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READINESS FOR RESILIENCE

A Resilient Technology Roadmap for Rebuilding Texas

With Partners:



Smart**Cities**Council

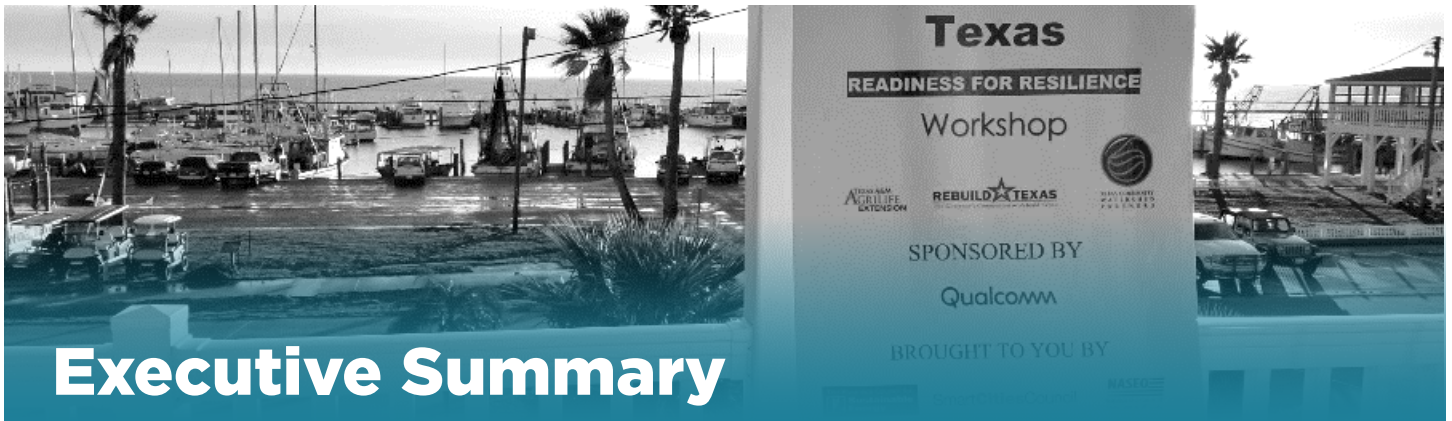


The Business Council
for Sustainable Energy®



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Executive Summary



We must rebuild infrastructure with improved resiliency to better prepare for the next disaster, better withstand such disasters, and and recover more quickly.



The State of Texas, led by the Texas A&M AgriLife Extension Service, has engaged in the Readiness for Resilience program to assist communities impacted by Hurricane Harvey rebuild critical infrastructure with smart, resilient technology. The Readiness for Resilience program, sponsored by Qualcomm, consists of a partnership between the Smart Cities Council, the Business Council for Sustainable Energy and the National Association of State Energy Officials (“Partners”).

The program includes three stages: 1) a discovery phase to build stakeholder support and learn of local rebuilding needs and project priorities; 2) the development of a “Resilience Roadmap” with technology best practices and solutions to meet identified community rebuilding needs; and 3) pairing technology roadmaps with planned rebuilding initiatives, public-private partners and funding opportunities to ensure smart, resilient and sustainable technology is incorporated into infrastructure rebuilding.

The Partners held three Discovery Workshops on December 11, 12 and 13 in the Texas counties of Harris, Orange and Aransas, respectively. These community-based workshops were designed to directly engage impacted communities and elevate the firsthand experiences of local officials and residents in dealing with Hurricane Harvey before, during and after impact. The Harvey experience was different in each county, as are the recovery and rebuilding needs. Nonetheless, it is widely agreed across all regions that the recovery and rebuilding effort should include the adoption of innovative technology and processes to improve infrastructure and overall community resilience.

Readiness for Resilience:

A Smart Technology Roadmap for Texas

SAVE THE DATE:

DECEMBER 11 HARRIS COUNTY

DECEMBER 12 ORANGE COUNTY

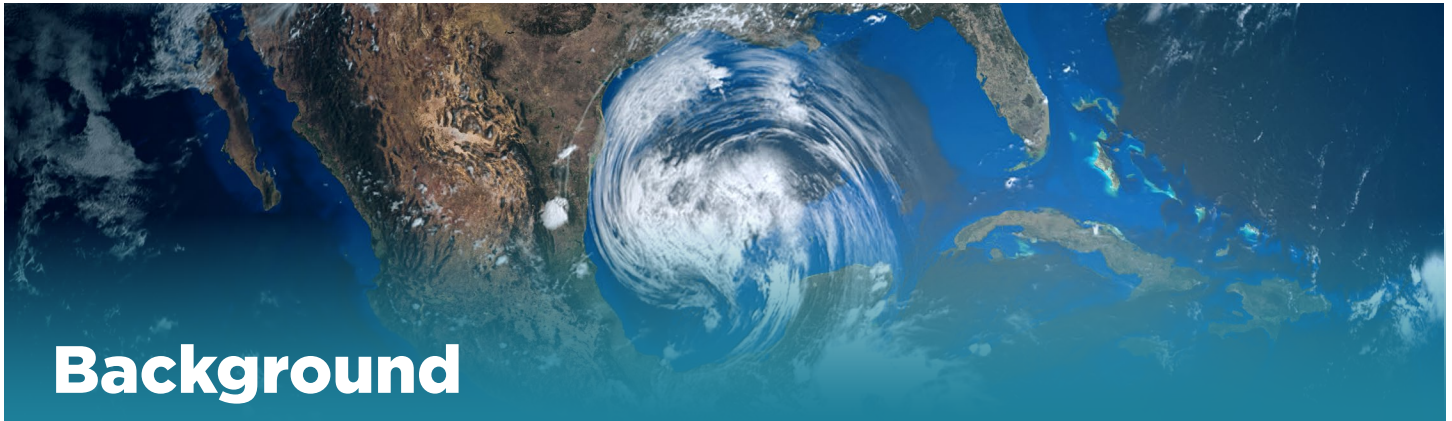
DECEMBER 13 ARANSAS COUNTY

The information generated from the Discovery Workshops was used to develop this report, a “Resilient Technology Roadmap” for Texas, linking local needs with potential resilient technology best practices and solutions. This roadmap outlines local priorities in the areas of Public Safety, Telecommunications and IT, Energy and Utilities, and Transportation and Mobility. It identifies 16 smart resilience projects to address these priorities, and maps them to recommendations from *Eye of the Storm: Report of the Governor’s Commission to Rebuild Texas*.

The Readiness for Resilience partners view the identified projects as a complement to the Governor’s Commission report and looks forward to working with all parties on successful implementation of local project needs.

This Roadmap will be the basis for discussion at a Summer 2019 Readiness for Resilience event, which will convene community leaders, stakeholders, and technology experts to pave the way for local projects. Additional breakout sessions will be held to discuss how to establish public-private-partnerships and identify potential federal, state and local funding streams to accelerate resilience projects.

This Roadmap is just the beginning of what the Partners hope will be a multi-year engagement with Texas throughout the rebuilding process. The path to recovering and rebuilding from natural disasters like Hurricane Harvey must incorporate smart, resilient technologies and processes. Community leaders meeting face-to-face with technology experts and citizen stakeholder groups exchanging knowledge, experience, concerns and aspirations – that is the essence of the type of partnership needed to rebuild more resilient and adaptive communities.



Background



The clearest and most important message we took from the Commission's work is that Hurricane Harvey was a warning we should heed.



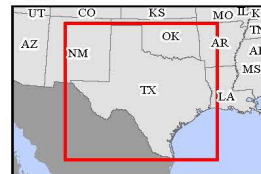
Impacts of Hurricane Harvey

According to the Report of the Governor's Commission to Rebuild Texas, Hurricane Harvey hit the Texas Gulf Coast on August 25, 2017 and the storm lasted for more than a week. Harvey came ashore just northeast of Corpus Christi and devastated Texas coastal communities with 130 mile-per-hour winds and a six-foot storm surge. From there, the storm moved eastward, leaving a path of destruction that covered an area of Texas the size of New Jersey. By the time the storm left the state, dozens of Texas counties and millions of Texans had been affected.

According to the National Hurricane Center, at least 68 people died directly due to Harvey's effects, most from drowning, and about 35 more people died from indirect effects such as vehicle accidents and the inability to reach medical aid.

Thousands of Texans were left homeless. More than a quarter of a million Texas homes had been damaged, and more than 15,500 were destroyed. Thousands of businesses were damaged or destroyed, as were about a quarter million vehicles. FEMA later said 24 hospitals were evacuated, 61 communities lost drinking water, 23 ports closed and 781 roads were impassable at some point. Harvey caused \$125 billion in damage in Texas, more than any other natural disaster in U.S. history except Hurricane Katrina.

FEMA-4332-DR, Texas Disaster Declaration as of 10/11/2017

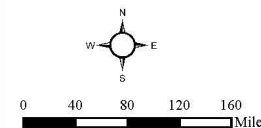


Data Layer/Map Description:
The types of assistance that have been designated for selected areas in the State of Texas.

All designated areas in the State of Texas are eligible to apply for assistance under the Hazard Mitigation Grant Program.

Designated Counties

- No Designation
- Public Assistance
- Individual Assistance and Public Assistance
- Public Assistance (Category B)
- Individual Assistance and Public Assistance (Categories A and B)
- Individual Assistance and Public Assistance (Categories A - G)



Data Sources:
FEMA, ESRI;
Initial Declaration: 08/25/2017
Disaster Federal Registry Notice: Amendment #10 - 10/11/2017
Datum: North American 1983
Projection: Lambert Conformal Conic

MapID ead96c4eeef1011171451hqprod

The Road to Recovery



It is essential that communities don't simply replace what was destroyed but they also increase the state's resilience.



Natural disasters are nothing new to Texas. Since 1953, the state has averaged one federally declared disaster — whether flooding, tornado, hurricane, wildfire or windstorm — every eight months. This has made Texas a national leader in responding to natural disasters.

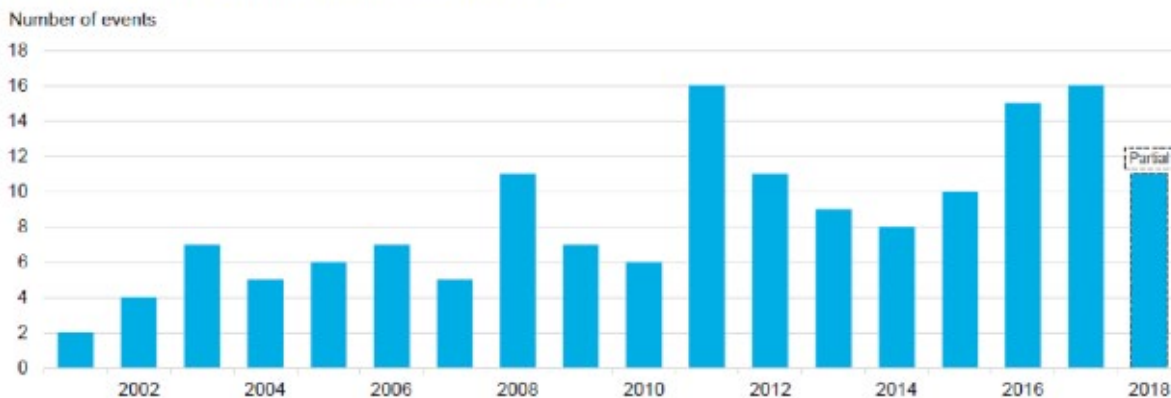
But Hurricane Harvey was the strongest hurricane to strike Texas since Carla in 1961 and its devastation tested the limits of emergency responders. Moreover, the Report of the Governor’s Commission to Rebuild Texas noted that Texas “particularly need(s) to do a better job during the long and difficult process of recovery — what is done in the weeks and months after a disaster to restore Texans, their communities and economies to a point where they are as good as or better than before disaster struck.” In that regard, Hurricane Harvey taught valuable lessons about how to build a state that is ready for future challenges. “We must make the Texas Gulf Coast — and indeed the entire state — more resilient and better able to withstand future disasters, whether the threat comes from hurricanes, tornadoes, wildfires, flooding or other disasters, a process Governor Abbott has called “future-proofing” our state.”

Eye of the Storm: Report of the Governor’s Commission to Rebuild Texas, released in December 2018, is a guide to future-proofing Texas to mitigate the impact of future disasters. With input from communities across the State, it assesses the federal, state and local response to Harvey and recommends how Texas can be better prepared to withstand future disasters.

With billions of federal, state and local dollars being spent in Texas to repair and replace what Harvey destroyed, the Governor’s Commission to Rebuild Texas notes that it is essential that communities do not simply replace what was destroyed but that they also increase the state’s resilience.

Policy: Infrastructure and resilience

U.S. billion-dollar weather and climate disasters



- The Disaster Recover Reform Act, signed by President Trump on October 5, 2018, sets a new formula for pre-disaster mitigation funding. The likely result based on historic disaster costs is that billions of federal dollars annually will help prepare and defend states and localities.
- DRRA also strengthens building code enforcement (including energy codes), identifies qualifying mitigation activities for natural disasters and directs infrastructure repaired or constructed using Stafford Act funds to be built to the most recent code or standard.
- The McCain National Defense Authorization Act, signed on August 13, 2018, gives the Department of Defense the ability to make grants to states and localities to address threats to the resilience of military bases. It defines resilience as the readiness of a military installation to react to extreme weather events.

Source: National Oceanic and Atmospheric Administration, BloombergNEF. Note: Portrays annual counts of drought, flooding, freeze, severe storm, tropical cyclone, wildfire and winter storm events in the U.S. with losses of more than \$1 billion each. 2018 count shown was as of October 9, 2018.

The Case for Smart Resilience



Resilience benefits accrue to organizations that prioritize the collection, collation, presentation, and sharing of data.

- Zolli & Healy, 2012)



The United States 2017 National Security Strategy states that enhancing resilience includes the ability to withstand and recover rapidly from deliberate attacks, accidents, natural disasters, as well as unconventional stresses, shocks and threats to our economy and democratic system. Rodin, in *The Resilience Dividend*, adds that resilience-building efforts should seek to not just recover from, but also to revitalize, or adapt and grow stronger as a result of, disruptive experiences.

This takes not only improvements in physical infrastructure, but also the incorporation of **Information and Communications Technology (ICT)** and the use of data to better prepare, respond, recover and revitalize. It also requires technology and data to improve connections and communications between people to make social networks more effective and resilient.

According to resilience literature, improving community and system resilience requires making them more:

- Aware, adaptive, diverse, integrated, self-regulating (Rodin, 2014)
- Resourceful, robust, redundant (100 Resilient Cities, City Resilience Framework)
- Adaptable, agile, cooperative, connected (Zolli & Healy, 2012)

Pervasive high-speed connectivity, the widespread use and declining costs of digital sensors and mobile devices, increases in computing power and distributed cloud computing, and advanced applications of artificial intelligence and data analytics are making it possible to be more connected, aware, integrated, adaptive, cooperative and self-regulating. Research by Zolli & Healy shows that “resilience benefits accrue to organizations that prioritize the collection, collation, presentation, and sharing of data”.

Critical to implementing smart and resilient technology is **reliable, secure and resilient energy systems**. Any investments made to rebuild and modernize infrastructure for resilience should include consideration of energy systems. The delivery of safe, secure and reliable power, heat and fuels is an essential and fundamental input for operations in all sectors and responding to extreme weather events and other disasters.

Energy systems are evolving and becoming more connected, providing enhanced resilience pre- and post-disaster and during “blue-sky” days. Innovative energy systems are more connected and integrated with public services, the built environment and transportation systems. They increasingly enable customers to communicate with these systems.

These enhancements rely on smart technology solutions that facilitate the collection of data via sensors along distribution networks, advanced analytics, and the incorporation of communications technologies. This optimizes performance, preempts problems, and allows for rapid response. To ensure resilience of these systems, strong cybersecurity protocols are required.

Technology Snapshots:

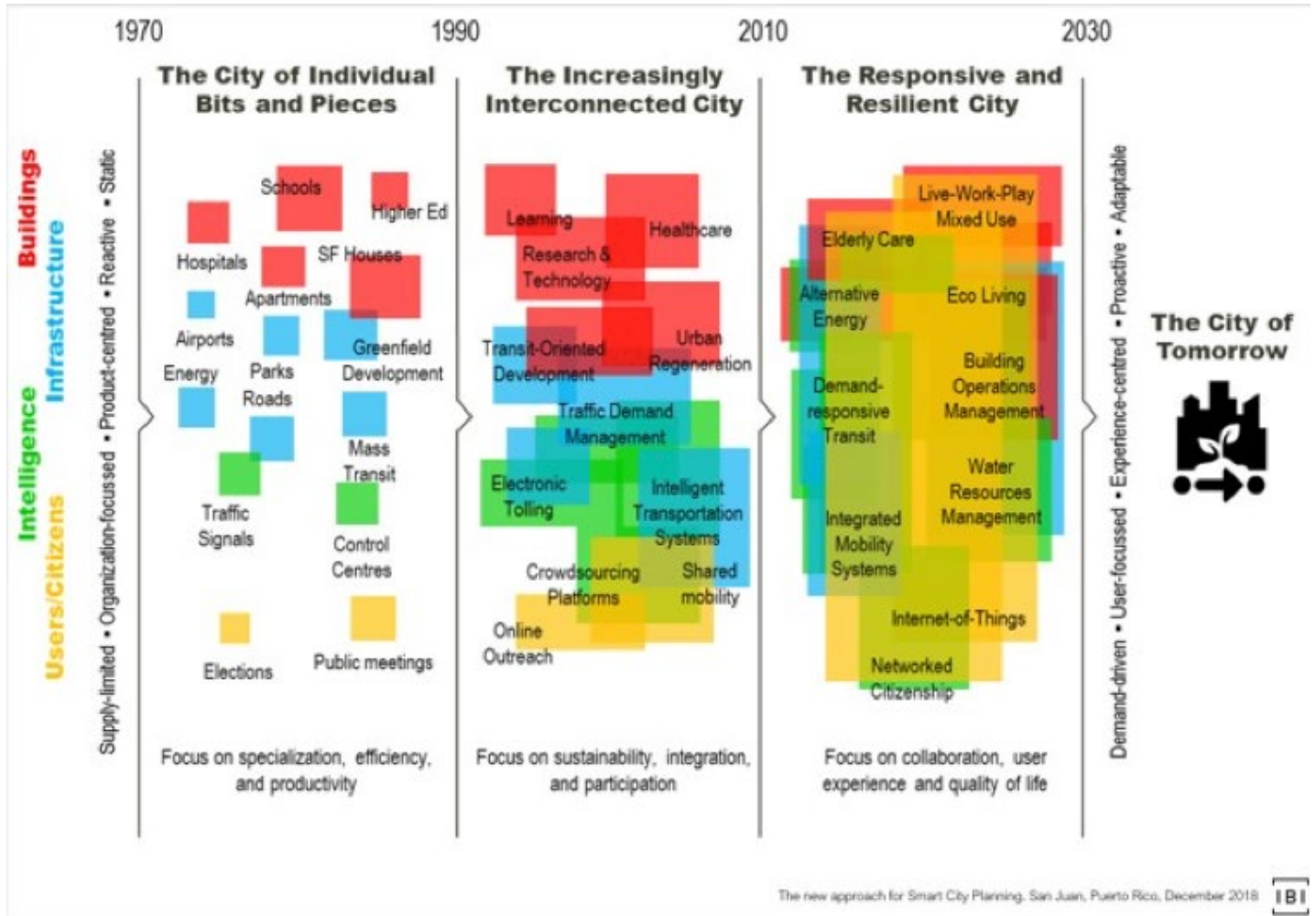
- Innovative energy systems increasingly integrate demand-response protocols for increased electric grid efficiency, as well as utility-scale and distributed renewable and clean energy technologies. As these applications expand, they will require upgrades to the grid system.
- Energy storage is also playing a larger role in the power, buildings, and transportation sectors – with significant resilience and energy performance benefits.
- Lighting systems represent 20 percent of U.S. energy use. Upgrading outdoor lighting systems can result in significant cost savings while providing other security, connectivity, and efficiency services. Higher efficiency technologies reduce load and ease the energy burden on strained communities post disaster.

The intersection between the development of smart and resilient communities can be seen in the [Code for Smart Communities](#), which identifies five (5) principles of smart urban development that closely align with the key resilience attributes:

- 1. Strategic:** Guided by a strategy that clearly identifies how investments in technology and data solutions will be made in order to accelerate livability, workability and sustainability outcomes.
- 2. Connected:** Access to best-in-class and ubiquitous connectivity while ensuring the interoperability of connected devices.
- 3. Aware:** Invests in the collection, integration, analytics and communication of data as a basis for building awareness, insights and optimization of services and performance.
- 4. Responsive:** A culture of ongoing positive change afforded through the insights and intelligence gathered from data and community collaboration.
- 5. Innovative:** A culture of creativity, equity and agility to help advance opportunities for innovation.

The path to building smarter, more responsive and more resilient communities of the future is further captured by IBI Group in Figure 1, emphasizing a focus on collaboration, user experience and quality of life.

Figure 1: The Responsive and Resilient City of Tomorrow. Credit: IBI Group.



Readiness for Resilience Program



The goal of the Readiness for Resilience program is to help communities rebuild their infrastructure with smart technology best practices to improve resilience



In the aftermath of the devastating 2017 hurricane season that brought hurricanes Harvey, Irma and Maria, it became clear that more needed to be done to assist long-term recovery and better prepare for future events.

Like so many concerned companies, organizations and individuals, Qualcomm made financial donations to communities impacted by these natural disasters and utilized its technology to help connect people and restore communications systems. But it also wanted to bring something new to the table and decided to focus on its strength - technology.

Qualcomm partnered with the Smart Cities Council, the Business Council for Sustainable Energy, the National Association of State Energy Officials, and in Texas, the Texas A&M AgriLife Extension Service. The partners collectively created the “Readiness for Resilience” program that combined Qualcomm funding with the expertise and resources from the partner organizations and their networks.

The goal of the Readiness for Resilience program is to help communities, first in Texas and Puerto Rico, rebuild their infrastructure with smart technology best practices to improve resilience so that they become better prepared for the next natural disaster, better withstand such disasters, and recover more quickly, for the benefit of the people. The program involves: 1) a discovery phase to build stakeholder support and learn of local rebuilding needs and project priorities; 2) the development of a “Resilience Roadmap” with technology best practices and solutions to meet identified community rebuilding needs; and 3) pairing technology roadmaps with planned rebuilding initiatives, public private partners and funding opportunities to ensure smart, resilient and sustainable technology is incorporated into infrastructure rebuilding.



Discovery Workshops



Community leaders exchanging knowledge, experience, concerns and aspirations with technology experts and citizen stakeholder groups—that is the essence of partnership.



Workshop Overview

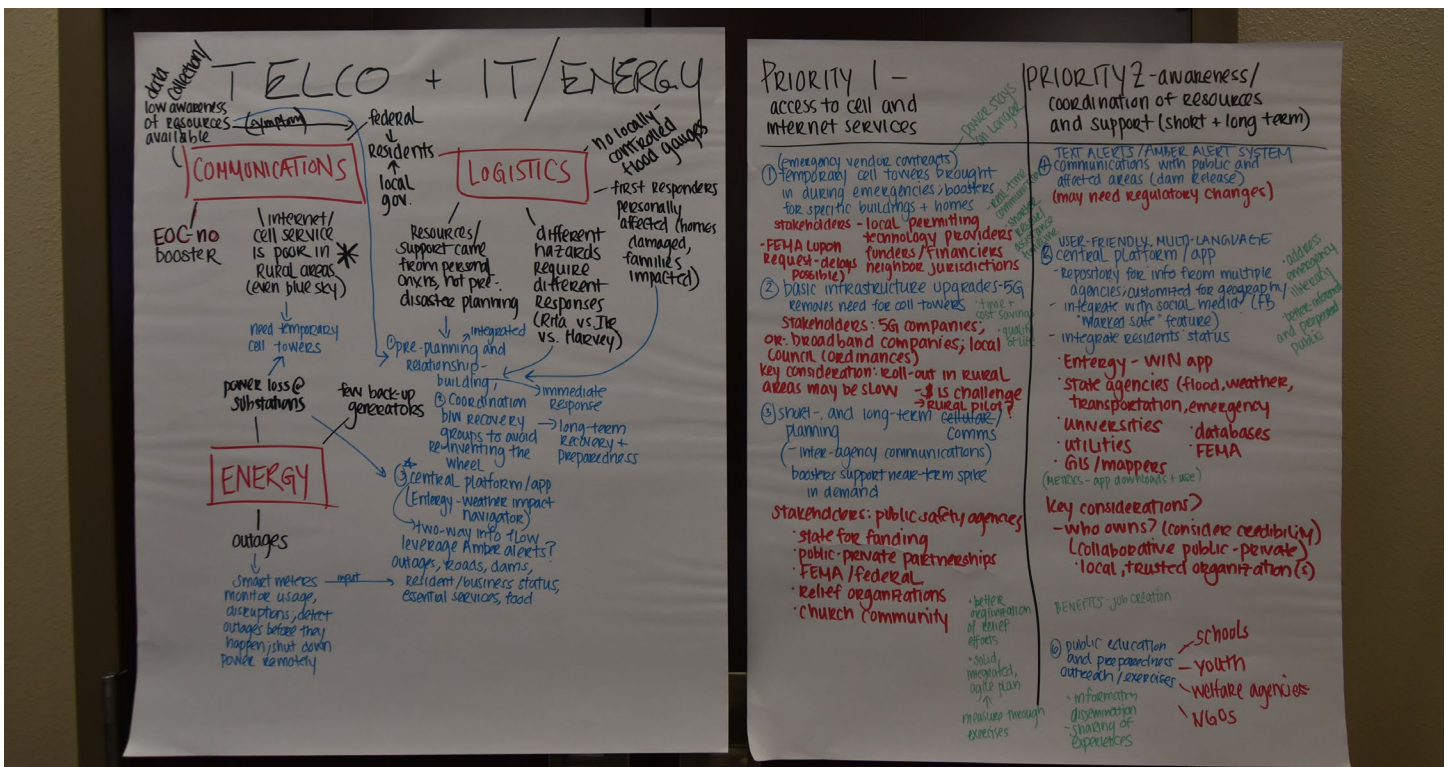
Three Discovery Workshops were held in the Texas counties of Harris, Orange and Aransas on December 11, 12 and 13, respectively. These regional workshops were designed to go directly to the impacted communities and hear firsthand the experiences of local officials and residents in dealing with Hurricane Harvey before, during and after impact. Attendees were drawn from local and surrounding counties, providing the project team with a regional perspective of recovery and technology issues.

The Discovery Workshops were held to identify specific rebuilding priorities of the local communities and to discuss innovative best practices and technology solutions to integrate into hurricane rebuilding projects to amplify resilience and other community benefits. This led to the identification by participants of potential “smart resilience” project ideas that were further vetted to identify benefits, stakeholders, potential technologies, critical success factors and next steps.

Workshop Action Areas

There are many opportunities to integrate smart cities technologies and processes to build greater disaster resilience. Based on the existing work conducted by AgriLife Extension, the following four areas were chosen to collect deeper community input. Together these four areas intersect with almost all aspects of the community, and they represent some of the most foundational and impactful smart and resilient technology applications. The Discovery Workshops brought community leaders from a variety of backgrounds together with resilience and technology experts to seek answers to the following questions in the priority areas:

- **Public Safety:** How can Texas factor smart city technologies and processes into public safety priority areas to keep people safer during and after natural disasters?
- **Energy:** How can Texas improve its energy resilience with smart city technologies and processes to build greater infrastructure resilience while creating co-benefits?
- **Telecom and IT:** What smart connectivity technologies and design principles should Texas consider as it designs more connected, citizen-centered, affordable and resilient services?
- **Transportation and Mobility:** What mobility solutions, technologies and standards might Texas consider as it moves to create a more intelligent, resilient and sustainable transportation system?





Public Safety



Better using data and intelligence will improve our ability to be more efficient and effective in emergency preparedness, response and post-disaster recovery.



Public safety is the most critical concern in the wake of a natural disaster, and as such was a top focus area for all discovery workshops. At its core, smart public safety is about the use of data and intelligence to keep as many people as possible out of harm's way, and to be more efficient and effective in emergency preparedness, response and post-disaster recovery. A key aspect is resilient energy sources to ensure that public safety systems work before, during and after the event.

Local Challenges and Priorities

Common themes – Workshop participants at each regional workshop saw opportunities to use smart technology and data to better (1) coordinate response across agencies (2) direct people and resources during and immediately after the disaster and (3) plan and prepare for emergencies before they occur, with an eye to vulnerable populations. While there were a number of commonalities, there were also differences in focus across the three regions.

Houston-Galveston Region, with its highly-populated, flood-prone areas around Houston, identified three Public Safety priorities: 1. Better coordination and dissemination of information during the response phase 2. Streamlined access to funding and other resources during the recovery phase, and 3. Building more affordable and resilient housing and structures to improve preparedness and amplify long-term resilience.

Southeast Texas, and nearby Newton County, consist of many rural areas and feature a key evacuation route of only two lanes with few gas, food and shelter resources along the way. It is not the first area to get emergency response support so localities have to do a lot themselves. A top priority is improving emergency evacuation processes and providing improved evacuee access to services. Efforts are hindered by a lack of robust communications and back-up power generation infrastructure.

Coastal Bend, consisting of the southern gulf coast areas of Texas which were ravaged by strong winds, focused on improved emergency planning and preparedness to improve the effectiveness of evacuation and recovery - including debris removal. The working group saw communications as a big gap - not only communications infrastructure and overcoming dead zones, but also addressing language barriers and reaching elderly populations.



Project Recommendations

Project PS-1: “Match.com”-style resilience tool: Integrated resilience tool for public to access people, processes, systems and data they need to assist with preparedness, response & recovery (Houston-Galveston and Coastal Bend). Recommendations included:

- Start with preparedness resources and extend to response and recovery.
- Go beyond providing a database of resources to offering localized, contextualized resources based on individual need
- Must be easily accessible and understandable to diverse populations and languages - consider artificial intelligence techniques to match people and resources, natural language processing for ease of access, and intuitive visualization.
- Requires buy-in and contribution from key local, state and federal stakeholder groups, as well as individual citizens.

- Adherence to open information exchange standards such as [OASIS](#) for emergency management.
- Leverage existing resources such as the [climate resilience toolkit](#) and the Essential Elements of Information adopted by DHS.

Example use cases for how the “Match.com” resilience tool could provide value in the preparedness stage:

Project PS-1A: Localized damage prediction: Integrate past and live storm data (sea level rise, storm surge, pressure, wind etc.) with local infrastructure data (building age/location etc.) and GIS and aerial/drone imagery. Use algorithms to predict damage at a highly localized level to better inform risk, evacuation needs, building codes and upgrades (Coastal Bend).

Project PS-1B: Proactive debris removal planning: Debris removal continued to plague parts of Texas well over a year after Hurricane Harvey. The resilience planning tool could be used to outline localized processes, removal resources and guidelines for debris removal before events occur. It would help community members and emergency responders understand rights of way, identify all the options for where to put debris and get MoU’s in place in advance, consider options for handling debris (what can be salvaged, mulched, used for waste-to-energy, etc.), and provide safety guidelines. Following an extreme weather event, the community and emergency response personnel can collectively use the tool to identify where debris is an issue and map removal resources. It is important to consider such options in a holistic manner and with a view to provide additional community benefits in blue sky days as well in response to an event (Coastal Bend).

Project PS-1C: Evacuation scenario planning: Although no one can predict the exact impact of a natural disaster on evacuation routes, smarter planning tools can run multiple “who, what, when, where” scenarios that better prepare people before disasters occur. It would incorporate past data about how routes were impacted, where congestion occurred, resource shortages, most effective communications channels, etc. along with sea level rise, storm surge, flooding and wind damage predictions to inform state and local evacuation and safety planning – including evacuation timing and sequencing (Southeast TX).

Project PS-2: Resilient Buildings: Improving the resilience of homes and other buildings to natural disasters (Houston-Galveston and Coastal Bend):

- Combining general building/ disaster risk assessment data with real-time sensor data to understand structural and performance risk – using moisture, vibration, environmental and other sensors.
- Improving access to resilient, sustainable material and repair guidelines through a web portal / mobile app from FEMA/HUD – including guidelines for repairs, permits, reputable contractors, and funding sources.

- Providing recognition, such as Smart Home America “Fortified Wise”, and incentives, such as insurance company and low-income household incentives, to get people to participate.
- Streamlining procedural and funding issues – it’s currently a long process to get approval to take down dilapidated buildings and there’s a lack of funding.

Project PS-3: Affordable Housing: Access and affordability of quality housing, especially with so many damaged homes and displaced people, is a short-medium-term recovery issue and a long-term resilience issue. Houston-Galveston workshop participants proposed a tracking tool that:

- Identifies housing needs in near real time
- Tracks funding – received versus spent
- Provides access to key resources such as United Way Habitat for Humanity, Housing Authority resources, General Land Office, CBGD, etc.

Project PS-4: Volunteer Rescue Network: Extending public safety response through a system of volunteers using “ride-sharing” technology. This could include offering evacuation car-pooling, connecting volunteer expertise with special populations, matching people in need to volunteers offering food and shelter, matching pets and temporary foster homes, etc. (Houston-Galveston and Southeast TX). Considerations:

- Get potential volunteers pre-registered and approved before disaster strikes.
- Look to existing best practices such as 311 services for resource/supply coordination.
- Use technology to connect to resources and also to educate.
- Connect to non-governmental, not-for-profit, and grassroots organizations who have the pulse of the communities, their needs and their capacities.
- Developing resilience/contingency plans for access to fuel and/or electric charging prior to the event.

New York City Metropolitan Resilience Network



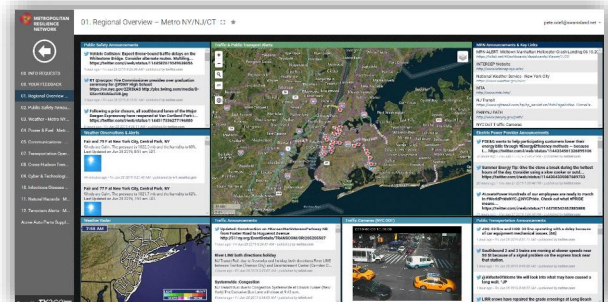
Superstorm Sandy highlighted the need for cross-organizational information sharing and situational awareness. In 2015, NYU/INTERCEP launched the NYC Metropolitan Resilience Network with a grant from the Port Authority of New York/New Jersey. Since inception, the network has grown to over 400 credentialed organizations and 1000+ credentialed participants.

Location: The New York City metropolitan area encompassing parts of New York, New Jersey, and Connecticut

Project Description: The MRN is a cloud-based, password protected situational awareness platform that allows both automated and analyst-driven monitoring of threats and disruptions.

Capabilities include:

- **Cross-organizational / Multi-jurisdictional:** The MRN crosses the boundaries of public, private, non-profit and other organizational types, allowing for a broad sharing capability.
- **Controlled access:** Each organization and user is vetted by INTERCEP personnel with username/password access to the system.
- **Blue sky automated situational awareness:** The all-hazards dashboards of the MRN are updated continuously from hundreds of information sources that pertain to the New York City area and surrounding states. News, social media, weather, crime, public health and many other types of feeds are combined to give users one stop information access.
- **Geospatial views:** Dashboards incorporate maps with visuals of traffic, public cameras, alerts and other items.
- **Segmented sharing:** Dashboards can be used to selectively share information with a subset of users due to sensitivity or sector relevance.
- **Incident specific dashboards:** When a major event occurs, INTERCEP analysts can quickly build a dashboard that incorporates all known information about the specific event in minutes.
- **Updatable status boards:** Based on a pre-defined threshold, green/amber/red visual codes can indicate the operational status of critical infrastructure (e.g. air, mass transit, etc.), providing an at-a-glance understanding of critical functions.



Metro NY/NJ/CT Dashboard

See the full white paper at www.bit.ly/2KUMVIm



Energy and Utilities



Energy is critical infrastructure and powers critical infrastructure.



About 300,000 electric utility customers in Texas experienced power outages the day after Hurricane Harvey made landfall, and restoration efforts continued into September. Electrical outages caused a ripple effect on communications, computing, water, sewer and other critical systems that are power dependent. Nineteen (19) drinking water systems and 31 wastewater systems went down and many more were threatened. Refining, oil and natural gas production were impacted, resulting in fuel shortages, and natural gas companies addressed natural gas leak risks at storage facilities and individual households.

Local Challenges and Priorities

Energy and utility-related resilience challenges varied across counties.

For **Houston-Galveston**, Harvey was more of a rain and flooding event than a wind event. That, as well as efforts to modernize and harden electric grid infrastructure following Ike, kept power systems from being devastated. That said, electric outages did occur and were amplified by a lack of access to distributed generation and energy storage resources. Power outages impeded communications between communities and emergency responders. In addition, a water treatment plant that serves almost one-third of the Houston population, was almost lost.

Harris County participants identified the following go-forward priorities for extreme weather event recovery and resilience:

- Stable and clean power generation
- Access to back up power during extreme weather emergencies
- Improving building codes relating to flooding and wind storms, and enabling counties to have more code authority.

Priorities for **Southeast Texas** include: 1) improving back up power generation – currently back-up generators are often diesel; and 2) improving planning and communications across entities in the field. The community also discussed the need for greater coordination and improved communication and resilience across ICT and energy assets – for instance, smart meters that alert utility responders to outages and enable them to prioritize power restoration efforts.

Parts of the **Coastal Bend**, which faced major wind damage, were without power for 21 days and had substantial water and natural gas pipeline damage. Power-dependent water and wastewater systems were also impacted. The area required a lot of outside utility help to repair and rebuild utility infrastructure. One of the challenging dynamics was the major damage to residences and other buildings. This forced people to leave and many have not returned, so utility revenue is down just as it is most needed to fund repairs. Damages to homes highlighted the need not just for smart and sophisticated technology improvements, but also baseline energy efficiency improvements (such as stronger building envelopes and more efficient heating and cooling systems) that are able to maintain more comfortable conditions for residents to shelter-in-place.



Project Recommendations

Project EU-1: Localized infrastructure monitoring: Improve monitoring of underground and above ground utility infrastructure at the connection level to provide household service visibility to expedite recovery (Houston-Galveston and Coastal Bend).

- Piggyback on IoT technologies, sensors, monitoring and data opportunities on existing infrastructure such as energy, water, natural gas and buildings.
- Leverage fiber optic infrastructure and sensing technology, pipeline sensors, individual household gas metering, CCTV

In addition to improved response and recovery post event, this approach will improve utility operations and maintenance, reduce costs and improve service quality, improve safety on an on-going basis, and enhance pre-disaster preparedness.

Project EU-2: Municipal Microgrids: Establish public-private partnerships to examine the feasibility of municipal microgrids that enable critical community assets to continue operating event during power outages or disruptions.

- Each community may wish to target specific campuses or infrastructure (such as police headquarters, shelters, or communications centers, among many others) depending on their individual assessments of disaster vulnerabilities and high-impact response strategies.
- Examine funding solutions, such as direct grants and utility rate-basing and coinvestment, or innovative financing structures such as Microgrid-as-a-Service agreements (as used in Montgomery County, Maryland).

Project EU-3: Smart Metering, Smart Grid, and Energy Efficiency: Better manage power outages, reduce financial losses, and shorten outage time by installing smart grid technologies and systems.

- Distribution automation devices (such as smart switches) identify faults in the distribution system and perform corrective actions automatically, lessening the need for field crews to locate and manually address faults.
- Advancing metering infrastructure communicates with utilities to verify outage status and dispatch repair crews accordingly.
- Baseline energy efficiency and energy management projects enable residential and business properties to better endure harsh weather conditions and extreme temperatures, without placing undue stress on the electric grid. When paired with smart grid and communications technologies, these measures enable effective communication to utilities to ensure field crews address highest-need outages first (for example, prioritizing households and residents that rely on medical equipment or properties that have been without power for extended periods of time).

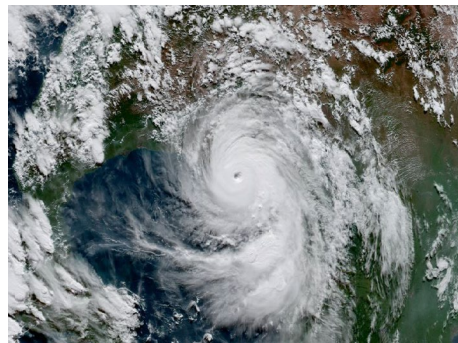
Advanced Metering Infrastructure Helps Hasten Power Recovery

Investments in grid modernization technologies such as advanced metering infrastructure helped utilities restore power in the aftermath of Hurricane Hurricanes Harvey and Irma in 2017.

Locations: Texas and Florida

- After Hurricane Harvey, CenterPoint Energy brought its customers online faster with advanced metering infrastructure technology, **saving an estimated 45 million outage minutes.**
- Within 48 hours of Hurricane Irma, Florida Power & Light had restored power **to 2.7 million customers**, and in just over a week, **all 4.4 million of its customers** were back online – the fastest large-scale restoration in history.

For more information: <https://gridwise.org>.





Telecommunications and IT



Reliable telecom systems, which can mean life or death in an emergency response situation, are foundational as well to the long-term economic resilience of communities.



Telecommunications and Information Technology are foundational to smart resilient communities, enabling people and systems to communicate with each other, directing first responders to where they're most needed, and enabling the collection, movement and analysis of data to improve situational awareness, predict and detect issues, enable resource coordination, and sponsor multi-agency and community communication and collaboration.

Local Challenges and Priorities

Common themes across the three Discovery Workshop regions included the need for:

1. more reliable baseline and emergency communications infrastructure.
2. improved information sharing with the public.
3. a standardized platform for agencies and communities engaged in recovery efforts.
Lack of local-level coordination impedes response and recovery.

Harris County called for more stable communications systems to aid first responders and enable better access and response allocation.

In **Orange County**, baseline cellular and internet service is unreliable and often unavailable during rain events -- even for the Office of Emergency Management. In addition, workshop participants called for improved planning and communications across entities in the field.

Harvey also devastated communications infrastructure in **Aransas County** so they could not even start the process of asking for assistance. The county seeks communications infrastructure hardening as well as hardening some key shelters to act as local command centers. More broadly, the county wants city, county, school, fire, public safety, wardens and other key officials to have access to robust and interconnected communications infrastructure, as opposed to disconnected assets and processes.



Project Recommendations

Discovery Workshop participants identified the following initiatives that have the potential to address local needs:

Project TI-1: Resilient communications infrastructure: All regions recommended creating greater telecom system resilience by hardening and expanding infrastructure and creating more redundancy. This would improve baseline community connectivity while withstanding damage to assist in emergency response and recovery. Key tenants:

- Use diverse networks to create redundancy, including cellular, mesh and Wi-Fi.
- Consider buried fiber lines in areas more impacted by wind damage.
- Consider fiber optic sensing technology to continuously monitor structural integrity, water flow, vehicle movement, human traffic, digging activity, seismic activity, temperatures, liquid and gas leaks, and many other conditions and activities.
- Combine permanent and temporary towers for better connection and faster recovery after events.
- Leverage existing community infrastructure assets – utility and streetlight poles, buildings, vehicles, etc.
- Piggyback on other initiatives – such as the FirstNet public safety network and utility upgrades to communications infrastructure.

Project TI-2: Integrated community notification system: All regions recommended improving the way storm related information gets to the public. A multi-faceted notification system to get key information out to the public, better guide evacuation, and assist people during and in the aftermath disasters. Considerations:

- Types of notifications: evacuation routes, roadway water levels, danger alerts, missing persons, places to shelter people and pets, etc.
- Should be a system that residents can sign up for.
- Needs to connect at the grass roots/ community level.
- Look to the Amber Alerts system – how can similar be used for natural disasters.
- Use visual notifications along evacuation routes, such as digital signage.
- Multi agency coordination including people who need transport help (EMS, utilities, schools, places of worship).
- Encourage media participation and coverage.

Project TI-3: Interlocal mobile communications system: Develop self-contained, mobile communications and IT system(s) for use in emergency and high-impact events. Mobile units can be shared across regions and agencies and directed to where they are needed the most (Coastal Bend). Potential features:

- Resilient communications, power and computing
- Sensors, cameras and potentially drones to expand reach
- Measure current weather, traffic, road conditions, air quality, debris
- Requires intergovernmental agreements and updated processes

Project TI-4: Telecom system gap analysis: Conduct a gap analysis of local connectivity and power and develop plan to fill gaps to improve emergency response planning, response and recovery (Coastal Bend). Consider:

- Local connectivity
- Integration across systems
- Back-up power
- Resources, manpower, knowledge
- Benefit-risk analysis
- Community education
- Access to public resources – schools, libraries
- Ability to plug into / subscribe to first responder community
- Legislative and regulatory barriers
- Funding sources
- Potential collaboration with EDA, higher education, and potentially the state as a repository for data



Streamlining transportation with technology and data enables quicker evacuation, faster rescue, and more effective recovery.



Transportation and Mobility issues overlap with Public Safety – spanning evacuation, emergency rescue, the movement of goods and resources to aid recovery, making roadways more resilient, and clearing transportation routes. Streamlining transportation and mobility with technology and data enables quicker evacuation, faster rescue, and more effective recovery.

Local Challenges and Priorities

All Discovery workshop regions expressed the need to incorporate more intelligence to streamline evacuation processes, keep more roadways open and enable better coordination across agencies.

Houston-Galveston workshop participants called for improved and more real-time broadcasting of information to the public about evacuation routes and closed roadways.

As outlined in the Public Safety section, a top priority from **Southeast Texas** workshop participants was improving emergency evacuation processes and evacuee access to services. Not just for Orange County residents, but also for those from across the State who evacuate through Newton and Orange counties.

For the **Coastal Bend**, opening up transportation routes after disasters, removing debris, and addressing the mobility needs of vulnerable populations (i.e., retirees, elderly, and poor) are priorities.



Project Recommendations

Project TM-1: Real-time, coordinated evacuation and resource routing: Improve evacuation effectiveness and efficiency by using a variety of communications devices, sensors and data to route and reroute people to safety and resources in real-time during a disaster. Not just at the individual local level but using a multi-jurisdictional command center to coordinate across all evacuation areas, localities and agencies. With situations changing minute by minute, a near real-time understanding of roadway obstacles, gas availability, shelter, food and water, and emergency medical resources is vital (Houston-Galveston and Southeast TX).

Features suggested by working group participants:

- Road, bridge and sewer sensors to track water levels and roadway obstructions
- Real-time traffic counting sensors
- Integration with existing mobile wayfinding apps such as Waze
- Business and crowdsourcing app that keeps individuals and agencies up to date on the status of gas stations, restaurants, motels, emergency shelters, road closures, and other information to assist evacuees.
- Sensors/ tracking of emergency and rescue vehicles
- Distress signal embedded in mobile apps to identify people who need help
- Overarching analytics platform for live route planning
- Sensors should be back-up battery powered
- Emergency back-up communications systems along evacuation routes to ensure the system functions in emergencies

Project TM-2: Smart signage: In addition to strategically placing signage and incorporating real-time data to improve signage along evacuation routes, a smart system would use real-time triggers, such as roadway water-level sensors, to adjust signage, suggest reroutes and automate road closure gates (Houston-Galveston and Southeast TX)

Project TM-3: Evacuation transportation assistance: Multi-agency and jurisdiction coordination to identify and assist with transportation and evacuation needs (Houston-Galveston and Coastal Bend). Components may include:

- A database of people who need assistance - with input from utilities, EMS, schools, houses of worship, etc.
- Evacuation criteria and transportation options
- A staging area for transportation alternatives
- Utilizing school buses, public transit
- Model on CAN database

Project TM-4: Roadway flood protection: As roadways are being repaired, seek opportunities to upgrade materials and incorporate green stormwater infrastructure and other sustainable design principles to improve drainage and reduce flood risks. Also incorporate water-level, traffic count, environmental and other sensors to enable real-time condition monitoring, reporting and route management (Houston-Galveston).

Project TM-5: Use of Alternative Fuel Vehicles in Emergency Response Fleets: Invest in alternative fuel vehicles in order to mitigate the impact of disruptions in petroleum and electricity supply, which may hinder emergency vehicles from providing critical response services for extended periods of time.

- Track locations of fleets and fueling/charging infrastructure using GIS (for instance, the Initiative for Resiliency in Energy through Vehicles (iREV) Tracking Tool, available at <https://naseo.org/irev>).
- Update state and local Emergency Operations Plans to promote future investments of alternative fuel vehicles and associated charging/fueling infrastructure as part of state and municipal fleet upgrades.



Ideas to Action



Converting ideas into action requires Governor's Commission alignment, identifying funding and financing, and structuring people and processes for success.



The Texas Discovery Workshops resulted in 16 smart resilience project concepts to address community rebuilding priorities. Converting these from ideas to implementable initiatives requires:

1. Alignment with recommendations from the Governor's Commission to Rebuild Texas Report to ensure they connect to but are not redundant with initiatives that have state backing and resources.
2. Identification of funding and financing resources, including the consideration of non-traditional business models such as Public-Private Partnerships.
3. Adherence to governance best practices - the people and processes that set structures for success.

Alignment with Governor's Report

The tables in this section map how the smart resilience project concepts align to recommendations from *Eye of the Storm: Report of the Governor's Commission to Rebuild Texas*. The intent is to factor these project ideas into the Governor's Commission Report recommendations as they are acted upon, infusing smart principles into rebuilding practices.

Project-Governor's Report Mapping: Public Safety

Smart Resilience Project	County			Resilience Focus			Relevant Governor's Commission Report Recommendations (Chapter #, Recommendation #)
	Harris	Orange	Aransas	Prepare	Respond	Recover/ Revitalize	
PS-1: Match.com-style resilience tool	●		●	●	●	●	6-9: Create recovery task force to provide specialized assistance to communities and individuals to speed local level recovery. 8-16: Examine ways to better inform public about how to prepare for and survive a disaster.
PS-1A: Localized damage prediction			●	●			8-4: Strengthen quality and sharing of data used in emergency management operations.
PS-1B: Proactive debris removal planning			●	●	●	●	6-1: Catastrophic debris management plan and model guide 6-2: Improve contracting for debris removal 6-3: Study issues surrounding removal of "wet" debris
PS-1C: Evacuation scenario planning		●		●	●		6-18: Grant TxDOT authority to pre-purchase and stockpile food and water for each hurricane season
PS-2: Smart, resilient buildings	●		●	●		●	6-7: Improve oversight, accountability and availability of individuals in building trades offering services to disaster survivors.
PS-3: Affordable housing	●				●	●	6-19: Study and recommend ways to resolve restrictions impeding debris removal or trailer placement for short-term disaster housing.
PS-4: Volunteer rescue network activation	●	●		●	●		8-2: Review current training courses to strengthen training for recovery operations for state and local emergency management personnel.

Project-Governor's Report Mapping: Energy & Utilities

Smart Resilience Project	County			Resilience Focus			Relevant Governor's Commission Report Recommendations (Chapter #, Recommendation #)
	Harris	Orange	Aransas	Prepare	Respond	Recover/ Revitalize	
Project EU-1: Localized infrastructure monitoring	●		●	●	●	●	4-1: Reorganize emergency management functions to unify most critical emergency response and recovery functions 7-3: Investigate ways to improve hardening of utilities and facilities. 8-15: Examine ways for state to apply data analytics to improve disaster management through more effective and timely information.
Project EU-2: Municipal microgrids	●	●	●	●	●	●	4-1: Reorganize emergency management functions to unify most critical emergency response and recovery functions. 7-3: Investigate ways to improve hardening of utilities and facilities.
Project EU-3: Smart metering, smart grid and energy efficiency	●	●	●	●	●	●	4-1: Reorganize emergency management functions to unify most critical emergency response and recovery functions. 7-3: Investigate ways to improve hardening of utilities and facilities. 8-15: Examine ways for state to apply data analytics to improve disaster management through more effective and timely information.

Project-Governor's Report Mapping: Telecom and IT

Smart Resilience Project	County			Resilience Focus			Relevant Governor's Commission Report Recommendations (Chapter #, Recommendation #)
	Harris	Orange	Aransas	Prepare	Respond	Recover/ Revitalize	
TI-1: Resilient communications infrastructure	●	●	●	●	●	●	<p>5-1: Consider appropriating additional funds from Emergency Radio Infrastructure Account to fund radio infrastructure.</p> <p>8-14: Cultivate relationships with private technology providers for assistance when communications systems are damaged or destroyed.</p>
TI-2: Integrated community notification system	●	●	●	●	●	●	<p>4-1: Reorganize emergency management functions to unify most critical emergency response and recovery functions.</p> <p>8-10: Establish state website at the Texas A&M University System that is easy to use and presents important post-disaster information about response and recovery activities.</p> <p>8-11: Consider ways to make better use of 911 and social media during disaster response.</p> <p>8-12: Explore development of new mobile app to deliver important information to responders and disaster victims alike.</p>
TI-3: Interlocal mobile communications system			●	●	●	●	<p>7-3: Investigate ways to improve the hardening of utilities and facilities.</p> <p>8-9: Review laws and practices affecting the use of drones during emergency events and recommend changes in operations to promote use.</p>
TI-4: Telecom system gap analysis			●	●	●	●	<p>7-4: Create comprehensive inventory of needed mitigation and resiliency projects statewide and develop a prioritization methodology to guide local, state and federal decision makers.</p>

Project-Governor's Report Mapping: Transportation

Smart Resilience Project	County			Resilience Focus			Relevant Governor's Commission Report Recommendations (Chapter #, Recommendation #)
	Harris	Orange	Aransas	Prepare	Respond	Recover/ Revitalize	
TM-1: Real-time coordinated evacuation and resource routing	●	●		●	●		<p>8-15: Examine ways for state to apply data analytics to improve disaster management through more effective and timely information.</p>
TM-2: Smart Signage	●	●		●	●		<p>8-15: Examine ways for the state to apply data analytics to improve disaster management through more effective and timely information.</p>
TM-3: Evacuation transportation assistance	●		●	●	●		<p>6-14: Develop a process to capture vehicle identification information in FEMA's vehicle assistance program.</p>
TM-4: Roadway flood protection	●			●	●	●	<p>7-1: Special study committee to propose options for state-local partnership to future-proof Texas against flood events on a watershed basis.</p>

Public Private Partnerships to Support Resilience

The public and private sectors have critical roles play to ensure that infrastructure assets are safe, secure, reliable and meet the needs of the 21st century economy. While there is broad recognition that public private partnerships are critical, increased communication, knowledge-exchange and planning is required between the business community and local and state leaders to capitalize on this momentum. Enhanced public private partnerships are vital to understand and capture opportunities:

- to enhance resilience with state of the art technologies, products and services;
- to access private capital; and
- to leverage the state and federal funding programs that exist to assist localities plan in advance of events as well as post-disaster.

Further, collaboration on planning and project pipeline development as well as the establishment of market structures to spur investment is needed. With regards to financial mechanisms, a range of options have been used successfully, but are most effective when they are tailored to the specific technology and/or application to be deployed. Some examples of financial mechanisms for consideration include: competitive grant programs, tax incentives, Energy Savings Performances Contracting and other authorization measures that create market-based incentives, which will guide investment dollars to more resilient projects and will better leverage private capital flows.

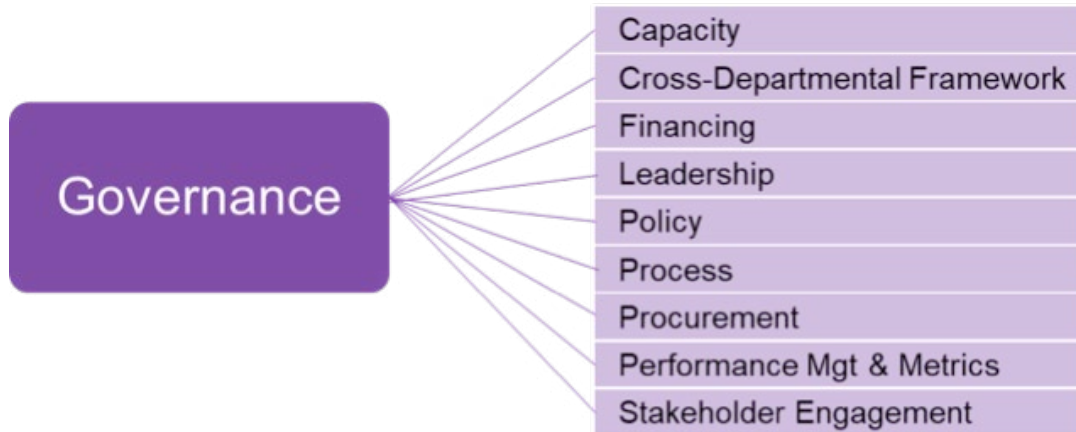
Resources:

- [Deloitte-the-challenge-of-paying-for-smart-cities-projects](#)
- https://www.dropbox.com/home/File%20requests/BCSE%20Resilience%20Roadmap%20Slides?preview=Carolyn+Sloan+-+Readiness+for+Resilience_6.28.19.pptx#

Governance Recommendations

Successful smart technology projects use smart governance practices. Figure 6 outlines some of the governance considerations for smart resilience program implementation. This is followed by specific recommendations.

Figure 6: Smart Cities Governance Considerations. Source: Smart Cities Council

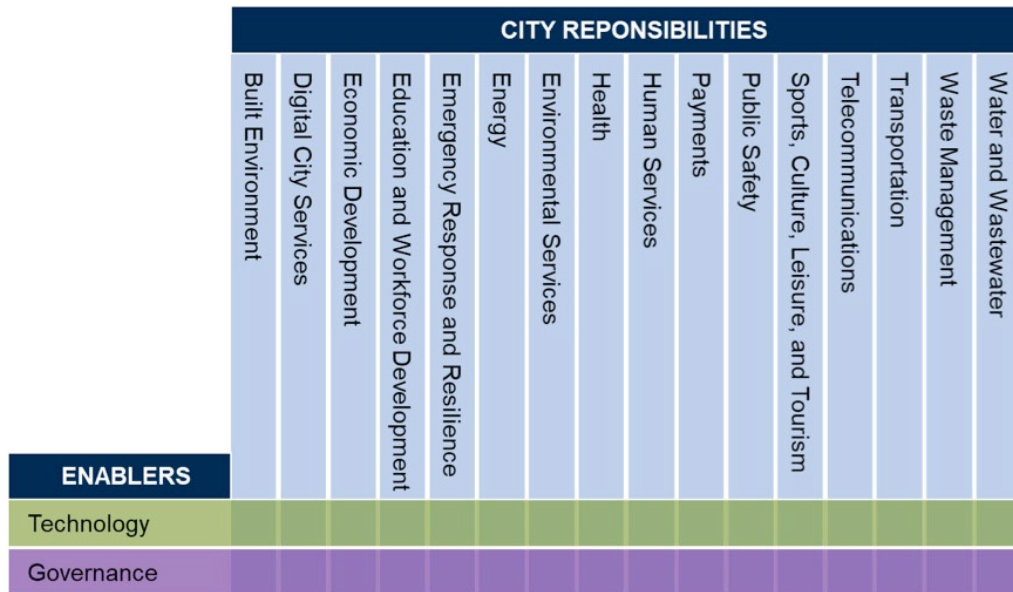


Include smart technology guidelines in rebuilding project planning and procurement:

Ensure projects adhere not only to updated building codes and flood maps, but also to modern connectivity, interoperability, data collection, energy management and automation standards. **Priority must go to making the most of existing investments**, not just new ones. Typically, that means retrofitting existing assets - streets, buildings, equipment - with sensors and communications. From an **interoperability** perspective, adhere to open standards to ensure systems use predefined mechanisms to talk to each other. Also use open integration architectures and loosely coupled interfaces so that components can be swapped in and out. **Energy resilience** is also critical. Consider energy resources availability for homes, business, communities - as well as at the municipal and county levels. Forge partnerships to ensure access to power and other energy resources needed for communications, transportation and housing in advance of an event. Consider how these investments help achieve other community needs and how they can provide valuable benefits every day. This helps with community buy in and financing.

Adopt a cross-departmental framework: The Smart Cities Framework - Figure 7 - provides a way to factor smart technology principles into community rebuilding and revitalization projects. Smart principles include looking for ways to multi-purpose projects and investments to achieve multiple benefit streams. For instance, solutions and technologies implemented in one city responsibility area should also be assessed to see how they can benefit other responsibility areas.

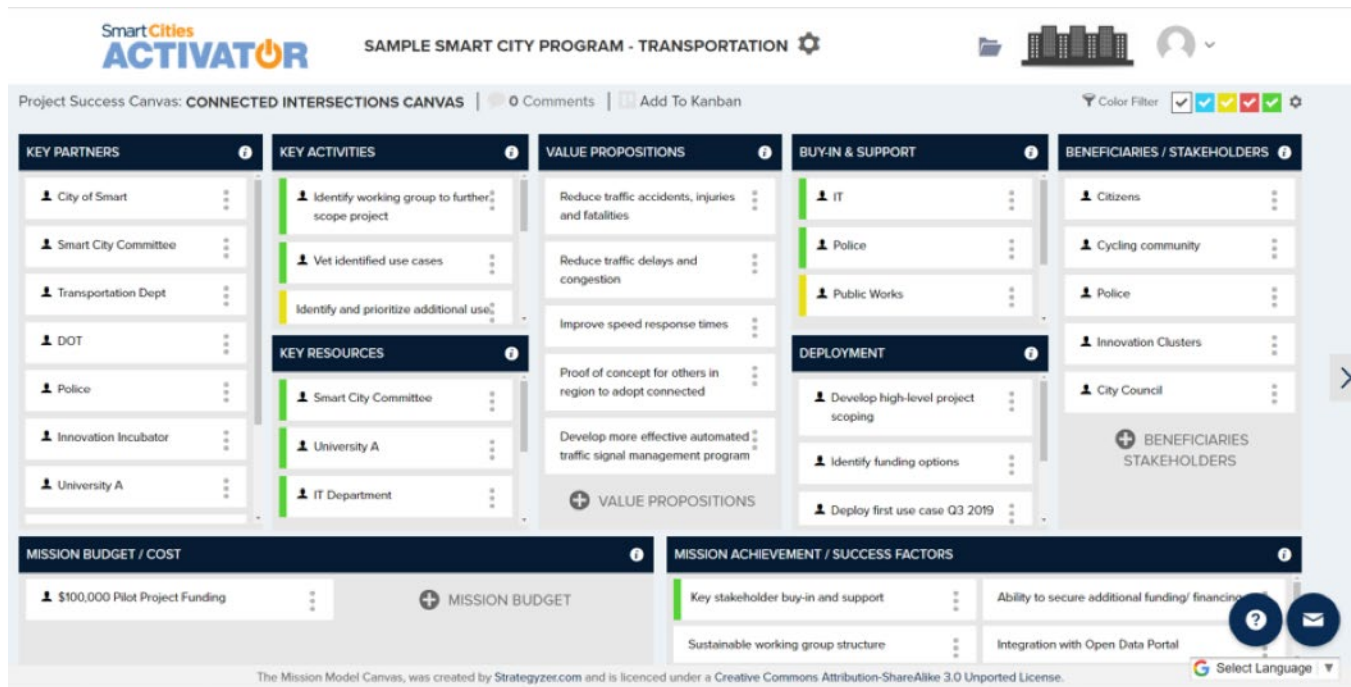
Figure 7: Smart Cities Framework. Source: Smart Cities Council



Collaboratively scope projects: Further develop each Discovery Workshop project concept by formalizing stakeholder roles and responsibilities, and identifying measurable targets, actions, funding mechanisms, implementation timelines and success factors. Consider using collaborative, digital planning tools and structured project templates to align stakeholders and make it easy to compare across projects.

Define and track metrics as part of project scoping. Set targets so you can measure progress and show how the outputs of investments and activities are delivering outcomes. [ISO 37120](#) is one resource for metrics, providing over 100 metrics for sustainable, smart and resilient cities. Also **use a baseline of current performance** to track progress and help frame the success of future performance. Ensure your governance arrangements allow for **clear responsibilities** to be identified for the function of ongoing monitoring, reporting and communication of the intended outcomes.

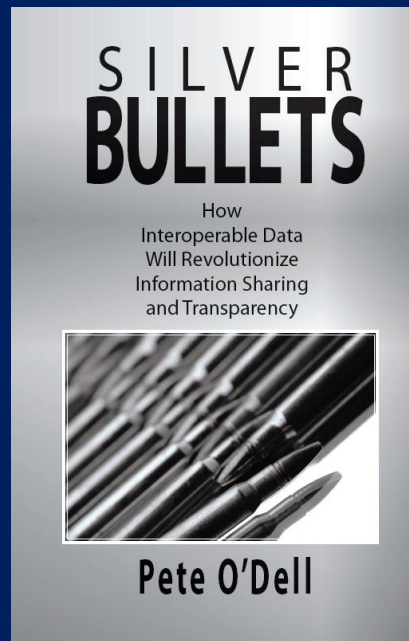
Figure 8: Sample Planning Template: Project Success Canvas. Source: Smart Cities Council, Smart Cities Activator



Revamp outdated procurement policies that impede progress and innovation. Adopt standardization around clauses, terms & conditions, evaluation criteria (including smart technology principles) and sub-contracting guidance. Promote greater engagement with other communities and counties to understand what has worked well and foster closer collaboration. Also look to **organize collective procurement processes** that take advantage of knowledge and synergies from different public authorities with similar needs. Consider **Public/Private Partnerships** as a mechanism to work closer with industry and procurement professionals to deliver projects while offsetting financial and technical risk. This will be explored in detail in the Spring / Summer 2019 Readiness for Resilience workshop.

Engage citizens and end-users – generate dialogue and create forums for exchange with the community around challenges and potential solutions.

“Our future is becoming complex and intertwined, with many issues interacting in ways we wouldn’t have anticipated. Think of interoperable data as a means to overcome the challenges.”



www.swanislandnetworks.com

Making use of interoperable data is an opportunity for every organization, big or small. Key benefits can include:

- **Enabling information sharing with trusted partners**
- **Enhancing system capabilities and longevity**
- **Lowering overall costs of information applications**
- **Improving the breadth and quality of information**
- **Increasing the speed and accuracy of decisions**
- **Improving transparency and speed of disclosure of information to valid constituents**
- **Preserving data for future uses, including those not yet conceived**

Funding and Financing Options

One of the biggest obstacles to overcome with any smart resilience project is securing funding or financing. Figure 5 provides an overview of some of the available funding sources. The Spring/Summer 2019 Readiness for Resilience workshop will further map funding and financing options to the smart resilience projects identified in the Discovery Workshops to move them toward implementation.

Figure 5 Hurricane Harvey Recovery Funding/ Finance Inventory. Source: National Association of State Energy Officials:

Hurricane Harvey Disaster Recovery: Funding and Financing Inventory: Prepared by the National Association of State Energy Officials (NASEO)							
Type of Funding	Agency(ies)	Structure of Funds/Assistance	Program Name	Target Applicants	Key Program Features	Relevance to Smart Technologies	For more information, visit:
Federal	Internal Revenue Service	Tax Relief	Tax Relief: Presidentially Declared Disaster Areas	"Affected Taxpayers," i.e. individuals and businesses located in the disaster area, those whose tax records are located in the disaster area, and relief workers. The same relief will also apply to any places added to the disaster area.	Affected taxpayers can claim disaster-related property damage, destruction, and theft losses attributable to a federally declared disaster.	While there is no direct connection to smart technologies, reimbursements for disaster-related expenses may be used to rehabilitate or replace property. These reimbursements (insurance payments, cash gifts, etc.) must be subtracted from the loss claims to the IRS.	https://www.irs.gov/newsroom/tax-relief-presidentially-declared-disaster-areas
Federal	Federal Emergency Management Agency	Insurance	National Flood Insurance Program	Home and business owners and tenants in communities that participate in the NFIP program.	Purchase of flood insurance is mandatory for all federal or federally-related financial assistance for the acquisition and/or construction of buildings in high-risk flood area.	Designed to restore property to pre-disaster condition. However, NFIP reduces flood insurance premiums for property owners in communities that promote elevation, outreach projects, hazard disclosure, floodplain mapping, stormwater management, flood warning and response, and other efforts. The program also offers "Increased Cost of Compliance" coverage for substantially damaged property and for additional measures needed to meet the floodplain management ordinance in a community.	https://www.fema.gov/national-flood-insurance-program
Federal	Federal Emergency Management Agency	Grant	Flood Mitigation Assistance Grant Program	States, Territories, federally-recognized tribes and local communities participating in the National Flood Insurance Program.	Funds projects and planning that reduces or eliminates long-term risk of flood damage to structures insured under the National Flood Insurance Program. Local communities may sponsor applications on behalf of homeowners, businesses, and nonprofits and then submit the applications to their State.	Funding support the development of mitigation strategies, data collection, and proven techniques that integrate cost-effective natural floodplain restoration solutions and improvements to NFIP-insured properties.	https://www.fema.gov/flood-mitigation-assistance-grant-program
Federal	Federal Emergency Management Agency	Grant	Pre-Disaster Mitigation Grant Program	States, Territories, federally-recognized tribes and local communities participating in the National Flood Insurance Program.	Planning and project grants support implementation of a sustained pre-disaster natural hazard mitigation program and public awareness-raising efforts. Local communities may sponsor applications on behalf of homeowners, businesses, and nonprofits and then submit the applications to their State Emergency Management Agency.	Funds can support mitigation, resilient infrastructure projects, planning, and program management costs. The "Resilient Infrastructure Competitive Funding" project type provides the opportunity to advance capital projects on a community level, ready for investment that will reduce risks, prevent loss of life and leads to significant savings by reducing damage from future disasters and lowering flood insurance premiums.	https://www.fema.gov/pre-disaster-mitigation-grant-program

Type of Funding	Agency(ies)	Structure of Funds/Assistance	Program Name	Target Applicants	Key Program Features	Relevance to Smart Technologies	For more information, visit:
Federal	Small Business Administration	Loans	Low Interest Disaster Loan Program	Homeowners and rentants in declared disaster areas	Loans cover losses not fully covered by insurance or other means. Up to \$200k to repair or replace property to pre-disaster condition or up to building code.	Loan increases may be available to make improvements that protect the property from future disasters (retaining walls, seawalls, sump pumps, safe rooms, storm shelters). Local governments may wish to examine and update building codes to ensure rebuilt homes are built to be resilient and/or energy-efficient to the extent possible.	https://www.disasterassistance.gov/get-assistance/forms-of-assistance/4477
Federal/State	Federal Emergency Management Agency, Texas General Land Office	Home repairs	Direct Assistance for Limited Home Repair	Pre-disaster Texan homeowners whose residence has undergone a FEMA-issued inspection with a FEMA verified loss of at least \$17,000	Key considerations for DALHR include: Repairs will be completed within 90 days from the start of the repair work. Needed repairs cannot cost more than fifty percent of the market value of the home and may not exceed \$60,000. Repairs are needed to make the home livable that are not covered by insurance or an SBA loan.	Direct home repairs are limited to real property components (such as heating, plumbing, ventilation and air conditioning, walls, floors and ceilings) but may offer opportunities for energy efficiency measures.	https://www.fema.gov/news-release/2017/12/19/fact-sheet-direct-assistance-limited-home-repair
Federal/State	Federal Emergency Management Agency, Texas General Land Office	Temporary housing and home repairs	Partial Repair and Essential Power for Sheltering (PREPS)	Homes that sustained less than \$17,000 in FEMA verified loss. FEMA determines an applicant's eligibility for the PREPS program.	Supplements emergency sheltering when communities are faced with needs that significantly exceed existing capacity. Provides immediate, temporary repairs. As a Hurricane Harvey Public Assistance program, FEMA pays for 90 percent of the expenses, and the GLO will use up to \$75,000,000 of the CDBG-DR Harvey allocation to cover repairs performed on homes.	Funds may be used for basic, emergency home repairs to enable sheltering-in-place. No apparent direct connection to smart or resilient rebuilding, but eligible emergency work may include utilities essential for water, hot water, HVAC, and food preparation, as well as securing and weatherproofing properties.	http://recovery.texas.gov/local-government/programs/fema-housing-sheltering/index.html
Federal	Economic Development Administration	Grants or cooperative agreements	"Economic Adjustment Assistance (EAA) Disaster Recovery Program"	"District Organization of an EDA-designated Economic Development District; Indian Tribe or a consortium; State, county, city, or other political subdivision of a State; institution of higher education or consortium; or public or private non-profit organization or association acting in cooperation with officials of a political subdivision of a State"	Supports economic recovery strategic planning, public works construction. Projects must enhance resilience. 2018 Disaster Supplement funding opportunity supports economic recovery activities associated with Hurricanes Harvey, Irma, Maria, and wildfires and natural disasters that occurred in calendar year 2017. Applicant cost-share is required.	EAA funds are flexible, and can be applied toward strategic planning and public works and infrastructure.	https://www.grants.gov/web/grants/view-opportunity.html?oppld=302953
Private Capital	Texas PACE Authority	Property Assessments	Texas Property Assessed Clean Energy (TX-PACE)	Commercial, multifamily, agricultural, nonprofit and industrial property owners in participating jurisdictions in Texas	Uses private capital to finance the upfront costs of water conservation, energy efficiency, resiliency, and distributed energy generation projects.	Financed improvements must be permanently fixed to the real property and have a demonstrated capacity to decrease water or energy consumption.	https://www.texaspaceauthority.org/
Federal	Federal Highway Administration	Grants	Emergency Relief Program	Federal-aid highways and roads on Federal lands	Supports the repair or reconstruction of roads which have suffered serious damage as a result of (1) natural disasters or (2) catastrophic failures from an external cause. Supplements the commitment of resources by States, their political subdivisions, or other Federal agencies to help pay for unusually heavy expenses resulting from extraordinary conditions.	Activities to plan, design, and construct highways to adapt to current and future climate change and extreme weather events are eligible for reimbursement. This includes the construction of projects or features to protect existing eligible assets from impacts and damage from extreme weather events.	https://www.fhwa.dot.gov/federalaid/120924.cfm

Listing of Disaster Recovery Funding Resources

58 Resources described below contain a wide range of federal, private, and non-profit funding, program and technical assistance resources that may be available pre and/or post disaster.

Another option is to open www.grants.gov, type in your key words and this will provide you with a good selection of available grants.

Federal Department/Agency Specific Resources

U.S. Department of Agriculture (USDA)

- Disaster Assistance Program: <https://www.fsa.usda.gov/programs-and-services/disaster-assistance-program/index>
- The Extension Disaster Education Network EDEN: Reducing the Impacts of Disasters Through Education: <http://eden.lsu.edu/Pages/default.aspx>
- U. S. Forest Service National Urban and Community Forestry Program: <http://www.fs.fed.us/ucf/nucfac.html>
- NRCS Emergency Watershed Protection (EWP) Program: <http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/landscape/ewpp/>
- NRCS Emergency Watershed Protection Program: Floodplain Easement Option (EWP FPE): http://www.nrcs.usda.gov/wps/portal/nrcs/detail/tn/newsroom/?cid=nrcs143_008225
- Natural Resources Conservation Services (NRCS) Technical Assistance: <http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/technical/>
- Rural Development : Community Facilities Direct Loan and Grant Program : <http://www.rd.usda.gov/programs-services/community-facilities-direct-loan-grant-program>
- Rural Development : Intermediary Relending Program : <http://www.rd.usda.gov/programs-services/intermediary-relending-program>
- Rural Development : Rural Community Development Initiative Grants: http://www.rurdev.usda.gov/HAD-RCDI_Grants.html
- Rural Development : Programs & Services for Communities & Nonprofits: <http://www.rd.usda.gov/programs-services/programs-services-communities-nonprofits>
- NRCS Small Watershed Program: http://www.nrcs.usda.gov/wps/portal/nrcs/detail/ca/programs/?cid=nrcs144p2_064043 assists
- NRCS Watershed Surveys and Planning: <http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/landscape/wsp/>
- Rural Development : Water & Waste Disposal Technical Assistance & Training Grants: <http://www.rd.usda.gov/programs-services/water-waste-disposal-technical-assistance-training-grants>

U.S. Department of Commerce

- EDA Funding Opportunities: <https://www.eda.gov/funding-opportunities/>
- EDA Regional Innovation Strategies Program (RIS): <https://www.eda.gov/oie/ris/>
- NOAA: Digital Coast: <http://coast.noaa.gov/digitalcoast/>
- NOAA: Coastal & Waterfront Smart Growth: <http://coastalsmartgrowth.noaa.gov/>
- NOAA : National Weather Service: Automated Flood Warning System: <http://water.weather.gov/afws/>

U.S. Army Corps of Engineers (USACE)

- Public Law 84-99 Rehabilitation Program: <http://www.iwr.usace.army.mil/Missions/FloodRiskManagement/FloodRiskManagementProgram/PartnersinSharedResponsibility/USACEStaff/PL8499RehabilitationProgram.aspx>

U.S. Department of Energy

- Weatherization and Intergovernmental Programs Office: <http://energy.gov/eere/wipo/weatherization-and-intergovernmental-programs-office>
- Texas Contacts for the weatherization program: <https://nascsp.org/state-contacts/texas/>
- National Renewable Energy Laboratory: Technology Deployment, Disaster Resiliency and Recovery: http://www.nrel.gov/tech_deployment/disaster_recovery.html

Federal Emergency Management Agency (FEMA)

- Community Disaster Loan Program: <https://www.fema.gov/community-disaster-loan-program>
- Fire Management Assistance Grant Program: <https://www.fema.gov/fire-management-assistance-grant-program>
- Hazard Mitigation Assistance : Hazard Mitigation Grant Program (HMGP): <https://www.fema.gov/hazard-mitigation-grant-program>
- Hazard Mitigation Assistance : Pre-Disaster Mitigation Grant Program (HMGP): <http://www.fema.gov/pre-disaster-mitigation-grant-program>
- Hazard Mitigation Assistance: Flood Mitigation Assistance Grant Program: <https://www.fema.gov/flood-mitigation-assistance-program>
- Repetitive Flood Claims Grant Program: <https://www.fema.gov/repetitive-flood-claims-grant-program-fact-sheet>
- Severe Repetitive Loss (SRL) Grant Program: <https://www.fema.gov/media-library/resources-documents/collections/14>

- Transit Security Grant Program:
<https://www.fema.gov/transit-security-grant-program>
- Unified Federal Environmental and Historic Preservation Review for Presidentially Declared Disasters: <https://www.fema.gov/unified-federal-environmental-and-historic-preservation-review-presidentially-declared-disasters>
- Emergency Management Performance Grant Program:
<https://www.fema.gov/emergency-management-performance-grant-program>
- Fire Prevention & Safety Grants:
<https://www.fema.gov/fire-prevention-safety-grants>
- Tribal Homeland Security Grant Program:
<https://www.fema.gov/fy-2014-tribal-homeland-security-grant-program-thsgp>

U. S. Department of Housing and Urban Development (HUD)

- Community Development Block Grant Entitlement Program:
<https://www.hudexchange.info/cdbg-entitlement/>
- Community Development Block Grant : Section 108 Loan Guarantee Program:
<https://www.hudexchange.info/section-108/>
- Community Development Block Grant Disaster Recovery (CDBG-DR) Program:
<https://www.hudexchange.info/cdbg-dr/>
- Office of Public and Indian Housing : Main Street Grants Program Hope VI:
<http://www.hud.gov/mainstreet>
- Capacity Building for Community Development and Affordable Housing Grants:
<http://portal.hud.gov/hudportal/HUD?src=/hudprograms/capacitybuilding>

U.S. Department of the Interior

- Fish and Wildlife Service: National Coastal Wetlands Conservation Grant Program: <http://www.fws.gov/coastal/CoastalGrants/>
- National Park Service : Federal Lands to Parks Program:
<http://www.nps.gov/ncrc/programs/flp/index.htm>
- National Park Service : National Register of Historic Places:
<http://www.nps.gov/nr/>
- National Park Service : National Trails System: <http://www.nps.gov/nts/>
- National Park Service : Rivers, Trails, and Conservation Assistance Program:
<http://www.nps.gov/rtca>
- National Park Service : State, Tribal, and Local Plans and Grants:
<http://www.nps.gov/orgs/1623/index.htm>
- National Park Service : Historic Preservation Fund Grants:
<https://www.nps.gov/preservation-grants/index.html>
- USGS : National Gap Analysis Program: <http://gapanalysis.usgs.gov/>

U.S. Department of Transportation

- Transportation Investment Generating Economic Recovery (TIGER) Discretionary Grants: <http://www.dot.gov/TIGER> (due: April 2020, Yearly)
- Federal Highway Administration : Recreational Trails Program: http://www.fhwa.dot.gov/environment/recreational_trails/
- Federal Transit Administration : Grant Programs: <https://www.transit.dot.gov/grants/13070.html>
- Federal Transit Administration: Public Transportation Emergency Relief Program: <https://www.transit.dot.gov/funding/grant-programs/emergency-relief-program/emergency-relief-program>
- Transportation.gov: Rail Programs: <https://www.transportation.gov/policy-initiatives/recovery/rail-programs>
- Federal Highway Administration : MAP-21: Moving Ahead for Progress in the 21st Century: <http://www.fhwa.dot.gov/map21/factsheets/mp.cfm>
- Recovery Resource Guide: A Transportation Stakeholder Guide to Recovery: https://cms.dot.gov/sites/dot.gov/files/docs/RECOVERY%20RESOURCE%20GUIDE_Final%20Version_08-27-2014.pdf

Environmental Protection Agency (EPA)

- Smart Growth: Building Blocks for Sustainable Communities: <https://www.epa.gov/smartgrowth/building-blocks-sustainable-communities>
- Smart Growth Implementation Assistance Program: <https://www.epa.gov/smartgrowth/smart-growth-implementation-assistance>

General Services Administration (GSA)

- GSA Programs for State and Local Customers, including Disaster Purchasing Program: <http://www.gsa.gov/portal/content/105300>

Selected Non-Federal Recovery Resources

- National Voluntary Organizations Active in Disasters Resources: <http://www.nvoad.org/>
- Regional Catastrophic Preparedness Grant Program (RCPGP): <https://www.federalgrantswire.com/regional-catastrophic-preparedness-grant-program-rcpgp.html>

Resources



- Resilience in Action: Case Study Slide Deck: [https://www.bcse.org/images/2019/Foundation/Readiness for Resilience_6.3.19.pdf](https://www.bcse.org/images/2019/Foundation/Readiness%20for%20Resilience_6.3.19.pdf)



- Resilience in a Transforming Energy Landscape – Findings from the 2019 Sustainable Energy in America Factbook: www.bcse.org/factbook

