Clear Sky Toolkit: Decision Support User Guide

Randy Deshazo,[1] Alana Todd,[1] Sarah Vitale,[1] and CJ Reynolds,[1]Jonathon Monken,[2] and Wilson Rickerson[2]

1 Tampa Bay Regional Planning Council
2 Converge Strategies, LLC

NREL Technical Monitor: Sara Farrar

NREL is a national laboratory of the U.S. Department of Energy
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NOTICE

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CLEAR SKY TAMPA BAY

Clear Sky Toolkit: Decision Support User Guide

A Resilience-Based Siting Template for Solar + Storage

A resource to assess the feasibility of commercial-scale solar + storage to support public safety, disaster preparedness, and post-disaster recovery objectives.

196-kW rooftop photovoltaic system at the Hillsborough County Courthouse (Credit: Hillsborough County)

October 2021

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1. Introduction and Template Overview

Purpose and Expectations

The Clear Sky Decision Support Template is a Microsoft Excel-based resource that enables users to screen and prioritize critical facilities for the addition of solar + storage. The Decision Support Template consolidates and streamlines the most relevant resources from the emergency management discipline, the electric utility sector, and national energy research institutions to assist in further site analysis and decision-making. The Decision Support Template is intended for use by local government and private sector decision-makers who aim to mitigate the effects of power outages on critical infrastructure, understand the potential for deploying photovoltaic (PV) and storage solutions on critical facilities, and align emergency management planning processes and utility needs with community resilience objectives.

The Decision Support Template is divided into five modules that provide a structured, step-by-step approach users can follow and apply to unique circumstances. This process guides a more thorough and accurate assessment of a site's potential to accommodate a solar + storage system, provide grid benefits to utilities, and support community resilience and disaster mitigation for the broader region. After identifying potentially viable and preferred sites for solar + storage using the Decision Support Template, users should conduct a more detailed evaluation and consultation with a solar professional.

✔ **<u>The Decision Support Template Will:</u>**

- **Leverage and streamline existing national resources.**
  This template is designed to be approachable and adaptable, integrating local practices and leveraging existing resources in a coherent way. The template integrates more than 20 government and research-driven tools, policies, and models (see Appendix) into a single template to save the user the time and challenge of seeking these resources out individually.

- **Incorporate resilience factors in solar + storage decision-making processes.**
  The template enables users to evaluate and prioritize critical facilities for commercial-scale solar + storage projects that can support specific public safety, disaster preparedness, and post-disaster recovery objectives for community resilience. The template guides the user through essential questions as an educational resource to support decision-making.

- **Enable a diversity of technical and nontechnical staff to conduct efficient assessments of energy and resilience needs.**
  The template fosters critical thinking and increases the technical capacity of users to conduct initial energy assessments that support informed decision-making.

- **Customize the assessment process.**
  Each module of the template is designed with a specific purpose in mind, ensuring the results will aid the user in answering targeted questions relevant to the assessment. Users can complete modules in any order depending on project needs and timeline.

- **Provide tools for collaboration and relationship-building.**
  The template's questions prompt new conversations to improve planning and communication across stakeholders with distinct mandates within a community (e.g., emergency management and sustainability departments, local governments and utilities).

- **Offer a means of storytelling and justification for energy resilience investments.**
  The template's assessment process and connected resources assist users in evaluating and communicating the potential benefits of deploying solar + storage projects for resilience. Incorporating resilience and hazard mitigation considerations in solar + storage decision-making can create opportunities to fund projects that address emergency management priorities.

- **Facilitate engagement with utilities and other potential project stakeholders.**
  The template explores a focused list of topics and questions relevant for outreach and collaboration with electric utilities that serve critical facilities. This engagement can improve alignment, determine operational gaps, and identify potential co-benefits from solar + storage investments across multiple stakeholders.

✗ The Decision Support Template Will Not:

- **Represent a full technical analysis of a proposed solar + storage project.**
  The template prioritizes information most relevant for further solar + storage studies and helps decision-makers determine where to focus future efforts. The template is not a substitute for full technical solar + storage feasibility or project development analyses. Instead, it is meant to help prioritize sites for further evaluation.

- **Replace a complete economic assessment of any individual solar + storage project.**
  The template will provide the user with the needed justification to pursue a more detailed assessment, but it does not constitute a detailed cost-benefit analysis.

- **Serve as a stand-in for regulatory review processes, utility-specific planning criteria, or local policy requirements for planning.**
  The template is designed to highlight key planning steps for coordination with regulators and utilities.

- **Require the user to be a technical or policy expert in energy resilience or solar + storage.**
  The template guides the user through essential questions as an educational resource to support decision-making.

Scale of Application

The Clear Sky Toolkit Decision Support Template is designed to support commercial-scale solar + storage at facilities that provide critical community services in emergency scenarios. Commercial-scale solar + storage generally encompasses systems that are larger than residential-scale but smaller than utility-scale, typically ranging in size from approximately 50 kilowatts (kW) to 3 megawatts (MW).

Users should consider facilities that strengthen the resilience of a community's U.S. Federal Emergency Management Agency (FEMA) Community Lifelines. For example, a medical facility that provides emergency services would become more resilient to power outages if solar PV panels and battery storage were added. Below is a list (not exhaustive) of facility types that would be ideal candidates for analysis using the template:

- Hospitals and emergency medical facilities
- Emergency shelters or evacuation centers
- Wastewater plants and other water treatment facilities
- Police stations, prisons, and jails
- Fire rescue facilities
- Military installations
- Major communications facilities
- Assisted living facilities
- Grocery and cold storage facilities
- Flood control structures
- Airports
- Gasoline stations

Potential Users

The Clear Sky Toolkit Decision Support Template is accessible to a broad range of stakeholders who seek improved community resilience through targeted investments in solar + storage technology. The template is designed primarily for local government staff, including critical facility managers, energy and sustainability coordinators, and emergency management personnel. Other potential users include state and tribal governments, utilities, and private sector entities.

The template does not require users to have deep technical or subject matter expertise. Different types of users will bring their own background knowledge, data, and information to the process, and the template is intended to offer a more streamlined approach to working across different sectors and stakeholders.

The following profiles describe the diverse set of potential users and use cases for the Clear Sky Decision Support Template:

Potential user	Possible motivation for using the template	Background information this user has	Additional information this user may need from other stakeholders	What this user might gain from using the template	How the results can be applied in this context
Sustainability Planners or Community Officials	Assessing community needs for solar + storage deployment to support local resilience goals	Organizational/ jurisdictional goals around community energy and resilience priorities Visibility into government data and partners	Facility-specific information Contact information for subject matter experts Research for supporting data	A way to prioritize projects A guide to engage utilities Understanding of important questions that could derail a project	Providing recommendations to leadership Guidance for additional research Establishing new partnerships
Emergency Management Staff	Determining energy resilience needs and priorities to support the community	Insight into threat and hazard information Understanding of resilience value	Facility-specific information Clarification regarding systems integration with utilities Private sector partnership	Increased visibility into viability of solar + storage Expanded stakeholders for emergency planning Clarification of emergency power needs	Providing recommendations to leadership A path for shared resilience value Establishing new partnerships
Utility Partners	Defining how and where to align company priorities for solar + storage deployment with community needs	Knowledge of utility prioritization process Technical knowledge of grid	Facility-specific information Community resilience goals Better visibility into the solar + storage resource pipeline	Improved government coordination Expanded stakeholders for emergency planning	Prioritization of investments Expanding project value streams Establishing new partnerships
Academics and Researchers	Studying solar + storage deployment to meet energy and community resilience needs to advise research and development	Access to tools and knowledge Resources for research and assessments	Facility-specific information Community resilience goals Utility cooperation	Higher quality modeling and assessment New valuation methods	Practical applications of research Road map for future studies Establishing new partnerships
Facility Owners/Operators or Solar Consultants	Assessing the viability of solar + storage deployment to support continuity of operations	Access to site-specific data Targets for continuity of operations	Insight to utility priorities and integration Community resilience goals Best practices to save time and money	Easier means of conducting feasibility assessments Improved understanding of solar + storage viability Knowledge of how external entities are involved in the siting process	Communicating the benefits of energy resilience within a community More avenues for project execution

Methodology

The Clear Sky Decision Support Template provides a high-level, holistic approach to prioritizing solar + storage applications for specific facility or community resilience and emergency management goals. This template uses components of two dozen existing models, plans, and processes to address requirements ranging from utility integration to valuing the community resilience benefit of an investment. It also allows the user to determine the details associated with the emergency power requirements of a facility in the context of federal planning guidelines.

The template integrates risk-based evaluations, including FEMA's Threat and Hazard Identification and Risk Assessment (THIRA) and the FEMA Community Lifelines[1] construct. These evaluations can assist users in site assessments that consider wide-ranging community resilience impacts, evaluating where solar + storage may be a productive resilient energy solution based on the role individual facilities play in the community's interrelated Lifelines.

The FEMA Community Lifelines model assembles the critical government and business functions that are essential to human health and safety or economic security. Lifelines are the most fundamental services in a community that, when stabilized, enable all other aspects of society to function. All critical facilities can be categorized within one of seven Community Lifelines (Figure 1). For example, the Safety and Security Lifeline corresponds with facilities that support law enforcement/security, fire service, search and rescue, government service, and community safety.

A sustained grid outage to critical facilities influences a community's ability to maintain essential services by limiting the availability of these FEMA Community Lifelines facilities for disaster response. The resiliency of energy systems during disasters is a vital building block of community resilience, and the benefits can extend far beyond year-round cost savings.

The methodology used to develop the template is detailed in the Appendix.

[1] Federal Emergency Management Agency's Community Lifelines: https://www.fema.gov/emergency-managers/practitioners/lifelines

Figure 1. FEMA Community Lifelines

2. Navigating the Decision Support Template

The Decision Support Template is divided into five modules. These modules provide a structured approach to prioritizing potential sites for solar + storage investments based on community resilience considerations, site feasibility, power requirements, and utility collaboration.

Each of the five modules includes a series of guiding questions to facilitate data and information collection and offers insights on how to interpret that information in the context of solar + storage decision-making. The Decision Support Template is designed to be flexible and adaptable; the user can complete modules in an order that satisfies the user's needs and timeline.

Quick Screening Module (7 questions, 1 sheet + summary)

The Decision Support Template walks users through key questions, considerations, and data collection related to resilience and solar + storage for individual community facilities. If starting with a large number of potential facilities (for example, a portfolio of government-owned buildings), users may wish to conduct an initial screening to narrow down the number of facilities being evaluated. The "critical pathway questions" are designed to help users more quickly eliminate facilities that have limited need for a resilient energy solution or do not meet basic solar siting criteria. The Quick Screening questions are repeated in subsequent modules but are front-loaded here as a first layer of site screening. Users can create a ranked list of the facilities to prioritize for further assessment.

Prioritization Module (11 questions per sheet, 3 sheets + summary)

The Prioritization Module provides a structure for assessing the relative criticality of three potential solar + storage candidate facilities based on the facilities' role in supporting FEMA Community Lifelines and other aspects of community resilience. The module yields a weighted ranking of the facilities that can help determine their relative importance in supporting community resilience. The module is informed by frameworks such as THIRA, the FEMA Community Lifelines, and Emergency Operations Plans process.

PV Siting Module (5 questions, 1 sheet + summary)

The PV Siting Module helps users evaluate whether a site meets essential installation requirements for PV technology. In addition, it helps users understand whether essential power needs could be met by installing a PV

system. Users can assess facilities for compatibility with essential solar + storage siting requirements. This module is largely based on the Rocky Mountain Institute's Municipal Solar Site Selection Tool, the U.S. Department of Housing and Urban Development Renew300 Solar Site Selection Guide, and guidance from Clear Sky Tampa Bay's national laboratory partners.

Critical Load Module (10 questions, 1 sheet + summary)

The Critical Load Module establishes criteria for understanding which entities rate the facility as "critical." It also considers the facility's critical functions and associated power requirements, as well as whether emergency power can support critical functions. The module guides users through the process of identifying critical functions and corresponding critical loads to determine emergency power needs. The module is informed by a variety of emergency management frameworks, national laboratory tools, and building code standards.

Utility Engagement Module (11 questions, 1 sheet + summary)

The Utility Engagement Module helps users engage with the local utility to identify sites for priority restoration. It also looks "beyond the fence" of the facility to consider the surrounding electricity infrastructure and its relationship to the facility. The module prompts users with questions that require outreach to local utilities to better understand the potential for grid benefits from an energy resilience project. The module is largely informed by existing utility performance metrics and siting frameworks.

Conducting an Assessment

Getting Started

1 Download the Decision Support Template

The user should first download the Decision Support Template from the Clear Sky website (www.tbrpc.org/clearsky).

2 Create initial list of facilities

Next, the user should identify a portfolio of potential facilities where solar + storage could enhance resilience and emergency management. Potential sites can include public and private facilities a community deems essential for vital services during and after a disaster or emergency scenario. Ideally the user will begin with at least three facilities, but the initial list can include as few or as many facilities as needed. Although the Decision Support Template is designed to assess single facilities (building by building), the user can expand questions to accommodate a complex of facilities (e.g., multiple buildings on the same campus).

3 Identify and contact stakeholders

The user should first review each module of interest to understand the data requirements and identify relevant stakeholders who can provide input. Users should contact relevant subject matter experts (for example, utility partners) before beginning the module to assist in data-gathering and expedite the analysis.

Time Estimation:

Completing the Decision Support Template's modules could take anywhere from a few days to a few weeks and is dependent on the user and their context. Several factors shape the data-gathering process, including the amount of facility information on hand or easily accessible to the user and their relationship with the electric utility and other stakeholders (especially building operators) needed to gather missing data.

In testing the toolkit, several of the Clear Sky Tampa Bay project's government partners noted that the Utility Engagement Module took the longest to complete due to utility response time. Users should review the questions and contact stakeholders before beginning the modules to minimize data retrieval delays.

Completing the Modules

1 Insert facilities into the Quick Screening Module

The first step to completing the Decision Support Template is to narrow the user's list of facilities down to three for more in-depth comparative analysis. The user should insert facilities into the Quick Screening Module composed of **"critical pathway questions,"** or certain questions throughout the template that identify whether a facility is a potential candidate for solar + storage for resilience. If the analysis begins with three or fewer predetermined facilities, users are still advised to complete the Quick Screening Module to determine whether those sites warrant further assessment.

In subsequent modules, critical pathway questions that are included in the Quick Screening Module are indicated by the module's symbol. The user will have already answered these and can copy the initial responses.

The Quick Screening Module produces a score for each facility to allow for comparison across all facilities and to identify the three highest-ranking sites in terms of need for a resilient energy solution and potential solar feasibility. **The three facilities with the highest score** should be carried into the subsequent Prioritization Module for more in-depth analysis. Facilities that received a lower score may still be appropriate for solar + storage or other resilient energy solutions and can be reassessed at a later time using context-specific conditions.

Quick Screening Module	Prioritization Module - Question 1	PV Siting Module - Questions 1, 2, and 3			Critical Load Module - Question 1	Utility Engagement Module - Question 1	Comparison Score
Critical Pathway Questions	After an electricity disruption, how quickly does the facility's function need to be restored to meet its stated purpose within a FEMA Community Lifeline?	1. When will the roof need to be replaced?	2. What percentage of the day is the PV system shaded?	3. What is the proposed PV system's orientation to the sun?	Does the facility require a backup generation strategy according to FEMA Guidelines?	Are there feeder limits or hosting capacity constraints for solar on the feeder that serves the facility?	A score will calculate below when responses to all critical pathway questions have been identified.
What is this question for?	This question compares facilities' level of importance and critical need to sustain power across the broader portfolio of sites being considered. A facility is prioritized for backup power investments based on the facility's level of importance in protecting the public's health, safety, and welfare. For example, facilities such as hospitals, emergency shelters, main fire stations, and water/wastewater facilities are critical and have adverse operational impacts from any disruption in service. Whereas facilities such as nursing homes, portable water booster and wastewater lift stations, and minor flood control structures are prioritized to resume operations within 24 hours after a disruption. Further explanation and examples are provided in the User Guide.	Commercial building rooftops last 20–30 years before they need to be replaced. PV systems should not be installed on roofs that are more than 10 years old to avoid the costs of having to remove and reinstall the PV systems when the roof is replaced. For PV siting purposes, a roof should have 16–20+ years of life remaining - or it should have 1–2 years of life remaining so that the roof replacement and PV system installation can happen concurrently.	Shade reduces PV system output. A PV system should be at least 3 times the height away from the tallest obstacle to the south. For example, a tree that is 20 ft higher than the PV system should be at least 60 ft away. PV systems should not be more than 10% shaded throughout the day in order to maximize its anticipated efficiency.	The direction a facility's roof faces, also referred to as its azimuth angle, is one of the primary factors determining how much sunshine a PV system will see over the course of the day. The ideal orientation for a PV system is due south, facing the sun. If the roof or terrain is flat, then the PV system can be oriented optimally. If the roof is sloped and rotated significantly to the east or west, PV electricity generation will be reduced. A roof orientation that is angled further away from the sun than due east or due west is not viable.	Navigating the Emergency Power Flowchart (Figure 2) allows the user to address fundamental questions regarding how quickly emergency power is needed and the length of time it must run in order to sustain essential functions. Question 5 provides users with a structured process to determine how asset performance criteria can impact decisions related to size and operating capabilities of a solar + storage energy resilience resource.	Utilities often limit the amount of inverter-based resources on a single distribution feeder due to operational and infrastructure constraints. This could potentially affect the size of an energy resilience asset designed to supply power to the local grid for economic or operational benefits. The purpose of this question is to help the user learn more about the constraints of the distribution system that serves the facility they are assessing. Having a better understanding of these potential limitations can inform project planning, development, and implementation.	A comparison score for each facility is provided as a means of assessing the comparative feasibility of a facility as a function of its ability to accommodate a solar + storage system for resilience. Therefore, the score of any one facility does not have significance on its own. Rather, the scores enable the user to see which facilities warrant further investigation.
How do I find the answer?	The "Critical Facility Index" (CFI) and other ranking systems are used by government emergency management to assist in prioritizing restoration and post-disaster economic redevelopment. The CFI used in local emergency management planning ranges from CFI 1 (cannot have any disruptions in service) to CFI 5 (can have varying levels of disruptions in service). When determining how long a facility is capable of operating without electricity, the user should not factor in the presence of a backup generator or uninterruptible power supply. Instead, this answer is based on the ability of the facility to function without electricity, regardless of its source. There is no national standard for power restoration by building type; therefore, the user should reference local emergency management planning documents to determine how quickly the facility must have its power restored. If such documents are unavailable, contact the facility manager or local emergency management personnel. Since "safety of life" is paramount during restoration and recovery, in the immediate aftermath of an event, these four types of CFI 1 facilities are often considered most critical to restore: hospitals, emergency shelters, main fire stations, and water/wastewater facilities.	The user should consult with the facility manager to determine when the roof needs to be replaced. The user should skip this question if the proposed solar system will be somewhere other than an existing roof.	If possible, search the address in Google Project Sunroof. If the usable space you are considering for this site is shaded purple or dark orange, mark your response as "More than 10%." Additional free software that can provide a shadow analysis include "SoarTheSun" mobile app for Android, "Sun Seeker" mobile app for iPhones, System Advisor Model (SAM) which has a "shading losses" option, and the 3D modeling tool Sketchup (free version).	To identify the roof's orientation, look up the address in Google Maps. For more specific details, refer to building design documents and/or contact the manager. Dropdown options are listed in order of preference. North is not included because any northward-facing (north, northeast, northwest) site would not make a viable PV project.	Review and complete the "Emergency Power Flowchart" (located below and in the FEMA P-1019 policy on pages 1-8) to determine whether the facility requires a backup generation strategy. If the user reaches the bottom of the flowchart and answers "yes" to the final question, the facility is a potential candidate for a resilient solar + storage solution. The user can proceed regardless. However, the earlier a "no" answer is provided, the less important an investment is to support the critical load of the facility. For example, if the only critical load requirement is 30 minutes of battery to cover egress lighting to evacuate, then a major energy investment is likely not needed.	This information is available from the utility provider.	
Facilities:							
[Insert Facility Name]	Critical Facility Index 1: Uninterrupted	10 years or sooner	More than 10%	Southeast	Yes	No	4
[Insert Facility Name]	Critical Facility Index 1: Uninterrupted	16–20+ years	Less than 10%	South	Yes	No	6
[Insert Facility Name]	Critical Facility Index 3: Less than 48 hours	11-15 years	To be determined	Southwest	No	Yes	Missing required field(s)
[Insert Facility Name]	Critical Facility Index 1: Uninterrupted	16–20+ years	Less than 10%	Southwest	Yes	To be determined	Missing required field(s)
[Insert Facility Name]	Critical Facility Index 2: Less than 24 hours	10 years or sooner	Less than 10%	Southwest	Yes	No	4

2 Insert the top three scoring facilities into the Prioritization Module (3 separate sheets)

The Prioritization Module allows users to input up to three facilities for consideration and create a ranked list that identifies the site with the highest priority for an energy resilience investment based on the facility's role in supporting community resilience.

Similar to the Quick Screening Module, the Prioritization Module is designed to give a weighted ranking of the facilities under evaluation to determine which facility merits further analysis. One Prioritization Module sheet is provided for each of the three facilities. If the user has two facilities under analysis, then they only need to use two of the Prioritization Module sheets (one each), and so on. In other words, the second and third facility sheets are optional and only used if comparing multiple facilities before moving on to the subsequent modules. If the user wishes to enter more than three facilities into the Prioritization Module sheets, they should make a copy of a Prioritization sheet and then manually compare the final score to the other three facilities. If the analysis begins with only one predetermined facility, the user should still complete the Prioritization Module to assess the relative criticality of that facility's community functions. After completing the Prioritization Module, users should have identified one facility to proceed through the rest of the modules.

3 Insert the highest-ranking facility from the Prioritization Module into the remaining PV Siting, Critical Load, and Utility Prioritization Modules, as needed

Once the user has identified a priority facility via the Prioritization Module, they should complete the PV Siting, Critical Load, and Utility Prioritization Modules, as needed. These modules screen for technical factors about the physical suitability and performance of solar + storage, as well as additional factors that might affect energy investments and eliminate low-potential sites. Users are not required to walk through any one of the remaining modules first; this can help users with limited resources begin an assessment with information they have on hand.

4 Review final stage Report Out

Each module includes a subsequent summary sheet that captures the module's answers for easy reference. The summary sheets include a "brief-out" that explains the overall significance of the answers and how the module supports decision-making. The Final Report Out sheet compiles the brief-outs and notes from all the modules for a side-by-side overview of the insights gained for ease in printing and distribution to decision-makers and other stakeholders.

Tips for How to Conduct an Assessment:

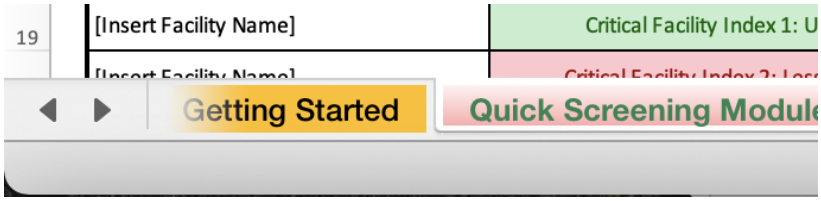
A series of case studies illustrate varying scenarios for using the Decision Support Template and describe the user's process in assessing sites for solar + storage within four local governments in Florida. Download the case studies at **tbrpc.org/clearsky**.

How to Use the Decision Support Template Microsoft Excel Tool

Navigating Between Modules:

Buttons at the end of each module take the user to the linked summary sheets. To navigate between modules, locate the colored module sheets at the bottom of the Excel document and use the arrows at the bottom left to browse back and forth between the modules.

At the completion of a module, click on the next desired module sheet to continue the assessment. Visit the “Getting Started” sheet to view all the module names in the recommended order. The names double as buttons that will take the user to the module sheet.



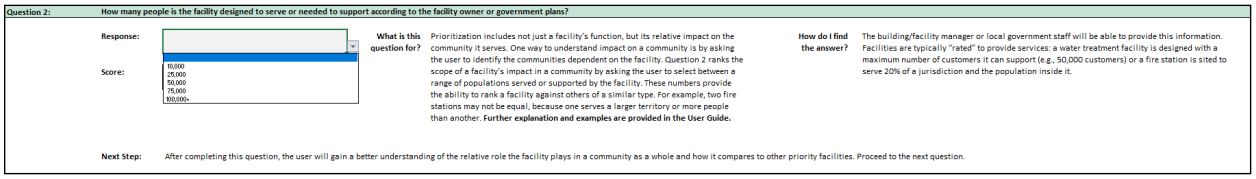
Insert Information About the Assessment:

Each module contains empty spaces at the top for the user’s name, the module start and end date, notes, and the facility’s name, where applicable.

User Name(s):	*[Insert User Name(s)]*	**Date Module Started:**	*[Insert Start Date]*	**Notes:**
		Date Module Completed:	*[Insert End Date]*	

Response Guidance:

Once clicked, the response cell includes a dropdown list of items to select from. The accompanying Decision Support User Guide and the “What is this question for?” and "How do I find the answer?" areas below include external references that may help determine the appropriate response. The next chapter of this Decision Support User Guide provides instructions and context for each question.



Insert Response:

The Decision Support Template includes a variety of potential response options, such as multiple-choice answers, long response, or select all that apply. For multiple choice and select all that apply answers, click on the response field and then click on the dropdown arrow which will display the potential answers.

Next Step:

The “Next Step” area below each question provides direction to the user on how to proceed.

Summary Sheets and Final Report Out:

Each module has a summary sheet that compiles the responses from the template that provides context for the questions and main takeaways from the assessment. The user is encouraged to add their own notes to the summary sheets before moving to the next module.

The Final Report Out sheet compiles the brief-outs and notes from the Prioritization, PV Siting, Critical Load, and Utility Engagement modules for a side-by-side overview of the resulting insights. This can be printed and distributed to decision-makers and other stakeholders.

Troubleshooting

Saving Assessment Progress:

Users should periodically save the Excel file, or enable the AutoSave feature, to reduce the risk of losing new responses if Excel malfunctions. Save the file with the date for easy reference and recordkeeping, and update with each new save.

Multi-User Editing:

Multiple users can collaborate on the Decision Support Template by using Excel Online (the web-based version of Excel) or turning on the Shared Workbooks feature (which requires Microsoft OneDrive). To share the Decision Support Template, click on *File*, then click on *Share* to open up a new window. Make sure the Decision Support Template is located in a shared folder on OneDrive, and then enter the information of the additional users.

Additional Tips:

1. Use the newest version of Microsoft Excel by installing the latest updates. This will ensure the template is running optimally.
2. If Excel is not responding, delays, freezes or stops working, visit the Microsoft Excel support webpage[2] for further troubleshooting guidance.
3. If you are having difficulty reading certain cells or text boxes, adjust the zoom settings in the bottom-right portion of the window.

[2] Microsoft Troubleshooting and Support: https://support.microsoft.com/en-us/office/troubleshooting-and-support-278f4691-6e1d-445a-a048-a7968a047e55?ui=en-US&rs=en-US&ad=US

3. Question-by-Question Guidance

The remainder of this guide is intended to be used alongside the Decision Support Template, or as a standalone resource. The guide provides question-by-question guidance and additional context regarding:

1. Why the question is being asked;
2. How and where the user can look for input and information to inform responses to the questions; and
3. Potential recommendations, decision-making considerations, and next steps.

Quick Screening Module

The Quick Screening Module is designed to assist users in quickly eliminating facilities that have limited need for a resilient energy solution or do not meet basic solar siting criteria. The questions are "critical pathway questions'' that appear within each module but are front-loaded here as a first layer of site screening. Critical pathway questions identify whether a facility is a potential candidate for solar + storage for resilience. Users can narrow down a large number of facilities to three (or fewer) by creating a ranked list of the facilities to prioritize for further assessment in the Prioritization Module. The Quick Screening Module is meant to be completed first even if the user already has fewer than three facilities, as some might not be ideal for further analysis.

The critical pathway questions appear in the remaining modules, indicated by the icon below:

- **Prioritization Module - Question 1**
- **PV Siting Module - Questions 1, 2, and 3**
- **Critical Load Module - Question 1**
- **Utility Engagement Module - Question 1**

Interpreting the Quick Screening Score:

The completed module produces an aggregated score for each facility to help the user compare multiple facilities based on their resilience needs and the ability to accommodate a solar system. The score of any one facility does not have significance on its own. Rather, the scores enable the user to see which facilities warrant further investigation. The user should take the three (or fewer) highest-scoring facilities into the Prioritization Module (one sheet each) and continue the assessment. Focusing on three facilities helps limit resource and data-gathering requirements, making the assessment process easier for users.

QUICK SCREENING MODULE - QUESTION 1

After an electricity disruption, how quickly does the facility's function need to be restored to meet its stated purpose within a FEMA Community Lifeline?

**CRITICAL PATHWAY QUESTION 1 FOR PRIORITIZATION MODULE

WHAT IS THIS QUESTION FOR?

This question compares facilities' level of importance and critical need for sustaining power across the broader portfolio of sites being considered. A facility is prioritized for backup power investments based on its role in protecting the public's health, safety, and welfare. For example, facilities such as hospitals, emergency shelters, main fire stations, and water/wastewater facilities are critical and have adverse operational impacts from any disruption in service. Whereas facilities such as nursing homes, portable water booster and wastewater lift stations, and minor flood control structures are prioritized to resume operations within 24 hours after a disruption.

Additionally, the length of time a facility is able to sustain its essential functions without access to electricity is important to determining the technical requirements of an energy resilience investment, as well as how urgently the outage must be addressed. This is also relevant for the length of time that power is needed to sustain functionality to ensure that any solution is sufficient to provide support in a long-duration outage. Highest priority for a solar + storage energy resilience investment should be placed on sites where critical functions are most sensitive to service disruptions, indicating the greatest benefit from an on-site, flexible resource.

HOW DO I FIND THE ANSWER?

The "Critical Facility Index" (CFI) and other ranking systems are used by government emergency management to assist in prioritizing restoration and post-disaster economic redevelopment. The CFI used in local emergency management planning ranges from CFI 1 (cannot have any disruptions in service) to CFI 5 (can have varying levels of disruptions in service):

- CFI 1: These facilities plan for continuous water, telecommunication, and electric service to ensure business continuity or continuity of government. Electric service is maintained through uninterrupted utility service or a momentary interruption followed by a transfer to backup generation.
- CFI 2: These types of facilities plan to resume operations within 24 hours.
- CFI 3: These types of facilities plan to resume operations within 48 hours.
- CFI 4: These types of facilities plan to resume operations within 72 hours.
- CFI 5: These types of facilities plan to resume operations after 72 hours.

When determining how long a facility is capable of operating without electricity, the user should not factor in the presence of a backup generator or uninterruptible power supply.

Instead, this answer is based on the ability of the facility to function without electricity, regardless of its source.

There is no national standard for power restoration by building type; therefore, the user should reference local emergency management planning documents to determine how quickly the facility must have its power restored. If such documents are unavailable, contact the facility manager or local emergency management personnel.

Since “safety of life” is paramount during restoration and recovery, in the immediate aftermath of an event, these four types of CFI 1 facilities are often considered most critical to restore: hospitals, emergency shelters, main fire stations, and water/wastewater facilities.

NEXT STEP

If the facility of interest belongs within CFI 1 (cannot have any disruption in service), the user can proceed to the next question with the understanding that this facility is critical to sustaining vital community services and is uniquely susceptible to service disruptions. If the facility of interest belongs within any other CFI category, the user can proceed to the next question with the understanding that this facility is of lesser priority for backup solar + storage investment than those classified as CFI 1, which the module score will reflect.

QUICK SCREENING MODULE - QUESTION 2

When will the roof need to be replaced?

**CRITICAL PATHWAY QUESTION 1 FOR PV SITING MODULE

WHAT IS THIS QUESTION FOR?

Commercial building rooftops typically last 20–30 years before needing to be replaced. Similarly, PV systems have an anticipated lifetime of 25 years. To avoid having to remove and reinstall a relatively new PV system (and incur associated costs) when a roof is replaced, PV systems generally are not installed on roofs that are more than 10 years old. For PV siting purposes, a roof should have 16–20+ years of life remaining — or it should have 1–2 years of life remaining so that the roof replacement and PV system installation can happen concurrently.

HOW DO I FIND THE ANSWER?

The user should consult with the facility manager to determine when the roof needs to be replaced.

The user should skip this question if the proposed solar system will be somewhere other than an existing roof.

NEXT STEP

If the user selects “10 years or under,” it is not recommended that this building moves forward with a rooftop PV system.

QUICK SCREENING MODULE - QUESTION 3

What are the potential shading losses associated with a PV system at this location?

**CRITICAL PATHWAY QUESTION 2 FOR PV SITING MODULE

WHAT IS THIS QUESTION FOR?

Shade reduces PV system output. A PV system should be at least 3 times the height away from the tallest obstacle to the south. For example, a tree that is 20 feet higher than the PV system should be at least 60 feet away. To maximize the anticipated efficiency, PV systems should not be more than 10% shaded throughout the day.

HOW DO I FIND THE ANSWER?

If possible, search the address in Google Project Sunroof.[3] If the usable space you are considering for this site is shaded purple or dark orange, mark your response as "more than 10%." Additional free software tools that can provide a shadow analysis include the ScanTheSun mobile app for Android, the Sun Seeker mobile app for iPhone, System Advisor Model (SAM),[4] which has a "shading losses" option, and the 3D modeling tool SketchUp (free version)[5].

NEXT STEP

If the user selects "More than 10%," it is not recommended that this building moves forward with a PV system. Alternatively, another site (e.g., parking area, rooftop, greenspace) can be considered as needed. If the answer is "Less than 10%," proceed to the next question.

[3] Google Project Sunroof: https://www.google.com/get/sunroof
[4] NREL's System Advisor Model (SAM): https://sam.nrel.gov/
[5] Trimble Inc.'s SketchUp: https://www.sketchup.com/plans-and-pricing/sketchup-free

QUICK SCREENING MODULE - QUESTION 4

What is the facility's orientation to the sun?

**CRITICAL PATHWAY QUESTION 3 FOR PV SITING MODULE

WHAT IS THIS QUESTION FOR?

The direction a facility's roof faces, also referred to as its azimuth angle, is one of the primary factors determining how much sunshine a PV system will see over the course of the day. The ideal orientation for a PV system is due south, facing the sun. If the roof or terrain is flat, then the PV system can be oriented optimally. If the roof is sloped and rotated significantly to the east or west, PV electricity generation will be reduced. A roof orientation that is angled farther away from the sun than due east or due west is not viable.

HOW DO I FIND THE ANSWER?

To identify the roof's orientation, look up the address in Google Maps[6]. For more specific details, refer to building design documents and/or contact the manager. Dropdown options are listed in order of preference. North is not included because any northward-facing (north, northeast, northwest) site would not make a viable PV project.

NEXT STEP

If the user selects "east or west," it is not recommended that this building moves forward with a PV system. If the answer is "south," "southwest," or "southeast," proceed to the next question.

[6] Google Maps: https://www.google.com/maps

QUICK SCREENING MODULE - QUESTION 5

Does the facility require a backup generation strategy, according to FEMA guidelines?

**CRITICAL PATHWAY QUESTION 1 FOR CRITICAL LOAD MODULE

WHAT IS THIS QUESTION FOR?

Navigating the Emergency Power Flowchart (Figure 2) allows the user to address fundamental questions regarding how quickly emergency power is needed and the length of time it must run in order to sustain essential functions.

Question 5 provides users with a structured process to determine how asset performance criteria can impact decisions related to size and operating capabilities of a solar + storage energy resilience resource.

HOW DO I FIND THE ANSWER?

Review and complete the "Emergency Power Flowchart" (located below and in the FEMA P-1019[7] policy on pages 1-8) to determine whether the facility requires a backup generation strategy.

If the user reaches the bottom of the flowchart and answers "yes" to the final question, the facility is a potential candidate for a resilient solar + storage solution. The user can proceed regardless. However, the earlier a "no" answer is provided, the less important an investment is to support the critical load of the facility. For example, if the only critical load requirement is 90 minutes of battery to cover egress lighting to evacuate, then a major energy investment is likely not needed.

NEXT STEP

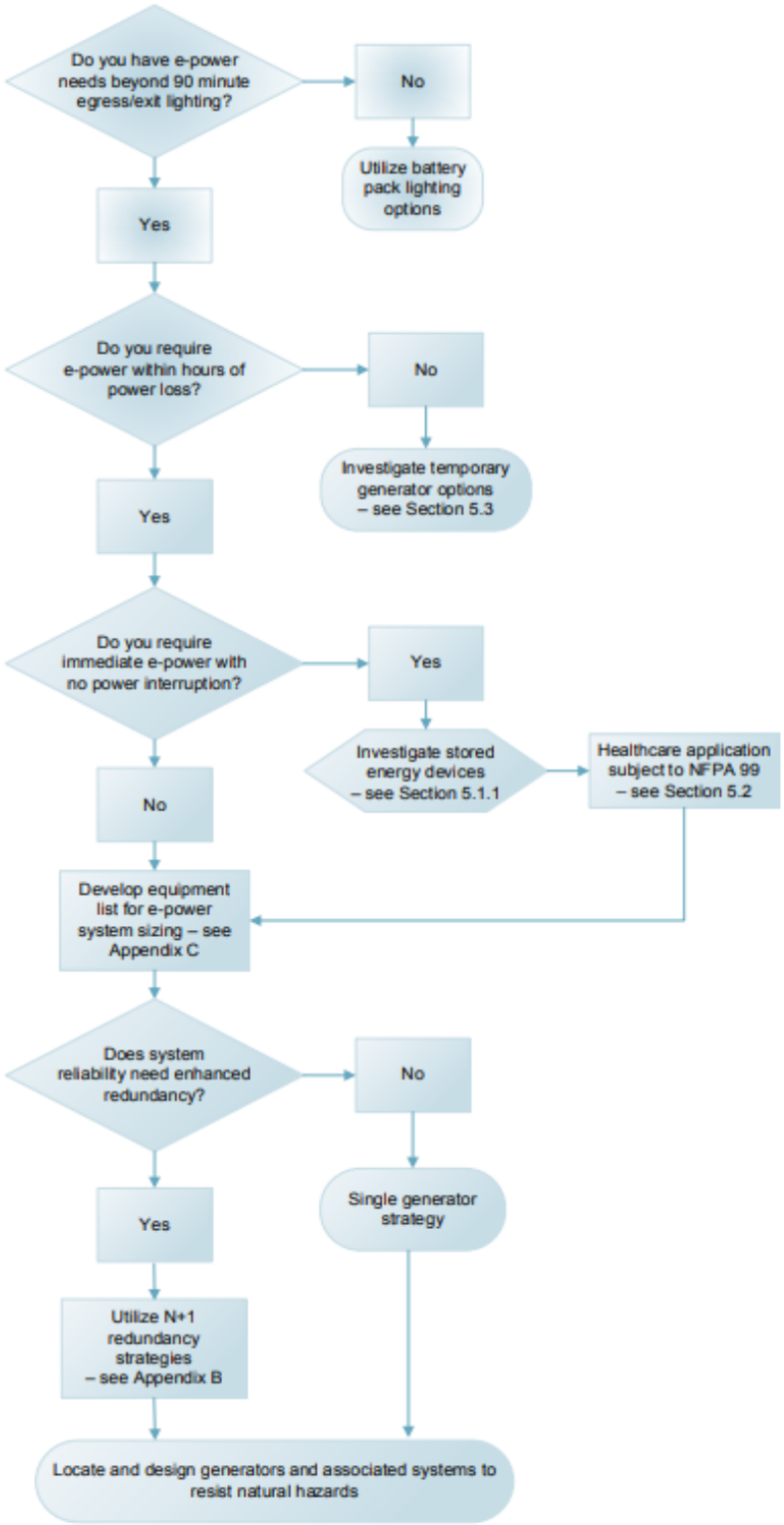
A backup generation strategy is required when uninterruptible power sources and backup generators fail to meet the critical energy needs of a facility based on the answers to these flowchart questions.

Note: Users may still proceed to the next question with a response of “no” if a solar + storage solution is desired over a traditional backup generator—for example, if funding has been secured specifically for a solar + storage system.

[7] FEMA Emergency Power Flowchart: https://www.wbdg.org/FFC/DHS/femap1019.pdf

Figure 2. FEMA's Emergency Power Flowchart*

*All text within the graphic, including references to specific sections and appendices, correspond to the FEMA P-1019 policy document, available at: https://www.wbdg.org/FFC/DHS/femap1019.pdf



QUICK SCREENING MODULE - QUESTION 6

Are there feeder limits or hosting capacity constraints for solar on the feeder that serves the facility?

**CRITICAL PATHWAY QUESTION 1 FOR UTILITY ENGAGEMENT MODULE

WHAT IS THIS QUESTION FOR?

Utilities often limit the amount of inverter-based resources on a single distribution feeder due to operational and infrastructure constraints. This could potentially affect the size of an energy resilience asset designed to supply power to the local grid for economic or operational benefits.

The purpose of this question is to help the user learn more about the constraints of the distribution system that serves the facility they are assessing. Having a better understanding of these potential limitations can inform project planning, development, and implementation.

HOW DO I FIND THE ANSWER?

This information is available from the utility provider.

NEXT STEP

If “yes,” feeder limits or hosting capacity constraints could potentially limit the use of solar energy as a resource and the facility may not be a strong candidate for a solar + storage investment. The user should consult with the local utility. If “no,” proceed to the next question.

Prioritization Module

The Prioritization Module provides a structure for assessing three facilities' relative criticality of community functions based on the facilities' role in supporting FEMA Community Lifelines and other aspects of community resilience.

One Prioritization Module sheet is provided for each of the three facilities. If the user has two facilities under analysis, then they need only to use two of the Prioritization Module sheets (one each), and so on. In other words, the second and third facility sheets are optional and only used if comparing multiple facilities before moving on to the subsequent modules. If the analysis begins with only one predetermined facility, the user should still complete the Prioritization Module to assess the relative criticality of that facility's community functions.

INTERPRETING THE PRIORITIZATION SCORE:

Each question will result in a score on a scale of 1–5 based on the unique criteria provided in the question description and corresponding linked resources for the user to review. Higher scores indicate a higher priority for the facility related to each aspect of criticality considered in the module. After all questions are answered, the scores are averaged into a composite score and organized into a comparison chart that can be used to determine the relative importance of a specific facility for supporting community resilience. Scores for multiple sites can be used to create a forced ranking to prioritize potential energy resilience investments.

Higher total scores indicate higher overall priority, and the comparison chart shows how facilities scored on each question and which answers differentiated each site. The questions are not weighted, so the final score is an average of all 11 answers expressed on the same scale of 1–5. There is no "threshold" score that a facility must attain in order to be considered a high priority. Instead, the module is designed to give a sense of comparison. Similar to the Quick Screening Module, the prioritization score of any one facility does not have significance on its own. The module's resulting score is not infrastructure-specific, allowing for a comparison of different facility types to ensure that an investment in an energy resilience resource can support the most vital need of a community regardless of what FEMA Community Lifeline it directly serves.

After completing the Prioritization Module, the user should identify **one** facility with the highest prioritization score to further assess in the remaining three modules.

MODULE RESOURCES:

The Prioritization Module is informed by national frameworks, specifically FEMA's National THIRA and Community Lifelines constructs; as well as local, state, and federal Emergency Operations Plan processes. See Appendix.

PRIORITIZATION MODULE - QUESTION 1

After an electricity disruption, how quickly does the facility's functionality need to be restored to meet its stated purpose within a FEMA Community Lifeline?*

***THIS QUESTION ALSO APPEARS IN THE QUICK SCREENING MODULE**

WHAT IS THIS QUESTION FOR?

This question compares facilities' level of importance and critical need to sustain power across the broader portfolio of sites being considered. A facility is prioritized for backup power investments based on the facility's level of importance in protecting the public's health, safety, and welfare. For example, facilities such as hospitals, emergency shelters, main fire stations, and water/wastewater facilities are critical and have adverse operational impacts from any disruption in service. Whereas facilities such as nursing homes, portable water booster and wastewater lift stations, and minor flood control structures are prioritized to resume operations within 24 hours after a disruption.

Additionally, the length of time a facility is able to sustain its essential functions without access to electricity is important to determining the technical requirements of an energy resilience investment, as well as how urgently the outage must be addressed. This is also relevant for the length of time that power is needed to sustain functionality to ensure that any solution is sufficient to provide support during a long-duration outage. Highest priority for a solar + storage energy resilience investment should be placed on sites where critical functions are most sensitive to service disruptions, indicating the greatest benefit from an on-site, flexible resource.

HOW DO I FIND THE ANSWER?

The "Critical Facility Index" (CFI) and other ranking systems are used by government emergency management to assist in prioritizing restoration and post-disaster economic redevelopment. The CFI used in local emergency management planning ranges from CFI 1 (cannot have any disruptions in service) to CFI 5 (can have varying levels of disruptions in service):

- CFI 1: These facilities plan for continuous water, telecommunication, and electric service to ensure business continuity or continuity of government. Electric service is maintained through uninterrupted utility service or a momentary interruption followed by a transfer to backup generation.
- CFI 2: These types of facilities plan to resume operations within 24 hours.
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- CFI 4: These types of facilities plan to resume operations within 72 hours.
- CFI 5: These types of facilities plan to resume operations after 72 hours.

When determining how long a facility is capable of operating without electricity, the user should not factor in the presence of a backup generator or uninterruptible power supply.

Instead, this answer is based on the ability of the facility to function without electricity, regardless of its source.

There is no national standard for power restoration by building type; therefore, the user should reference local emergency management planning documents to determine how quickly the facility must have its power restored. If such documents are unavailable, contact the facility manager or local emergency management personnel.

Since “safety of life” is paramount during restoration and recovery, in the immediate aftermath of an event, these four types of CFI 1 facilities are often considered most critical to restore: hospitals, emergency shelters, main fire stations, and water/wastewater facilities.

NEXT STEP

If the facility of interest belongs within CFI 1 (cannot have any disruption in service), the user can proceed to the next question with the understanding that this facility is critical to sustaining vital community services and is uniquely susceptible to service disruptions. If the facility of interest belongs within any other CFI category, the user can proceed to the next question with the understanding that this facility is of lesser priority for backup solar + storage investment than those classified as CFI 1, which the module score will reflect.

PRIORITIZATION MODULE - QUESTION 2

How many people is the facility designed to serve or needed to support, according to the facility owner or government plans?

WHAT IS THIS QUESTION FOR?

Prioritization includes not just a facility's function, but its relative impact on the community it serves. One way to understand the impact on a community is by asking the user to identify the communities dependent on the facility. Question 2 ranks the scope of a facility's impact in a community by asking the user to select between a range of populations served or supported by the facility. These numbers provide the ability to rank a facility against others of a similar type. For example, two fire stations may not be equal, because one serves a larger territory or more people than another.

The greater the number of people (or the higher percentage of the total population within a defined territory) served by the facility, the higher its weighting for solar + storage prioritization, since it will have a greater degree of impact on resilience. The number of people is one of many ways to understand the impact on a community. This indicator can help decision-makers think through how their community is served; users are encouraged to explore additional community indicators relevant to their context.

HOW DO I FIND THE ANSWER?

The building/facility manager or local government staff will be able to provide this information. Facilities are typically "rated" to provide services: a water treatment facility is designed with a maximum number of customers it can support (e.g., 50,000 customers) or a fire station is sited to serve 20% of a jurisdiction and the population inside it.

NEXT STEP

After completing this question, the user will gain a better understanding of the relative role the facility plays in a community as a whole and how it compares to other priority facilities.

PRIORITIZATION MODULE - QUESTION 3

Question A) How many FEMA Community Lifelines does the facility rely on to maintain its missions?

Question B) What are the FEMA Community Lifelines that the facility relies on?

WHAT ARE THESE QUESTIONS FOR?

The Prioritization Module uses the lens of the FEMA Community Lifelines process to assess the value of a project in the context of how it impacts a community holistically. The seven FEMA Community Lifelines represent the most fundamental services in the community that, when stabilized, enable all other aspects of society to function. The integrated network of assets, services, and capabilities that provide Lifeline services support the recurring needs of the community and enable all other aspects of society to function on a daily basis. Facilities being assessed individually can still benefit from having a score to gauge what impacts a site's priority in the context of the FEMA Community Lifelines.

Questions A and B provide the user with a better understanding of the essential functions of the facility and how they relate to the FEMA Community Lifelines. Facilities with a greater number of dependencies on other Lifelines to sustain functionality are more vulnerable to disruption. The type of Lifelines selected will not affect the overall scoring. Instead it will highlight the degree of interdependence with other Lifelines, indicating both susceptibility to disruption and the complexity of supply chains.

HOW DO I FIND THE ANSWERS?

For Question A, review the FEMA Community Lifelines Toolkit[8] and identify the number of Lifeline(s) the facility relies on, based on your knowledge of the facility. The facility will likely rely on multiple Lifelines. For example, a hospital's ability to conduct its core functions could be disrupted, at a minimum, by the loss of the following FEMA Community Lifelines: Health & Medical, Energy, and Communications.

For Question B, specify which Lifeline(s) the facility belongs to and select the appropriate responses.

NEXT STEP

After completing this question, the user will gain a better understanding of the facility's direct dependencies related to the FEMA Community Lifelines and how this compares to other priority facilities.

[8] FEMA Community Lifelines Toolkit: https://www.fema.gov/emergency-managers/practitioners/lifelines

PRIORITIZATION MODULE - QUESTION 4

Would a disruption to any other FEMA Community Lifeline prevent the facility's operation, even if electricity was restored?

WHAT IS THIS QUESTION FOR?

It is important to understand the extent to which a facility depends on other Community Lifelines to meet its core functions and deliver community services. A facility with multiple "critical path"[9] dependencies (different from "critical pathway" questions) is likely to be more vulnerable to disruption. Accordingly, a resilient energy solution needs to account for additional dependencies from a planning and design perspective. For example, a hospital has more than one Lifeline dependency in order to maintain operations. While electricity is needed to sustain life-support equipment such as ventilators, the hospital also requires access to potable water in order to do everything from patient hydration to tool sterilization. Considering this question helps the user identify other infrastructure risks to the same facility in order to adequately account for these risks and incorporate them into the facility's broader resilience strategy.

HOW DO I FIND THE ANSWER?

Using your answers to Question 3, consider the impact of the facility losing access to a Lifeline other than electricity. Would it prevent the facility from performing its critical function(s)? Review the FEMA Community Lifelines Toolkit[10] and select which FEMA Community Lifeline(s) the facility depends on, based on your knowledge of the facility.

For example, a fire station, which is part of the Safety and Security Lifeline, may be dependent on the Transportation Lifeline for vehicles to provide services, the Communications Lifeline for radio dispatch, and the Energy Lifeline to keep the facility operational. More detailed information can be collected from the facility operator to determine additional dependencies.

NEXT STEP

After completing this question, the user will gain a better understanding of the facility's indirect dependencies related to the FEMA Community Lifelines, and how this compares to other priority facilities. The answer further determines the facility's rank of criticality. Proceed to the next question.

[9] Critical Path Definition https://hbr.org/1963/09/the-abcs-of-the-critical-path-method
[10] FEMA Community Lifelines Toolkit: https://www.fema.gov/emergency-managers/practitioners/lifelines

PRIORITIZATION MODULE - QUESTION 5

Question A) How many FEMA Community Lifelines depend on the facility?

Question B) What are the FEMA Community Lifelines that depend on the facility?

WHAT ARE THESE QUESTIONS FOR?

The purpose of this question is to provide the user with a better understanding of the essential functions of the facility and how they relate to the FEMA Community Lifelines. Facilities with a greater number of dependencies on other Lifelines to sustain functionality are more vulnerable to disruption.

Question 3 assists the user in determining the extent to which the facility of interest depends on other FEMA Community Lifelines to meet its core functions and deliver community services.

Question 5 asks the opposite question to assist the user in determining how other facilities may rely on the facility of interest in this assessment. Dependency in this section indicates that a Lifeline can be compromised by the loss of the facility under assessment.

HOW DO I FIND THE ANSWERS?

For Question A, review the FEMA Community Lifelines Toolkit and identify the number of Community Lifeline(s) that depend on the facility being assessed based on your knowledge of the facility. It is likely that multiple Community Lifelines at a time will depend on the facility. For example, without having to investigate further, it can be presumed that the “Food, Water, Shelter” Lifeline would be compromised by the loss of a water treatment facility, a component of the “Food, Water, Shelter” Lifeline.

To provide an additional example, the “Health & Medical” Lifeline depends on a hospital’s operation. If a hospital is not operating, then other services and facilities within the “Health & Medical” Lifeline will be affected or will not be able to function as intended.

For Question B, specify which Community Lifeline(s) depend on the facility of interest and select the appropriate responses.

NEXT STEP

After completing this question, the user will gain a better understanding of the facility’s role as a dependency within the broader community and how this compares to other priority facilities. Proceed to the next question.

PRIORITIZATION MODULE - QUESTION 6

Question A) How many hazards is the facility vulnerable to?

Question B) What are the hazards that the facility is vulnerable to?

WHAT ARE THESE QUESTIONS FOR?

This question prompts the user to outline potential hazards to the facility, providing a risk-based assessment of a facility's priority for mitigation (higher risk = greater priority). A facility with five or more hazards receives a score of 5 to indicate maximum risk. Identifying specific hazards likely to impact a facility will support further decisions around siting (flood risk indicates a need to elevate assets), hardening requirements (hurricane or high wind risk requires appropriate construction standards), and resource sizing for storage (hazards indicating a likelihood of long-term outages require a larger storage asset for longer operation).

The user should also be aware that an important factor for siting an infrastructure project is proximity to flood zones. Facilities located in areas FEMA has designated as high risk for flooding are more prone to infrastructure service disruptions. Therefore, these facilities are unlikely to be eligible for federal grant funding to support construction at the site without substantial mitigation measures to account for the increased risk. Utilities are also unlikely to invest in distribution or transmission assets for areas at high risk of flooding without proper mitigation such as elevating equipment or enhanced site development to improve drainage and runoff.

While no flood designation is capable of eliminating a site from consideration for an energy resilience investment, it must be included as a critical factor in determining a project's economic and operational feasibility. Significant flooding could render an energy resilience investment moot if the facility becomes inoperable. If a priority facility does face a high risk of flooding, it is advisable to ensure that the facility is eligible for an infrastructure investment before continuing with the assessment. When designing the project, consider housing the solar + storage system above the predicted level of flooding.

HOW DO I FIND THE ANSWERS?

A government's Local Mitigation Strategy contains information about the hazards that create risk for its respective jurisdiction. The FEMA Guide to THIRA[11] identifies threats and hazards at the national level to consider and provides additional information on assessing hazard vulnerability [see Step 1 on pages 11-14]. FEMA's interactive National Risk Index[12] identifies a community's risk to 18 different natural hazards as well as its social vulnerability and resilience.

[11] FEMA Guide to THIRA: https://www.fema.gov/sites/default/files/2020-07/threat-hazard-identification-risk-assessment-stakeholder-preparedness-review-guide.pdf

[12] FEMA's National Risk Index: https://hazards.fema.gov/nri/map

For Question A, review the jurisdiction's Local Mitigation Strategy or FEMA Guide to THIRA to identify the number of hazards the facility faces based on your knowledge of the facility and the respective jurisdiction. It is possible for the facility to be vulnerable to multiple hazards. To determine a community's natural hazard risk using FEMA's National Risk Index, select "Census Tract View," type in the address of the critical facility, and count the number of hazards in the sidebar listed as "Relatively Moderate," "Relatively High," or "Very High". Users can then type those hazards in the text box for Question B.

For Question B, specify which hazards the facility is vulnerable to and input the appropriate response.

NEXT STEP

After completing this question, the user will gain a better understanding of the facility's potential hazards and how they compare to other priority facilities. Proceed to the next question.

PRIORITIZATION MODULE - QUESTION 7

Does the facility require backup power under local code, or has it been identified for a generator installation in a county Local Mitigation Strategy?

WHAT IS THIS QUESTION FOR?

This question helps the user determine whether backup power is required for the facility of interest under state or local code or through legislation. For example, the National Fire Protection Association (NFPA) Code 99 outlines the backup power requirements for health care facilities of different types. The Florida Statutes, meanwhile, require nursing homes to have backup generators that can provide 96 hours of temperature control in facilities. Local jurisdictions often have specific requirements or plans for backup generation. For example, counties identify and prioritize facilities for backup power generator installation as part of a Local Mitigation Strategy process. A facility identified in a Local Mitigation Strategy has already been reviewed by emergency management staff as a priority and is likely to have a more detailed risk assessment already completed and available for review.

There are many facility types with statutory requirements to have backup power (e.g., gas stations on evacuation routes) or the presence of "pig tails," which are wiring panels on the exterior of a building designed for rapid generator installation. Reviewing code for requirements of this type is essential to ensuring the energy resilience solution pursued complies with local ordinances and can provide added justification for investment by helping the facility to meet its backup power obligations for all loads identified in code.

HOW DO I FIND THE ANSWER?

To determine whether a state has building codes that affect the construction of an on-site energy resource or existing requirements to provide power to certain facility types, the user can complete a web-based search[13], looking specifically at energy requirements. Not all states have comprehensive codes for these requirements, but a search can provide a baseline to assess project feasibility and determine critical loads.

NEXT STEP

Answers to this question will provide the user with strong justification to pursue an investment and will indicate which facilities emergency management planners have already identified as essential. Proceed to the next question.

[13] Search building codes by state, BuildingsGuide.com: https://www.buildingsguide.com/blog/resources-building-codes-state/

PRIORITIZATION MODULE - QUESTION 8

Does the facility support recovery of a standardized impact?

WHAT IS THIS QUESTION FOR?

Standardized impacts are key quantifiable consequences associated with major threats and hazards, and they are used to inform capability targets for facilities or communities. They are selected based on how a community is affected by the loss of a capability or facility combined with the community-specific number of people affected (e.g., the patient capacity of a hospital).

A familiarization with FEMA's Standardized Impact Planning model allows the user to more clearly articulate the role a facility plays in supporting community resilience. Additionally, the model allows for a numerical assessment of impact to give the user a better sense of comparative resilience value from one facility to the next.

HOW DO I FIND THE ANSWER?

FEMA's THIRA guide[14] [see Step 2 on pages 15-18] outlines the process of identifying standardized impacts and determining the community-specific number of people affected. The user should review the list of impacts to identify the ones supported by the facility being assessed.

NEXT STEP

Any standardized impacts identified as part of this question will be explored in further detail as part of Question 10. The user should be prepared to assess which impacts the facility is capable of mitigating by avoiding any disruptions in service.

[14] FEMA Guide to THIRA: https://www.fema.gov/sites/default/files/2020-07/threat-hazard-identification-risk-assessment-stakeholder-preparedness-review-guide.pdf

PRIORITIZATION MODULE - QUESTION 9

Question A) Does the facility reduce the negative effects of a standardized impact?

Question B) What missions were identified in the Continuity of Operations Plan / Emergency Operations Plan (if any)?

WHAT ARE THESE QUESTIONS FOR?

When setting priorities for a solar + storage energy resilience solution, establishing standardized impacts can determine the specific ways a facility's continued operation can reduce or mitigate the impact of a disaster. For example, preventing a power disruption at a nursing home simultaneously reduces four standardized impacts:

1) The number of people requiring evacuation
2) The number of people with access and functional needs requiring evacuation
3) The number of businesses closed due to the incident
4) The number of fatalities as a direct result of the incident

As a result, an investment would have a substantial overall impact on the resilience of the community.

HOW DO I FIND THE ANSWERS?

To answer Questions A and B, review the facility's Continuity of Operations Plan or the local jurisdiction's Emergency Operations Plan to determine whether the facility is required to perform a specific function to reduce a hazard's community impact. Contact the appropriate facility operator, or city, corporate, county, or state emergency entity to obtain the necessary plan, or confirm with the plan's author that the facility is included in the jurisdiction's Emergency Operations Plan.

The FEMA Guide to THIRA[15] [see Step 2 on pages 15-18] outlines the process of identifying standardized impacts and determining the community-specific number of people affected.

NEXT STEP

This information provides the user with specific details about how the facility can support community resilience outcomes in a way that is easy to understand and compatible with emergency management planning processes.

[15] FEMA Guide to THIRA: https://www.fema.gov/sites/default/files/2020-07/threat-hazard-identification-risk-assessment-stakeholder-preparedness-review-guide.pdf

PRIORITIZATION MODULE - QUESTION 10

How many electricity-dependent beneficiaries are in the facility's zip code?

WHAT IS THIS QUESTION FOR?

Many variables, including demographics like age and gender, will help determine the presence of vulnerable populations near a facility of interest. For energy resilience, the most important indicator of vulnerable populations is a dependence on electricity to support essential health services. This question helps the user determine the concentration of Medicare electricity-dependent health beneficiaries near the facility being assessed. This group needs electricity for medical devices and equipment, such as ventilators, to live independently—for them, a power outage could be life-threatening. A heavy concentration of this population type may indicate an increased priority for service due to an overall increase in community impact if power is lost.

A large population that is susceptible to power outages in a specific jurisdiction points to specific standardized impacts, such as the number of people with functional needs who need to be evacuated. This may also result in an increased priority for facilities that can help mitigate this impact (e.g., shelters with medical capabilities).

HOW DO I FIND THE ANSWER?

The U.S. Department of Health and Human Services has an interactive mapping tool[16] where a user can enter a zip code and determine the number of Medicare electricity-dependent beneficiaries. Multiple zip codes can be added based on the jurisdiction or service territory of the facility being evaluated.

NEXT STEP

Awareness of these post-disaster needs can guide recommendations for investments in an energy resilience project to support specific outcomes, and it can also inform the comparisons of candidate sites. A facility with a greater ability to offset impacts on vulnerable populations could provide more community resilience value than those with a relatively limited benefit.

[16] U.S. Department of Health and Human Services emPOWER Map: https://empowermap.hhs.gov/

PRIORITIZATION MODULE - QUESTION 11

What is the Social Vulnerability Index score for the census tract where the facility is located?

WHAT IS THIS QUESTION FOR?

Emergency management staff in all jurisdictions have a fundamental responsibility to consider the needs of all members of the community, including those who may be disproportionately affected by disruptions in Lifeline services. Question 11 brings consideration to a facility's broader community, adding a layer of prioritization to include social vulnerability. Social vulnerability refers to a community's resilience when confronted by external stresses on human health, natural or human-caused disasters, or disease outbreaks. Reducing social vulnerability can decrease both human suffering and economic loss.

Socially vulnerable populations often bear the brunt of a major disaster's impact and tend to have the fewest resources for recovery. Socially vulnerable populations include those with special needs such as, but not limited to, people without vehicles, people with disabilities, older adults, and people with limited English proficiency.

HOW DO I FIND THE ANSWER?

Review the U.S. Centers for Disease Control and Prevention's Social Vulnerability Index (SVI)[17] and enter the facility address in the search bar. Be sure to select "Overall SVI - Census Tracts" in the legend. In the map, click anywhere near the address marker (within the census tract color) to reveal the SVI score for the census tract where the facility is located. Possible scores range from 0 (lowest vulnerability) to 1 (highest vulnerability).

NEXT STEP

After completing this question, the user will gain a better understanding of the surrounding community's social vulnerability and be able to prioritize facilities based on proximity to socially vulnerable populations. Planning that accounts for solar + storage investments in disinvested communities can ensure that people in those communities maintain access to essential community services in the wake of a disaster.

[17] Social Vulnerability Index Map: https://svi.cdc.gov/map.html

Prioritization Module Brief-Out:

Main Takeaway: These questions establish a facility ranking process driven by community resilience.

Upon completing this module, the user will be able to provide decision-makers with a risk-informed assessment of the importance of a particular facility. The assessment's format and language will be compatible with those of standard emergency management plans. Additionally, the user will be able to give specific examples of how a facility supports specific FEMA Community Lifelines. These examples help illustrate why certain functions are important to the local population and what the consequences of a prolonged outage could be. Finally, if leadership can only advance one energy resilience investment at a time, the summary comparison of this module can inform the selection of a single facility with the confidence that it is supported by a resilience analysis.

PV Siting Module

The PV Siting Module helps users assess facilities for compatibility with essential solar + storage siting requirements and identifies criteria to ensure a facility can support installation. The module questions allow users to quickly screen the suitability of a site's rooftop or identify the available space needed to support a PV array of sufficient size to meet energy resilience needs.

Users interested in assessing non-rooftop solar solutions such as parking lot canopies, open fields, brownfields, and landfills can use the Rocky Mountain Institute's Municipal Solar Site Selection Tool[18], which provides more detailed site selection guidance for non-rooftop sites.

If a site candidate for solar + storage investment consists of multiple buildings, the user can answer the module questions on a per-building basis in order to identify the aggregated results. The total usable area will need to be reviewed to determine the feasibility of an energy resilience resource.

Module Resources:

The PV Siting Module is largely based on the Rocky Mountain Institute's Municipal Solar Site Selection Tool, the U.S. Department of Housing and Urban Development Renew300 Solar Site Selection Guide, and guidance from Clear Sky Tampa Bay's national laboratory partners. See Appendix.

[18] Municipal Solar Site Selection Tool: https://cityrenewables.org/resources/municipal-solar-site-selection-tool-mssst/

PV SITING MODULE - QUESTION 1

When will the roof need to be replaced?*

***THIS QUESTION ALSO APPEARS IN THE QUICK SCREENING MODULE**

WHAT IS THIS QUESTION FOR?

Commercial building rooftops last 20–30 years before they need to be replaced. PV systems should not be installed on roofs that are more than 10 years old to avoid the costs of having to remove and reinstall the PV systems when the roof is replaced. For PV siting purposes, a roof should have 16–20+ years of life remaining — or it should have 1–2 years of life remaining so that the roof replacement and PV system installation can happen concurrently.

HOW DO I FIND THE ANSWER?

The user should consult with the facility manager to determine when the roof needs to be replaced.

The user should skip this question if the proposed solar system will be somewhere other than an existing roof.

NEXT STEP

If the user selects “10 years or under,” it is not recommended that this building moves forward with a PV system. If the user selects an alternative option, proceed to the next question.

PV SITING MODULE - QUESTION 2

What are the potential shading losses associated with a PV system at this location?*

***THIS QUESTION ALSO APPEARS IN THE QUICK SCREENING MODULE**

WHAT IS THIS QUESTION FOR?

Shade reduces PV system output. A PV system should be at least 3 times the height away from the tallest obstacle to the south. For example, a tree that is 20 feet higher than the PV system should be at least 60 feet away. To maximize the anticipated efficiency, PV systems should not be more than 10% shaded throughout the day.

HOW DO I FIND THE ANSWER?

If possible, search for the address in Google Project Sunroof.[19] If the usable space you are considering for this site is shaded purple or dark orange, mark your response as "more than 10%." Additional free software tools that can provide a shadow analysis include ScanTheSun mobile app for Android, the Sun Seeker mobile app for iPhones, System Advisor Model (SAM),[20] which has a "shading losses" option, and the 3D modeling tool SketchUp (free version)[21].

NEXT STEP

If the user selects "More than 10%," it is not recommended that this building moves forward with a PV system. Alternatively, another site (parking area, rooftop, greenspace) can be considered as needed. If the answer is "Less than 10%," proceed to the next question.

[19] Google Project Sunroof: https://www.google.com/get/sunroof
[20] NREL's System Advisor Model (SAM): https://sam.nrel.gov/
[21] Trimble Inc.'s SketchUp: https://www.sketchup.com/plans-and-pricing/sketchup-free

PV SITING MODULE - QUESTION 3

What is the facility's orientation to the sun?*

***THIS QUESTION ALSO APPEARS IN THE QUICK SCREENING MODULE**

WHAT IS THIS QUESTION FOR?

The direction a facility's roof faces, also referred to as its azimuth angle, is one of the primary factors determining how much sunshine a PV system will see over the course of the day. The ideal orientation for a PV system is due south, facing the sun. If the roof or terrain is flat, then the PV system can be oriented optimally. If the roof is sloped and rotated significantly to the east or west, PV electricity generation will be reduced. A roof orientation that is angled farther away from the sun than due east or due west is not viable.

HOW DO I FIND THE ANSWER?

To identify the roof's orientation, look up the address in Google Maps[22]. For more specific details, refer to building design documents and/or contact the manager. Dropdown options are listed in order of preference. North is not included because any northward-facing (north, northeast, northwest) site would not make a viable PV project.

NEXT STEP

If the user selects "east or west," it is not recommended that this building moves forward with a PV system. If the answer is "south," "southwest," or "southeast," proceed to the next question.

[22] Google Maps: https://www.google.com/maps

PV SITING MODULE - QUESTION 4

Will future nearby property developments cast shade on the proposed solar PV at this site?

WHAT IS THIS QUESTION FOR?

Solar PV systems can generate electricity for more than two decades. During this time, the built environment around PV systems can change dramatically. Consider whether the area to the south of the PV system could someday be developed with structures that may shade the system.

HOW DO I FIND THE ANSWER?

The user should consult with the local building permit authority, local zoning board, and/or neighboring facility managers to determine what nearby property development plans exist.

NEXT STEP

If the user selects “yes,” it is not recommended that this building moves forward with a PV system. Otherwise, a PV system may be suitable for this building given that neighboring properties will not cast shade on the proposed system. Proceed to the next question.

PV SITING MODULE - QUESTION 5

How much of the on-site space is available for PV development?

WHAT IS THIS QUESTION FOR?

HVAC equipment, elevator equipment rooms, exhaust stacks, staggered roofing sections, skylights, and/or television dishes and antennae can occupy large portions of available roof space and cause shading on solar arrays. When thinking about available roof space, add 6 feet to each dimension of rooftop equipment to determine the area that should be excluded from potential PV areas. Also subtract 4–8 feet from each outside edge of the building due to fire code setback requirements. Additionally, any space that is located on-site and available to the facility owner can be considered for solar assets.

HOW DO I FIND THE ANSWER?

The user should consult with the facility manager to determine how much space is available for PV development. Another option for estimating the usable space for solar is to use the National Renewable Energy Laboratory (NREL)'s PVWatts® Calculator, which estimates the performance of potential PV installations. Appendix F[23] of the Department of Housing and Urban Development's Renewable Energy Toolkit[24] provides a helpful guide to calculating a building's available rooftop area for a PV system.

If users are interested in assessing non-rooftop solar solutions such as parking lot canopies, open fields, brownfields, and landfills, they can use the Rocky Mountain Institute's Municipal Solar Site Selection Tool[25], which provides more detailed site selection guidance for non-rooftop sites.

NEXT STEP

If the answer to Question 5 is "less than two-thirds," consider the total square footage of roof space available for use to ensure enough PV panels can be installed to support the load of the facility. A building with two-thirds or more of available roof space will likely accommodate enough PV panels to support the load of the building.

[23] Appendix F of the Renewable Energy Toolkit: https://files.hudexchange.info/resources/documents/Appendix-F-Rooftop-Calculation-Tool.pdf
[24] Department of Housing and Urban Development's Renewable Energy Toolkit: https://files.hudexchange.info/resources/documents/Renewable-Energy-Toolkit.pdf
[25] Municipal Solar Site Selection Tool: https://cityrenewables.org/resources/municipal-solar-site-selection-tool-mssst/

PV Siting Module Brief-Out:

Main Takeaway(s): These questions assist in addressing the basics of PV siting.

Not all facilities and sites are compatible with solar + storage energy resource installations. Decision-makers need to have answers for the variables used to assess sites so that they only spend time pursuing investments in realistic locations. Based on just five questions, the summary from this module allows the user to recommend whether or not to pursue additional studies or to move on to another candidate site.

Critical Load Module

The Critical Load Module considers the facility's essential functions and associated power requirements, as well as whether emergency power can support those functions when grid electricity is not available.

The Critical Load Module helps users identify critical functions and corresponding critical loads to determine emergency power needs. The essential functions of a facility are only a subset of its full operating capability, and the electricity needed to support the facility can also vary depending on its anticipated requirements. While the electricity needs of a police station are relatively constant during steady-state operations compared to an event response, a community center designated as a disaster shelter would expect to see a dramatic increase in power consumption during a major event. This increase must be accounted for when determining the critical load.

Completion of this module will help the user identify functions that should be included in the critical load (according to operating code or FEMA guidance) and how this impacts the design of the energy resilience investment. In addition, the user will have the information needed to conduct a high-level assessment of the facility's essential functions, the corresponding electricity requirements needed to support them, and the compatibility of emergency power needs with federal guidelines and planning processes.

The module will also provide the user with the questions needed to size a solar + storage system that supports its FEMA Community Lifeline. How much load must be served, the existing backup capabilities, and connectivity to the current distribution system will all affect the potential size, siting, and cost of a new emergency power resource. While additional engineering assessments will be needed, completion of this module will provide enough information to support a project proposal.

Module Resources:

The Critical Load Module is informed by a variety of emergency management frameworks, national energy laboratory tools, and building code standards. See Appendix.

CRITICAL LOAD MODULE - QUESTION 1

Does the facility require a backup generation strategy, according to FEMA guidelines?

****THIS QUESTION ALSO APPEARS IN THE QUICK SCREENING MODULE**

WHAT IS THIS QUESTION FOR?

Navigating the Emergency Power Flowchart (Figure 2) allows the user to address fundamental questions regarding how quickly emergency power is needed and the length of time it must run in order to sustain essential functions.

Question 5 provides users with a structured process to determine how asset performance criteria can impact decisions related to size and operating capabilities of a solar + storage energy resilience resource.

HOW DO I FIND THE ANSWER?

Review and complete the "Emergency Power Flowchart" (located below and in the FEMA P-1019[26] policy on pages 1-8) to determine whether the facility requires a backup generation strategy.

If the user reaches the bottom of the flowchart and answers "yes" to the final question, the facility is a potential candidate for a resilient solar + storage solution. The user can proceed regardless. However, the earlier a "no" answer is provided, the less important an investment is to support the critical load of the facility. For example, if the only critical load requirement is 90 minutes of battery to cover egress lighting to evacuate, then a major energy investment is likely not needed.

NEXT STEP

A backup generation strategy is required when uninterruptible power sources and backup generators fail to meet the critical energy needs of a facility based on the answers to these flowchart questions.

Note: Users may still proceed to the next question with a response of “no” if a solar + storage solution is desired over a traditional backup generator—for example, if funding has been secured specifically for a solar + storage system.

[26] FEMA Emergency Power Flowchart: https://www.wbdg.org/FFC/DHS/femap1019.pdf

CRITICAL LOAD MODULE - QUESTION 2

Question A) Is a backup power resource currently in place at the facility?

Question B) How many hours can the current backup power resource supply energy for?

WHAT ARE THESE QUESTIONS FOR?

This question helps users to identify whether there is backup power in place, and more specifically, how long the backup power is intended to last. Current backup power resources should be considered in the context of a resource designed to support a defined list of facility functions deemed to be essential. For the purposes of this question, the type of energy source is not relevant, only the presence of the resource or the availability of fuel. The type of fuel used affects the availability, burn rate, and maintenance requirements of the generator.

Knowing the existing backup generation and refueling strategy guides the user's design and investment choices for a solar + storage solution. For example, if the facility has a backup generator of sufficient size to power critical loads during an emergency and an adequate supply of fuel with a strong refueling plan, investing in only PV panels may be more cost-effective than also procuring energy storage.

HOW DO I FIND THE ANSWERS?

Review the facility's Continuity of Operations Plan or the local jurisdiction's Emergency Operations Plan to determine whether a backup power resource is currently in place at the facility and how long the backup power is intended to last.

The appropriate selection for this question would consider both the presence of backup power and the ability to support critical functions independently (e.g., necessary fuel is stored on-site) for the period of time defined by the facility's Continuity of Operations Plan or the local jurisdiction's Emergency Operations Plan.

If the information is not easily accessible, contact the building/facility manager.

NEXT STEP

The user now can proceed with the assessment better informed of the current system's ability to operate, and for what length of time, during power outage events. Proceed to the next question.

CRITICAL LOAD MODULE - QUESTION 3

Can the facility ensure an emergency resupply of fuel for the backup generator?

WHAT IS THIS QUESTION FOR?

This question instructs users to identify whether there is a contract in place for the resupply of the backup generation fuel source. The primary reasons diesel generators fail following a major event are:

1) Lack of fuel availability
2) Maintenance failure
3) Improper load match

Of these, lack of fuel availability is the most common cause. Demand for diesel gasoline dramatically increases when power outages occur, due to the high usage rate of generators that are not usually running. Given the finite quantity of fuel stored on site, the primary indicator of a backup generator's ability to support a facility's critical load is the assurance of resupply. A facility with a pre-existing contract to resupply fuel is more likely to maintain functionality following a disaster.

HOW DO I FIND THE ANSWER?

Contact the building/facility manager to obtain this information.

With this information readily available, the user can begin to weigh potential options for acquiring backup generation and perform a more detailed cost analysis of solar + storage compared to a backup generator.

NEXT STEP

If the answer is "yes," then the backup generator may be resupplied in the event of a prolonged outage and may be sufficient to power the critical load(s) of the facility.

If the answer is "no," then there is no guarantee the backup generator will have adequate fuel to power the critical load(s) at the onset of an outage or be resupplied to provide power for the full duration of the outage.

Proceed to the next question.

CRITICAL LOAD MODULE - QUESTION 4

Does the building have a separate, “emergency” circuit for critical loads?

WHAT IS THIS QUESTION FOR?

To consider developing solar + storage for this facility, the user must understand any present site-specific limitations. An emergency circuit is needed to provide a secondary power source on site or from the serving utility. The purpose of this question is to help the user identify whether additional electrical engineering work will be needed to install a backup energy supply (e.g., a generator or solar + storage solution).

A building may have a separate, “emergency” circuit installed by the distribution utility in order to maintain the supply of power for critical loads. The emergency circuit is a redundancy that allows the utility to isolate a particular customer from others on the same distribution feeder. The presence of this circuit indicates the utility has prioritized the facility and has flexibility in providing service following an event.

Additionally, an emergency circuit is very useful for inverter-based resources such as solar, because the facility can be connected (or disconnected) more easily from the distribution grid. This reduces the risk of power electricity back-feed to line personnel working on the distribution system.

HOW DO I FIND THE ANSWER?

This question allows the user to input “yes,” they have an emergency circuit that is connected to critical load(s), or “no,” there is no emergency circuit connected to all of the critical loads.

The electric utility providing service to the facility should have the needed information.

NEXT STEP

If the facility does not have an emergency circuit, one will need to be designed and installed, which will add costs to the project. Additional electrical engineering work will need to be performed to install a backup energy supply.

If the facility does have an emergency circuit, the installation of solar + storage will not be limited by this factor.

Proceed to the next question.

CRITICAL LOAD MODULE - QUESTION 5

Question A) Does the facility have code requirements under the International Building Code, Life Safety Code, and health-related codes such as National Fire Protection Association (NFPA) Code 99 that may help identify essential facility functions and corresponding energy needs?

Question B) What level of operation (as defined by FEMA) does the facility require in order to maintain code compliance?

WHAT ARE THESE QUESTIONS FOR?

This question reminds the user that there may be relevant building, life safety, and health-related code requirements related to backup power needs to sustain essential functions. These requirements can drive investment priorities to maintain compliance and can open up additional funding for solar + storage projects if they are fulfilling unmet needs.

HOW DO I FIND THE ANSWERS?

For question A, review the building codes chart located in the FEMA P-1019 Policy[27] (see pgs. 4-7) to determine what level of backup generation is necessary.

For question B, review the table (pg. 4) to determine the facility's level of operation (Level I, IB, II, III) required by code.

NEXT STEP

For question A, if the answer is "yes," the solar + storage solution should power the code requirements at a minimum. Additionally, the user should investigate what local, state, and federal incentives may support a solar + storage investment to help meet code requirements.

Emergency power requirements are not limited to those identified in code. If the answer to question A is "no," the user should work with the facility manager to conduct an independent assessment of functions requiring electricity to sustain operations during an outage.

The answer to 5B is solely for the user to reference during solar + storage project scoping and development.

Proceed to the next question.

[27] FEMA P-1019 Policy: https://www.wbdg.org/FFC/DHS/femap1019.pdf

CRITICAL LOAD MODULE - QUESTION 6

What is the energy profile of the building?

WHAT IS THIS QUESTION FOR?

This question prompts the user to select a predetermined energy profile that most closely matches the use case of the facility, providing a basis for further estimation of the building's energy profile. Understanding a facility/building's energy profile is a starting point for determining its emergency power needs.

The Renewable Energy Integration and Optimization (REopt™) Lite[28] online tool models load profiles for 16 building types in 16 distinct climate zones to approximate the energy profile of a facility. These energy load profiles are located on a drop-down menu from the tool's main landing page.

This model is used within the Decision Support Template to provide a standardized list of building types. Buildings of particular types operate with similar energy profiles, which is an essential variable in assessing the cost-benefit of an energy resilience investment. While differences exist in the profiles of specific buildings based on external factors like weather, construction materials, and design, answering this question will provide the user with a starting point to navigate the REopt Lite tool without the need to first conduct a detailed analysis of the building.

HOW DO I FIND THE ANSWER?

Determine which of the provided building types most closely represents the facility of interest. For example, if the facility being assessed is a grocery store, the user should select "supermarket." If the building type is not clear, use the "other" category.

Note: If the user intends to use REopt Lite to conduct a cost-benefit analysis, the response to this question will also be used for that purpose.

NEXT STEP

This energy profile can be used to provide a generic, overall assessment of a building's energy needs if the user does not have one. Proceed to question 7 for a more detailed breakdown of the facility's energy needs.

[28] NREL's REopt Lite: https://reopt.nrel.gov/tool

CRITICAL LOAD MODULE - QUESTION 7

Question A) What is the facility's monthly energy consumption (in kilowatt-hours)?

Question B) What is the facility's annual peak load (in kilowatts)?

WHAT ARE THESE QUESTIONS FOR?

This question helps the user understand the energy requirements of the facility to inform the scoping and sizing of a solar + storage solution for resilience. The facility's monthly energy consumption is the primary driver for economically optimizing the design of the energy solution. While the solution must be capable of covering the peak, it will be configured to run in a cost-efficient manner based on the average monthly consumption.

HOW DO I FIND THE ANSWERS?

For question A, the facility's monthly energy consumption can be obtained from the servicing utility or facility manager. The monthly energy consumption number must be supplemented with information about daily or yearly trends, such as daily peak demand and seasonal fluctuations, to better understand needs during a major event.

If the facility's monthly energy consumption is not readily available, the Department of Energy's Technical Resilience Navigator[29] can be used to estimate it. Note: The tool is free but does require the creation of an account.

For question B, the facility's annual peak energy consumption (in kW) can be obtained from the servicing utility or facility manager. If the facility has a separate emergency circuit for critical loads, the user should identify the peak load on the critical circuit.

NEXT STEP

The answers to questions A and B provide important points of reference for solar + storage project scoping and development.

Determining the highest consumption of electricity allows for proper scaling of an energy resilience asset to ensure resource adequacy. Proceed to the next question.

[29] Technical Resilience Navigator: https://trn.pnnl.gov/login

CRITICAL LOAD MODULE - QUESTION 8

Question A) Do the facility's occupancy and corresponding energy needs change under emergency conditions?

Question B) What are the conditions when the peak of energy consumption is expected?

WHAT ARE THESE QUESTIONS FOR?

This question helps the user identify whether the facility will be used for an emergency purpose different from its use during normal operations. It also helps identify whether the electricity consumption or load profile of the facility will change significantly during an emergency scenario.

Energy consumption can experience dramatic shifts as a result of several conditions. These conditions can affect the configuration and sizing required of a solar + storage asset to support a facility's continued operation. Determining the conditions (time of year, temperature, number of occupants, special events) that drive peak consumption allows for proper scaling of an energy resilience asset to ensure resource adequacy. These conditions include the emergency usage of the building (e.g., a community center designated as a shelter can expect to increase its power consumption considerably when it is full of people seeking shelter), or the impact on consumption from external factors such as weather.

The user should be able to surmise the existence of certain conditions and estimate when they are likely to occur. For example, a hurricane requiring the use of the facility as a shelter combined with high seasonal temperatures is a likely condition for peak consumption. An increase (or decrease) in power consumption during a major event should be captured to ensure adequate emergency power to support essential functions.

HOW DO I FIND THE ANSWERS?

For question A, this information will reside with the facility manager based on Continuity of Operations Plans or "surge" capacity requirements outlined in local Emergency Operations Plans.

For question B, this information can be obtained from the servicing utility or facility manager.

NEXT STEP

The answers to questions A and B provide important points of reference for solar + storage project scoping and development. Proceed to the next question.

CRITICAL LOAD MODULE - QUESTION 9

Question A) What percentage of the facility's load is considered critical?

Question B) Does this percentage vary?

WHAT ARE THESE QUESTIONS FOR?

This question helps the user quantify the energy demand of critical functions as a subset of the total needs of the facility. Critical load should be limited to the assets (lighting, HVAC, equipment, hardware, etc.) essential to operations needed to support community resilience. In other words, the critical load includes mission-critical, life-sustaining loads that warrant 100% resilience. The user is seeking the smallest percentage possible in order to reduce the size, complexity, and cost of an energy resilience asset as much as possible.

As established by question 4, the presence of an emergency circuit connected to critical load(s) is needed in order to provide a secondary power source on site or from the serving utility. Identifying the size of the critical load is necessary for determining the size of the solar + storage system needed.

HOW DO I FIND THE ANSWERS?

The user can work with facility operators to identify the specific systems required to sustain critical functions and how much energy those systems require, which are the critical loads. Some questions to ask include: (1) which systems require reliable access to energy? (2) would the loss of energy to support these functions lead to mission failure or mission degradation? (3) How much energy is required to sustain the critical loads?[30]

The answers to questions 5–7 are useful to determine critical load as a percentage of the facility's total power consumption. Additionally, the user may estimate based on the building "profiles" researched earlier. Variance in the percentage can be determined based on the answer to question 8.

The Clean Coalitions value-of-resilience (VOR123) methodology[31] provides a useful tiering classification — critical, priority, and discretionary loads — for facilities. The typical size of a facility's critical load is about 10%, but that fluctuates depending on the facility type and its services. For example, a hospital's critical load would be closer to 50%.

NEXT STEP

Proceed to question 10 to determine critical load requirements expressed as a function of time.

[30] Technical Resilience Navigator: https://trn.pnnl.gov/module/baseline-development/action/2
[31] Clean Coalition VOR123 methodology: https://clean-coalition.org/disaster-resilience/

CRITICAL LOAD MODULE - QUESTION 10

Do any of the facility's critical loads have a run-time constraint (i.e., they only need power for a defined number of hours?)

WHAT ARE THESE QUESTIONS FOR?

Functions supported by critical loads can have a variety of requirements regarding how long the power is needed to sustain operations. While a short-term battery can provide a few minutes to back up a computer's files, a ventilator will need to run indefinitely. Identifying what functions (and what loads) have this requirement is important to the design of the energy resilience resource.

HOW DO I FIND THE ANSWERS?

The user will need a breakdown of the critical loads by function to estimate the amount of time energy is needed to sustain them. These numbers can also be estimated based on the user's knowledge of the facility. The user can also work with the facility operator to determine how long the critical load must run to meet mission requirements.

NEXT STEP

After completing this question, the user will gain a better understanding of what functions (and what loads) have run-time constraints, which is important to the design of the energy resilience resource. The Critical Load Module is complete.

Critical Load Module Brief-Out:

Main Takeaway(s): These questions assist in determining what emergency power a facility really needs to sustain critical functions.

Following the completion of this module, the user will know the facility's true energy needs for supporting its essential functions. This information will be used in other parts of the process, because it has bearing on the size, configuration, and performance capabilities of an energy resilience investment. Answers to these questions can help explain the shortcomings or inadequacies of current backup power and help make the case for a new resource. Additionally, they can highlight the need to answer critical questions about gaps in current planning around generator maintenance, fuel contracts, and the important variables that must be considered regarding emergency power.

Utility Engagement Module

The Utility Engagement Module determines whether the local utility identifies the facility for priority restoration. It also looks “beyond the fence” of the facility to consider the surrounding electricity infrastructure and its relationship to the facility.

The information the user collects during the first three modules will maximize the efficiency of meetings with utility partners by helping to guide the conversation and address several questions they are likely to ask. Additionally, completion of the modules ensures the engagement will remain focused on a small number of sites already identified based on priority and known to be candidates for solar + storage resources for emergency power requirements.

The Utility Engagement Module prompts users with questions that require outreach to local utilities to better understand the potential for grid benefits from an energy resilience project. The user can adapt the questions and any initial answers as a meeting outline template for discussing these issues with the utility provider. Each question is designed to stimulate a discussion with utilities about aligning planning processes, clarifying roles and responsibilities, establishing shared priorities, and determining joint opportunities for infrastructure and resource investment. Some questions cannot be answered until an initial meeting takes place and can serve as advance preparation for a meeting. The module is designed to structure the engagement around the most impactful policy and technical subject areas, with an emphasis on collaborative engagement.

The module also includes questions about policies or technical constraints that can impact customers’ ability to construct and deploy a solar + storage resource—these include local, state, or federal regulations and the surrounding distribution system’s operational constraints. Most importantly, the module provides targeted questions to guide conversations with the servicing utility that sharpen the focus of joint resource planning on the topics of central importance.

At the conclusion of the Utility Engagement Module, the user will gain a better understanding about how priorities for restoration are made by utilities. The module also helps identify opportunities to improve the alignment of facility-specific energy resilience planning with transmission and distribution planning. Additionally, the module will help surface potential technical limitations while identifying economic advantages to pursuing an investment.

Module Resources:

The Utility Engagement Module is largely informed by existing utility restoration planning methods, system design specifications, and utility performance criteria. See Appendix.

UTILITY ENGAGEMENT MODULE - QUESTION 1

Are there feeder limits or hosting capacity constraints for solar on the feeder that serves the facility?

****THIS QUESTION ALSO APPEARS IN THE QUICK SCREENING MODULE**

WHAT IS THIS QUESTION FOR?

Utilities often limit the amount of inverter-based resources on a single distribution feeder due to operational and infrastructure constraints. This could potentially affect the size of an energy resilience asset designed to supply power to the local grid for economic or operational benefits.

The purpose of this question is to help the user learn more about the constraints of the distribution system that serves the facility they are assessing. Having a better understanding of these potential limitations can inform project planning, development, and implementation.

HOW DO I FIND THE ANSWER?

This information is available from the utility provider.

NEXT STEP

If “yes,” feeder limits or hosting capacity constraints could potentially limit the use of solar energy as a resource and the facility may not be a strong candidate for a solar + storage investment. The user should consult with the local utility. If “no,” proceed to the next question.

UTILITY ENGAGEMENT MODULE - QUESTION 2

A) Does the servicing utility have a priority ranking for critical facilities?

B) Is the facility explicitly identified by the utility provider as a priority for restoration?

WHAT ARE THESE QUESTIONS FOR?

Understanding how utilities identify essential facilities to expedite power restoration is essential to establishing shared priorities for energy resilience. The purpose of question 2A is to understand what facilities the utility has prioritized for restoration during an outage and how they will be restored.

All electric utilities have restoration plans and seek to minimize the power restoration timeline — i.e., to turn customers' power back on as quickly as possible. As part of this planning, the utility designates certain facilities as more critical than others for restoring power on the local distribution network. After learning what variables or criteria the utility applies to rank critical facilities, the user can apply that knowledge for mutual technical and operational benefit, aligning a solar + storage investment with the utility's priorities.

The purpose of question 2B is to make the utility aware of the community resilience critical functions supported by the facility. This knowledge can facilitate the inclusion of the facility within the utility's restoration priorities, helping to provide near-term resilience in the form of more rapid service restoration following an outage.

If the utility identifies the facility as a priority for restoration, a solar + storage solution for resilience can provide operational value to the utility by reducing the number of sites they need to be concerned with. Additionally, if both parties agree that a particular site is important, it may incentivize co-development or co-investment in the project. In some instances, it can help justify rate-based recovery of an infrastructure investment.

HOW DO I FIND THE ANSWERS?

For question 2A, contact the utility service provider to determine whether they have a facility criticality-ranking process. In addition, the user should determine whether the electric utility has a restoration plan for critical loads. Some utilities have restoration plans that apportion a certain amount of energy to serve critical loads, but those plans may involve a quasi-demand response program that requires non-critical loads in the same facility to remain unpowered. For question 2B, contact the utility service provider to determine whether the facility is listed as a priority for power restoration.

NEXT STEP

It is useful to know whether a facility has already been given priority for power restoration, because then the utility is likely to have the infrastructure and service data readily available. Additionally, any site with a priority designation will provide added justification for investment and better engagement from the utility. Proceed to the next question.

UTILITY ENGAGEMENT MODULE - QUESTION 3

Are there separate interconnection rules or queues for PV, energy storage, or microgrids for the utility that provides service to the facility?

WHAT IS THIS QUESTION FOR?

The purpose of this question is to prompt the user to seek guidance from the utility on how the grid interconnection process works for PV, energy storage, and microgrids. Because PV and energy storage are in some cases still considered emerging technologies, there may or may not be distinct rules or processes that project developers must follow to initiate or gain approval for projects. These rules are specific to the requirements of the state regulatory utility commission that oversees the servicing utility.

It is important for the user to understand the interconnection process in a utility service territory, because the process could have significant implications for the project development timeline or project feasibility.

HOW DO I FIND THE ANSWER?

Additional information about interconnection requirements can be found in pages 1-9 of the North American Electric Reliability Corporation Reliability Guideline[32] on Improvements to Interconnection Requirements for Bulk Power System-Connected Inverter-Based Resources (2019).

NEXT STEP

Any information provided by the utility regarding the existence of rules should be considered as part of a plan to pursue a solar + storage energy resilience investment. Proceed to the next question.

[32] NERC Reliability Guideline: https://www.nerc.com/comm/PC_Reliability_Guidelines_DL/Reliability_Guideline_IBR_Interconnection_Requirements_Improvements.pdf

UTILITY ENGAGEMENT MODULE - QUESTION 4

Does the facility have a redundant distribution line feed?

WHAT IS THIS QUESTION FOR?

A redundant line feed means the facility is serviced by more than one distribution line, typically from a different transformer/substation. The purpose of this question is to inform the user of existing reliability measures the utility has taken.

HOW DO I FIND THE ANSWER?

This information is available from the utility service provider or the facility manager.

If there is a redundant distribution line feed running to a facility, it has likely been identified as a priority load by the utility company, which will strengthen the case to prioritize an investment. Similarly, if there is a redundant distribution line feed, that facility may not experience feeder or host capacity constraints for installing PV and energy storage, which improves the user's likelihood of implementing resilient energy solutions for the facility. Finally, a redundant feed carries the added benefit of supporting the local distribution system in a more versatile way, improving the utility's access to the completed resource to support operations in the area.

NEXT STEP

The presence of a redundant feed can be incorporated into the planning/design process for an investment. Proceed to the next question.

UTILITY ENGAGEMENT MODULE - QUESTION 5

Does the utility have a demand response program with storage participation?

WHAT IS THIS QUESTION FOR?

Demand response provides an opportunity for energy consumers to play a significant role in the operation of the electric grid by reducing or shifting electricity usage during peak periods. Consumers can make these adjustments in response to time-based rates or other financial incentives. A facility with a dedicated resource like a solar + storage asset can be taken off grid electricity to reduce demand on the servicing utility, which allows the utility to redirect power supply elsewhere. Providing this service comes with the opportunity to be paid by the utility for allowing them the option of routing available capacity to other customers in need. This flexibility can help avoid a load shed (forced blackout or brownout).

If a system is installed with the necessary controls and is integrated with the local utility to support demand response, the resource could generate revenue for the facility owner. The purpose of question 5 is to encourage the user to consider financial incentives that could enhance project economics and also provide grid services. In addition, it is useful to determine whether the utility and/or facility jurisdiction has any programs or incentives for microgrids to support resilience goals.

HOW DO I FIND THE ANSWER?

The Federal Emergency Management Program has developed profiles of utility demand response programs[33] throughout the United States. If the answer is unclear, contact the utility service provider to determine if they have a demand response program/market.

NEXT STEP

Regardless of whether the project is pursued, the user should explore utility programs to see if there are financial incentives they can use. Proceed to the next question.

[33] Federal Emergency Management Program's demand response program profiles: https://www.energy.gov/eere/femp/demand-response-and-time-variable-pricing-programs

UTILITY ENGAGEMENT MODULE - QUESTION 6

Where in the system does this project improve resilience (e.g., bulk power system, distribution system, individual facility)?

WHAT IS THIS QUESTION FOR?

The purpose of this question is to encourage the user to think more broadly about the benefits of the project and determine how project intentions can be aligned with utility interests. The larger and more significant the positive grid impact of a proposed investment is, the more likely the utility is to support it. Addressing an area of need for a utility (distribution upgrades, capacity sharing, etc.) can bring meaningful utility advocacy and increase the chances of a project moving forward.

HOW DO I FIND THE ANSWER?

Information regarding the project scale and the potential energy resilience impacts will require discussion with the servicing utility to understand the difference between each type of system benefit.

The bulk power system typically involves the transmission system or a grid-scale generation source. The distribution system comprises local infrastructure at voltages below 67 kV for a single feeder or a radial feeder. Facility-specific means the energy benefits do not extend beyond the meter on which the resource was installed.

NEXT STEP

Watch the video[34] by the U.S. Energy Information Administration on utility reliability metrics before proceeding to the next question.

[34] Reliability metrics video: https://www.youtube.com/watch?reload=9&v=oVH9L0fCMTU&feature=youtu.be

UTILITY ENGAGEMENT MODULE - QUESTIONS 7-9

Question 7: What is the System Average Interruption Frequency Index (SAIFI)?

Question 8: What is the System Average Interruption Duration Index (SAIDI)?

Question 9: What is the Customer Average Interruption Duration Index (CAIDI)?

WHAT ARE THESE QUESTIONS FOR?

Questions 7–9 are intended to provide the user with data regarding utilities' historical performance in a facility's respective utility service territory. This data can help the user understand where projects could create shared value for facility owners and utilities alike. The statistics will also indicate the frequency with which customers are impacted by disruptions (SAIFI), the average outage length (SAIDI), and the combined average of both (CAIDI), providing key indicators for areas in greater need of energy resilience investments to offset disruptions caused by disasters and major events. These statistics are based on the overall performance of a company across its service territory, so they will not provide information specific to the facility being assessed. The categories of system performance can be applied to a particular site in order to determine whether it is performing above or below the average of the service territory as a whole.

In addition to improving awareness of the performance criteria used to rate utilities, collecting utility reliability statistics helps the user better understand overall electric service performance in the facility's territory while providing useful information for investment prioritization and justification. This information is not intended to provide a tool to negotiate a cost-share with utilities. Instead, it helps illuminate the ways an energy resilience investment can be valued by the service provider.

HOW DO I FIND THE ANSWERS?

Accessing the information on the U.S. Energy Information Agency's website will produce a searchable spreadsheet from which the user can select a specific utility based on its company name. Refer to the agency's website[35] to find the most recent year's statistics for the utility that serves the facility.

The American Public Power Association (APPA) Annual Benchmarking website will give the user a better idea of a specific company's performance compared to the industry as a whole. Refer to the APPA Annual Benchmarking website[36] for information about utility performance. Select from numbers 1–5 based on the utility performance on the AAPA Annual Benchmarking website.

[35] U.S. Energy Information Agency website: https://www.eia.gov/electricity/data/eia861/

[36] APPA Annual Benchmarking website: https://www.mcphersonpower.com/wp-content/uploads/2020/04/2019-APPA-Annual-Benchmarking-Report-eReliability-Tracker-002.pdf

NEXT STEP

The utility metrics will indicate how frequently outages occur and how long they last. The higher the numbers, the more a resilient energy solution will benefit the facility and the utility serving it. This will provide the user with insight into the operating conditions of the servicing utility while helping to make the case for an investment that supports the better outcomes and performance for both parties. Proceed to the next question.

UTILITY ENGAGEMENT MODULE - QUESTION 10

How many times has the servicing utility declared a Major Event in the past ten years?

WHAT IS THIS QUESTION FOR?

A Major Event (ME) is defined as a catastrophic event that exceeds reasonable design or operational limits of the electric power system and during which at least 10% of the customers within an operating area experience a sustained service interruption during a 24-hour period. Areas with a significant number of MEs (identified in the drop-down menu), indicate an area of higher risk for events resulting in substantial outages. This will advise the assessment of overall risk to a facility and provide added justification for an energy resilience investment. Proper investment in energy infrastructure can reduce the overall number of MEs by elevating the standards of "reasonable design."

HOW DO I FIND THE ANSWER?

This information is available from the utility service provider or the state utility commission.

NEXT STEP

The presence of a high number of Major Events should be included in discussions with the utility about how to address risk and should be included in investment justifications.

Utility Engagement Module Brief-Out:

Main Takeaway(s): These questions and topics are important to discuss with utility partners.

Engagement with utilities can be a complicated and time-consuming process if the right questions are not being asked. The module is designed to structure outreach and engagement to ensure important topics are raised. These topics can affect the viability and priority of an investment, and they establish a foundation for collaborations that emphasize dual benefits. The results can be used as a de-facto agenda for initial meetings and advise leadership regarding the relative technical, operational, or economic benefits of projects to the user and the utility.

References

Introduction

FEMA's Design Guide for Improving Critical Facility Safety from Flooding and High Winds: https://www.fema.gov/sites/default/files/2020-08/fema543_design_guide_complete.pdf
NREL's Resilience Roadmap: https://www.nrel.gov/resilience-planning-roadmap/
Federal Emergency Management Agency's Community Lifelines: https://www.fema.gov/emergency-managers/practitioners/lifelines
Microsoft Troubleshooting and Support: https://support.microsoft.com/en-us/office/troubleshooting-and-support-278f4691-6e1d-445a-a048-a7968a047e55?ui=en-US&rs=en-US&ad=US

Quick Screening Module

FEMA Flood Insurance Rate Map (FIRM) Mapping Tool: https://msc.fema.gov/portal/search
NOAA Sea Level Rise Viewer: https://coast.noaa.gov/slr/
Google Project Sunroof: https://www.google.com/get/sunroof
Trimble Inc.'s SketchUp: https://www.sketchup.com/plans-and-pricing/sketchup-free
NREL's System Advisor Model (SAM): https://sam.nrel.gov/
Google Maps: https://www.google.com/maps
FEMA Emergency Power Flowchart: https://www.wbdg.org/FFC/DHS/femap1019.pdf

Prioritization Module

FEMA Flood Insurance Rate Map (FIRM) Mapping Tool: https://msc.fema.gov/portal/search
FEMA's National Risk Index: https://hazards.fema.gov/nri/map
NOAA Sea Level Rise Viewer: https://coast.noaa.gov/slr/
FEMA Community Lifelines Toolkit: https://www.fema.gov/emergency-managers/practitioners/lifelines
FEMA Guide to THIRA: https://www.fema.gov/sites/default/files/2020-07/threat-hazard-identification-risk-assessment-stakeholder-preparedness-review-guide.pdf
BuildingsGuide: https://www.buildingsguide.com/blog/resources-building-codes-state/
HHS emPOWER Map: https://empowermap.hhs.gov/
Social Vulnerability Index Map: https://svi.cdc.gov/map.html

PV Siting Module

Rocky Mountain Institute Municipal Solar Site Selection Tool: https://cityrenewables.org/resources/municipal-solar-site-selection-tool-mssst/
Google Project Sunroof: https://www.google.com/get/sunroof
Trimble Inc.'s SketchUp: https://www.sketchup.com/plans-and-pricing/sketchup-free
NREL's System Advisor Model (SAM): https://sam.nrel.gov/
Google Maps: https://www.google.com/maps
Department of Housing and Urban Development's Renewable Energy Toolkit: https://files.hudexchange.info/resources/documents/Renewable-Energy-Toolkit.pdf

Critical Load Module

FEMA Emergency Power Flowchart: https://www.wbdg.org/FFC/DHS/femap1019.pdf
FEMA P-1019 Policy: https://www.wbdg.org/FFC/DHS/femap1019.pdf
REopt Lite: https://reopt.nrel.gov/tool
Technical Resilience Navigator: https://trn.pnnl.gov/login
Emergency Power Facility Assessment Tool (EPFAT): https://www.usace.army.mil/Portals/2/docs/Emergency%20Ops/National%20Response%20Framework/power/EPFAT_Fact_Sheet_21_April_2015.pdf
Technical Resilience Navigator: https://trn.pnnl.gov/module/baseline-development/action/2
Clean Coalition VOR123 methodology: https://clean-coalition.org/disaster-resilience/

Utility Engagement Module

NERC Reliability Guideline:
https://www.nerc.com/comm/PC_Reliability_Guidelines_DL/Reliability_Guideline_IBR_Interconnection_Requirements_Improvements.pdf
Federal Emergency Management Program's demand response program profiles:
https://www.energy.gov/eere/femp/demand-response-and-time-variable-pricing-programs
U.S. Energy Information Agency Reliability Metrics video:
https://www.youtube.com/watch?reload=9&v=oVH9L0fCMTU&feature=youtu.be
U.S. Energy Information Agency Annual Electric Power Industry Report: https://www.eia.gov/electricity/data/eia861/
APPA Annual Benchmarking website:
https://www.mcphersonpower.com/wp-content/uploads/2020/04/2019-APPA-Annual-Benchmarking-Report-eReliability-Tracker-002.pdf

Appendix

Background on Decision Support Template Development Process

The Clear Sky resources were created using a “team of teams” approach to ensure the relevance of the template through an expertise-agnostic format. The template is designed to allow users of all disciplines, experience levels, and technical knowledge levels to navigate the tool, benefit from completing the process, and use the results. Achieving this required a comprehensive review of nationally recognized multidisciplinary tools, models, plans, and research papers, elements of which are integrated into the Decision Support Template (see list below). This included interviews with national laboratory experts, as well as reviews of recent publications focusing on energy resilience analysis tools.

Emergency Management:

- FEMA Community Lifelines Toolkit
- FEMA Emergency Support Function (ESF) #14 Doctrine
- FEMA Flood Insurance Rate Map (FIRM)
- FEMA P-1019: Emergency Power Systems for Critical Facilities
- FEMA Threat and Hazard Identification and Risk Assessment (THIRA)
- Florida Department of Agriculture and Consumer Services “Mapping the Energy Landscape of Water and Wastewater Treatment Plants"
- Florida Statutes on “Alternate generated power capacity” Requirements
- State and County Emergency Operations Plans
- United States Army Corps of Engineers Emergency Power Facility Assessment Tool
- U.S. Department of Health and Human Services emPOWER Map 3.0
- U.S. Environmental Protection Agency Power Resilience Guide

Research:

- Clean Energy Group: Understanding Solar + Storage
- Lawrence Berkeley National Laboratory (Berkeley Lab) Interruption Cost Estimate (ICE) Calculator
- National Renewable Energy Laboratory (NREL) PVWatts® Calculator
- NREL Renewable Energy Integration and Optimization REopt™ Lite Tool
- Renew300 Solar Site Selection Tool
- Rocky Mountain Institute (RMI) Municipal Solar Site Selection Tool (MSSST)
- Smart Electric Power Alliance (SEPA): The Microgrid Playbook: Community Resilience for Natural Disasters

Utilities:

- NARUC National Association of Regulatory Utility Commissions (NARUC) papers
- Resilience in Regulated Utilities
- Advancing Electric System Resilience with Distributed Energy Resources
- North American Electricity Reliability Corporation (NERC) papers
- System Average Interruption Duration Index (SAIDI)
- System Average Interruption Frequency Index (SAIFI)
- Customer Average Interruption Duration Index (CAIDI)

- U.S. Department of Energy (DOE) “Assessing Critical Loads” Tool

In its review of microgrid analytical tools, the Clear Sky Tampa Bay team drew a distinction between tools that focus primarily on techno-economic analysis and tools that focus on power flow analysis. Techno-economic tools optimize distributed energy resources investments, dispatch, and grid-power purchase decisions given constraints such as technical specifications and technology costs. They seek to meet an objective or set of objectives, such as minimizing the total capital and operating cost of the microgrid, minimizing emissions, or a weighted combination of both.

Power system tools provide power system analysis — that is, they model the physical components of a power grid and solve governing equations (load-flow equations) to simulate the evolution of electrical variables such as voltage, current, frequency, phase angle, and active and reactive power. Although both types of tools are important for microgrid development, power flow tools are more relevant for electrical engineering studies, which was not in scope for the Clear Sky Tampa Bay project.

The Clear Sky Tampa Bay team focused its review on techno-economic tools, which included consideration of tools available from the U.S. national labs, such as Reopt Lite and the Distributed Energy Resources Customer Adoption Model (DER-CAM); tools developed for international use, such as RETScreen; and commercially available tools, such as XENDEE and HOMER Energy. In addition, the Clear Sky Tampa Bay team reviewed a range of tools available from the Solar Energy Innovation Network national laboratory partners — NREL and Berkeley Lab — to determine which might be best suited to the objectives of the project.

The Clear Sky Tampa Bay team also identified and reviewed tools related to resilience for critical facilities, published by federal agencies and national laboratories, including the Distributed Generation for Resilience Planning Guide (U.S. DOE Better Buildings), Combined Heat and Power Screening Tool (U.S. DOE Better Buildings), Resilient Strategies Guide for Water Utilities (U.S. Environmental Protection Agency), and the Technical Resilience Navigator (Federal Energy Management Program). None of these tools specifically supports decisions related to solar + storage for critical facilities, and so the Clear Sky Tampa Bay team did not evaluate whether to adopt any one of these tools in its entirety. Some of the tools focused only on specific technologies (e.g., combined heat and power) or facility types (e.g., water utilities), whereas others provided overall guidance but did not address the Clear Sky Tampa Bay’s core issues in sufficient depth.

The Clear Sky Tampa Bay team conducted a high-level qualitative assessment of the tools’ pros and cons in order to identify elements that could be incorporated into — or at least inform — the development of the Clear Sky decision-making framework.

Several of the pros include:

- Providing guided self-assessments rather than definitive analysis
- Offering options for simple, informative pathways through the tools, with guidance on additional steps or other tools to go deeper
- A modular approach that allows users to on- or off-ramp at different points based on

need without having to complete each module in succession
- The option to compare a portfolio of sites side-by-side to support early screening
- To the degree possible, using web-based tools rather than Excel to broaden the potential user base and avoid issues regarding compatibility across different generations of software

The Clear Sky Tampa Bay team reviewed solar energy siting and site selection guides available from federal agencies and national organizations. The existing tools are comprehensive, and there is not a need for the Clear Sky Tampa Bay team to recreate solar siting materials.

- Municipal Solar Site Selection Tool (MSSST) - Rocky Mountain Institute
- Renew300 Solar Site Selection Guide - U.S. Department of Housing and Urban Development
- Solar Site Assessment and Utility Data Spreadsheet- U.S. Environmental Protection Agency
- On-Site Commercial Solar Decision Guide - U.S. Department of Energy

Based on the benchmarking process, the Clear Sky Tampa Bay team concluded that the REopt Lite tool should be integrated into the overall toolkit as an ancillary resource to support further resilience benefit-cost analysis. The REopt tool is built to analyze both renewable energy and resilience. It will create outputs that would be directly useful as part of the Clear Sky Toolkit. It also has a proven track record of solar analysis nationally and within Florida, is publicly available, and has a large number of input cells pre-populated with reasonable “starting point” data.

Stakeholder Engagement

To aid in the development of these resources, the Clear Sky Tampa Bay team led a robust stakeholder mapping and engagement process that touched over 100 unique stakeholders. The stakeholder engagement process managed by the Clear Sky Tampa team was successful in validating the objectives of the project, gathering information that informed the development of the template, and developing a network of interested and committed stakeholders that are well positioned to continue community resilience dialogue and project development after the completion of the Clear Sky Tampa Bay project.

Utility Engagement Meetings

The Clear Sky Tampa Bay team prioritized early engagement with the investor-owned utilities that service the Tampa Bay Region to ensure their awareness of the project and include their expertise. In August and September of 2020, one meeting was held with each of the three utilities: Duke Energy, Florida Power and Light Co. (FPL), and Tampa Electric (TECO). The purpose of these meetings was to share the Clear Sky Tampa Bay project's objectives with the utilities and articulate the importance of their involvement in the project. The Clear Sky Tampa Bay team sought to understand:

- existing utility emergency preparedness processes
- how the utilities prioritize critical facilities
- how outage repair costs and benefits are weighed when considering investment in infrastructure
- what interest the utilities might have in deploying solar + storage for special populations for community resilience (e.g., electricity-dependent Medicare recipients)

Following these meetings, all three utilities actively participated in the subsequent stakeholder engagement processes, including workshops and follow-on interviews. The Clear Sky Tampa Bay team also conducted interviews with the leadership of Emera Technologies. Emera Technologies is an affiliate of TECO, and the two companies have partnered to develop an energy resilient housing development in Tampa that would be supported by a solar + storage microgrid.

Stakeholder Mapping and Engagement Strategy

In addition to the utility engagements, the Clear Sky Tampa Bay team developed a stakeholder engagement strategy for public sector, private sector, and non-profit partners. The stakeholders included experts focusing locally on the Tampa Bay Region and experts focusing on topics relevant at the state and national levels. The comprehensive list of stakeholders was initially organized according to the FEMA Lifeline that the stakeholder's organization or expertise related to. The list was subsequently updated to categorize stakeholders according to the role that they would play in the Clear Sky Tampa Bay project.

The stakeholder engagement strategy was built around four categories of stakeholders: Partners, Super Stakeholders, Collaborators, and Participants. These categories articulated how and when the stakeholders in these groups would participate in various stages of

template development, with the engagement strategy spanning from August 2020 to March 2021.

To maximize input from stakeholders while minimizing redundancy between methods of engagement, the Clear Sky Tampa Bay team settled on pursuing a four-step engagement model. The four steps included:

1. In-depth, needs assessments interviews with select stakeholders identified by the Tampa Bay Regional Planning Council (TBRPC)
2. A broad survey of stakeholders from the comprehensive list
3. A down-selected data call asking for more specific information from willing participants identified in the survey
4. A series of template framework feedback and validation workshops, which included project partners, self-selected participants from the survey, and subject matter experts identified through the needs assessments and survey

Needs Assessments

Converge Strategies, LLC (CSL) conducted 18 needs assessments between September 15th and November 2nd, 2020. The interviewees were recommended stakeholders from TBRPC and individuals with whom CSL had pre-existing working relationships. The interviewed stakeholders had a breadth of subject matter expertise that encompassed the seven FEMA Community Lifelines.

Each needs assessment lasted between 30 and 60 minutes, following a qualitative, semi-structured interview format. The needs assessments sought to uncover how the interviewee understood the state of energy resilience in the Tampa Bay Region, what policy and regulatory obstacles exist to achieving community resilience, and what successful Clear Sky Tampa Bay project outcomes would look like for their respective organizations.

<u>Needs Assessment Key Findings</u>

Across the needs assessments, several topics were consistently discussed by stakeholders, regardless of their professional background: the lack of streamlined processes to access funding opportunities for solar + storage in the Tampa Bay Region; the need for a strong convener or improved convening process to engage stakeholders across the energy and emergency management communities; and a desire to improve awareness of solar, energy storage, electric vehicle, and energy resilience generally within the region. These findings informed the structure of the subsequent survey and data call, which sought to gather existing documents and strategies related to energy resilience planning across Tampa Bay. These stakeholder conversations also validated the focus of the project and confirmed that the template would help address growing practitioner needs related to resilience in the region.

Survey and Data Call

The Clear Sky Tampa Bay team designed an initial outreach survey to identify stakeholders that would want to participate in the future data call and workshops. These efforts aimed to

gather insight into the existing technical and policy frameworks that guide organizational roles in community preparedness and energy resilience. The goal of the survey (and subsequent data call) was to help the Clear Sky Tampa Bay team understand and identify how energy requirements of critical facilities are documented, the emergency preparedness planning processes of organizations, and the technical specifications of current and proposed infrastructure assets.

The survey drew 36 respondents. Using the results of the survey, the Clear Sky Tampa Bay team structured its data call to target self-selected survey respondents and stakeholders already identified as Partners, Super Stakeholders, Collaborators, and Participants. The data call was designed to gather documents, policies, frameworks, plans, and processes that would assist with:

1. Determining the existing emergency management policies, programs, processes and disaster preparedness best practices (e.g., FEMA THIRA, Community Lifelines, etc.) used by stakeholders in the Tampa Bay Region and the state of Florida
2. Identifying what specific disaster impacts and resilience data are associated with specific facilities and systems
3. Understanding what state and local policies exist to support energy resilience investment
4. Uncovering what information is needed for decision support questions and use-case scenarios for different building types and systems

Survey and Data Call Key Findings

Survey responses largely indicated a dearth of information related to existing policies, reports, and legislation focused on Florida regional emergency response, renewable or resilient energy, and disaster response. Respondents indicated that existing knowledge related to these topics is sparse, but there is a growing interest and need for more information. Most of the survey responses indicated that the team should review local emergency planning documents and policies already identified by the Clear Sky Tampa Bay team (e.g., county Local Mitigation Strategies). These survey responses did not yield significant new findings. They did, however, validate the Clear Sky Tampa Bay team's approach to gathering and analyzing local policies and plans for emergency management and backup generation within the Tampa Bay Region.

The data call response rate was lower than anticipated. Only seven stakeholders or organizations replied. Most of the respondents provided documentation or responses that had already been uncovered through the needs assessments and surveys, but a few responses shed light on new organizations and documentation that had not previously been uncovered. The most notable include:

- Reference to the Tampa Bay Urban Area Security Initiative: The initiative manages the preparation of the regional THIRA.
- Documentation for a Duke Energy Standby Generation Tariff: Duke Energy has a negotiated tariff offering with clear pricing signals that could serve as a template or model for a resilient solar + storage tariff.

- Pinellas County CIP Request Form: The Pinellas County capital improvement budget request form revealed that the county relies on qualitative elements to justify capital improvements. The envisioned output of the template (a forced prioritization ranking of critical facilities) would lend itself naturally to project development and budget justification dialogues in the region.

Workshops

Given the importance of end-user input into and familiarity with the Decision Support Template, the Clear Sky Tampa Bay team convened two virtual workshops to elicit stakeholder feedback on the framework design. A Valuation Workshop was held on November 12th, 2020 to inform components of the Decision Support Template related to cost-benefit analyses, and a Siting Workshop was held on November 19th, 2020 for solar + storage siting components of the Decision Support Template.

The Valuation Workshop focused on the socio-economic cost-benefit modules of the template, which were later relocated as additional resources to accompany the template. Participants provided insights into topics such as ways to assess the relative value of energy resilience investments that support essential community functions.

The Siting Workshop focused on the site identification and prioritization modules of the template. Attendees discussed the tools and models used to determine the compatibility of sites for solar and battery storage investment, as well as how to assess the relative criticality of a facility.

The Rocky Mountain Institute led the design of the workshop agenda and the facilitated exercises during the workshops themselves. The Clear Sky Tampa Bay team provided in-workshop support (e.g., small group facilitation) and prepared and delivered background presentations. Both workshops had over 30 stakeholders in attendance. The invitees included stakeholders that had previously been identified through engagement activities, as well as new stakeholders with relevant subject matter expertise from CSL's network.

Workshop Key Findings

The workshops provided valuable direction for the Decision Support Template development and insights into the structure and content of the template's User Guide. The key findings from the workshop include:

Front-loaded "go or no-go" questions. Potential end-users identified the need for the modules to readily identify important questions up front that would render further analysis of critical facilities irrelevant. These were referred to as "go or no-go" questions that would help local government officials easily articulate to their teams why certain infrastructure investments would not yield desirable results or weren't economically or operationally feasible.

Assessing critical loads. Participants expressed a need to better understand how to identify buildings' critical functions and loads. Participants also highlighted that collecting the data necessary to identify and characterize critical loads posed a significant challenge. This

feedback informed the creation of a section in the user guide that provides deeper guidance on critical load assessment and encourages the end-user to map out relevant subject matter experts ahead of using the template.

The bottom line. The workshops revealed that economic factors are ultimately the driving force behind any capital investment in the region, regardless of potential community benefits. Workshop participants did not identify additional social metrics or benefits that could be quantified and included in infrastructure investment assessments at the county, city, or utility levels. Robust valuation methodologies and cost-benefit analysis tools, however, are important for the end-users, who need to be able to articulate the value of a solar + storage investment. A noted challenge to the economic viability of resilient solar + storage systems is the lack of financial incentives and funding mechanisms in the state.

The stakeholder engagement process managed by the Clear Sky Tampa Bay team was successful in validating the objectives of the project, gathering information that informed the development of the template, and developing a network of interested and committed stakeholders. These stakeholders are well positioned to continue community resilience dialogue and project development after the completion of the Clear Sky Tampa Bay project.