**TRN Resource: Solution Examples**

Examples of solutions that address risk to energy and water systems are presented in this resource, categorized by their resilience attributes and solution type, to aid in the solution brainstorming process. While the final list of solutions will be site specific, these are provided as potential solutions for the resilience planning team to consider with stakeholders as a starting point in the brainstorming process.

The resilience planning team is encouraged to consider other solutions not listed here and can use other resources, tools or subject matter experts to brainstorm innovative solutions targeted toward specific identified gaps at the site. Any solution that is generated through the brainstorming process but is not presented as an example here should be assigned relevant attributes and a solution type. Ideally, solutions will incorporate at least one of the resilience attributes and fall into at least one solution type.

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| **Solution Type** | **Solution Description** | **Solution Type** | **Resilience Attributes Incorporated** |
| Energy | Microgrid serving critical loads with onsite storage and islanding controls. | Technological | RedundancyRobustness |
| Energy | Energy storage from Electric Vehicles (EVs) with power exporting capacity equipped with bidirectional chargers function as Mobile Batteries for Vehicle to Building (V2B) energy storage for resilience benefits and demand management capabilities.  | Technological | RedundancyRobustnessResourcefulness |
| Energy and Water | Recovery plans in place and exercised. | Operational | ResourcefulnessRecovery |
| Energy | Develop strategic investment plan for critical infrastructure and end-of-life replacement with more resilient infrastructure. | OperationalInstitutional Technological | ResourcefulnessRecovery |
| Energy and Water | Increase site security, remote monitoring, and/or develop robust fence and gate infrastructure for physical security.  | Operational Institutional | ResourcefulnessRobustness |
| Energy and Water | Develop pre-event checklist for site preparation. | Operational | ResourcefulnessRobustness |
| Energy | Develop distributed resources for spatial diversity and grid flexibility, implement redundant transmission and distribution lines, and/or diversify energy supply.  | Operational Technological | RedundancyResourcefulnessRobustnessRecovery |
| Energy and Water | Utility agreements to allow for islanding and quick recovery on-site.  | Operational  | ResourcefulnessRecovery |
| Energy | Develop demand response programs for grid flexibility and load shedding for load management during disruptive events. | Operational Technological | ResourcefulnessRecovery |
| **Solution Type** | **Solution Description** | **Solution Type** | **Resilience Attributes Incorporated** |
| Energy and Water | Site equipment (e.g., substations, HVAC, and water tanks) within protective structures.  | Operational Technological | Resourcefulness |
| Energy | Develop building-integrated distributed resources to increase energy flexibility and redundancy in buildings.  | Technological | Redundancy |
| Energy and Water | Develop and protect redundant energy and water networks (e.g., multiple supply lines, underground distribution lines). | Technological | Redundancy |
| Energy and Water | Develop MOUs with utilities for prioritized recovery, especially to critical functions.  | Operational | Recovery |
| Energy and Water | Site exposed equipment and infrastructure appropriately (e.g., increase elevation of equipment above storm surge and/or flood zones; ensure installations comply with ASCE 7-16 wind loads; secure potential equipment or structures that may become airborne).  | Operational Technological | ResourcefulnessRobustnessRecovery |
| Energy | Create a robust and responsive redundant system for critical loads during disruptive events (e.g., develop distributed resources for backup power, utilize mobile energy resources for backup power). | Operational TechnologicalInstitutional | ResourcefulnessRobustnessRecoveryRedundancy |
| Energy and Water | Develop strategic staging/storage of supplies, develop redundant transportation for supply chains, and diversify transportation options for critical materials, supplies, or personnel. | Operational Institutional | ResourcefulnessRobustnessRecoveryRedundancy |
| Energy and Water | Implement training for personnel (e.g., operations and maintenance training, risk training, COOP exercises).  | Operational Institutional | ResourcefulnessRobustnessRecovery |
| Water | Develop site appropriate water infrastructure (e.g., redundant supplies; implement water saving/reuse measures, separate combined sewer infrastructure to reduce system stress and reduce treatment energy loads).  | Operational Technological | ResourcefulnessRobustnessRecoveryRedundancy |

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| **Solution Type** | **Solution Description** | **Solution Type** | **Resilience Attributes Incorporated** |
| Water | Implement redundancy and develop prioritization plan for critical loads and processes (e.g., develop water storage network to ensure emergency supply, reduce water use through conservation measures, develop water prioritization plan for water shortages). | Operational Technological | ResourcefulnessRobustnessRecoveryRedundancy |
| Energy and Water | Improve communications networks for water and energy management (e.g., develop redundant communication networks and diversify; develop analog backup to communication systems) | Operational Technological | ResourcefulnessRobustnessRecovery |
| Energy  | Develop policy and codes to govern facility design (e.g., ensure facility compliance with site-specific requirement for expected hazards; develop passive survivability standards for infrastructure, and replace end-of-life facilities with resilient-design buildings).  | Operational TechnologicalInstitutional | ResourcefulnessRobustness |
| Water and Energy | Reduce consumption and demand of cooling loads and diversify supply water.  | OperationalTechnological | ResourcefulnessRobustness |
| Water | Increase coordination with appropriate water monitoring agencies and utilities. | OperationalInstitutional | ResourcefulnessRobustness |
| Water | Implement gravity-fed distribution line designs to provide water to critical loads or processes during a disruptive event.  | OperationalTechnological | ResourcefulnessRobustnessRedundancyRecovery |
| Water | Incorporate backup energy systems along the distribution lines, pumps, and lift stations to ensure operation during disruptive events.  | OperationalTechnological | ResourcefulnessRobustnessRedundancyRecovery |