U.S. DEPARTMENT OF
ENERGY

Office of
ENERGY EFFICIENCY &
RENEWABLE ENERGY

Developing and Prioritizing Resilience Solutions within the Technical Resilience Navigator

January 13, 2021

FEMP
Federal Energy Management Program

Agenda

1. Agenda and Workshop Objectives
2. FEMP Introduction
3. Technical Resilience Navigator (TRN) Overview
4. Developing Resilience Solutions within the TRN
5. Prioritizing Resilience Solutions within the TRN
6. Demonstration of the TRN
7. Q&A

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/fempodw059
- 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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Interactive Activity

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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

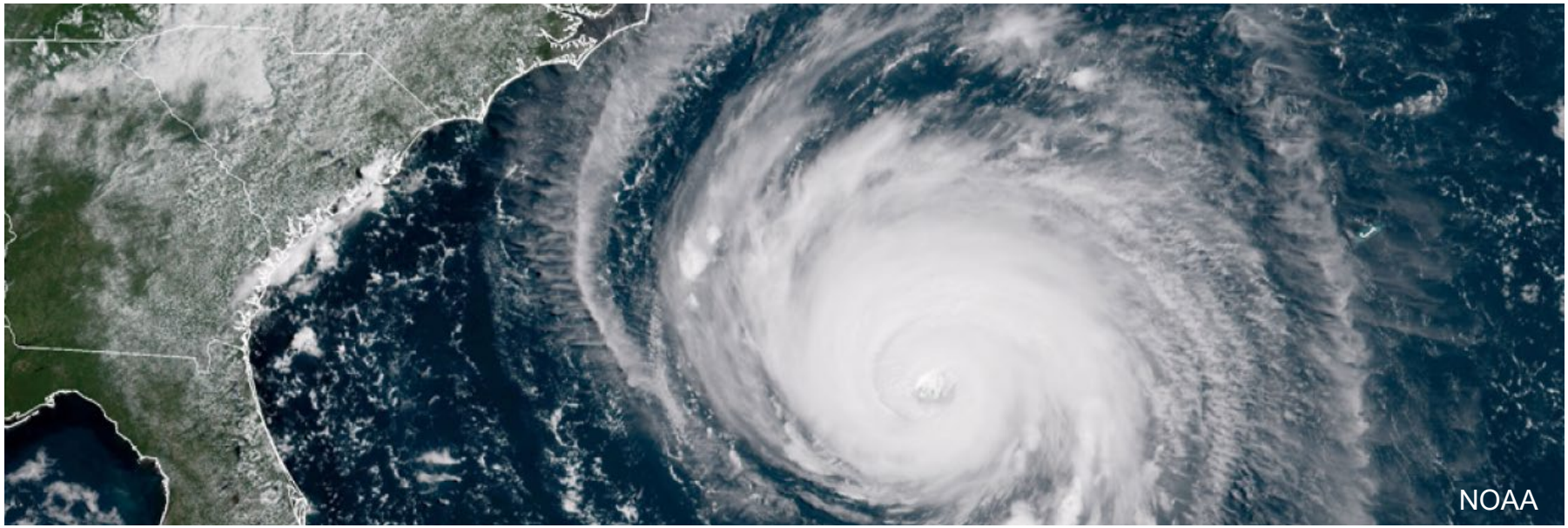
What is Resilience?

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

Beyond Disaster Preparedness

Resilience planning is *distinct* from disaster preparedness

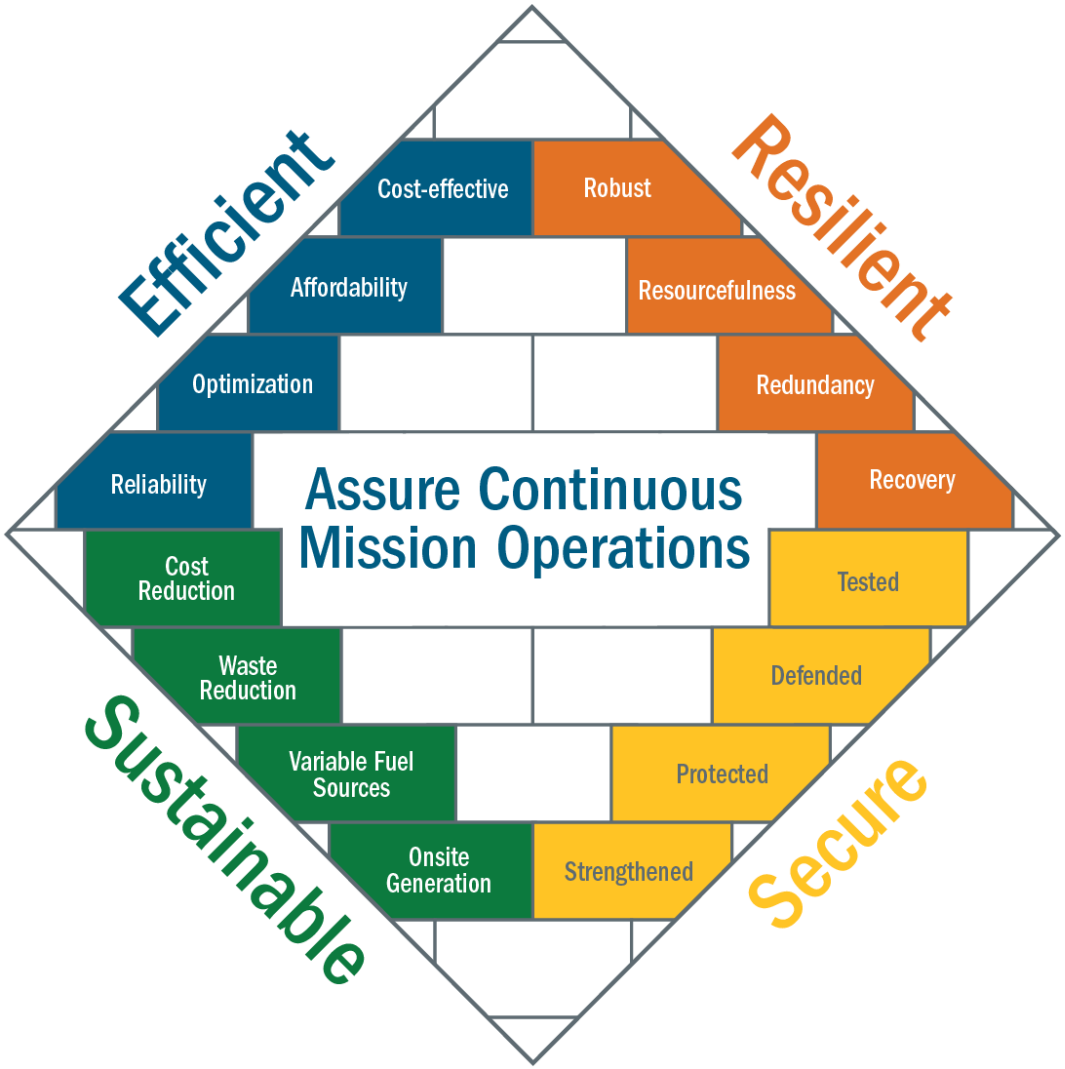
- It emphasizes **proactive** strategies and actions that can be implemented to mitigate the impacts of unplanned disruptions



$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*

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

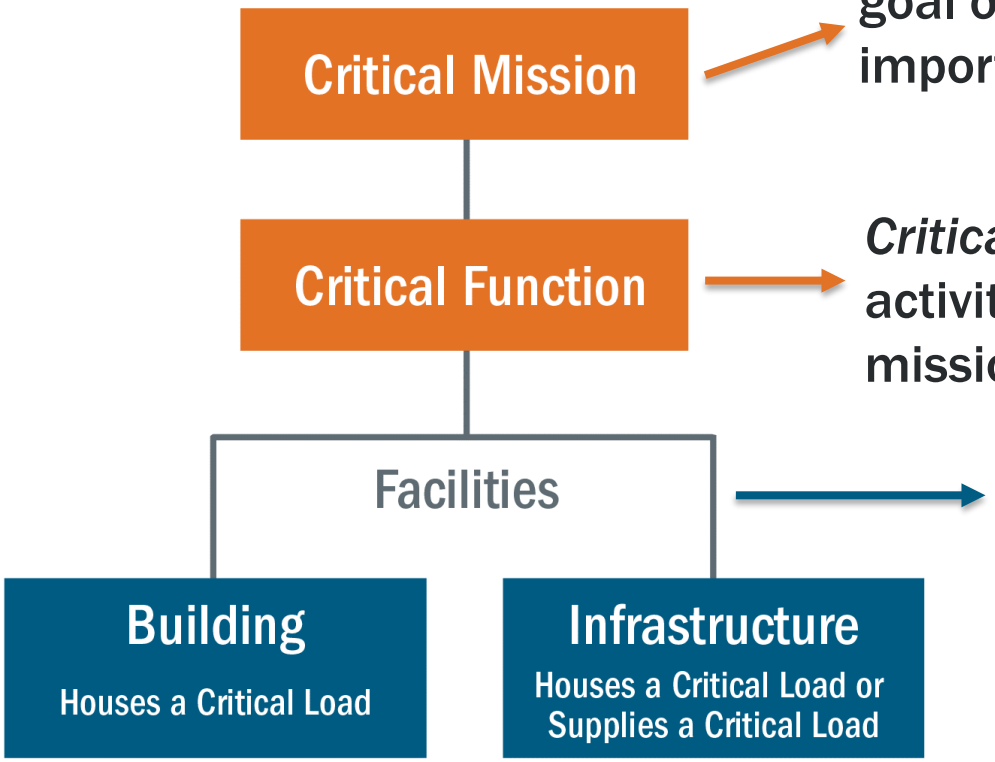
TRN Benefits

- ✓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

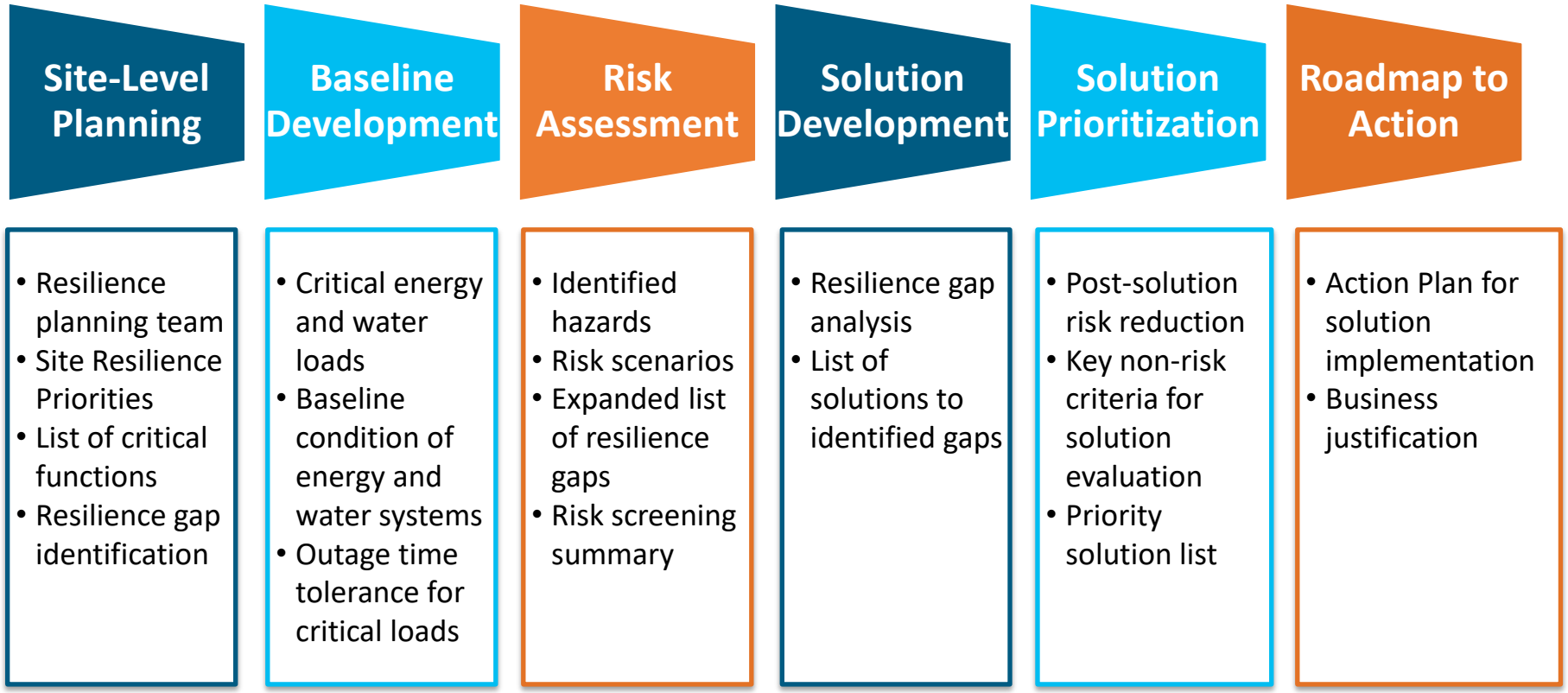


When defining *critical missions,* an organization may look to an organizational goal or set of requirements of such high importance that it must be fulfilled.

Critical functions are the operations and activities required to enable a critical mission.

Critical functions should be mapped to the facilities that house those functions.

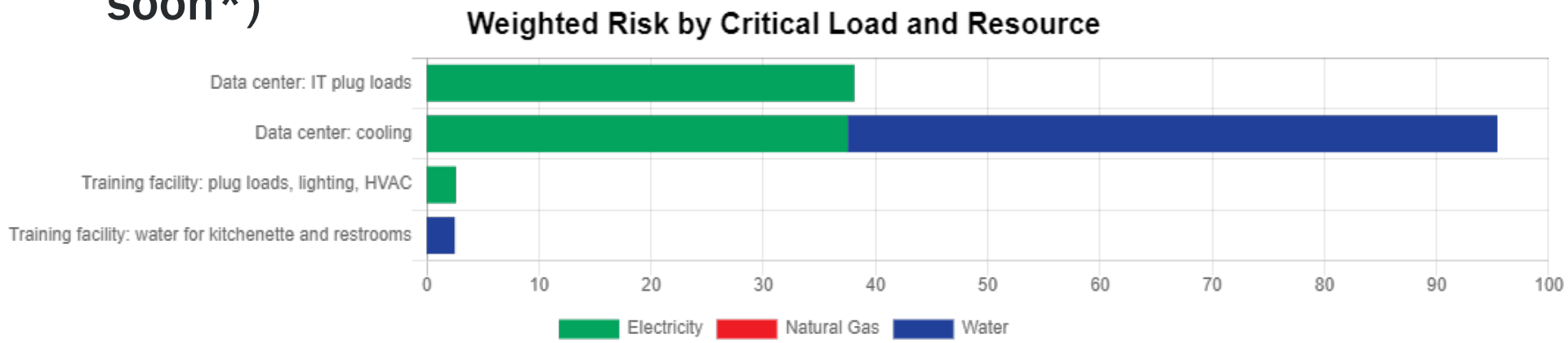
Outcomes from TRN Modules



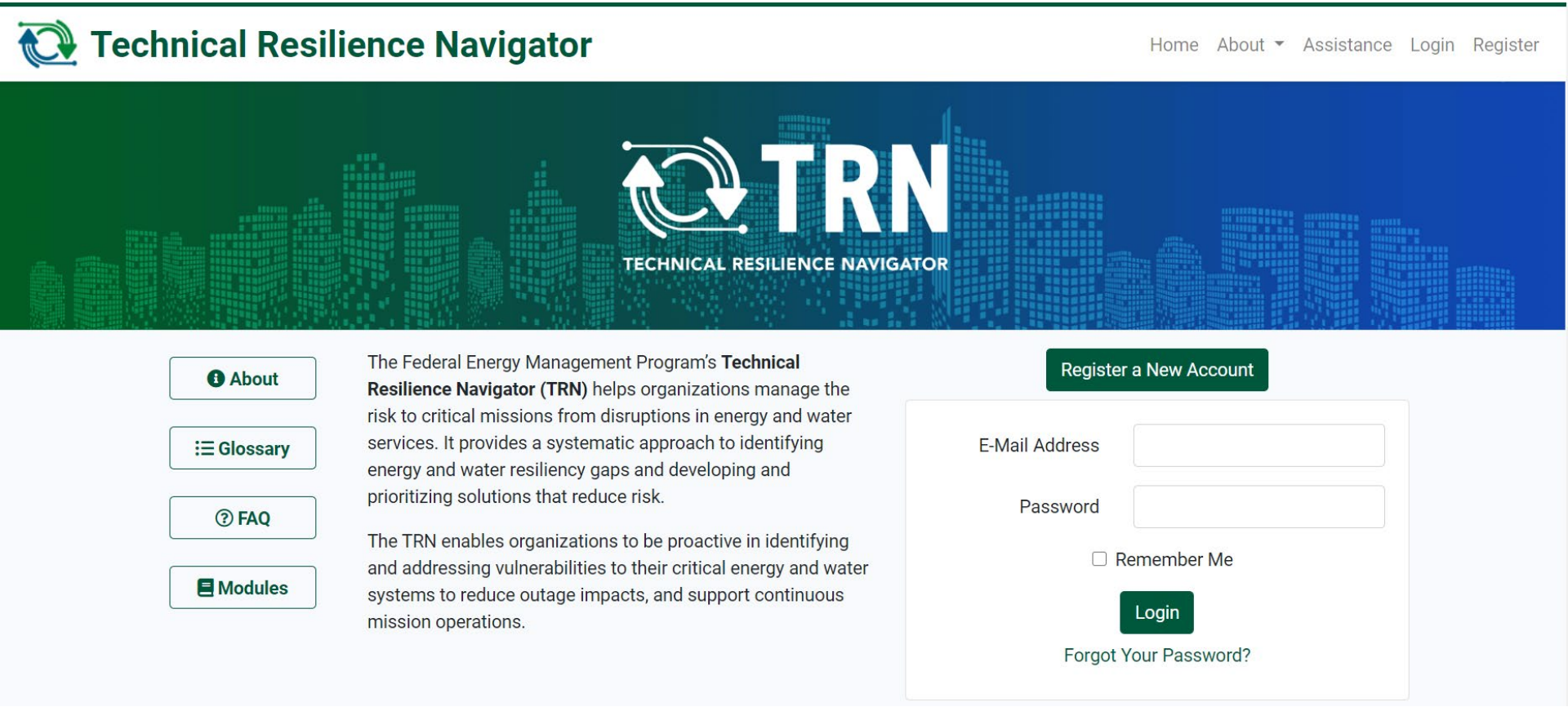
Outcome that will be used in SD or SP	TRN module in which it was created
Resilience Priorities	Site-Level Planning
Resilience Gaps	Site-Level Planning, Baseline Development, Risk Assessment
Risk Screening Assessment	Risk Assessment

TRN Background: Risk Drivers

- Users gain important insight into the major risk drivers from the TRN Risk Assessment process
- These can help to identify additional resilience gaps and focus attention in the Solution Development module on factors that contribute significantly to the site's risk
- More detail on the TRN Risk Assessment methodology and the outcomes of the Risk Assessment module can be found in the TRN Risk Assessment training on the WBDG site (*coming soon*)



TRN Web Application



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

Solution Development

Module 4: Solution Development

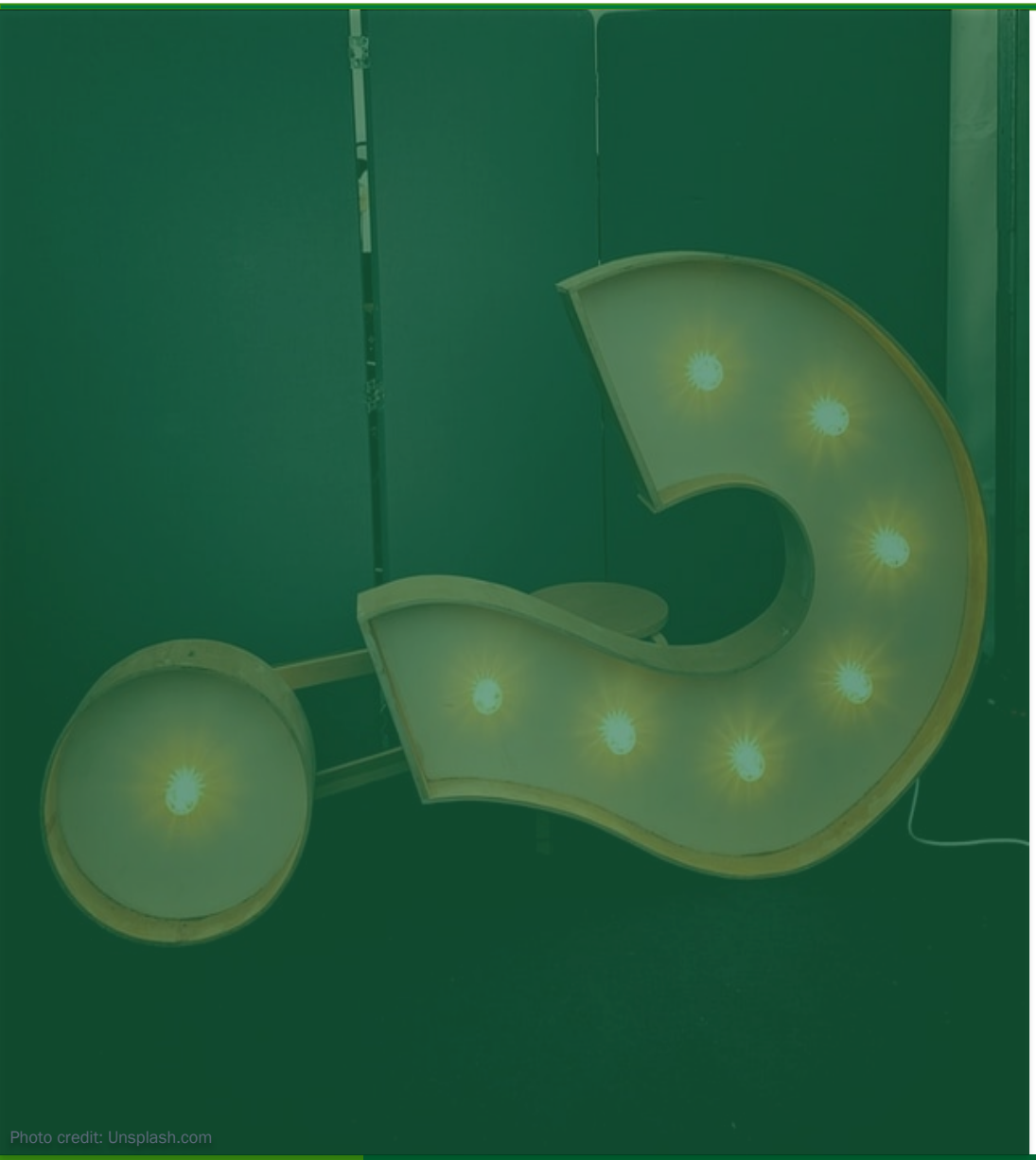


Photo credit: Unsplash.com

Brainstorm solutions to address identified gaps and increase resilience

What resilience gaps do I need to fix?
What resilience solutions would be applicable to my site?

Solution Development Actions

Action 1: Analyze Resilience Gaps

Action 2: Identify Resilience Solutions

Action 1. Analyze Resilience Gaps

- Notice areas where no gaps have been identified and think about whether there are gaps that have been missed
- Understand the ***root cause*** of the gaps in order to develop solutions targeted at the source of the gaps
- Identify opportunities for solutions that solve multiple gaps at once

Gap Types & Resilience Attributes

Gap Types

Technological: Gaps in physical systems including their availability, design, and performance (e.g., vulnerabilities in the systems that inhibit reliable power to a critical load)

Operational: Gaps in existing processes or procedures that ensure energy or water availability (e.g., automatic start-up systems for backup generation or training programs for manual start-up systems)

Institutional: Gaps in organizational or site plans, policies, and other data that have the potential to broadly enhance site resilience.

Resilience Attributes

Resourcefulness: the ability to skillfully prepare for, respond to, and manage a crisis or disruption as it unfolds

Redundancy: the availability of redundant systems to support the primary source in case of failure

Robustness: the ability to maintain critical operations and functions in the face of a crisis

Recovery: the ability to return to and/or reconstitute normal operations as quickly and efficiently as possible after a disruption

Action 1. Analyze Resilience Gaps

Consolidate Resilience Gaps

- *Utilize resilience gaps collected in the previous modules*
- *Review Risk Assessment for gaps with lower contribution to the site's overall risk but, if addressed, would enhance resilience priorities*

Gap Description	Type of Gap			Resilience Attributes Impacted				Critical Functions or Loads Impacted by Gap
	Technological	Operational	Institutional	Redundant	Robust	Resourceful	Recovery	
48-hour lag if operations need to move to offsite data center, and no training on that process.								

Action 1. Analyze Resilience Gaps

Characterize Resilience Gaps

Is this gap operational, institutional, or technological?

Which resilience attributes are impacted by this gap?

Gap Description	Type of Gap			Resilience Attributes Impacted				Critical Functions or Loads Impacted by Gap
	Technological	Operational	Institutional	Redundant	Robust	Resourceful	Recovery	
48-hour lag if operations need t… move to offsite data center, and no training on that process.	*X*	*X*					*X*	*Data center IT plug loads and cooling.*
Total Number of gaps in type or attribute:								

What is the total number of gaps by type? By resilience attribute?

Are any critical functions or loads impacted by this gap?

Action 1. Analyze Resilience Gaps

Refine Gap Description

- What is the gap?
- Why is it a gap?
- Who is impacted by the gap?
- Where is the gap?
- When does the gap need to be resolved?

Photo credit: Unsplash.com

Action 1. Analyze Resilience Gaps

Identify Similarities Between Gaps

- Is there a common source for any of the gaps?
- Are multiple gaps related to the same critical function or load?
- Are any gaps geographically co-located, such as in the same facility?
- Are critical loads with high risk distributed evenly across the site or accumulated in one area of the site?
- Are there gaps related to meeting organizational and site priorities?

Identifying gap similarities will assist with formulating holistic solutions that can address multiple gaps.

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Action 2. Identify Solutions

Solution Brainstorming

Goal: Solutions should also be brainstormed around meeting the energy and water demand of critical functions during a disruption (e.g., onsite battery storage and water tanks) for the expected outage duration determined in the Risk Assessment module.

Brainstorm solutions to resilience gaps from multiple angles:

- Solutions addressing each **resilience attribute**: redundancy, resourcefulness, robustness, and recovery
- Solutions addressing each **type of gap**: operational, institutional, and technological
- Solutions to gaps with **similarities** (e.g., geographic).

Action 2. Identify Solutions

Resource Impacted	Solution Description	Solution Type	Resilience Attributes Incorporated
Energy	Microgrid serving critical loads with onsite storage and islanding controls.	Technological	Redundancy Robustness
Energy and Water	Recovery plans in place and exercised.	Operational	Resourcefulness Recovery
Energy	Develop strategic investment plan for critical infrastructure and end-of-life replacement with more resilient infrastructure.	Operational Institutional Technological	Resourcefulness Recovery
Energy and Water	Increase site security, remote monitoring, and/or develop robust fence and gate infrastructure for physical security.	Operational Institutional	Resourcefulness Robustness
Energy and Water	Develop pre-event checklist for site preparation.	Operational	Resourcefulness Robustness
Energy	Develop distributed resources for spatial diversity and grid flexibility, implement redundant transmission and distribution lines, and/or diversify energy supply.	Operational Technological	Redundancy Resourcefulness Robustness Recovery
Water	Develop site appropriate water infrastructure (e.g., redundant supplies; implement water saving/reuse measures, separate combined sewer infrastructure to reduce system stress and reduce treatment energy loads).	Operational Technological	Resourcefulness Robustness Recovery Redundancy

*Table presents a subset of example solutions included in TRN

Action 2. Identify Solutions

Energy

Energy Efficiency

Distributed Energy Resources

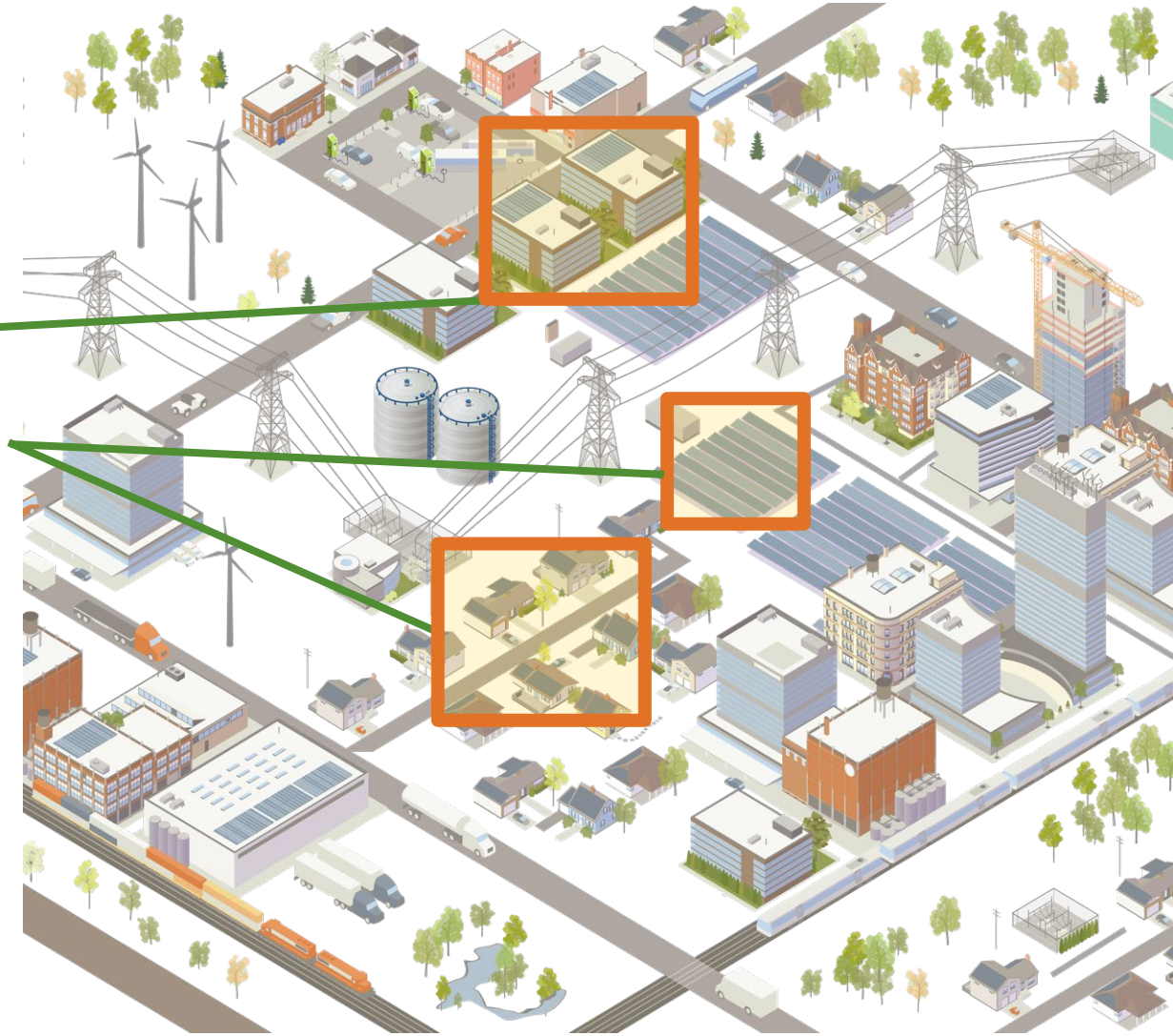

Image Source: Anthony Castellano, NREL

Example Solution: Technological

Microgrids for resilience

Resource Impacted: Energy

Solution Type: Technological

Attributes:
Redundancy
Robustness

Solution Description: Microgrid serving critical loads with onsite storage and islanding controls.

Microgrids are one solution that can enhance energy resilience by ensuring critical loads have onsite energy and providing a redundant system beyond the main grid system.

Microgrids can be an effective option for enhancing resilience, since they provide a functional electric power system that can operate independently of the main grid.

Action 2. Identify Solutions

Water

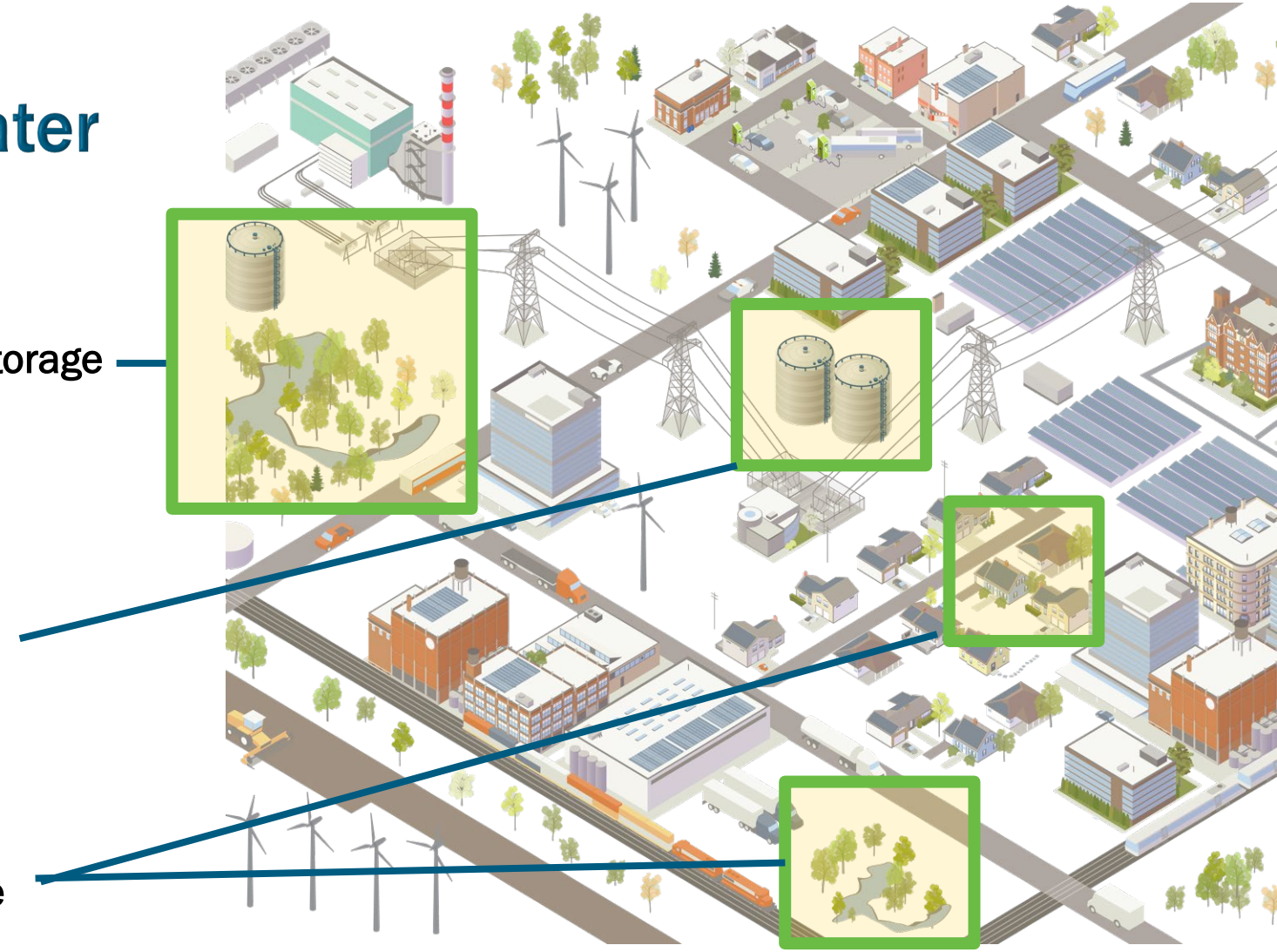

Image Source: Anthony Castellano, NREL

Example Solution: Technological

Develop site appropriate water infrastructure

Resource Impacted: Water

Solution Type:
Operational
Technological

Attributes:
Resourcefulness
Robustness
Recovery
Redundancy

Solution Description: Develop site appropriate water infrastructure (e.g., redundant supplies; implement water saving/reuse measures, separate combined sewer infrastructure to reduce system stress and reduce treatment energy loads).

Sufficient onsite water storage capacity can enhance resilience by ensuring critical water loads have onsite water supply and by providing a redundant system beyond the main water distribution system.

Implementing water saving and reuse measures minimizes water use and therefore also minimizes the needed water storage capacity. Furthermore, water reuse measures reduce wastewater generation and treatment needs.

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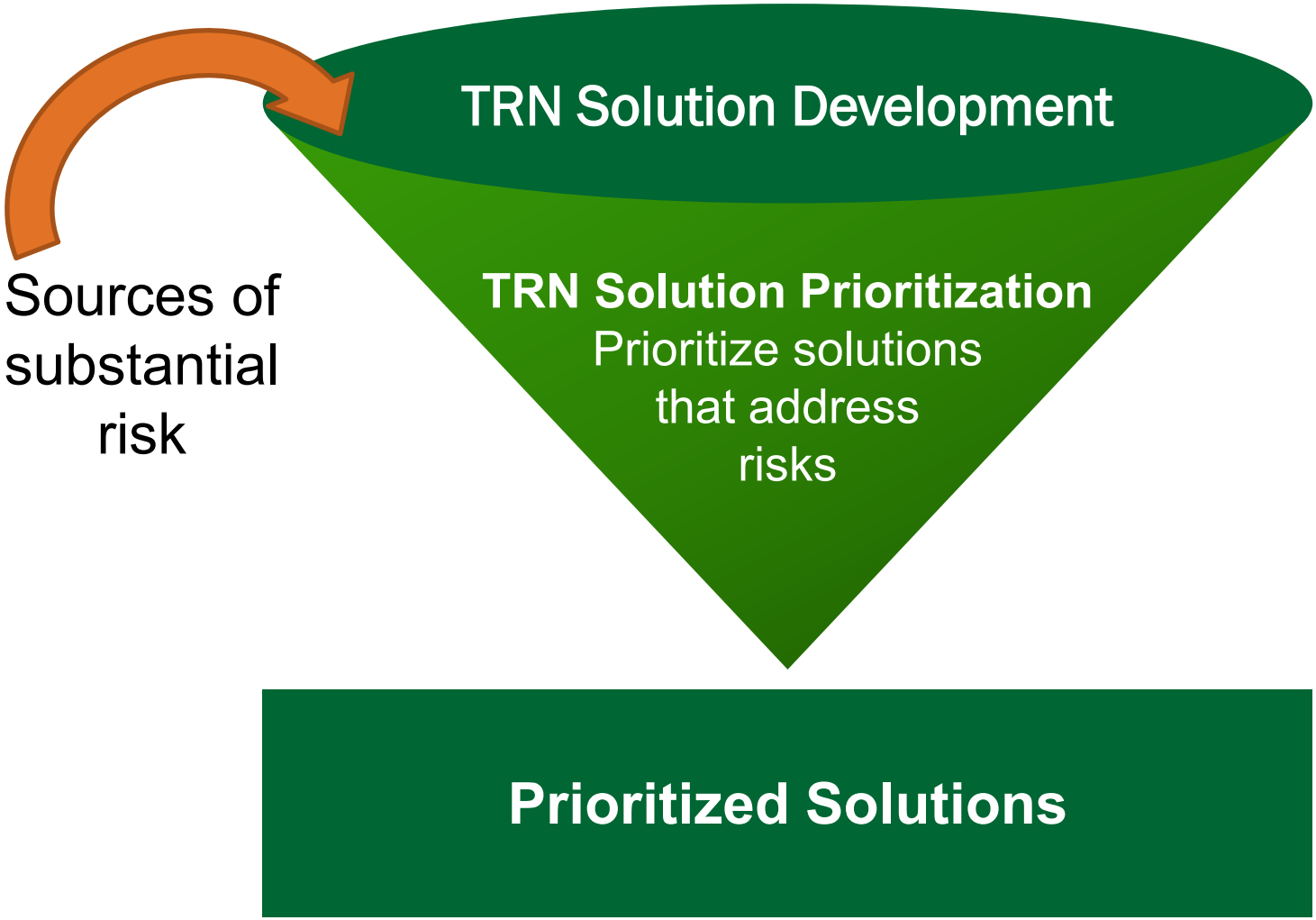
Solution Prioritization

Module 5: Solution Prioritization

Evaluate which solutions best meet your needs

Which solutions decrease my risk the most?
What priorities should guide my decision making?

Risk-informed Solution Development and Prioritization



Generate a Prioritized List of Resilience Solutions

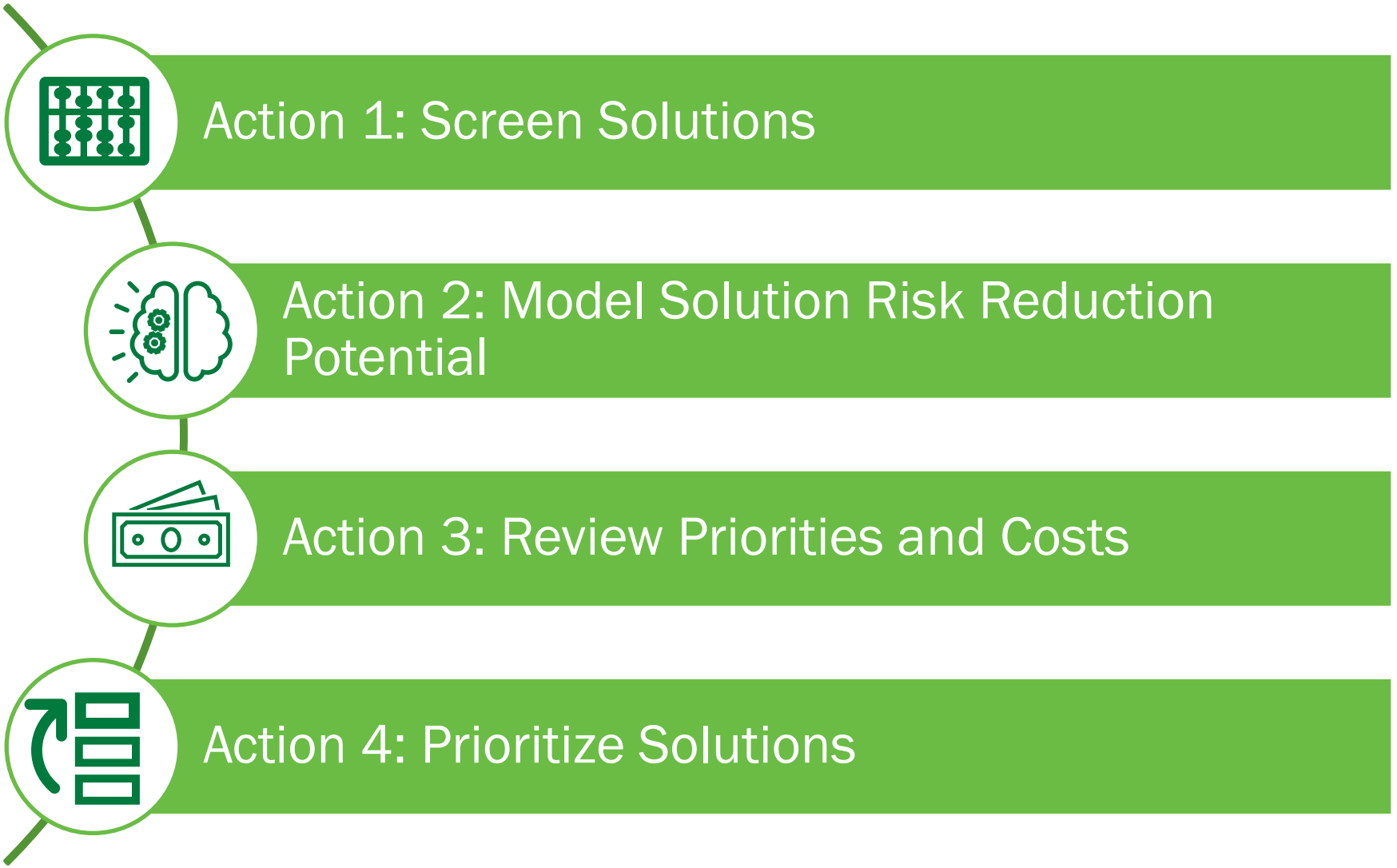
Prioritize solutions based on:

1. Risk-reduction potential
2. Site prioritization criteria
3. Cost of implementation and ongoing costs


BLM

BLM

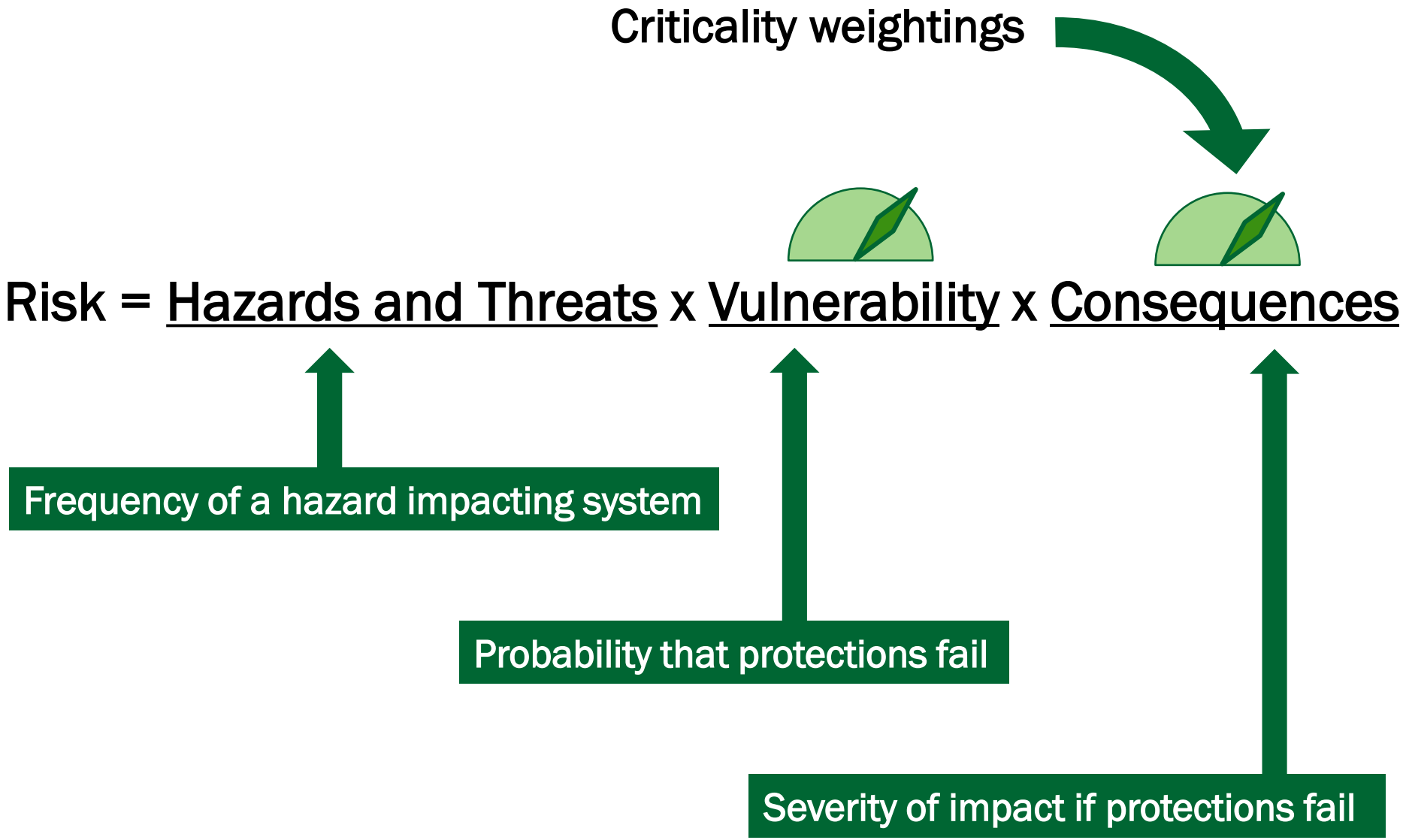
Solution Prioritization Actions



Action 1: Screen Solutions

- **Initial narrowing down of list of solutions, via Go/No-Go criteria, such as:**
  - Extreme cost
  - Technical difficulty
  - Not of interest to site at this time
- **Record remaining solutions, and any *solution sets*, for further analysis**

Action 2: Determine Solution Risk Reduction Potential



Action 3: Review Priorities and Costs

- **Specify any additional prioritization criteria, which can include decision-making factors important to the site, such as:**
  - Addressing efficiency or sustainability goals
  - Addressing training requirements
  - Addressing leadership priorities

- **Choose criteria weights, for both risk reduction and any additional prioritization criteria**

Select Number of Criteria: 3

#	Description	Weight	Weighted Percentage
1	**Risk-reduction efficacy**	80	80%
2	Improves resource efficiency	10	10%
3	Meets site training requirements	10	10%

- **Estimate high-level costs for each resilience solution, providing a key component to generate a prioritized list of solutions**
  - Initial implementation cost
  - Annual/ongoing costs

Action 4: Prioritize Solutions

- **First, qualitatively rate solutions against additional criteria**

Solution Criteria Legends

Residual risk	Risk-reduction efficacy	Score
> 50%	Minor	1
> 20% to 50%	Moderate	2
5% to 20%	Significant	3
< 5%	Major	4

How Well Solution Meets Solution Prioritization Criteria	Response	Score
Solution does not address this criterion	Not well	1
Solution addresses some part of criterion, but only partially	Moderately well	2
Solution addresses criterion	Well	3
Solution could not address criterion any better	Very well	4

- **TRN then calculates *Resilience Solution Benefit Potential* as a weighted average score, using these components:**
  - Categorized risk-reduction efficacy
  - Categorized ratings against additional criteria
  - Criteria weights

Action 4: Prioritize Solutions

- **Can choose to sort by**
  - 1) Potential benefit (descending), cost (ascending)
  - 2) Cost (ascending), potential benefit (descending)
- **Example sorted by 1st option**

Priority Order	Solution	Potential Benefit	Cost Category	Priority	10-Year Total Cost
1	Solution set: MOU/mutual aid agreement to obtain fuel resupply + seismic upgrades for elec redundant system + improvement of process to move data center operations offsite.	High	High	8	$920,000
2	Solution set: MOU/mutual aid agreement to obtain fuel resupply + seismic upgrades for elec and water redundant systems + water efficiency + improvement of process to move data center operations offsite.	High	High	8	$1,430,000
3	Reduce required time to move operations to offsite data center, and train on that process.	Moderate	Low	10	$200,000
4	Implement COOP plan.	Moderate	Moderate	11	$650,000
5	Solution set: seismic upgrades for elec and water redundant systems + water efficiency + improvement of process to move data center operations offsite.	Moderate	High	12	$1,310,000
6	Implement ability to move training offsite.	Low	Minimal	13	$70,000
7	Improve water efficiency to extend water redundant system capability.	Low	Low	14	$110,000
8	Arrange MOU/mutual aid agreement to obtain fuel resupply, extending electrical redundant system capability.	Low	Low	14	$120,000
9	Upgrade electrical redundant system with seismic design.	Low	Moderate	15	$600,000
10	Upgrade electrical and water redundant systems with seismic design.	Low	High	16	$1,000,000

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TRN Demo

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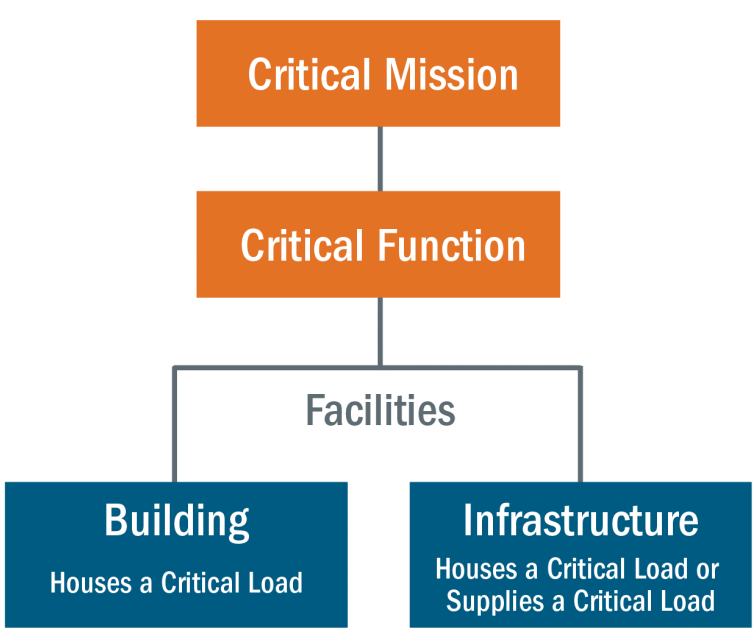
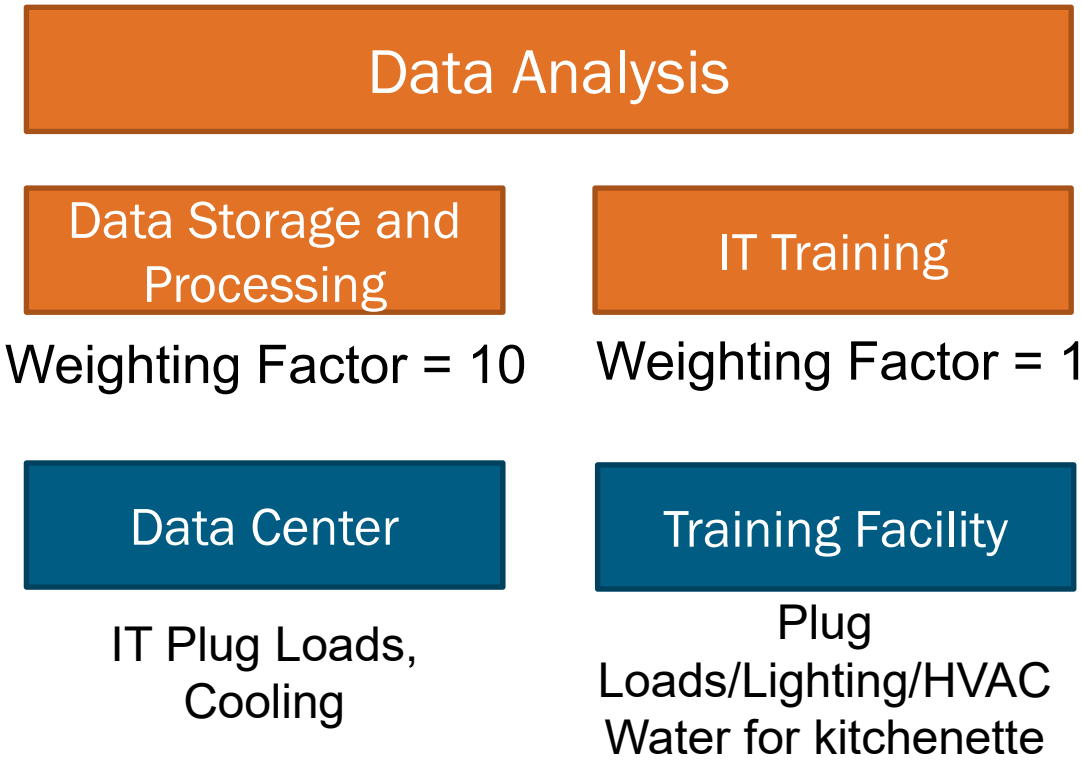
Demo Background

- Today's training features a demonstration of the TRN webtool, which assumes a user has already worked through the Site-Level Planning, Baseline Development, and Risk Assessment modules





Demo Background: Site Characteristics

Electric

- UPS + diesel generator with 5 days of on-site fuel
- No seismic protections of backup power system
- Electric backup starts automatically
- Robust preventative maintenance program in place for electric
- No secondary redundant system

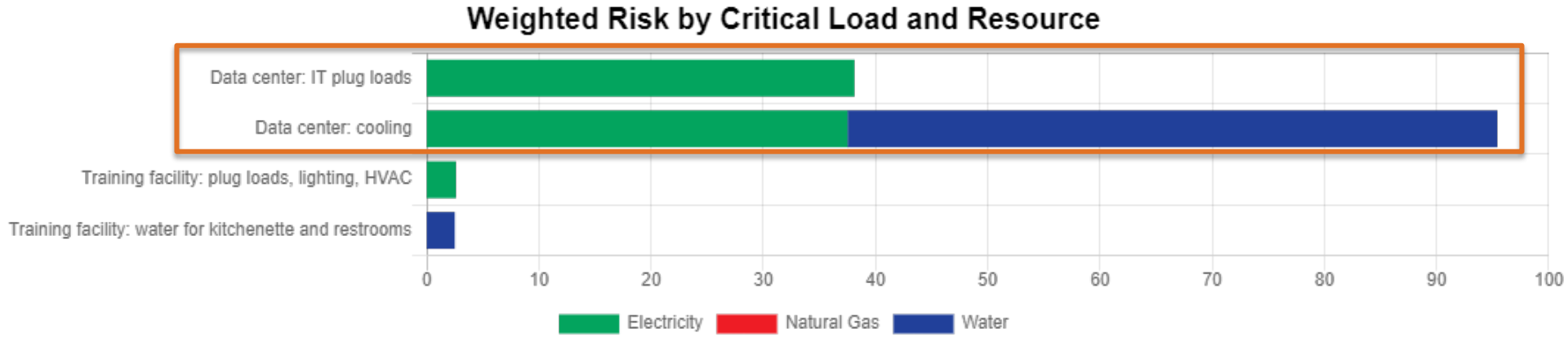
Water

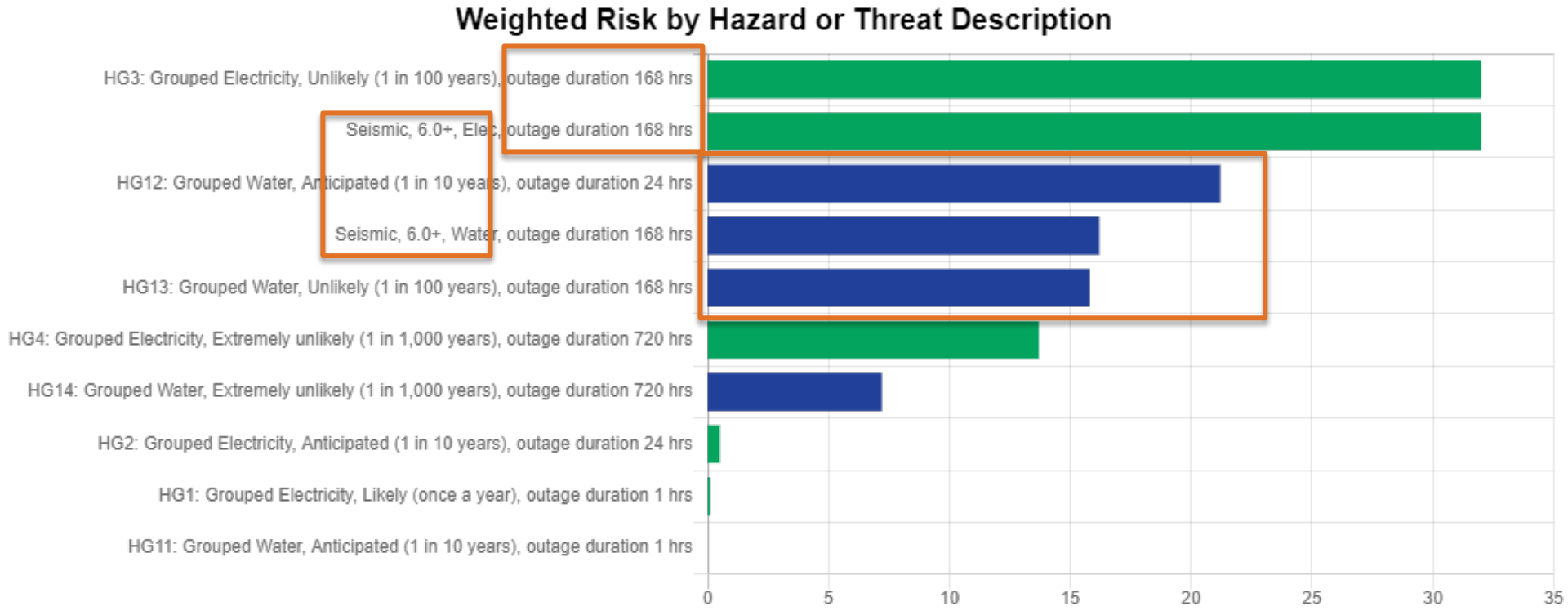
- Water tower (on-site) with 14 days of storage available
- No seismic protections of backup water system
- Backup water requires manual start-up
- No preventative maintenance program in place for water
- No secondary redundant system

Add'l Characteristics:

- No Coop Plan
- Ability to move some functions off-site

Demo Background: Risk Drivers





Demo Background: Resilience Gaps

Gap Description	Types of Gap	Resilience Attributes Impacted	Critical Functions or Loads Impacted by Gap
48-hour lag if operations need to move to offsite data center, and no training on that process.	Technological Operational	Recovery	Data center IT plug loads and cooling
Lack of automated start-up for water redundant system, and no training/exercises for manual start-up.	Technological Operational	Redundant Robust	All water loads
Lack of seismic design for power redundant system	Technological	Redundant Robust	All electrical loads
Lack of seismic design for water redundant system	Technological	Redundant Robust	All water loads
No COOP plan in place or exercised.	Operational Institutional	Redundant Robust Resourceful Recovery	All functions and loads
5-day diesel fuel supply prevents addressing longer outage durations	Technological Institutional	Redundant Robust	All electrical loads
14-day water supply prevents addressing longer outage durations	Technological Institutional	Redundant Robust	All water loads
No ability to move training off-site.	Technological Operational	Recovery	Training facility water and electrical loads

Example Demo Solution: COOP

Continuity of Operations Plan

Resource Impacted:
Energy
Water

Solution Type:
Operational
Institutional

Attributes:
Redundant
Robust
Resourcefulness
Recovery

Solution Description: Create and implement a COOP

- Establish a continuity of operations plan (COOP), develop with a team of stakeholders and get senior leadership buy-in/support.
- Formalize the COOP, exercise the plan on a regular basis with the necessary stakeholders to train, raise awareness, and institutionalize the plan.
- Review the plan on an annual basis to determine where modifications are needed and communicate changes to all stakeholders during exercises.

Web Demo

trn.pnnl.gov

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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

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