility Commissions

- **Set substantive and procedural requirements for plans, including**
  - **Setting objectives**, based on state policy goals and customer expectations
  - Establishing **scope and timing requirements** based on priorities
  - Establishing **metrics** to measure performance
  - Determining **cost recovery** mechanisms
- **Approve or accept plans**
- **Fund improvements** (cost recovery approval through and/or outside General Rate Case)

Distribution System Owners & Operators

Utilities

- **Develop plans**
  - **Align objectives**
  - Develop **long-term strategy** and **short-term implementation plans** integrated with current planning processes
  - **Prioritize** short-term vs long-term needs through **risk assessments**
  - **Coordinate** planning and operations
  - Re-design **business practices**
  - Establish staged, **technology deployment plans and cost estimates**
- **Implement approved plans**

Stakeholder Input Processes

Framework Components

The framework will address:

- The respective roles and responsibilities of state-level entities and utilities with regard to these components
- Relationships among components
- Approaches to the components in practice today

Threat & Vulnerability Assessments
(NAERM findings and other inputs)

Resilience Objectives Determination
(what and when)

Analytical Methodologies for Resilience Measures
(e.g., identification of options, evaluation, prioritization, and sequencing)

Performance Assessment of Resilience Measures
(metrics)

Funding Options for Resilience Measures
(e.g., utility cost recovery, legislative appropriations)

Integration of Resilience into Planning Processes
(e.g., grid modernization, distribution system, integrated planning)

Thank You

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