U.S. DEPARTMENT OF **ENERGY**

Office of
ENERGY EFFICIENCY & RENEWABLE ENERGY

Technical Resilience Navigator (TRN)
Risk Assessment Module Training

September 15, 2020

FEMP
Federal Energy Management Program

Agenda

1. Agenda and Workshop Objectives
2. FEMP Introduction
3. Technical Resilience Navigator (TRN) Overview
4. TRN Risk Assessment Overview
5. Risk Assessment Demo
6. Conclusion

To Receive IACET-Certified CEUs for a Workshop

To Receive IACET-Certified CEUs, Attendees Must:

- Attend the training in full. No exceptions

- Complete an assessment demonstrating knowledge of course learning objectives **within six weeks of the training.** A minimum of 80% correct answers is required.

- Complete an evaluation of the training event within **six weeks of the training**

To Access the On-Demand Workshop Assessment and Evaluation, Visit:

- https://www.wbdg.org/continuing-education/femp-courses/fempodw058
- If you do not have a WBDG account created, you will be required to create one.

Interactive Activities in Today's Training

- Today's training has interactive activities for participants to better understand some of the concepts contained within the slide presentations

- In another web browser window or with your smart phone, go to www.menti.com

- If you have questions, please enter them into the WebEx Q&A

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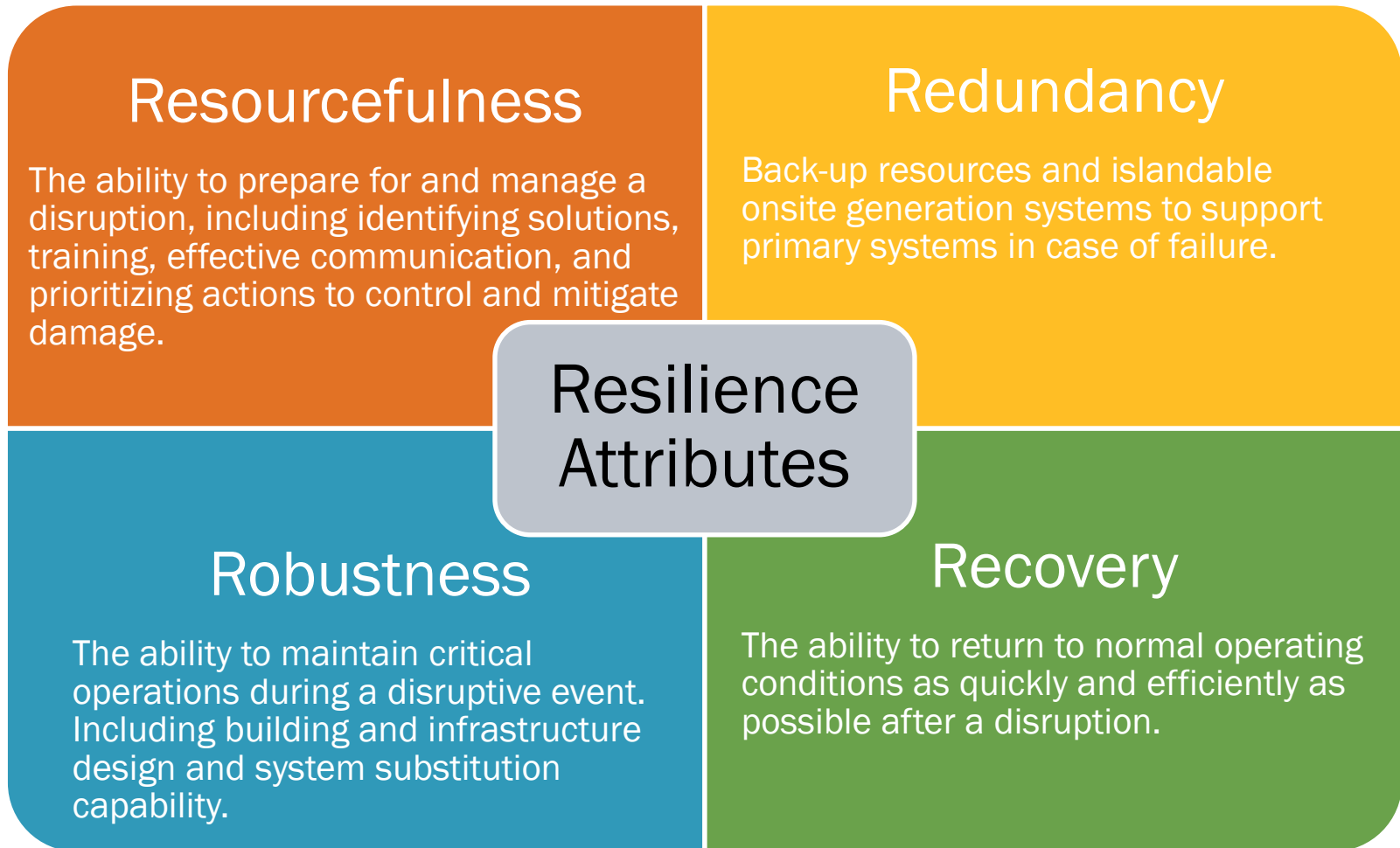
Resilience is a Top Priority for FEMP

Energy and water resilience is a key component of federal facility infrastructure operations

Resilience is accomplished when operational and procedural elements are able to withstand, adapt to, respond to, and recover from disruption

AP/David Philip

What is Resilience?

The ability to anticipate, prepare for, and adapt to changing conditions and to withstand, respond to, and recover rapidly from disruptions.

Resourcefulness
The ability to prepare for and manage a disruption, including identifying solutions, training, effective communication, and prioritizing actions to control and mitigate damage.

Redundancy
Back-up resources and islandable onsite generation systems to support primary systems in case of failure.

Resilience Attributes

Robustness
The ability to maintain critical operations during a disruptive event. Including building and infrastructure design and system substitution capability.

Recovery
The ability to return to normal operating conditions as quickly and efficiently as possible after a disruption.

Beyond Disaster Preparedness

Resilience planning is _distinct_ from disaster preparedness

- It emphasizes **proactive** strategies and actions that can be implemented to mitigate the impacts of unplanned disruptions

NOAA
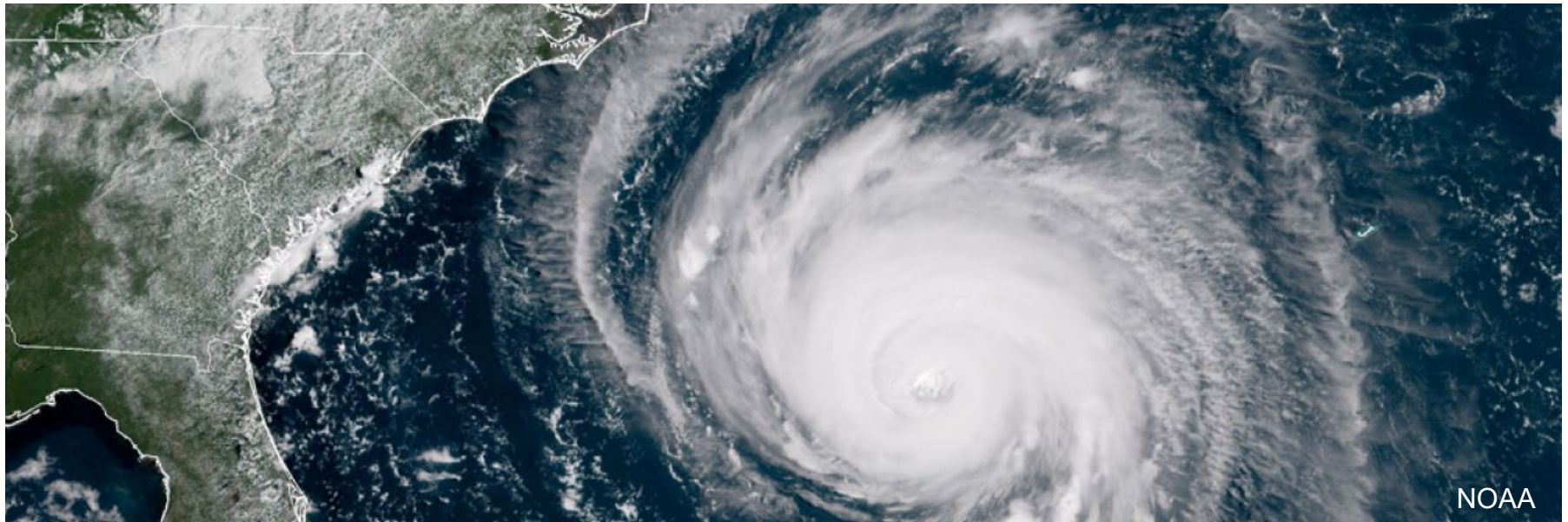
$1 spent on resilience is worth $4 spent on recovery
NIBS, The Natural Hazard Mitigation Saves: 2017 Interim Report

Resilient, Efficient, and Secure Approaches to Strategic Energy Management
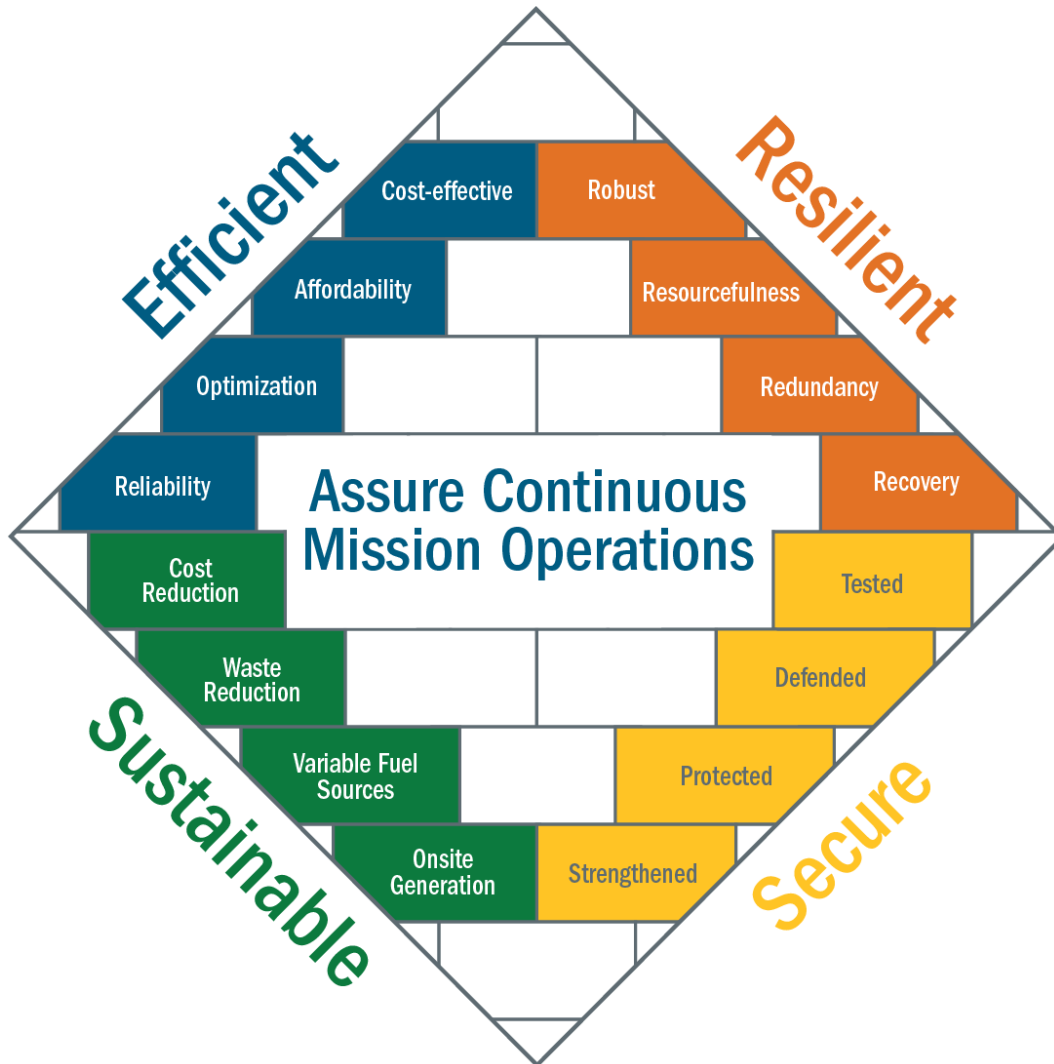
Integration Drives FEMP's Resilient-Efficient-Secure Nexus

- **Solutions that incorporate energy efficiency, resiliency, security, and sustainability, are essential for agency mission assurance.**

- **FEMP provides agencies the tools and resources needed to identify, develop and execute integrated solution sets.**

  - 50001 Ready Navigator

  - REopt Lite

  - Facility Cybersecurity Toolset

  - Distributed Energy Resources Cybersecurity Framework

  - Procurement

Technical Resilience Navigator (TRN)

Overview

DOE Federal Energy Management Program's
Technical Resilience Navigator

Site-Level Planning → Baseline Development → Risk Assessment → Solution Development → Solution Prioritization → Roadmap to Action

The Technical Resilience Navigator (TRN) helps users assess risk to a site's critical functions from energy and water utility disruptions and prioritize solutions that reduce risk.

Key Outcomes
- Identify site hazards and vulnerabilities in energy & water systems, operations and plans
- Establish relative risk from different sources and how solutions reduce risk
- Better integrate planning for energy and water management, continuity of operations, other site priorities

Technical Resilience Navigator

TRN Benefits

✓ Establishes resilience priorities

✓ Identifies critical energy/water loads

✓ Delivers processes for risk-informed decision making

    ✓ Prioritized list of resilience solutions

✓ Provides resources for continual engagement with leadership and stakeholders

Flexible Approach

✓ Allows agency/site priorities to shape assessments and solutions

✓ Speaks to all levels of resilience planning expertise

✓ Allows users to "drop in" and use modules they find useful

✓ Web-based application

Flexible Approach to Critical Missions and Functions

Critical Mission

When defining *critical missions,* an organization may look to an organizational goal or set of requirements of such high importance that it must be fulfilled.

Critical Function

Critical functions are the specific procedures, tasks, and decisions that ensure the critical mission will be sustained.

Facilities

Critical functions should be mapped to the facilities that house those function.
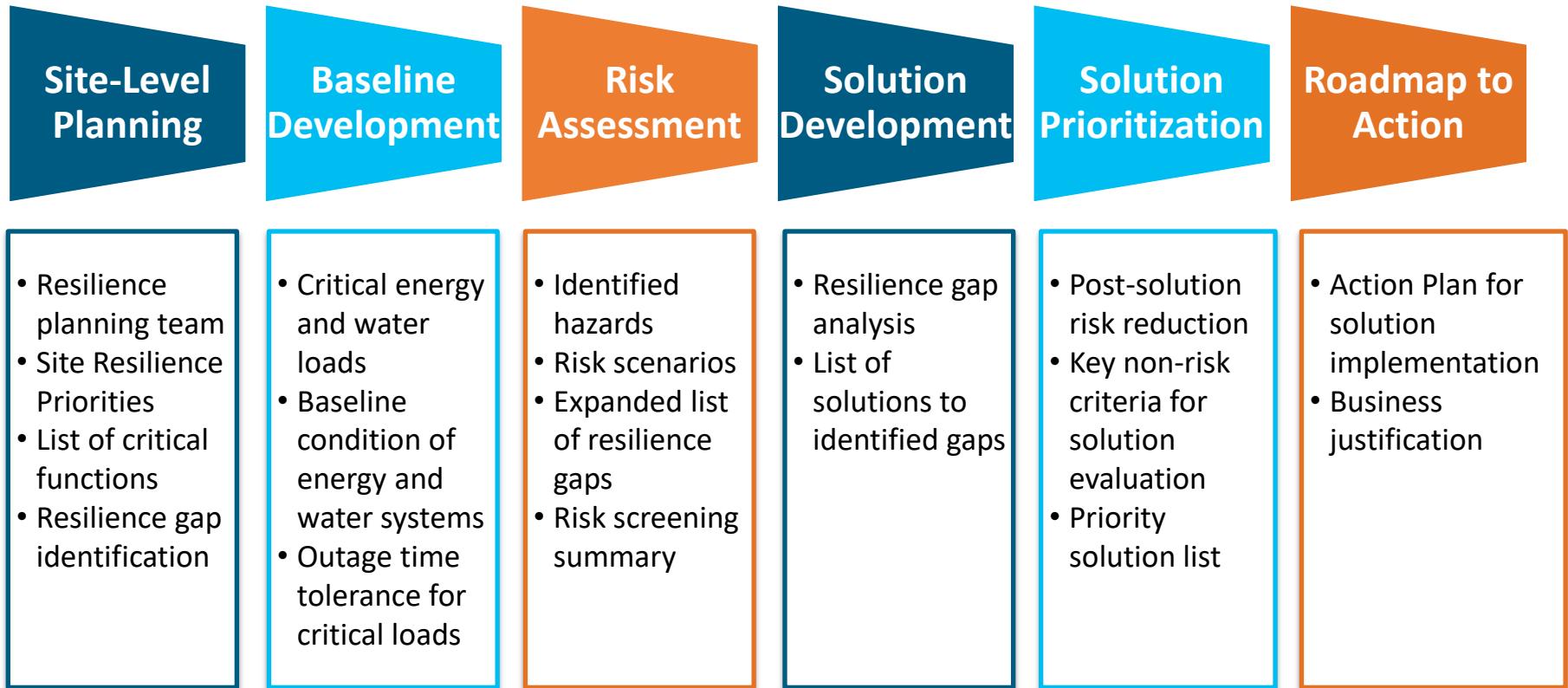
Building
Houses a Critical Load

Infrastructure
Houses a Critical Load or Supplies a Critical Load

The types of facilities that enable critical functions are organization- and site-specific; some common examples include: Mission-specific administration headquarters, Data centers, Emergency operations centers/command and control centers, etc.

Outcomes from TRN Modules

Site-Level Planning	Baseline Development	Risk Assessment	Solution Development	Solution Prioritization	Roadmap to Action
• Resilience planning team • Site Resilience Priorities • List of critical functions • Resilience gap identification	• Critical energy and water loads • Baseline condition of energy and water systems • Outage time tolerance for critical loads	• Identified hazards • Risk scenarios • Expanded list of resilience gaps • Risk screening summary	• Resilience gap analysis • List of solutions to identified gaps	• Post-solution risk reduction • Key non-risk criteria for solution evaluation • Priority solution list	• Action Plan for solution implementation • Business justification

TRN Web Application

Get started at https://trn.pnnl.gov/

Technical Resilience Navigator (TRN)

Risk Overview

A Risk-Informed Perspective

What can go wrong? (A *scenario*)

How likely is it? (A probability or frequency)

How bad would it be? (A consequence severity)

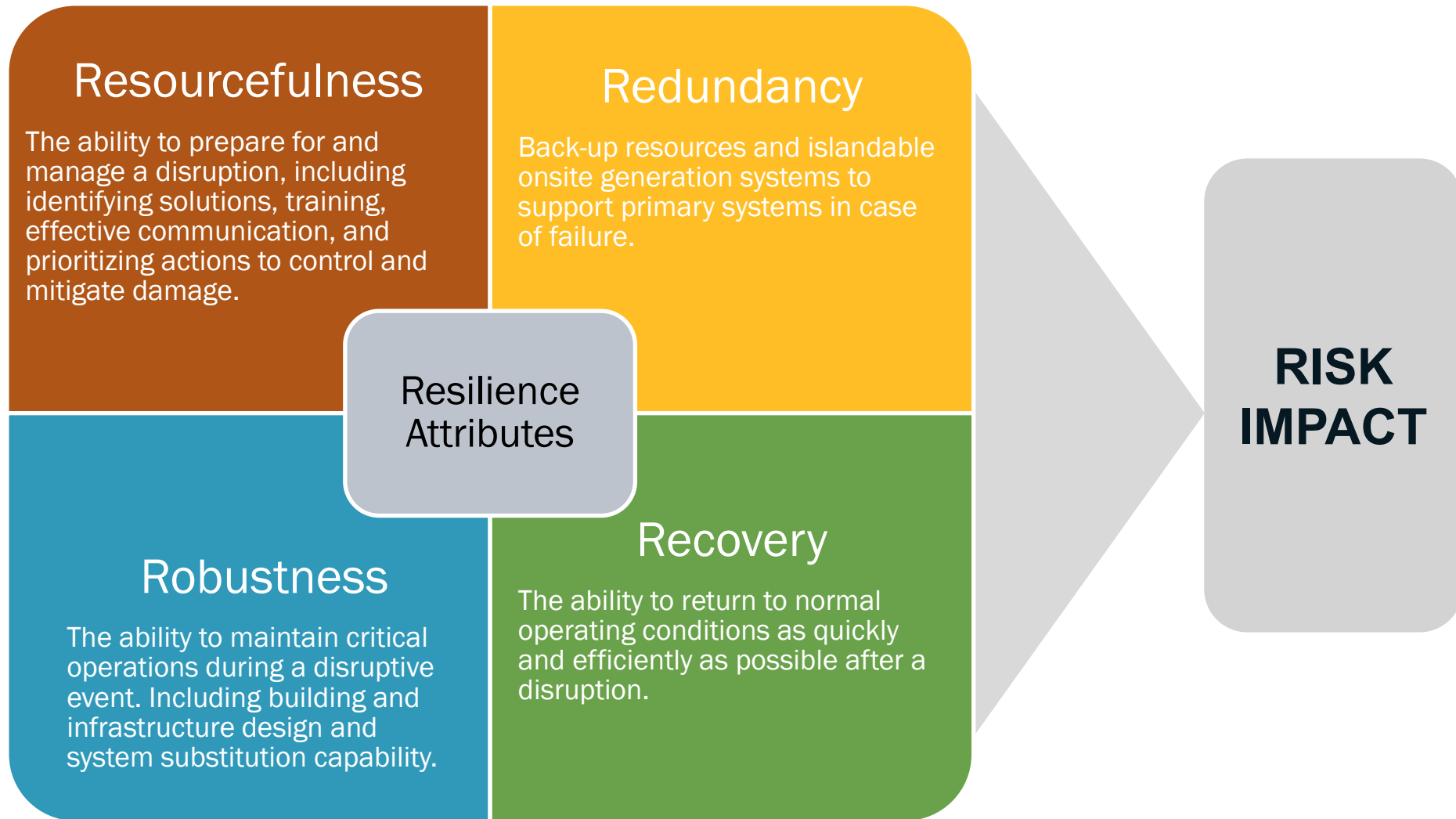# A Risk-Informed Perspective

What can go wrong? (A *scenario*)

How likely is it? (A probability or frequency)

How bad would it be? (A consequence severity)

Simplest expression of risk
Risk = Probability x Consequence

Summed over scenarios

Using Risk to Evaluate Resilience Enhancement Solutions

Resourcefulness

The ability to prepare for and manage a disruption, including identifying solutions, training, effective communication, and prioritizing actions to control and mitigate damage.

Redundancy

Back-up resources and islandable onsite generation systems to support primary systems in case of failure.

Resilience Attributes

Robustness

The ability to maintain critical operations during a disruptive event. Including building and infrastructure design and system substitution capability.

Recovery

The ability to return to normal operating conditions as quickly and efficiently as possible after a disruption.

RISK IMPACT

Risk-Informed Decision-Making:
The ALARP "Carrot"

As Low As Reasonably Practicable
(ALARP)

REDUCE RISK REGARDLESS OF COST — Risk intolerable

FOLLOW GOOD PRACTICE
CONSIDER COST OF RISK-REDUCTION — Tolerable if "as low a risk as reasonably practicable"

DE MINIMIS RISK — Risk tolerable

General Applications of Risk Assessment

General Application	Relevance to TRN
Screening where most risk resides. Risk-informed prioritization of areas for risk-reduction considerations	This is the primary TRN application – identifying areas for resilience enhancement. Does not require high quantitative precision
Comparison of risk mitigation options and cost-benefit analysis	Used in TRN for comparing the relative risk-reduction efficacies of candidate resilience solutions, and for preliminary cost-benefit analysis
Assessing compliance with pre-established numerical risk tolerance levels	*Not* a TRN application. Would require greater quantitative precision, uncertainty analysis

A Potential Risk Scenario

Backup power to critical load is successful?

Yes

Duplicate the function without critical load?

Yes

No

No

Function Interruption
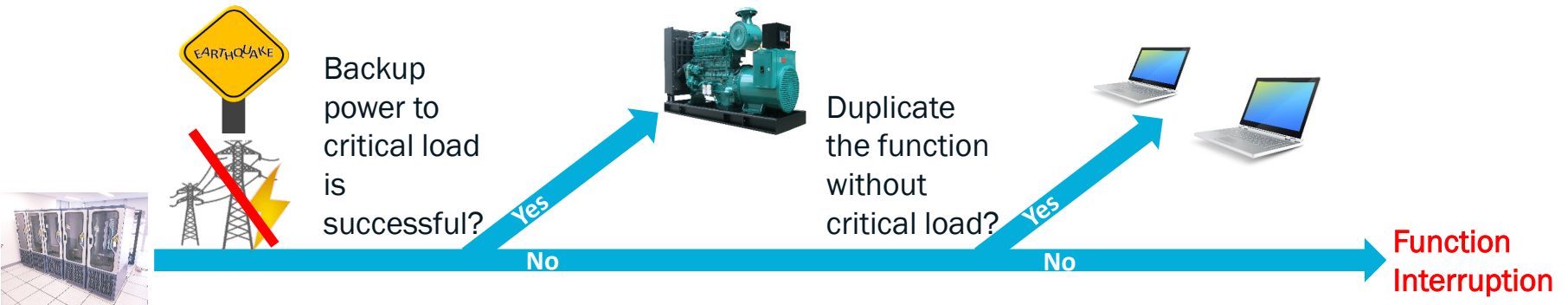
Enhance preventive maintenance program

Install microgrid backup power capability

Establish capability for offsite mission duplication

Aseismic upgrade to diesel generator

Fully train on offsite mission transfer

| Resourcefulness | Redundancy | Robustness | Recovery |

Manage Risk through Enhancing Resilience

Risk Formula for a System or Site

Risk = <u>Hazards and Threats</u> x <u>Vulnerability</u> x <u>Consequences</u>

Frequency of a hazard impacting system

Probability that protections fail

Severity of impact if protections fail

Determine weighted risk

Criticality weightings

Risk = <u>Hazards and Threats</u> x <u>Vulnerability</u> x <u>Consequences</u>

Frequency of a hazard impacting system

Grouped Hazards
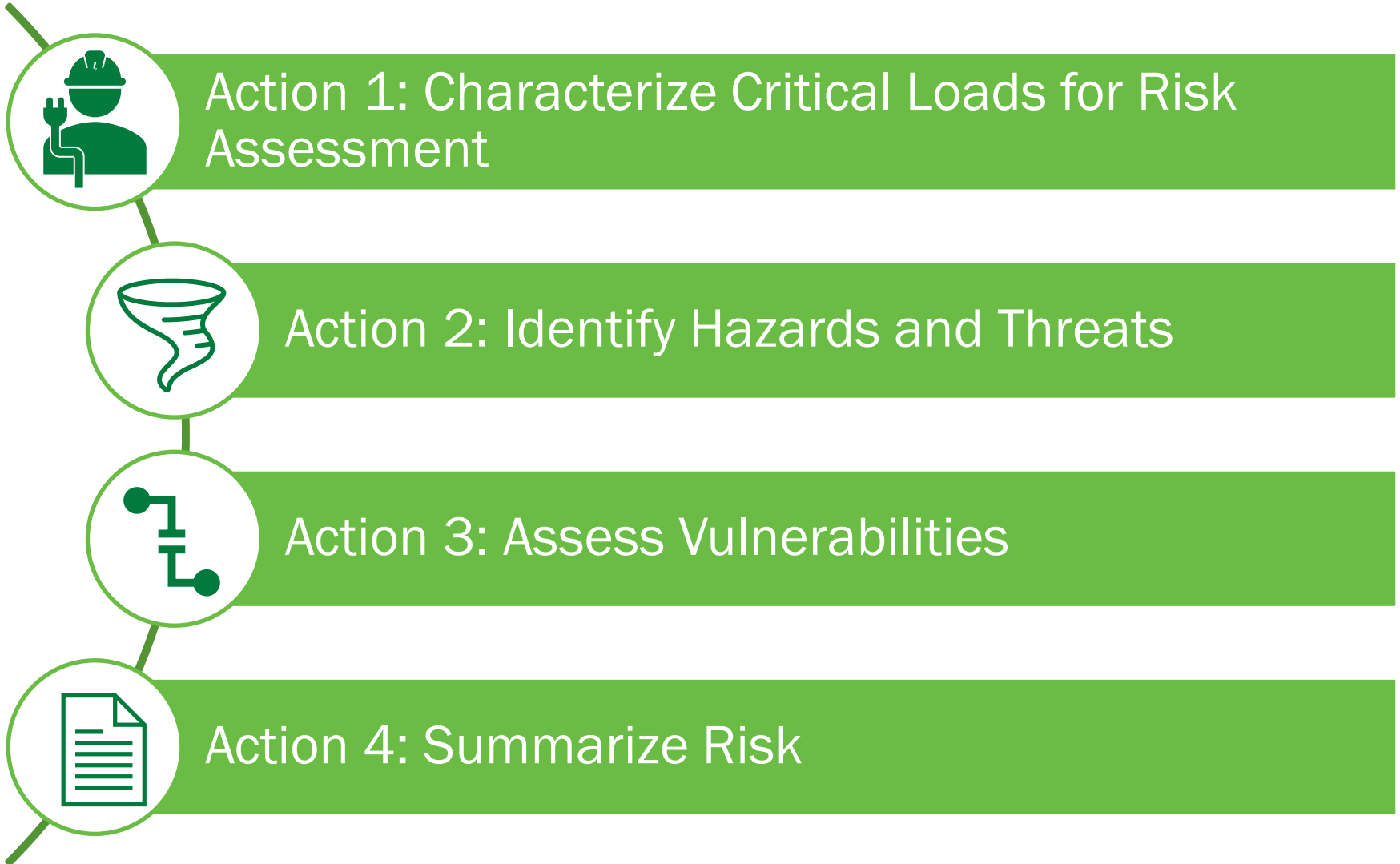Dual-impact Hazards

Probability that protections fail

State of redundant systems

Severity of impact if protections fail

Outage duration (hours)

TRN Risk Assessment Actions

Action 1: Characterize Critical Loads for Risk Assessment

Action 2: Identify Hazards and Threats

Action 3: Assess Vulnerabilities

Action 4: Summarize Risk

TRN Risk Assessment Actions

Action 1: Characterize Critical Loads for Risk Assessment

Inputs	- Relative importance of critical functions served by loads - Function restoration capability - Tolerable outage duration of loads
Affected Risk Elements	Scenarios: Creating scenarios involving critical load loss Consequences: Critical function outage durations

TRN Risk Assessment Actions

Action 2: Identify Hazards and Threats

| Inputs	- Site-specific energy/water resources loss frequencies and durations - Dual-impact hazards that could affect both primary service and site redundant systems
Affected Risk Elements	Scenarios: Creating scenarios involving hazard and threat realization Hazards and threats: Frequencies of hazards and threats Consequences: Primary system outage durations due to realized hazards and threats

TRN Risk Assessment Actions
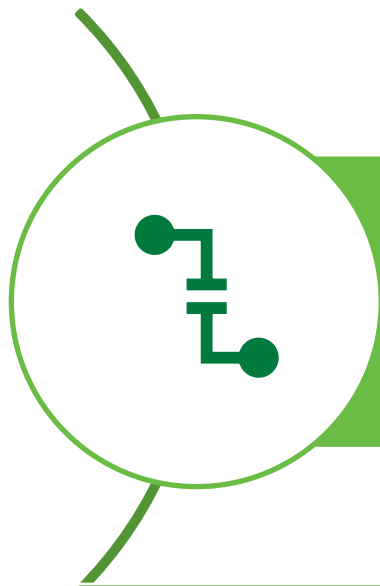
Action 3: Assess Vulnerabilities

Inputs	- Redundant system capability - Identifying design, operational and maintenance factors that could affect system reliabilities
Affected Risk Elements	Scenarios: Creating scenarios involving redundant system failures Vulnerabilities: Assessing probabilities of redundant system failures

TRN Risk Assessment Actions

Action 4: Summarize Risk

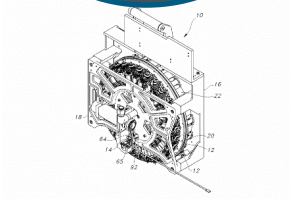| Inputs	- N/A
Affected Risk Elements	Displays the distribution of unweighted and weighted risk across critical loads, hazards, and scenarios

What-If? Risk Assessments

Assessing Resilience Solutions Against Model

Improve system redundancy?

Upgrade design bases?

Enhance reliability management?

Improve response planning?

Establish mission duplication?

TRN Screening Risk Assessment

Selection and Prioritization of Risk Reduction Options

Interactive Activity

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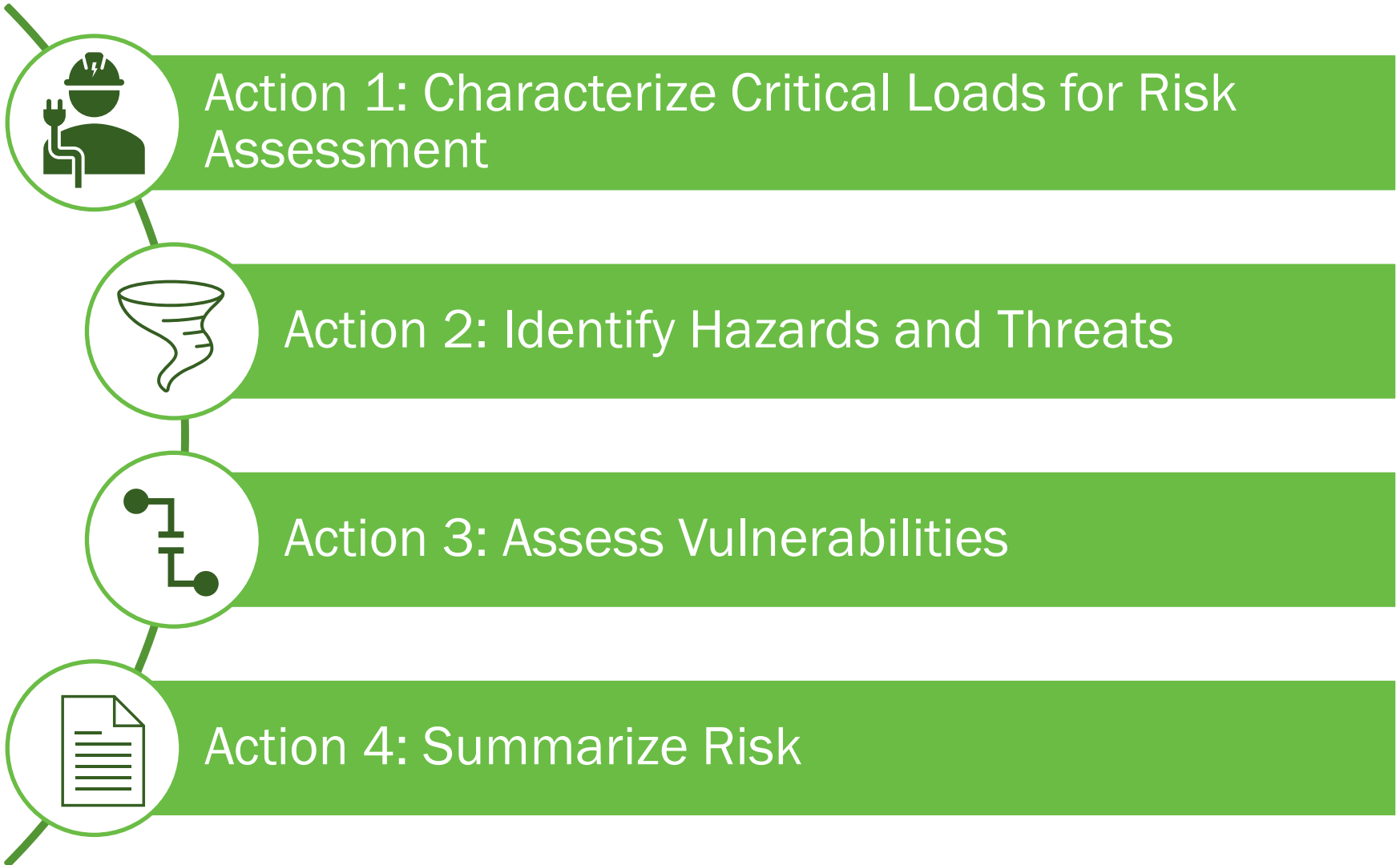
Q&A

Any Questions?

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Technical Resilience Navigator (TRN)

Risk Assessment Module Inputs

Risk Screening Summary

Risk Assessment Actions

Action 1: Characterize Critical Loads for Risk Assessment

Action 2: Identify Hazards and Threats

Action 3: Assess Vulnerabilities

Action 4: Summarize Risk

Risk Assessment: Module Overview

1. **Characterize Critical Loads for Risk Assessment**

    a.   Pulls together information previously collected in Baseline Development and Site-Level Planning

    b.   New: think about mission duplication capabilities

2. **Identify Hazards and Threats**

    a.   Pulls together information previously collected in Site-Level Planning

    b.   New: research additional or alternative hazards/threats
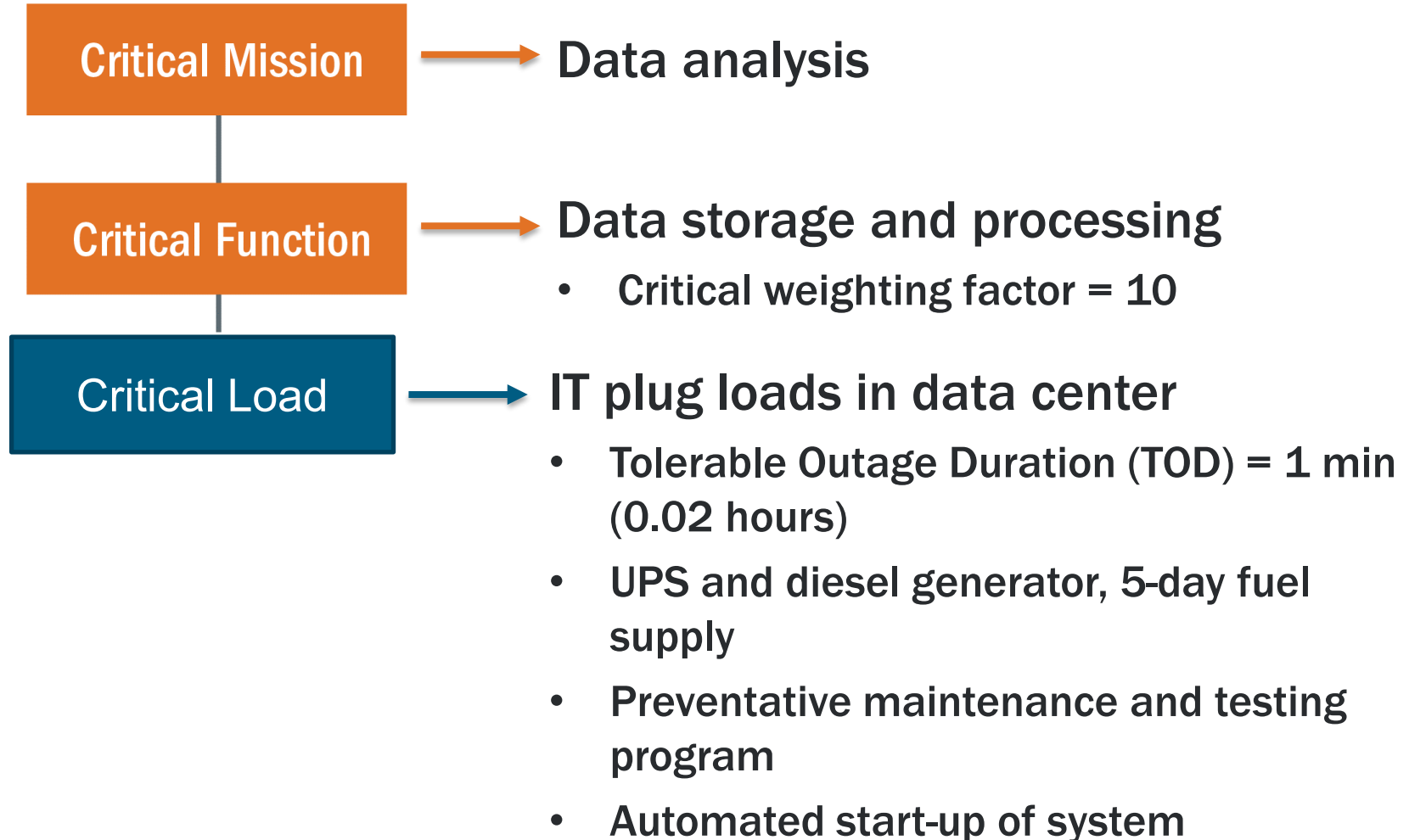
3. **Assess Vulnerabilities**

    a.   Pulls together information previously collected in Baseline Development

    b.   New: think about the information as it relates to <u>risk scenarios</u>; think about what redundant system QUALIFIES under different duration of outages

4. **Summarize Risk**

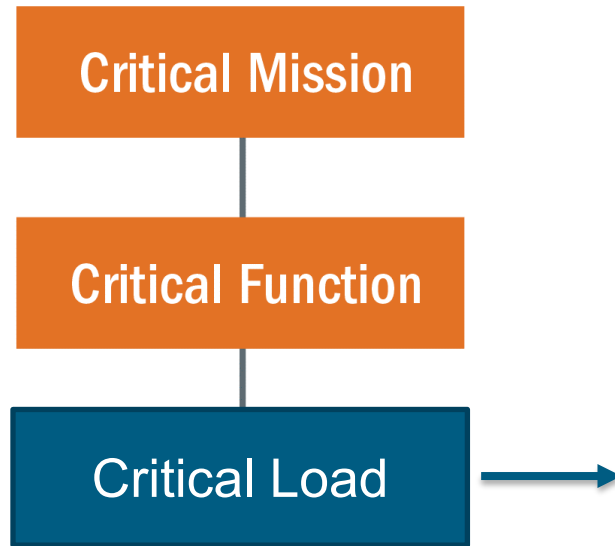   a.   New: review output for risk drivers

Demo Example

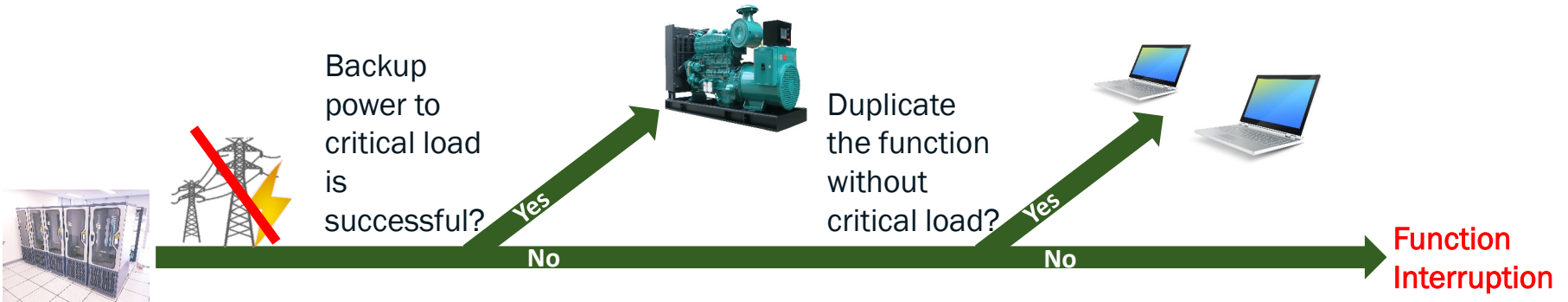**Previously identified in Site-Level Planning & Baseline Development**

| Critical Mission | → Data analysis |

Data analysis

Data storage and processing
- Critical weighting factor = 10

IT plug loads in data center
- Tolerable Outage Duration (TOD) = 1 min (0.02 hours)
- UPS and diesel generator, 5-day fuel supply
- Preventative maintenance and testing program
- Automated start-up of system

Critical Mission

Critical Function

Critical Load

Demo Example

Identified in Risk Assessment

```
┌─────────────────────┐
│   Critical Mission  │
└─────────────────────┘
          │
┌─────────────────────┐
│  Critical Function  │
└─────────────────────┘
          │
┌─────────────────────┐
│    Critical Load    │ ──────►
└─────────────────────┘
```

IT plug loads risk information

- Mission restoration capabilities
  - 48-hour initiation
  - No documentation or exercises
- Power outage
  - 1-week duration
  - 1 in 100 year expected frequency

Demo Risk Scenario

Backup power to critical load is successful?

Yes

Duplicate the function without critical load?

Yes

No

No

Function Interruption

Assess Vulnerabilities
Vulnerability probability

Identify Hazards and Threats
Hazard/threat frequency
Outage duration (consequence)
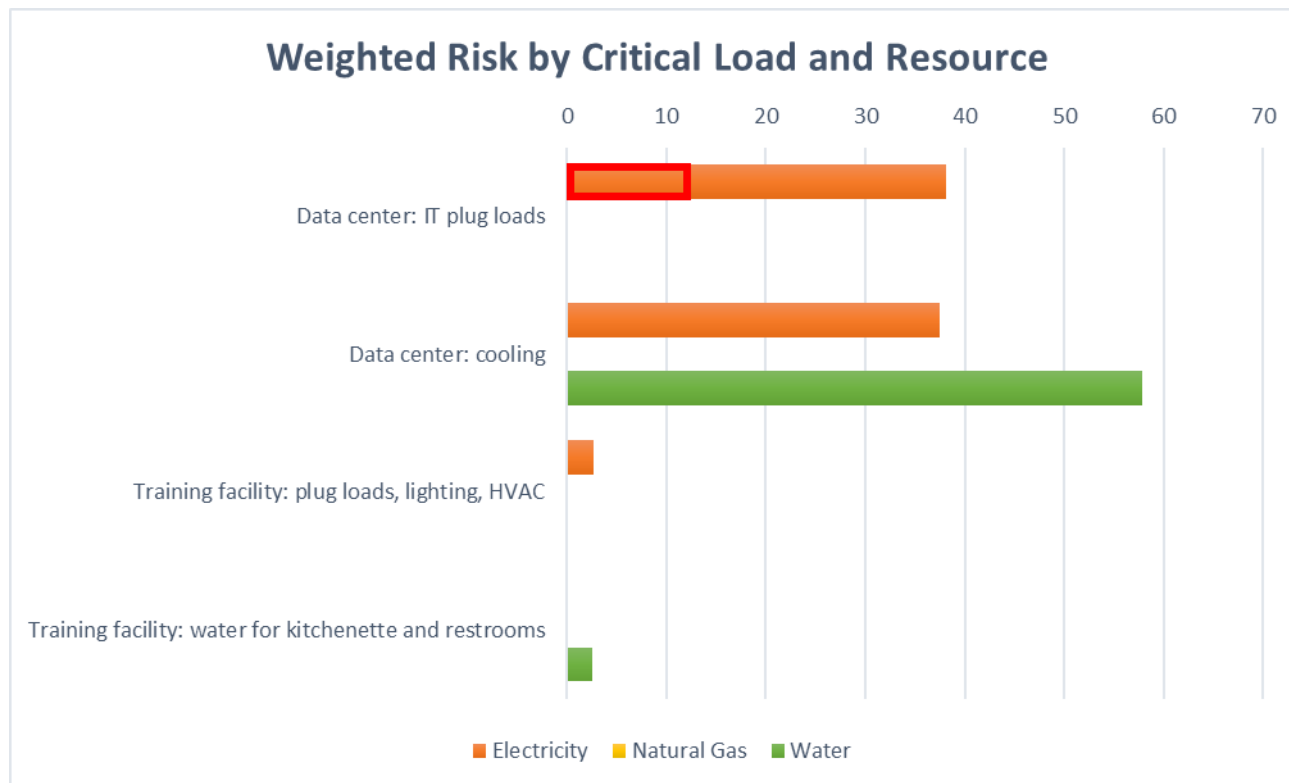
Characterize Critical Loads
Consequence reduction

Interactive Activity

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Summarize Risk: Visualizations

Weighted Risk by Critical Load and Resource

Clustered bar chart created via copying and pasting Weighted Risk by Critical Load and Resource table into Excel

Highlights risk from scenario entered during demo

Summarize Risk: Visualizations

Hazards & Threats		Critical Loads			
	Data center: cooling	Data center: IT plug loads	Training facility: plug loads, lighting, HVAC	Training facility: water for kitchenette and restrooms	Grand Total
HG01: Grouped Electricity, Likely (once a year), outage duration 1 hrs		0.1			0.1
HG02: Grouped Electricity, Anticipated (1 in 10 years), outage duration 24 hrs	0.2	0.2			0.4
HG03: Grouped Electricity, Unlikely (1 in 100 years), outage duration 168 hrs	15.4	15.6	1		32
HG04: Grouped Electricity, Extremely unlikely (1 in 1,000 years), outage duration 720 hrs	6.5	6.5	0.6		13.6
HG12: Grouped Water, Anticipated (1 in 10 years), outage duration 24 hrs	21.2				21.2
HG13: Grouped Water, Unlikely (1 in 100 years), outage duration 168 hrs	14.8			0.9	15.7
HG14: Grouped Water, Extremely unlikely (1 in 1,000 years), outage duration 720 hrs	6.5			0.6	7.1
Seismic, 6.0+, Elec, outage duration 168 hrs	15.4	15.6	1		32
Seismic, 6.0+, Water, outage duration 168 hrs	15.3			0.9	16.2
Grand Total	95.3	38	2.6	2.4	138.3

Pivot table created via copying and pasting Risk by Hazard and Critical Load table into Excel

Conditional formatting added, with darker colors indicating higher risk

Highlights risk from scenario entered during demo

Summarize Risk: Visualizations

Weighted Risk by Hazard and Critical Load
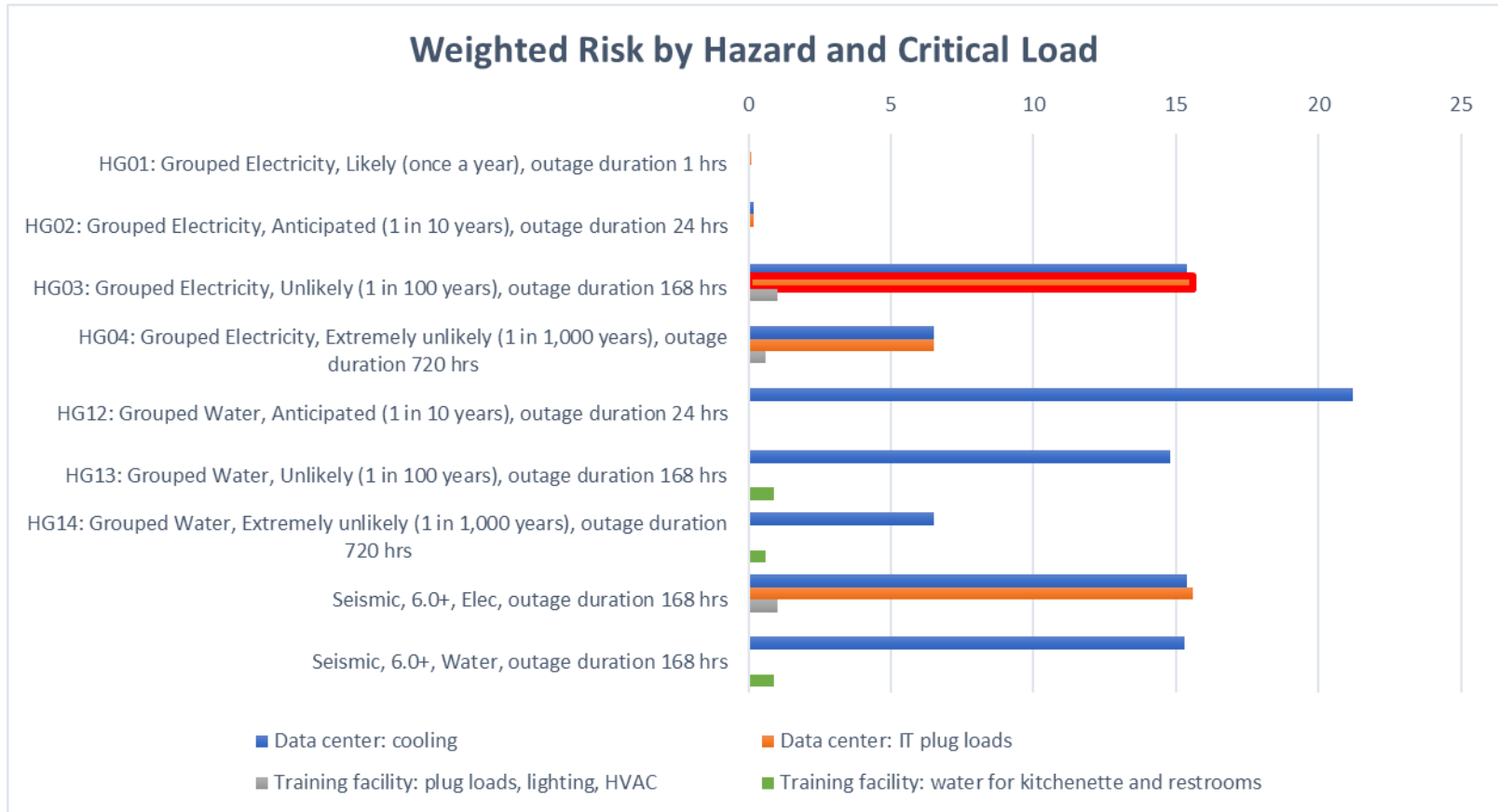
Clustered bar chart created using pivot table output shown on previous slide

☐ Highlights risk from scenario entered during demo

Next Steps

Risk assessment module outputs and methodology play key roles in remaining modules

- **Solution Development module**
  - Risk outputs inform resilience solutions
- **Solution Prioritization module**
  - Risk outputs and methodology used to evaluate solution risk reduction
  - Risk reduction a key criterion in prioritizing solutions

Interactive Activity

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Q&A

Any Questions?

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Want to Find Out More?

TRN Risk Assessment Training
- ✓ Technical Resilience Navigator Overview https://www.wbdg.org/continuing-education/femp-courses/fempodw057
- ✓ Technical Resilience Navigator - Risk Assessment Overview https://www.wbdg.org/continuing-education/femp-courses/fempodw058

Thank You

Website: https://femp.energy.gov