U.S. DEPARTMENT OF
ENERGY

Office of
ENERGY EFFICIENCY &
RENEWABLE ENERGY

Decarbonization Considerations: Resilience Planning

September 7, 2022

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- Logistical issues: wbdg@nibs.org
- Don't hesitate to ask questions!
  - Send questions to all panelists in the Q&A window
  - Feel free to contact us through the FEMP Assistance Request Portal (https://www7.eere.energy.gov/femp/assistance/node/add/application-combined)

Today's Speakers

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Goal and Purpose of Today's Training

- **FEMP is helping agencies understand how to maximize decarbonization while harnessing climate adaptation techniques and maintaining site resilience, allowing agencies to meet current and future decarbonization goals. This training will provide attendees with an understanding of which tools and resources are available to help plan for climate resilience and adaptation.**
- **Upon completion of this course, attendees will be able to:**
  - Identify climate adaptation and vulnerability needs
  - Understand the intersection between resilience and decarbonization
  - Leverage available FEMP and other resources to incorporate resilience planning into decarbonization
- **To earn CEUs, take the quiz at the same link you registered**

Agenda

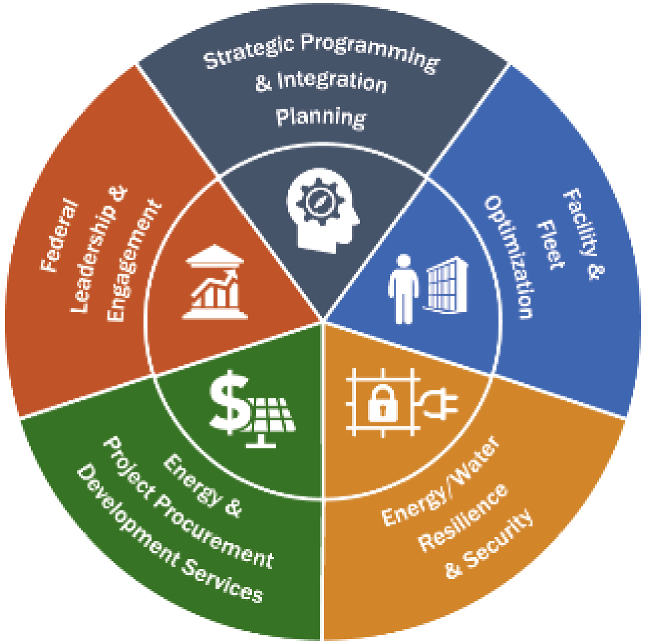
- FEMP Resilience Program Overview
- Technical Resilience Navigator (TRN) Overview
- New TRN action: Analyze Emissions Impact
- Web Demo
- Q&A

Federal Energy Management Program (FEMP)

FEMP works with its stakeholders to enable federal agencies to meet energy-related goals, identify affordable solutions, facilitate public-private partnerships, and provide energy leadership to the country by identifying government best practices.

FEMP was codified by the Energy Act 2020 to facilitate the implementation by the Federal Government of cost-effective energy and water management and energy-related investment practices:

A. to coordinate and strengthen Federal energy and water resilience; and
B. to promote environmental stewardship.



FEMP
Federal Energy Management Program

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 can withstand, adapt to, respond to, and recover from disruption

What is Resilience?

RESOURCEFULNESS

Preparedness with optimized performance of energy and water systems and adequate planning, personnel training, and testing to manage through a disruption

REDUNDANCY

Availability of back-up resources and islandable onsite generation systems that enable continuity to critical loads during primary system disruptions

ROBUSTNESS

Ability to maintain critical operations during a disruptive event through building, infrastructure, and redundant system design, as well as system substitution capability

RECOVERY

Ability to return to normal operating conditions as quickly and efficiently as possible after a disruption

Achieving Resilience Through Proactive Planning

A site that is energy and water resilient has:

★ Optimized systems and operations

★ Identified risk, consequences, and cost

★ Trained personnel and capabilities

★ Actionable strategies to achieve diverse solutions

Agencies seek to ensure their facilities and operations adapt to and are increasingly resilient to climate change impacts. Actions include climate vulnerability assessments, integrating climate-readiness across missions, and managing and mitigating climate risks.

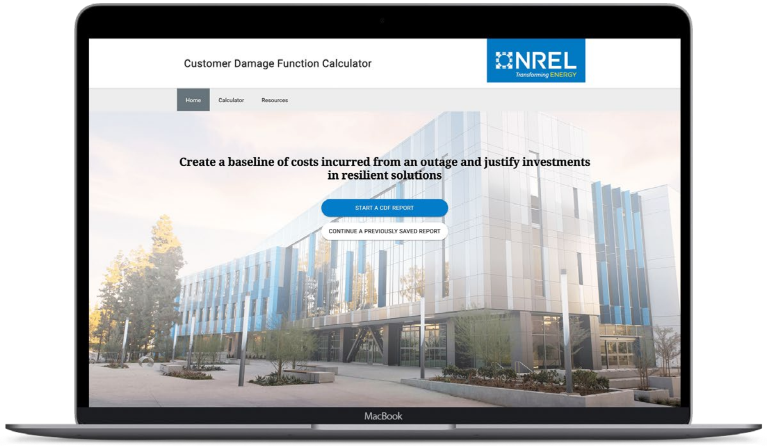
FEMP Resilience Program Offerings

Resilience Planning

- Agency agnostic tools and resources to guide stakeholders through the process of assessing and implementing projects that enhance site resilience

Resilience Valuation

- Tools and frameworks to help stakeholders better quantify the benefits from resilience projects or measures



FEMP’s Technical Resilience Navigator

TRN
TECHNICAL RESILIENCE NAVIGATOR

Visit: https://trn.pnnl.gov/

The TRN helps users assess risk to a site’s critical functions from energy and water utility disruptions and prioritize solutions that reduce risk

TECHNICAL RESILIENCE NAVIGATOR

Focuses on Energy and Water Resilience

Replicable and Robust Planning Process

Online Webtool with Downloadable Option for Data Security

TRN Overview

Risk-Informed Resilience Planning

What can go wrong?
(A *scenario*)

How likely is it?
(A probability or frequency)

How bad would it be?
(A consequence severity)

The TRN follows best practices in risk assessment.

By identifying drivers of risk, users can focus on creating solutions in areas likely to have the biggest impact.

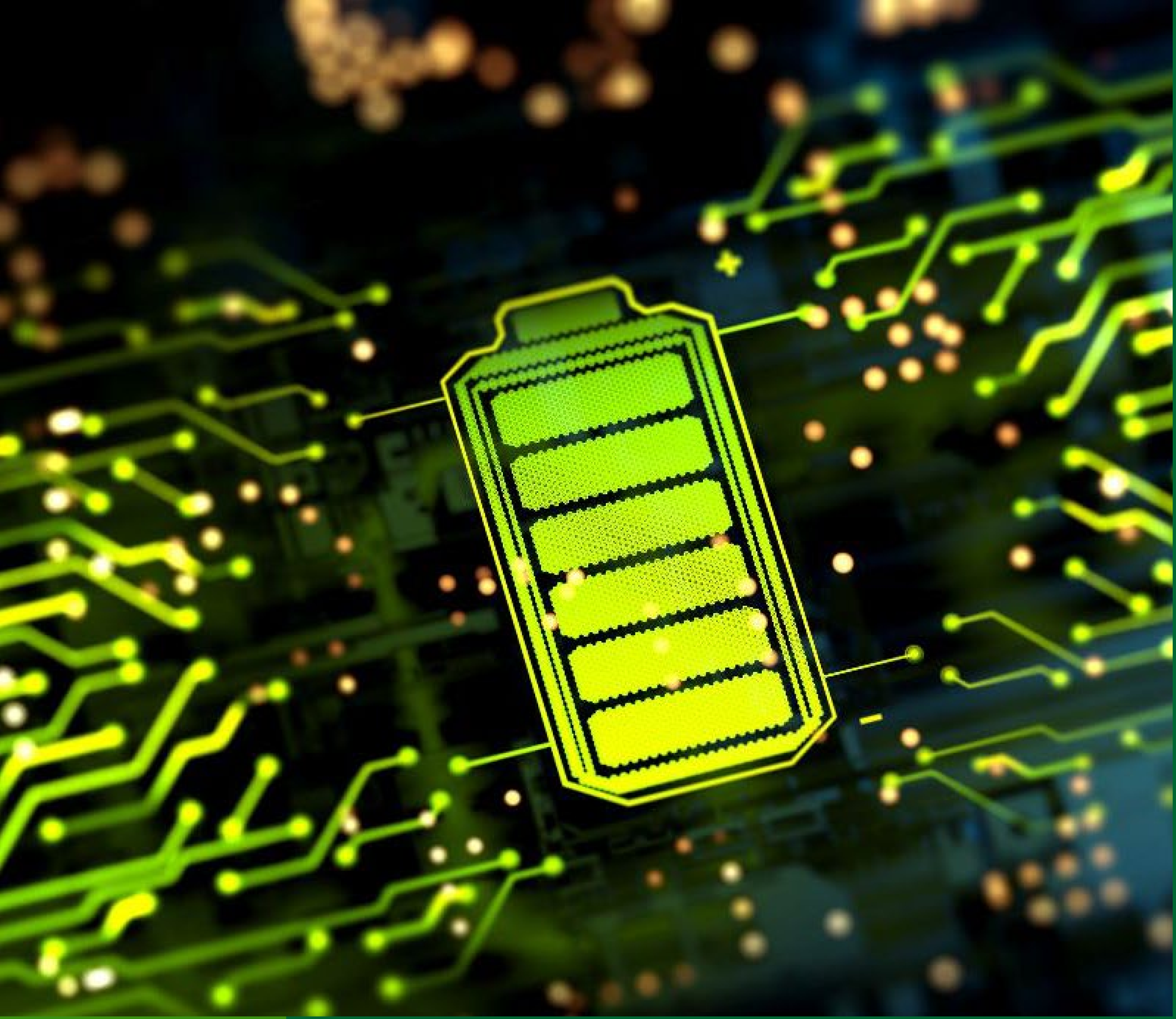
Calculating Risk in the TRN

Key Inputs

- Hazard
- Vulnerability
- Consequence
- Criticality Weighting Factor

Risk = Hazard x Vulnerability x Consequence x Criticality

Hazard	Vulnerability	Consequence	Criticality
Hazard Frequency Frequency of detrimental event that can lead to an energy or water outage.	**Probability of Failure** Probability that preventive measures at the site will fail.	**Outage Duration** Amount of time that the site will be unable to perform a critical function if energy or water supply is lost.	**Criticality Weighting Factor** Importance of the impacted critical function to the site's mission.
User input: Can use Identify Potential Hazards Tool to estimate dual-impact hazard frequency.	**Calculated:** Based on answers to redundant system characterization questions.	**User input:** Outage duration, tolerable outage duration, function restoration.	**User input:** Criticality tier for each critical function.



Resilience solutions address key gaps and risk drivers identified from analysis.

TRN users then model each solution to see its potential benefit on the site in terms of risk reduction, emissions impact, and other user-defined decision criteria

Prioritizing Resilience Solutions

Solution	How well does solution meet criteria?		
	Criterion 1: Risk-reduction efficacy Weight: 80%	Criterion 2: Emissions reduction Weight: 10%	Criterion 3: Meets site training requirements Weight: 10%
Reduce required time to move operations to offsite data center, and train on that process.	Significant (64%)	None (0%)	Well
Implement ability to move training offsite.	Minor (3%)	None (0%)	Well
Full set of electrical and water redundant system improvements (water efficiency, hazard design, robust water PM, automate water start-up, MOU) + improvement of process to move data center operations offsite.	Major (98%)	None (0%)	Very well
Full set of electrical and water redundant system improvements (water efficiency, hazard design, robust water PM, automate water start-up, MOU)	Major (92%)	None (0%)	Well
Add PV microgrid with batteries, capable of supporting elec. critical loads for 1 week, and 20% of site elec. loads during normal operations.	Significant (52%)	Significant (36%)	Not well
Improve electrical efficiency, reducing critical load electrical use by 30%, extending diesel generator capability to 7 days, and cutting site elec. use by 15%.	Minor (20%)	Significant (18%)	Not well

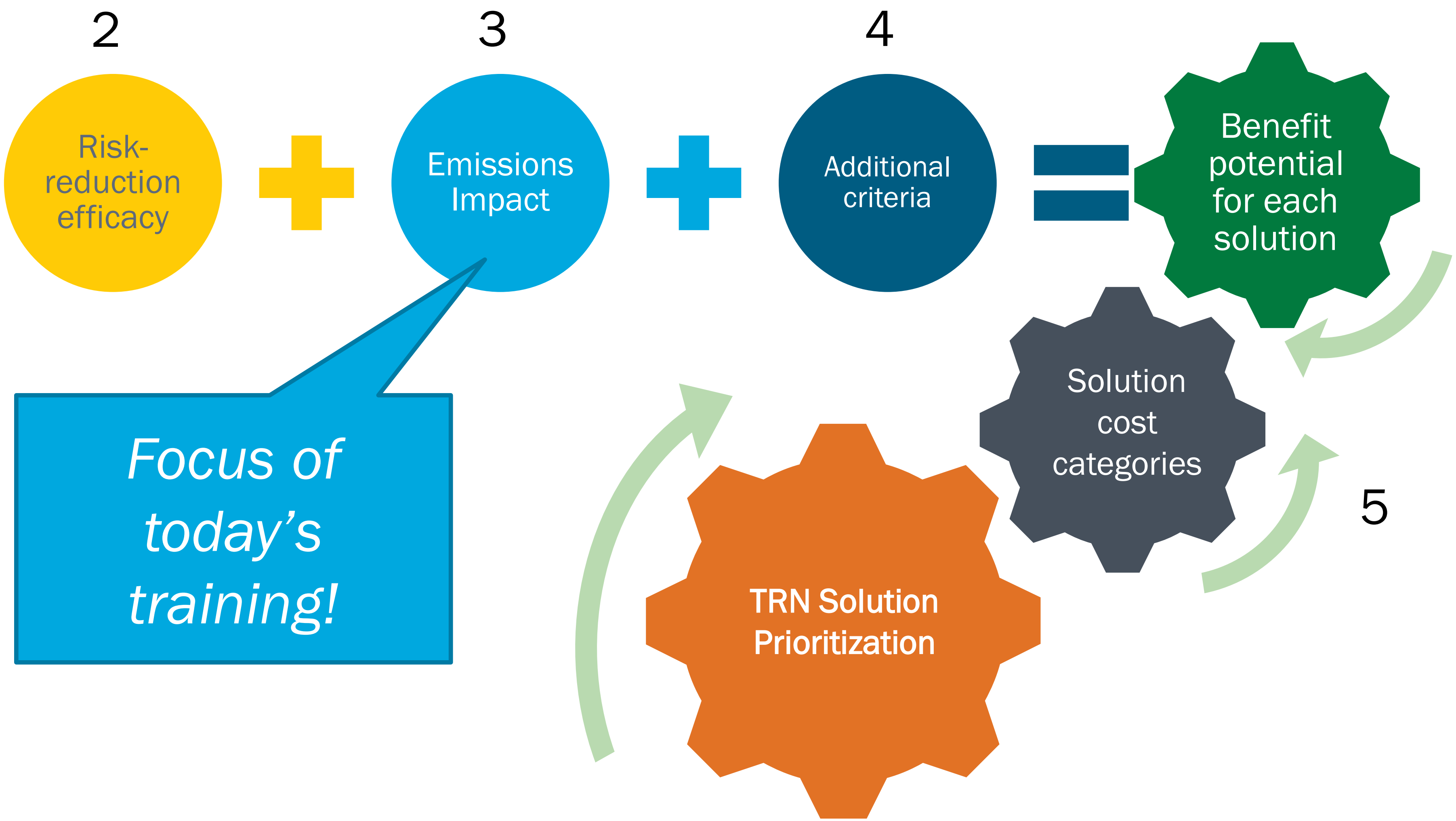
Required & Modeled/ Quantitative (Criteria 1–2)

User-Defined/ Qualitative (Criterion 3)

All projects have trade-offs; the TRN helps users compare resilience solutions to consider how well a solution can reduce risk, support emissions reduction, and meet additional user-defined criteria while also considering cost

Prioritizing Resilience Solutions

1. Screen Solutions
2. Model Solution Risk Reduction Potential
3. Model Emissions Impact
4. Review Priorities and Cost
5. Prioritize Solutions

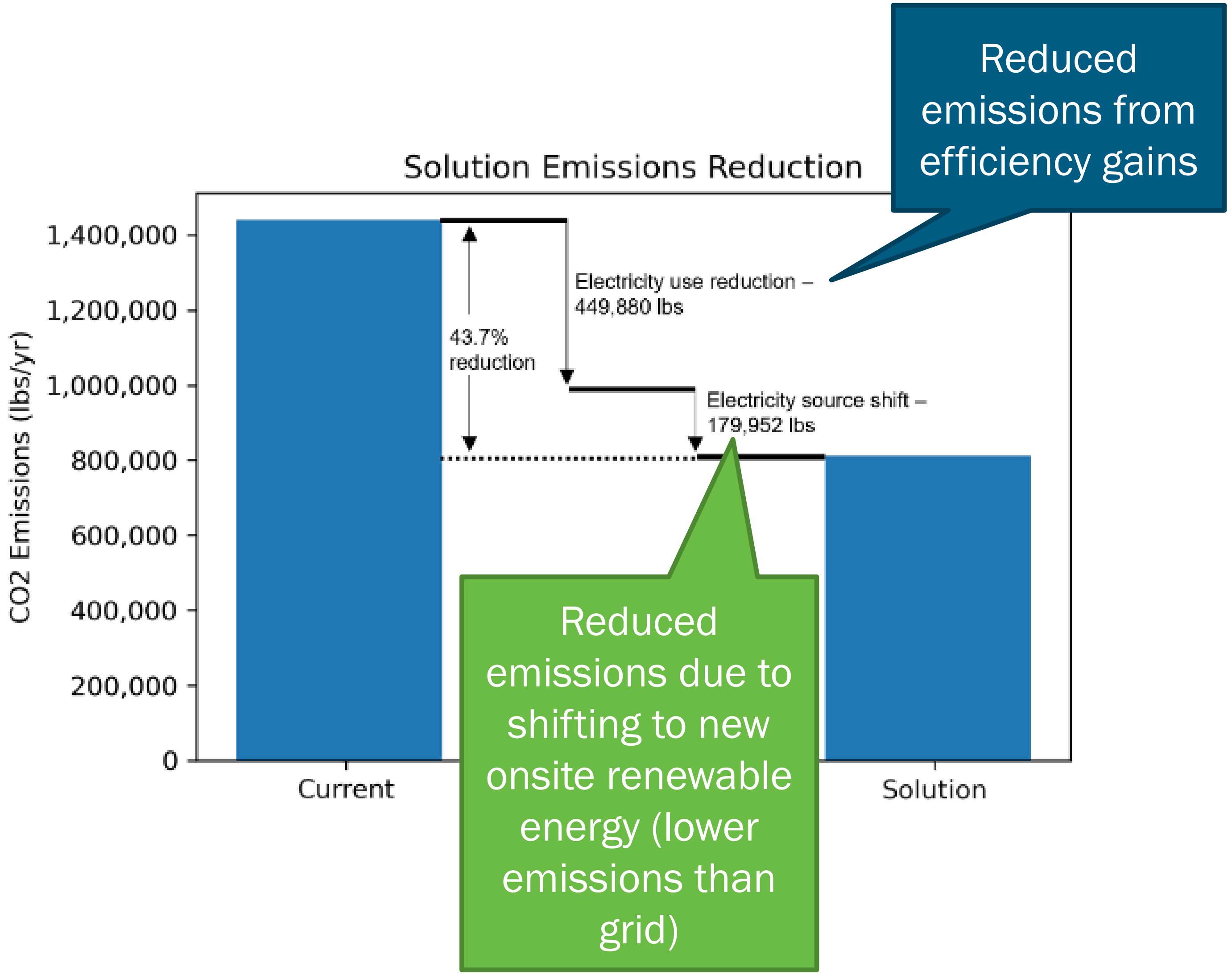


In Focus: Modeling Potential Emissions Impact

Evaluates potential emissions impact from:

1) Changes in energy use
2) Shift in electricity supply

Solution emissions compared against current site emissions



Data Requirements

Electricity: average and marginal emissions factors pre-populated from EPA eGRID data (lbs/MWh)

Present Site Energy Use and Emissions

Offsite Electric Utility: Potomac Electric Power Co

Energy Type	Site Annual Use		CO_2 Emission Factor *Average*		CO_2 lbs/yr	CO_2 Emission Factor *Marginal*	
Electricity	13575	MWh/yr	652.458	lbs/MWh	8,857,117	1233.44	lbs/MWh
Natural Gas	0	MMBtu/yr	116.7	lbs/MMBtu	0		
			Total Emissions:		8,857,117		

Natural Gas: assumed to be 116.65 lbs/MMBtu

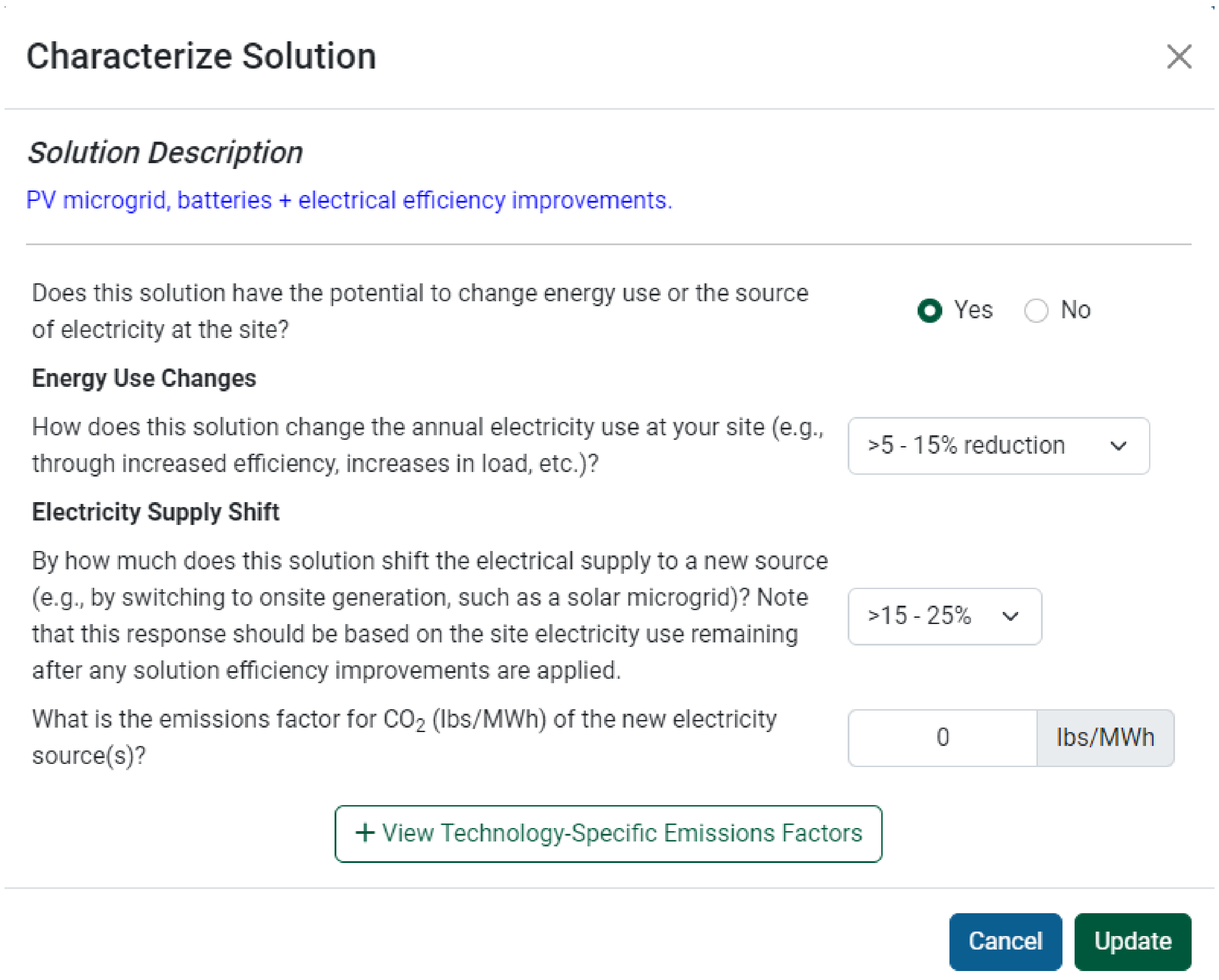
Solution Agnostic Inputs

- Emissions factors associated with the site's current energy usage
- Present annual site energy use (electricity and natural gas)

Data Requirements

Solution-Specific Inputs

- How the solution changes the quantity of energy used (electricity and natural gas)
- How the solution shifts electricity consumption from the existing electricity supply to a lower emissions resource



TRN Resource: Emissions Factors

— Hide Technology-Specific Emissions Factors

Note: Median *[25% quartile – 75% quartile]*

Type	CO_2 lbs/MWh	
Coal	2,297 [2,146–2,448]	use
Diesel Generator	1,538	use
Energy Storage	Varies	
Fuel Cell	0	use
Geothermal	154 [0–154]	use
Hydro	0	use
Hydrogen	0	use
Natural Gas	1,009 [814–1,321]	use
Nuclear	0	use
Oil	1,815 [1,594–2,671]	use
Purchased Steam	0	use
Solar	0	use
Waste Heat	0	use
Wind	0	use

- TRN Resource provides
  - Background on Average and Marginal Emissions Factors
  - Table of technology-specific emissions factors based on eGRID Technical Guide, eGrid 2020 power plant data, and EPA data
- Important to note that these emissions factors ONLY reflect ongoing emissions from generation

Example Analysis: Current Site Energy Use

Analysis of Emissions Related to Current Site Energy Use

- Site uses 2,000 MWh/year of electricity but does not use any natural gas
- Emissions factors for the site's eGRID subregion are
  - Average electricity emissions factor = 719.9 lbs/MWh
  - Marginal electricity emissions factor = 1,124.7 lbs/MWh

	Electricity	Natural Gas
Energy use	2,000 MWh/yr	0 MMBtu/yr
CO_2 emissions factor	719.9 lbs/MWh	116.65 lbs/MMBtu
Total current emissions	1,439,800 lbs/yr	0 lbs/yr

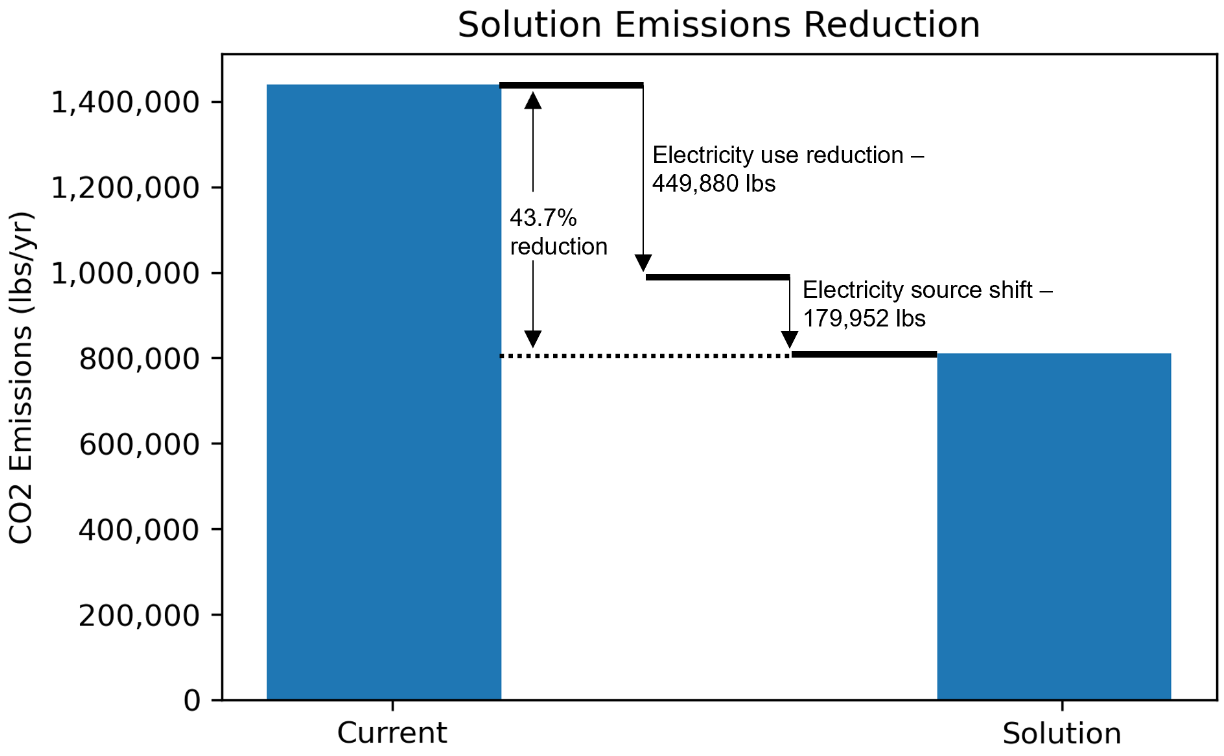
Example Analysis: Solution Characterization

Solution Characterization:

- Efficiency improvements resulting in a 20% reduction in electricity use
- Shifts 10% of remaining electricity use to a solar PV microgrid
- No change in natural gas usage

	Electricity use reduction	Shift in electricity source
Percent change	20%	10%
Avoided or shifted electricity use	400 MWh/yr	160 MWh/yr
CO_2 emissions factor	1,124.7 lbs/MWh	0 lbs/MWh
Avoided CO_2 emissions	449,880 lbs/yr	179,952 lbs/yr

Example Analysis: Results



Emissions reduction category	Range
Major Emissions Reduction	≥ 50%
Significant Emissions Reduction	10% to < 50%
Marginal Emissions Reduction	> 0% to < 10%
No Emissions Reduction	≤ 0%

Elliott et al., 2022

Solution Prioritization

The math behind the scoring for Resilience Benefit Potential

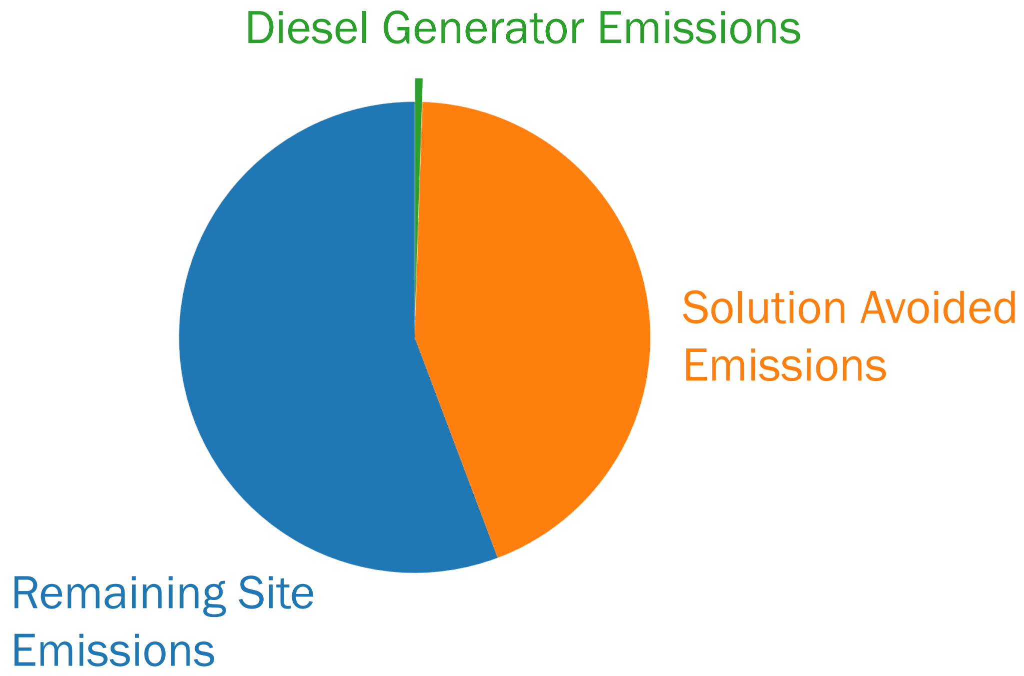
Solution	**Criterion 1:** Risk Reduction Efficacy (Weight 40%)	**Criterion 2:** Emissions Reduction (Weight 40%)	**Criterion 3:** Meets Site Training Requirements (Weight 20%)
Add PV Microgrid with Batteries	Moderate (27%)	Significant (43.7%)	Not Well

Score	2	3	1	
Weight	0.4	0.4	0.2	
Score x Weight	(2 x 0.4) =0.8	(3 x 0.4) =1.2	(1 x 0.2) =0.2	
Calculation	0.8	1.2	0.2	= 2.2

Benefit Potential

Moderate (2.2)

Considerations Outside the Scope of the TRN Emissions Impact Methodology



- **Emissions impact of redundant systems**
  - Does not consider emissions reductions *during outage events* associated with switching to lower emission redundant systems
- **Focuses on emissions reductions associated with electricity and natural gas use at a site**
  - Does not consider indirect emissions reductions associated with water use
  - Does not consider other fuel sources

Web Demo

Summary

- **The TRN allows users to consider emissions reduction benefits of energy and water resilience solutions developed through a risk-informed resilience planning process**

- **Emissions reduction benefits are determined as a percentage of current site emissions associated with electricity and natural gas use through two strategies:**
  - Changing energy usage (e.g., energy efficiency improvements)
  - Shifting electricity from current source to a lower emissions source

Any Questions?

Find Out More – Visit TRN Today

- View TRN action text
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- Create & verify account
- Take TRN Accredited Training
- Explore Identify Potential Hazards Tool

Visit: https://trn.pnnl.gov/