**TRN Resource: Categorized Resilience Gaps**

Resilience gaps can be categorized by type to help with the systematic and holistic identification of solutions in the Solution Development module. Gaps can be identified by assessing the root causes within categories, such as operational, institutional, and technological (energy and water) gap types.

## Operational Resilience Gaps

Operational resilience focuses on techniques or processes that allow people and systems to adapt to changing conditions. The ability to alter operations during energy or water disruptions will help facilitate overall resilience. Sometimes operational resilience may require a new policy or a change in a continuity of operations (COOP) plan to allow for modified tactics during a stressor or disruption. An example of an operational gap is relying on automatic controls to close hangar doors at an airport to prepare for a hurricane in order to protect airplanes. If a power outage were to occur and there is no manual redundant process in place to close the hangar doors, the airplanes will be susceptible to damage.

Identify operational gaps, such as operations and maintenance (O&M) plans, procedures, practices, and trainings that are needed and will enhance resilience if implemented.

Identify Operational Resilience Gaps
The resilience planning team can consider the following questions while compiling and analyzing operational resilience gaps.

* Has resilience been incorporated into site-level procedures, practices, and training? If not, could this be improved to enhance resilience?
* Do O&M schedules include a review of equipment for resilience-specific considerations? If not, could this be integrated onsite?
* Is O&M contracted out or conducted by onsite staff? If onsite staff conduct O&M, are they involved in the resilience planning activities as part of the TRN implementation onsite?
* Have energy efficiency and water conservation measures been implemented to optimize performance throughout facilities and systems? If not, can these be aligned with resilience projects to enhance resilience further?
* Have staff been identified and properly trained in response and recover procedures? Are there multiple tenants on site and do they follow similar protocols or have different procedures in place? Are staff cross-trained in different procedures?

## Institutional Resilience Gaps

Institutional resilience includes developing capabilities within an organization and improving resilience throughout an organization. Gaps related to energy and water resilience could include lack of access to real-time data for improved system management, lack of operational intelligence, operating in a silo without engaging stakeholders, and not implementing relevant institutional processes once identified. Similar to operational solutions, institutional solutions will be specific to an organization.

Review the list of resilience gaps documented previously to determine whether improvements to institutional protocols can be made, including reviewing protocols and procedures for both normal operations and during disaster response and recovery situations.

Identify Institutional Resilience Gaps
The resilience planning team can consider the following questions while compiling and analyzing institutional resilience gaps, potentially during a review of recovery or COOP documents.

* Are distinct actions necessary to return to normal operations clearly described?
* Are mutual aid agreements in place?
* Have agreements with outside entities (such as energy and water utilities) been reviewed to identify connections with partners on response and recovery procedures?
* Has an emergency manager been assigned to participate in community activities to identify synergies between the community and the site? Participation encourages communication that enhances site response and recovery from disruption.
* Is there a culture of resilience already? If not, how does the team think the culture could be institutionalized?

## Technological Resilience Gaps

Technological gaps include a lack of robust energy and water infrastructure technologies currently used at the site. Since the TRN focuses on energy and water resilience, some examples of gaps the resilience planning team could consider include aging infrastructure that is inefficient and susceptible to energy outages, lack of onsite distributed energy generation and water supply, reliance on a single energy and/or water source, and so on.

### Identify Technological Resilience Gaps

The resilience planning team can consider the following questions while compiling and analyzing technological resilience gaps.

* Does the site have a history of energy and water disruptions? If so, what resilience gaps have been exposed during those disruptive events?
* Is there a reliance on a single supply of energy or water to the site?
* Are critical loads backed up by redundant systems?
* Do onsite energy systems have black start capabilities and energy storage?
* Do energy systems, such as microgrids, have islanding controls? What is the lag-time between losing energy and the backup system turning on? Is that lag-time acceptable in terms of outage tolerance to the load being served?
* Are the buildings efficient and do they have the ability to house staff during a disruptive event with extreme heat or extreme cold?
* Is backup fuel or water stored onsite, and how many hours can a site or mission operate without fuel, water, or energy?
* Do interdependencies between energy and water systems that need to be addressed during the solution brainstorming exercises?
* Are alternative solutions being used for onsite collection or storage of water?
* Is water quality or quantity essential to maintaining operations during a disruptive event?