Argonne NATIONAL LABORATORY

Critical Infrastructure Dependencies

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Prepared by

Frédéric Petit and Julia Phillips
Infrastructure Assurance Center, Decision & Information Sciences

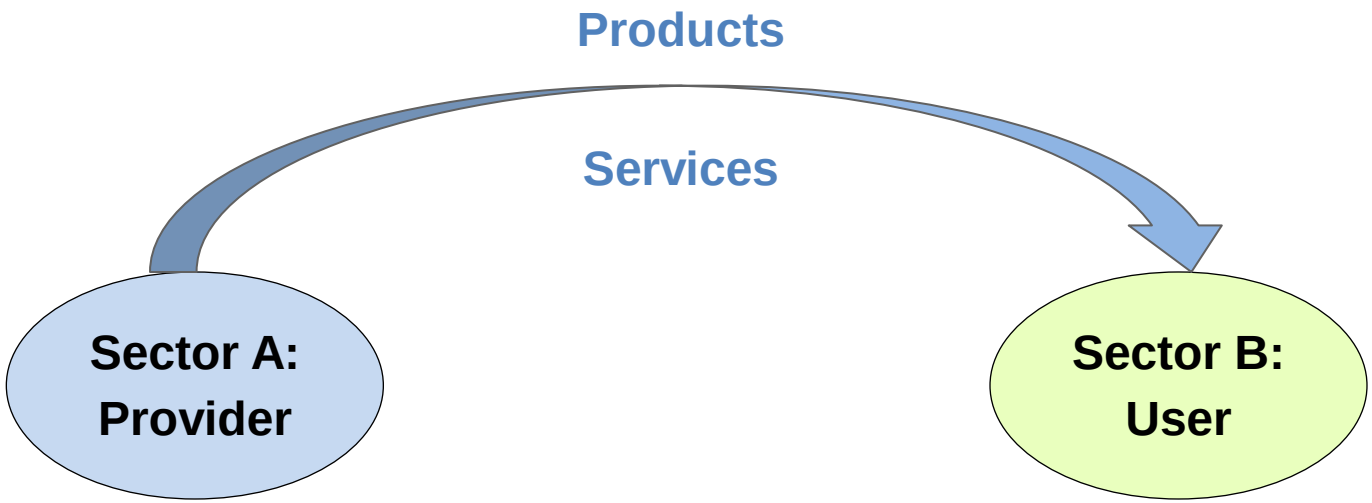
U.S. DEPARTMENT OF ENERGY

Critical Infrastructure Dependency

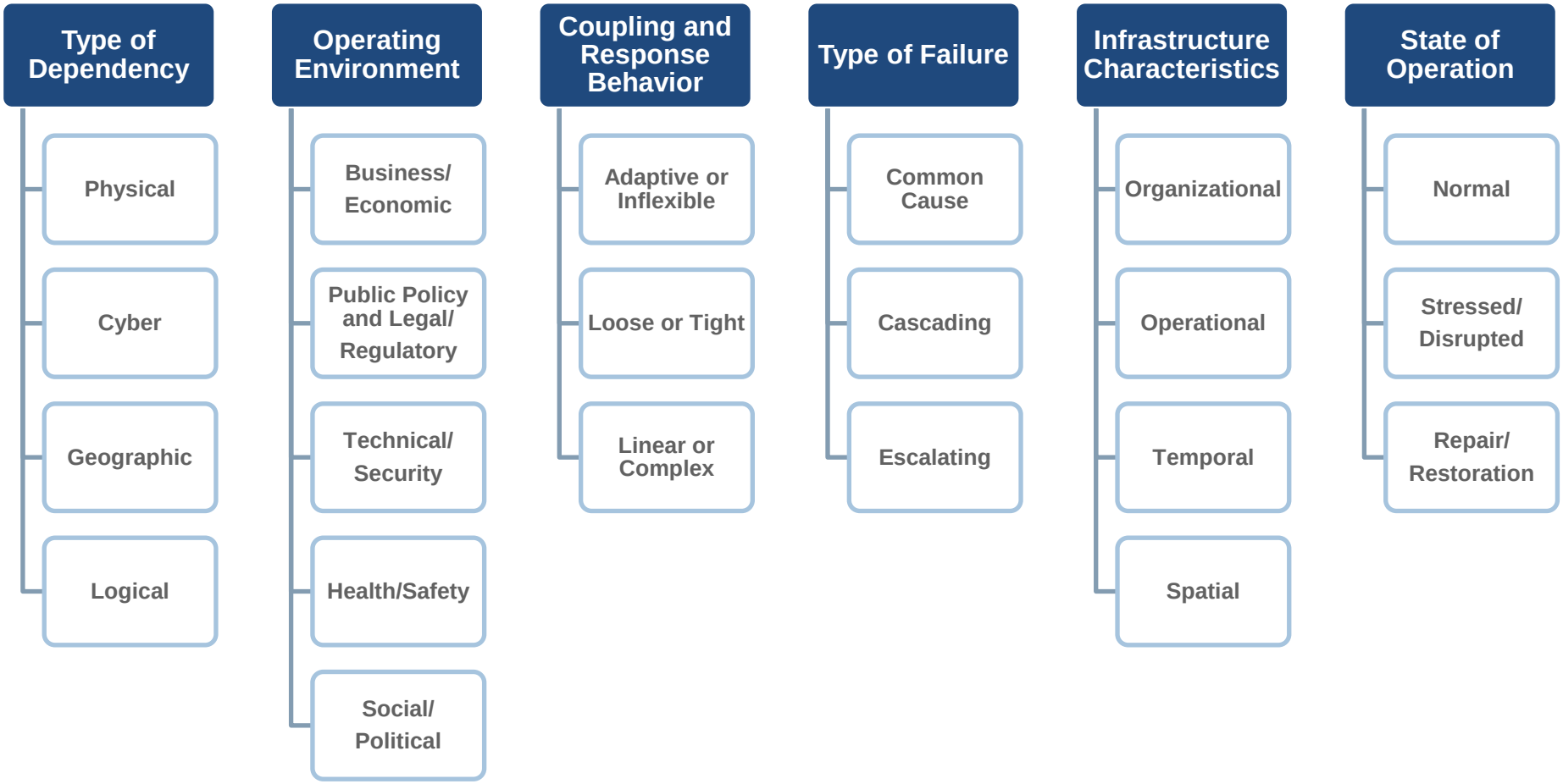
WHAT?

Critical Infrastructure Dependency

- linkage or connection between two infrastructures, by which the state of one infrastructure influences or is reliant upon the state of the other

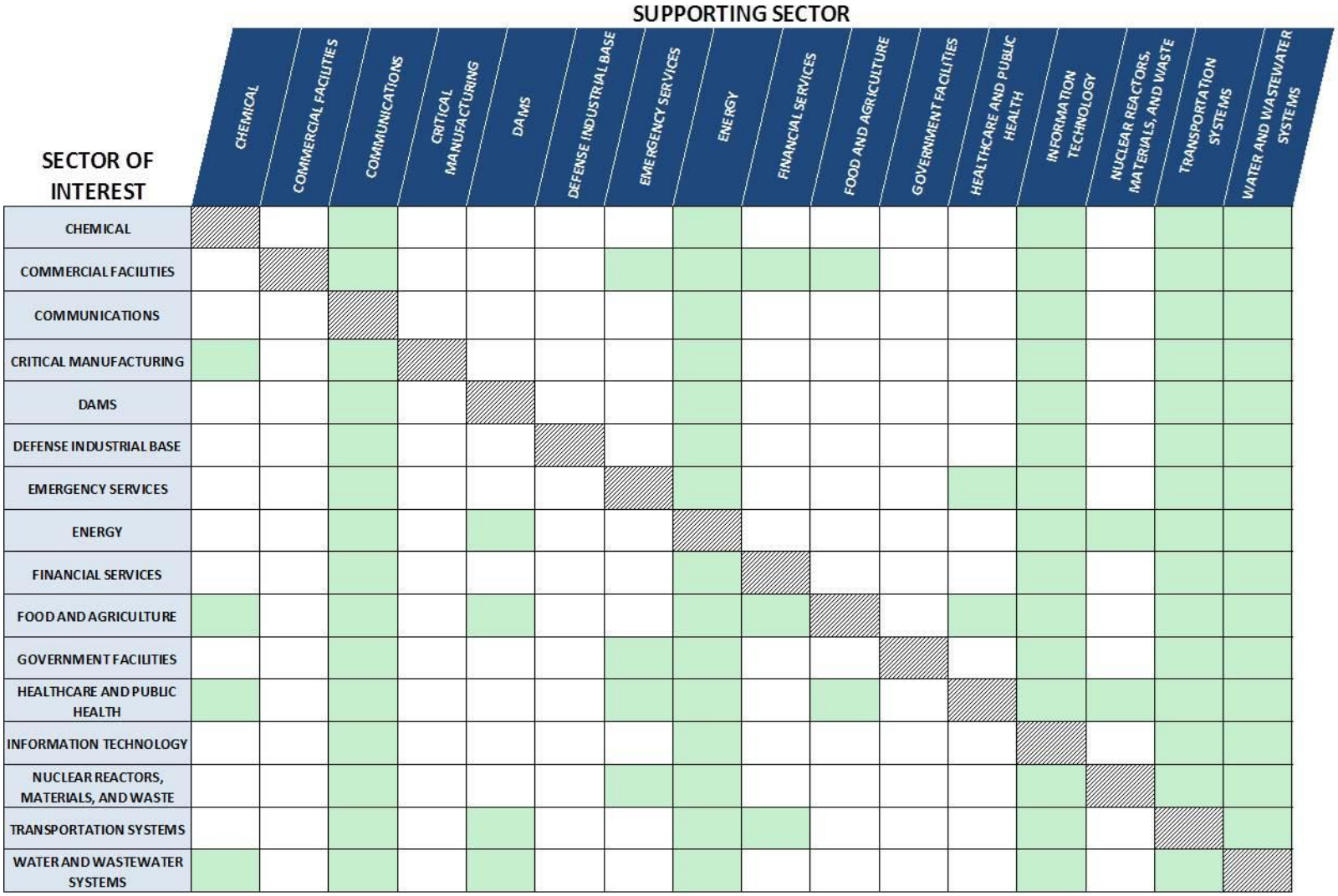


Dimensions of Dependencies



(Adapted from Rinaldi, Peerenboom, and Kelly, 2001)

Sector Dependency Matrix



Water Sector Dependency

Upstream Dependencies

- Chemical
- Communications
- Dams
- Energy
- Information Technology
- Transportation Systems

Is Dependent Upon

Water and Wastewater Systems Sector

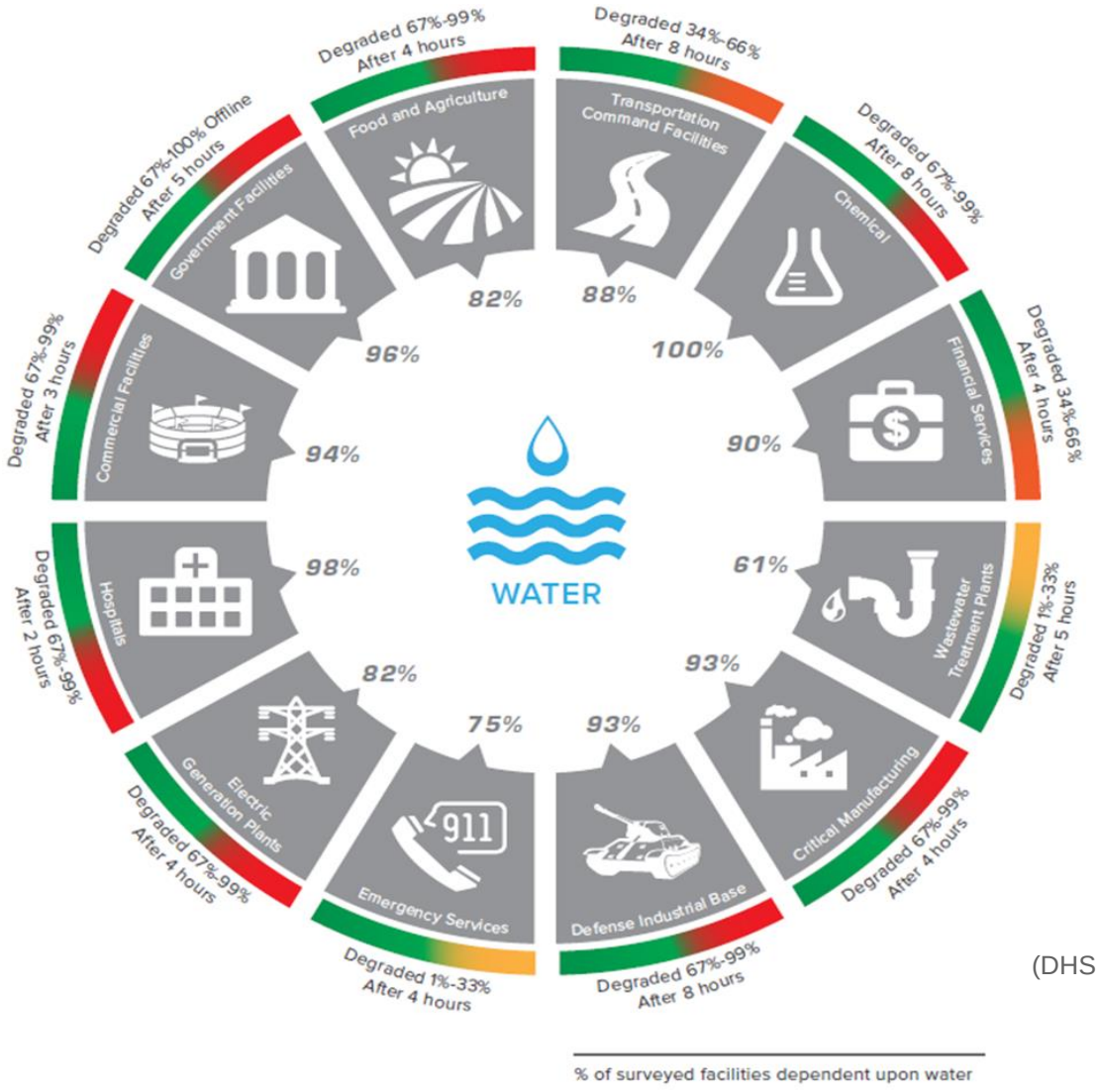
- Raw Water Supply
- Raw Water Transmission
- Raw Water Storage
- Water Treatment Facility
- Treated Water Storage
- Treated Water Distribution System
- Treated Water Monitoring System
- Treated Water Distribution Control Center
- Wastewater Facility
- Regulatory, Oversight, or Industry Organization

Provides Products To

Downstream Dependencies

- Chemical
- Commercial Facilities
- Communications
- Critical Manufacturing
- Dams
- Defense Industrial Base
- Emergency Services
- Energy
- Financial Services
- Food and Agriculture
- Government Facilities
- Healthcare and Public Health
- Information Technology
- Nuclear Reactors, Materials, and Waste
- Water and Wastewater Systems

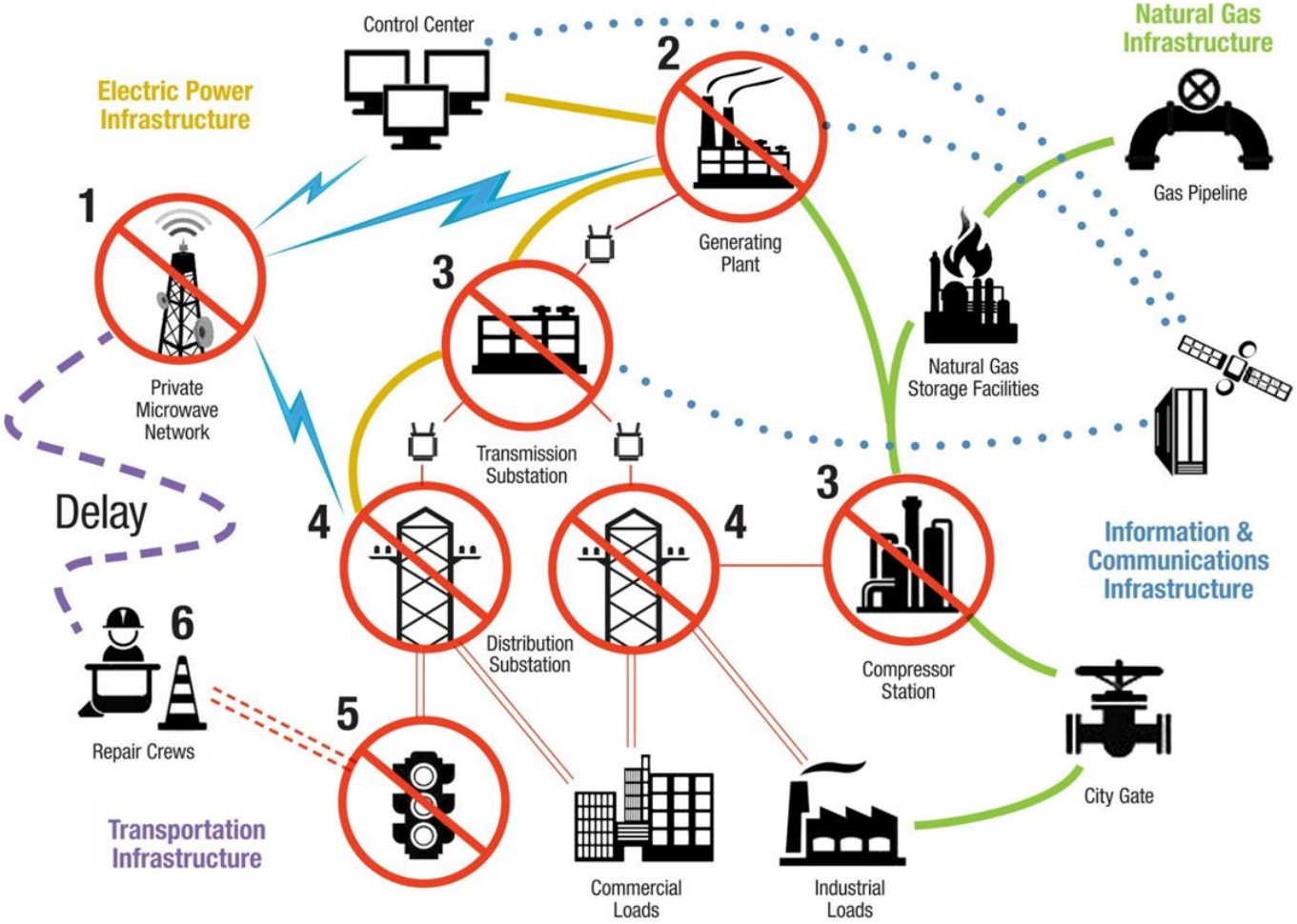
Water Facility Dependency



(DHS OCIA, 2014)

Cascading and Escalating Failures

WHY?

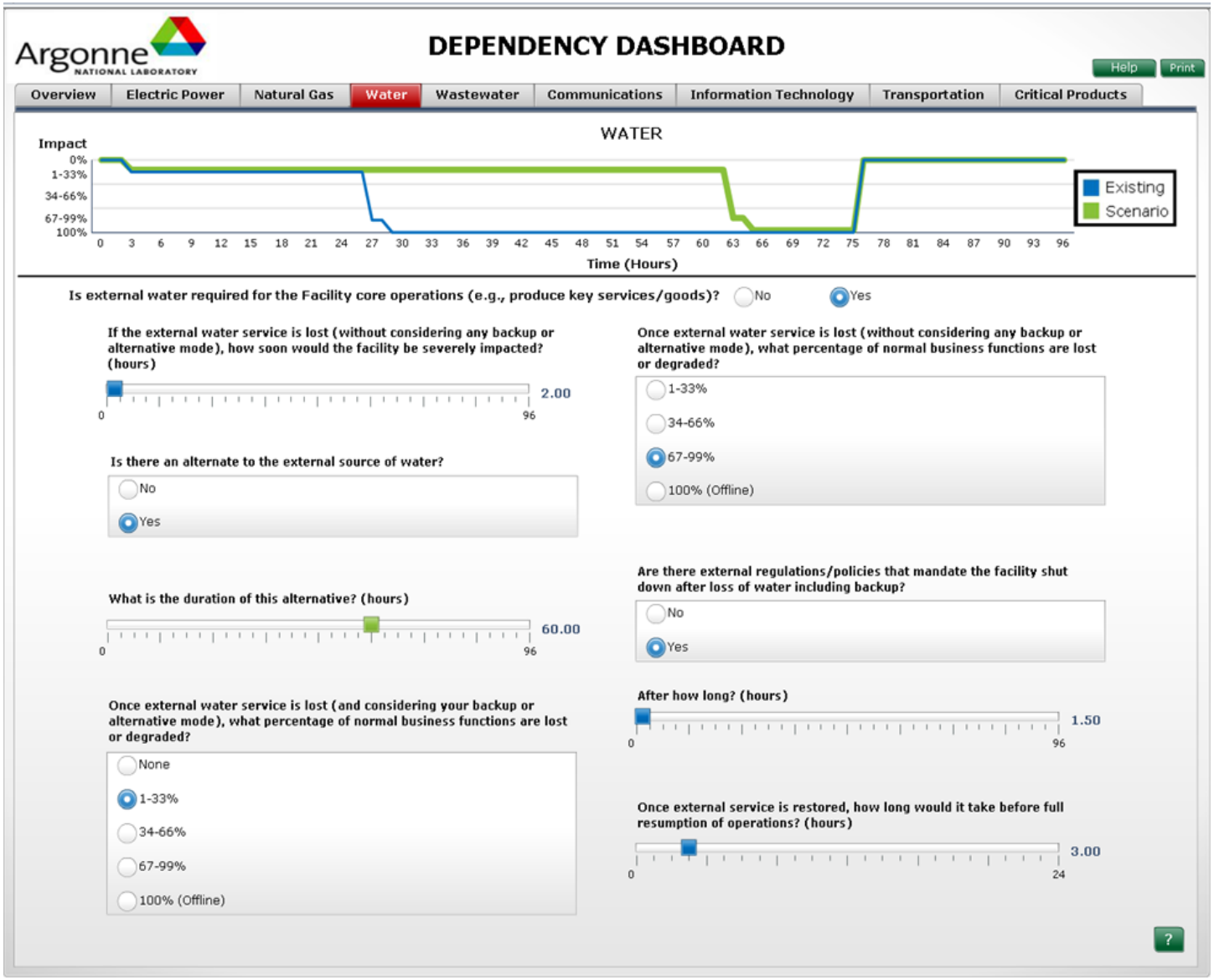


Critical Infrastructure Dependencies and Risk

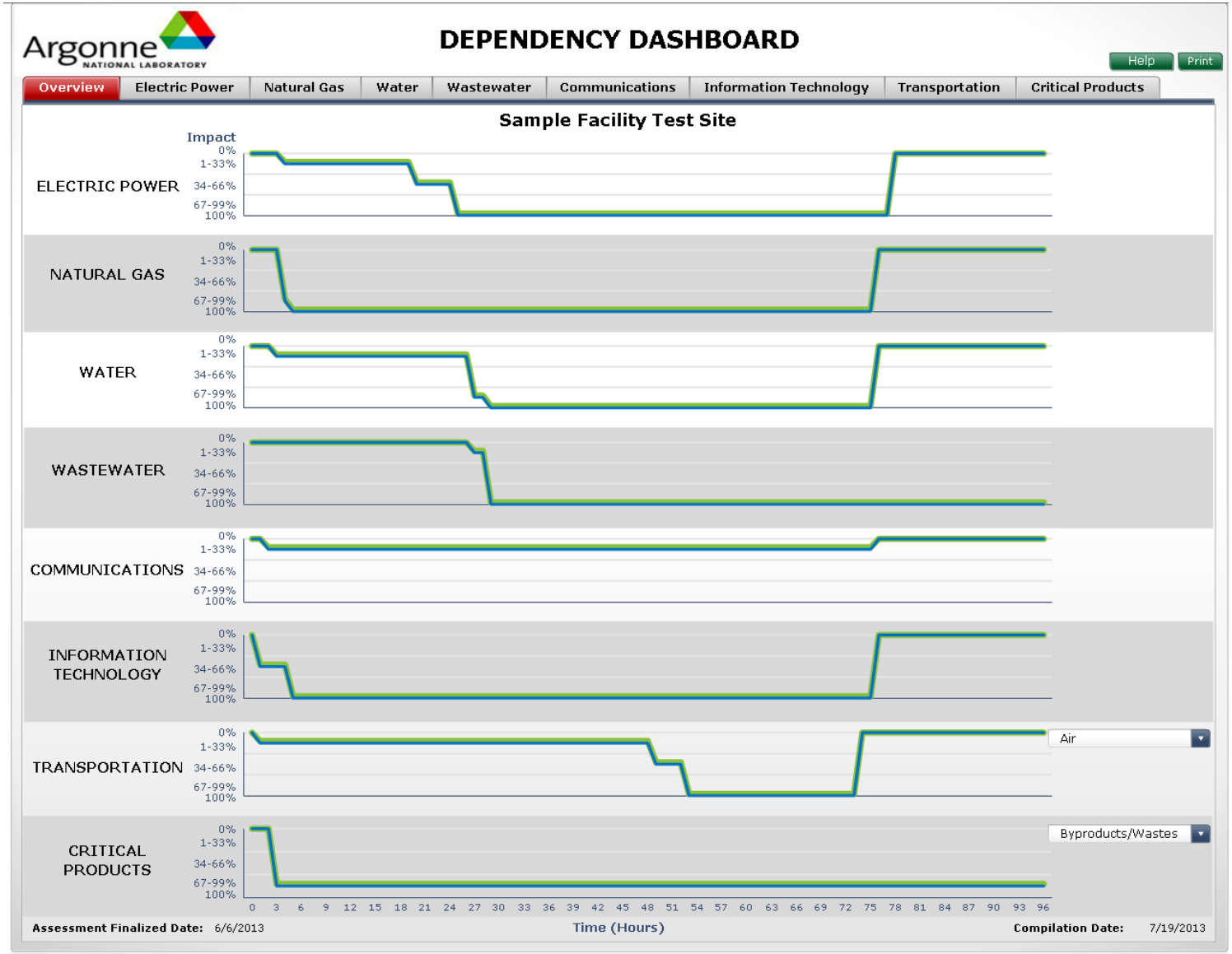
Critical Infrastructure Dependency

- Typical approaches
  - **Top-Down**
  - **Bottom-Up**

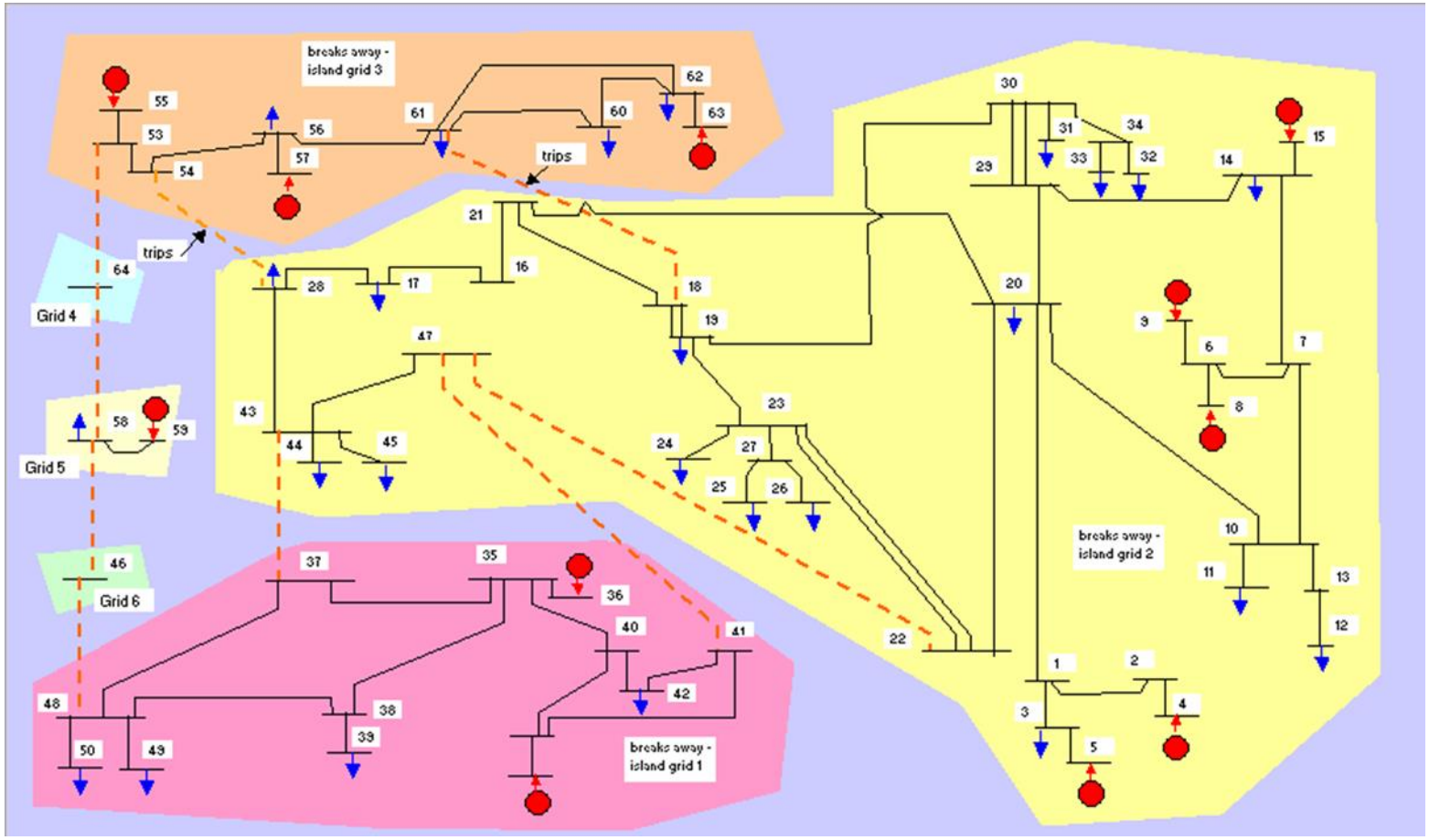
Dependency Curves Dashboard



Dependency Curves Dashboard (Cont'd)

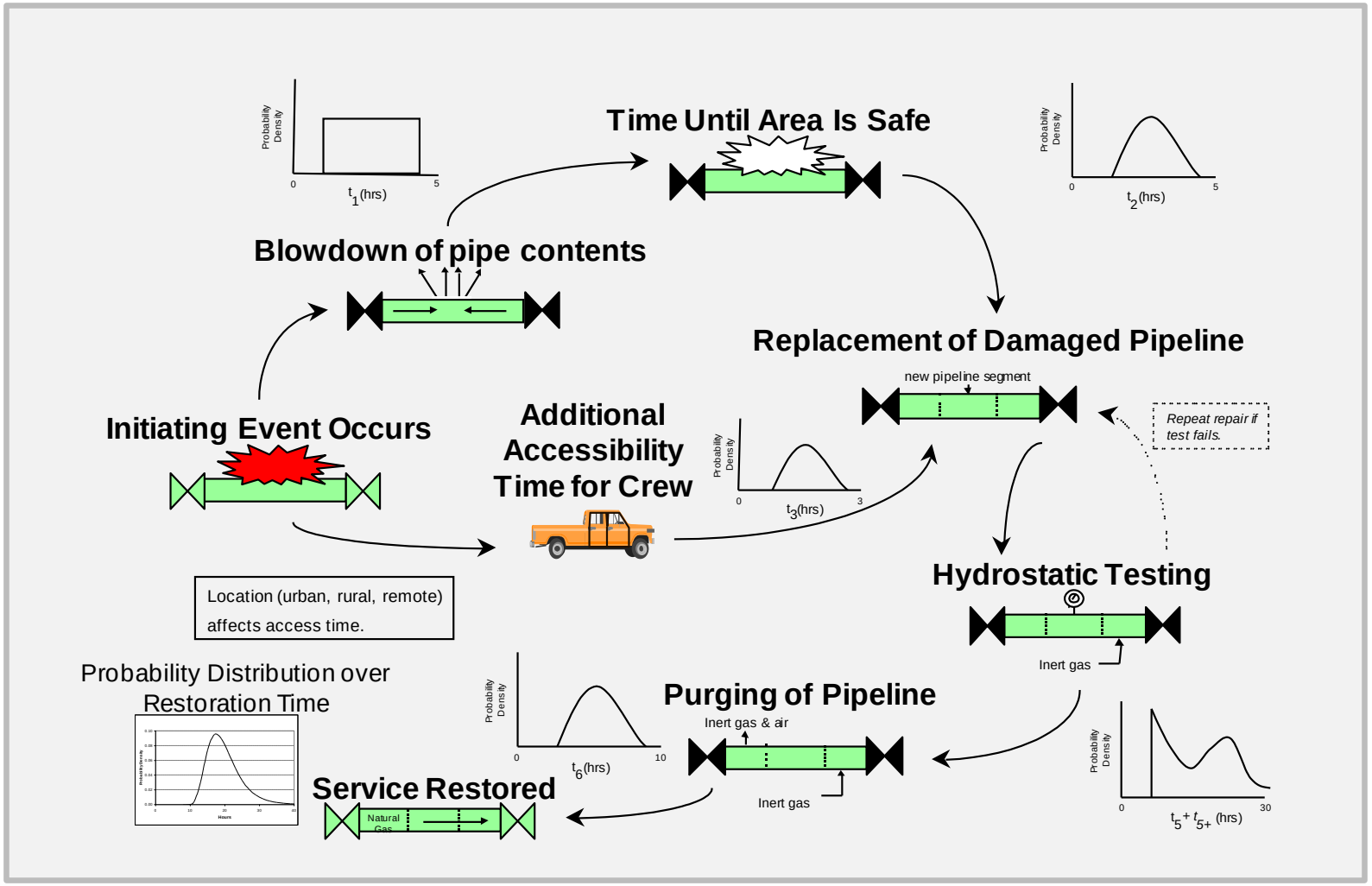


Critical Infrastructure Resilience



(Portante et al., 2011)

Critical Infrastructure Resilience



Summary

WHAT

- Dependencies are **complex and multi-dimensional**

WHY

- Infrastructure dependencies should be **factored into risk decisions** – protection/resilience
- **Assessment of interdependencies**

HOW

- There is **no one solution** to analyzing dependencies
- Dependencies constitute a growing research area with great **need for enhanced capability and innovation**