Energy's Role in Resilience Planning

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NREL at a Glance

2,050

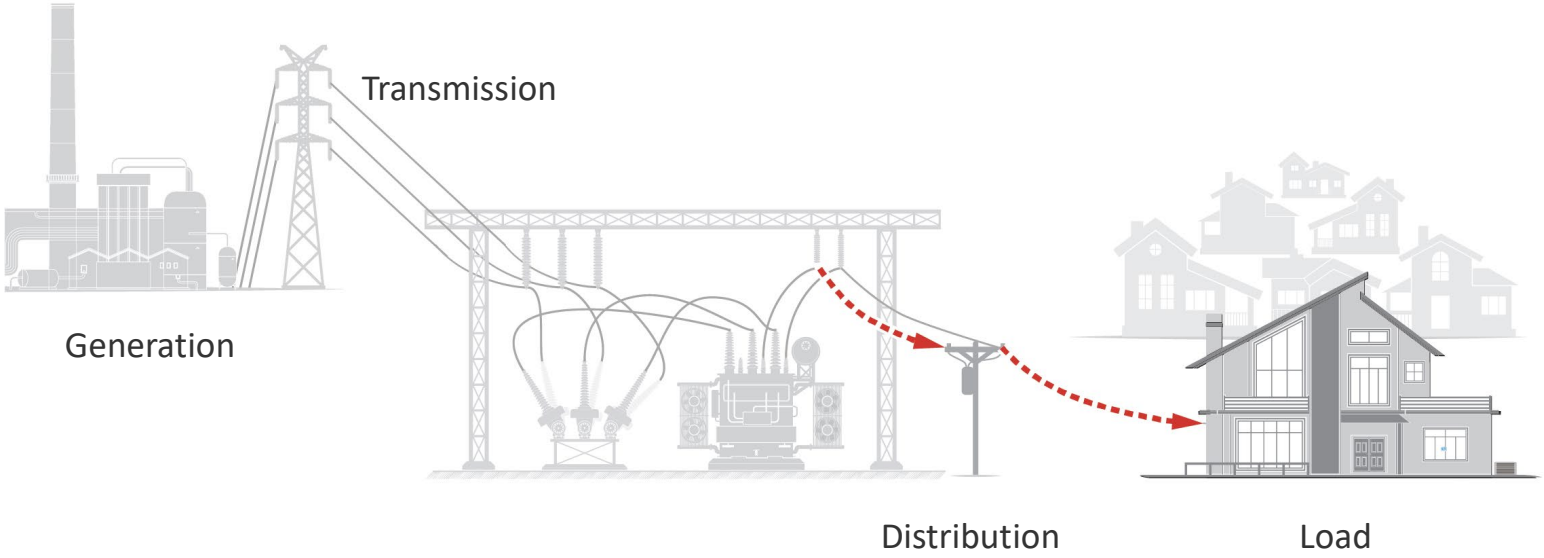
Employees,
plus more than
400
early-career researchers
and visiting scientists

World-class
facilities, renowned
technology experts

nearly
820

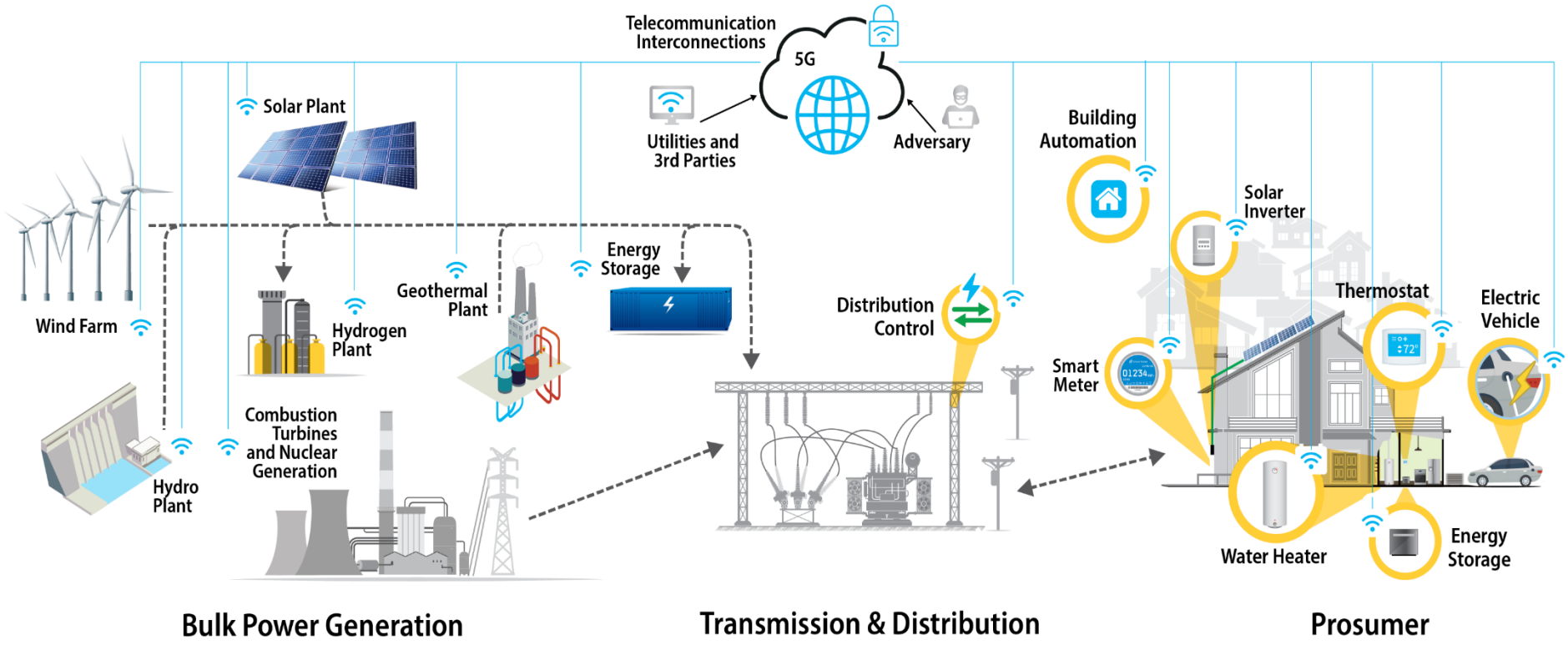
Partnerships
with industry,
academia, and
government

Campus
operates as a
living laboratory



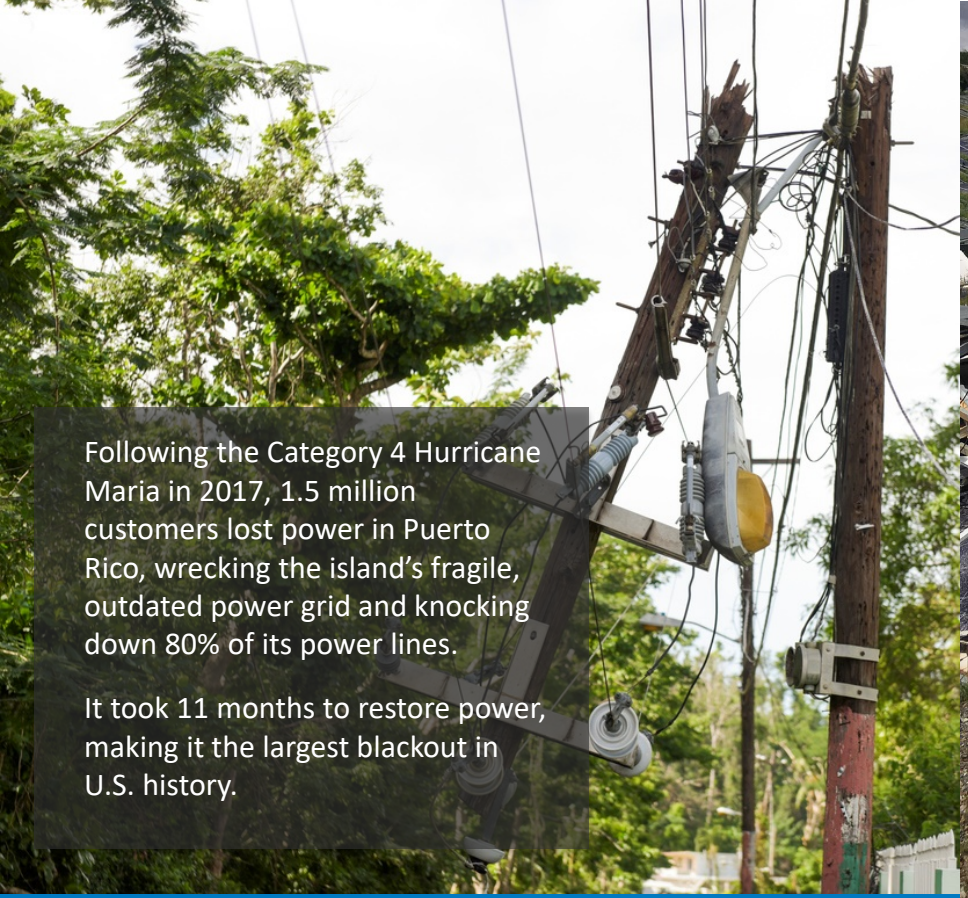
The grid of the past

The grid of the past was designed for one-way, centralized power, requiring limited communications.



The grid is changing

NREL's work supports this transformation, through development of systems that are intrinsically secure and resilient by design.

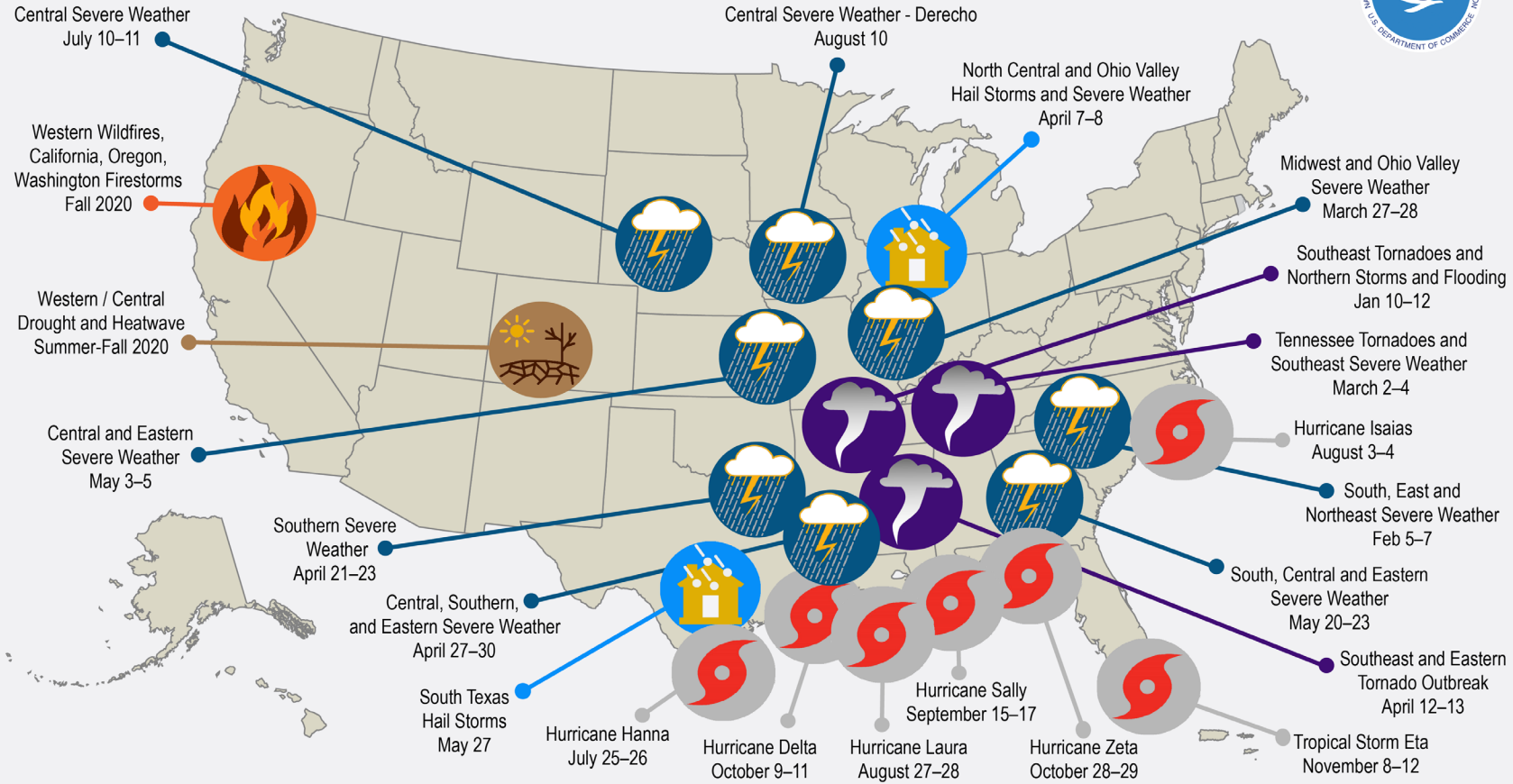


Following the Category 4 Hurricane Maria in 2017, 1.5 million customers lost power in Puerto Rico, wrecking the island's fragile, outdated power grid and knocking down 80% of its power lines.

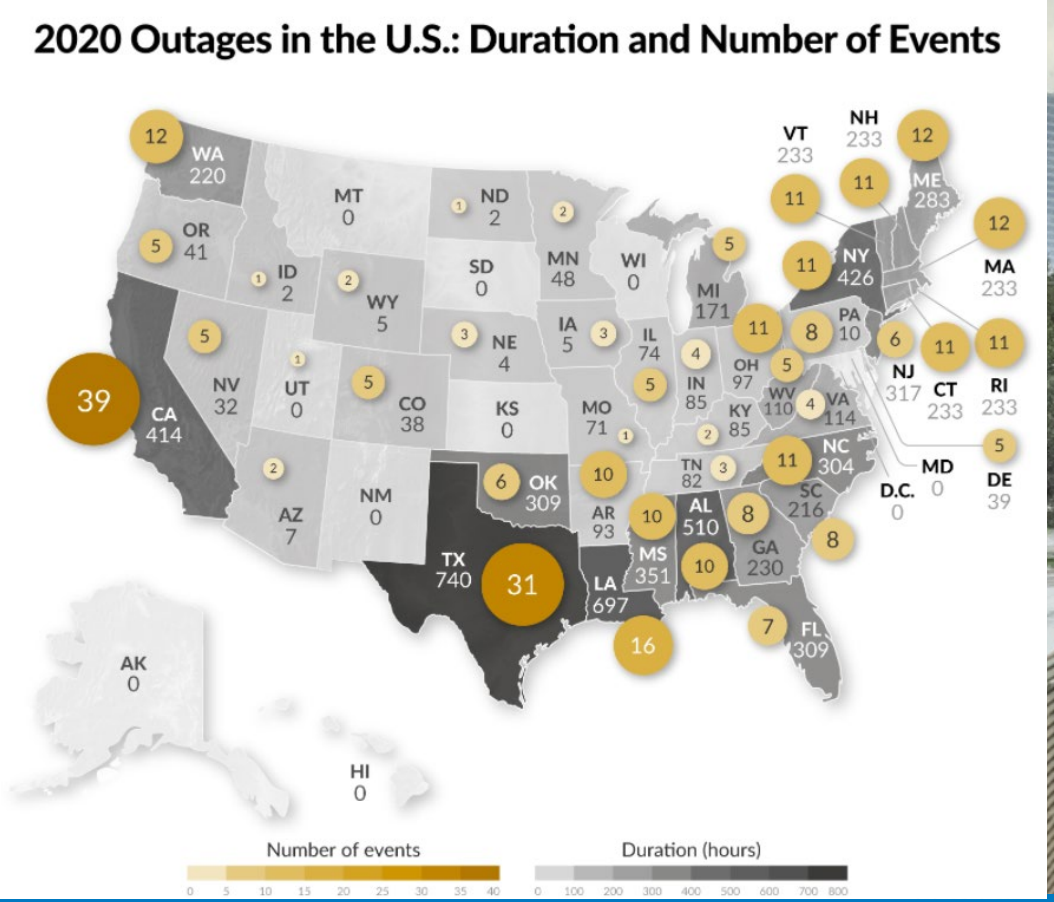
It took 11 months to restore power, making it the largest blackout in U.S. history.

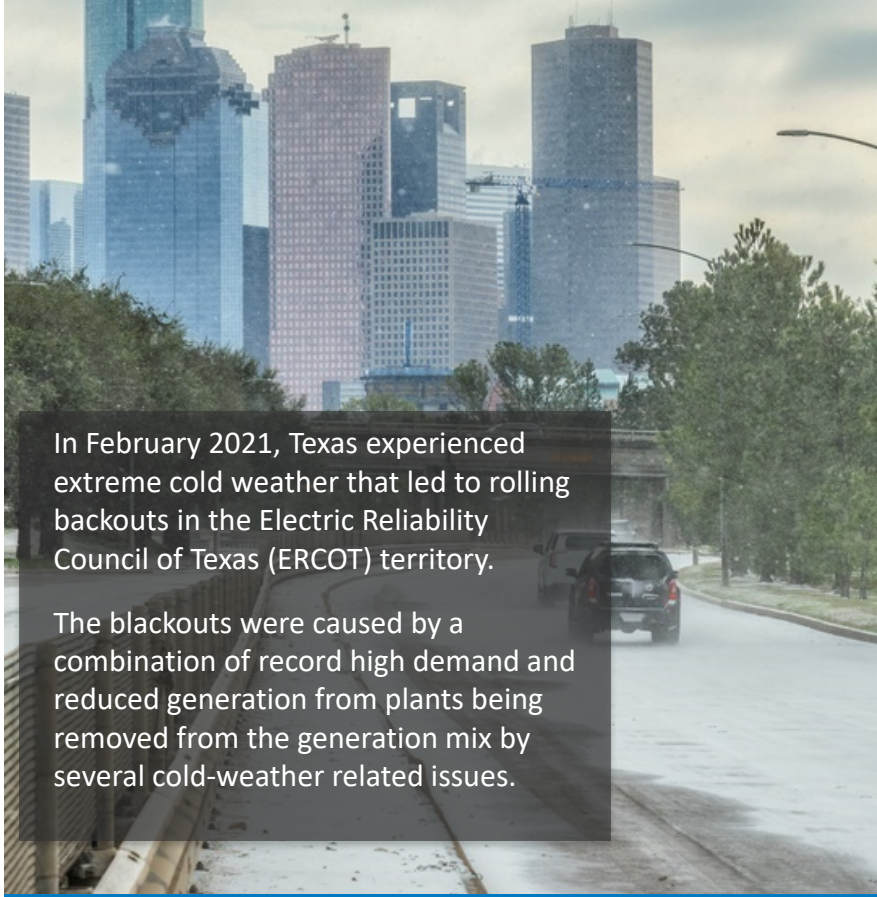
Natural hazards to the grid can be devastating

U.S. 2020 Billion-Dollar Weather and Climate Disasters



*This map denotes the approximate location for each of the **22 separate billion-dollar weather and climate disasters that impacted the United States during 2020**.*



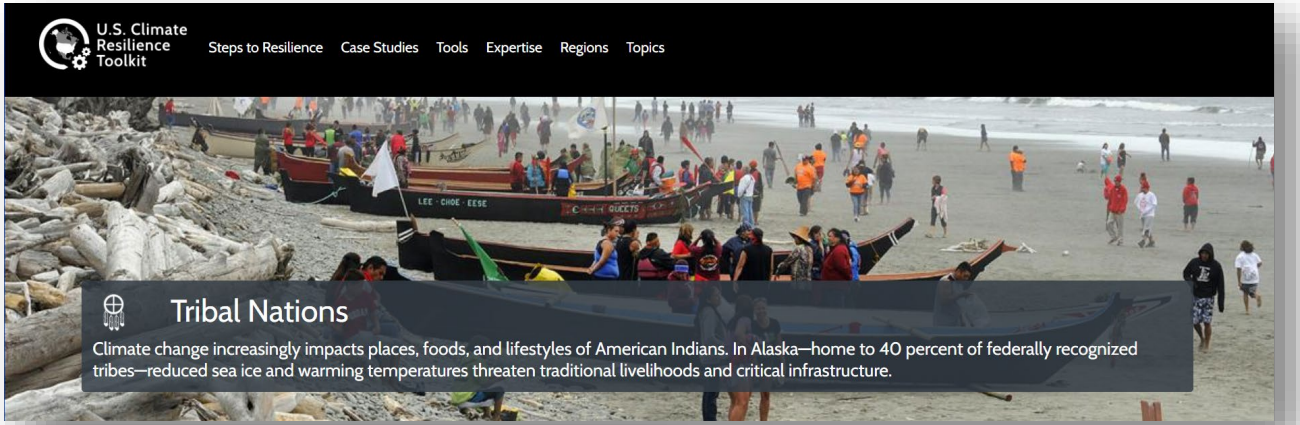


In February 2021, Texas experienced extreme cold weather that led to rolling backouts in the Electric Reliability Council of Texas (ERCOT) territory.

The blackouts were caused by a combination of record high demand and reduced generation from plants being removed from the generation mix by several cold-weather related issues.

Outage duration and frequency is variable

Long-term Impacts



Shishmaref, AK

Isle de Jean Charles, LA

Resilience Planning

Examples exist at the state, community, and federal levels for resilience

Use existing resilience modeling and planning tools and methodologies to help prioritize resilience solutions.

Tools can help with **site hazard identification in energy and water systems; solutions to reduce risk; and integrating planning for energy and water management and continuity of energy operations**.


Cape Cod National Seashore


Quinault Indian Nation


Basalt, Colorado


Cordova, Alaska


DOD Installation Support

Renewable Power

- Solar
- Wind
- Water
- Geothermal

Sustainable Transportation

- Bioenergy
- Vehicle Technologies
- Hydrogen

Energy Efficiency

- Buildings
- Advanced Manufacturing
- Government Energy Management

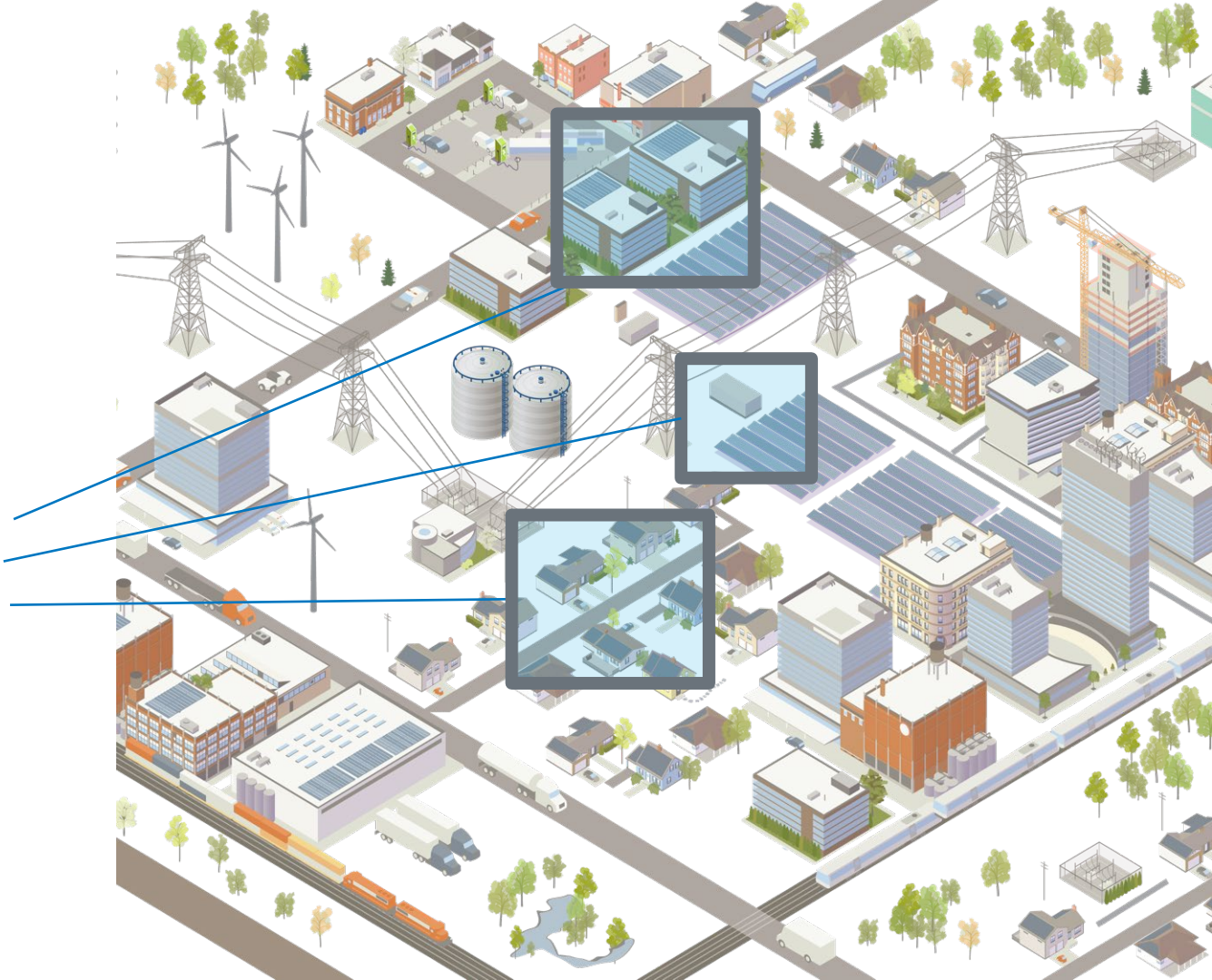
Energy Systems Integration

- High-Performance Computing
- Data and Visualizations

Energy

- **Energy Efficiency**
  Energy efficient buildings not only lower energy bills on an annual basis, but can also allow occupants to shelter in place during a disruptive event. Architectural design concepts, such as passive survivability, can be incorporated to help vulnerable populations avoid life-threatening situations.

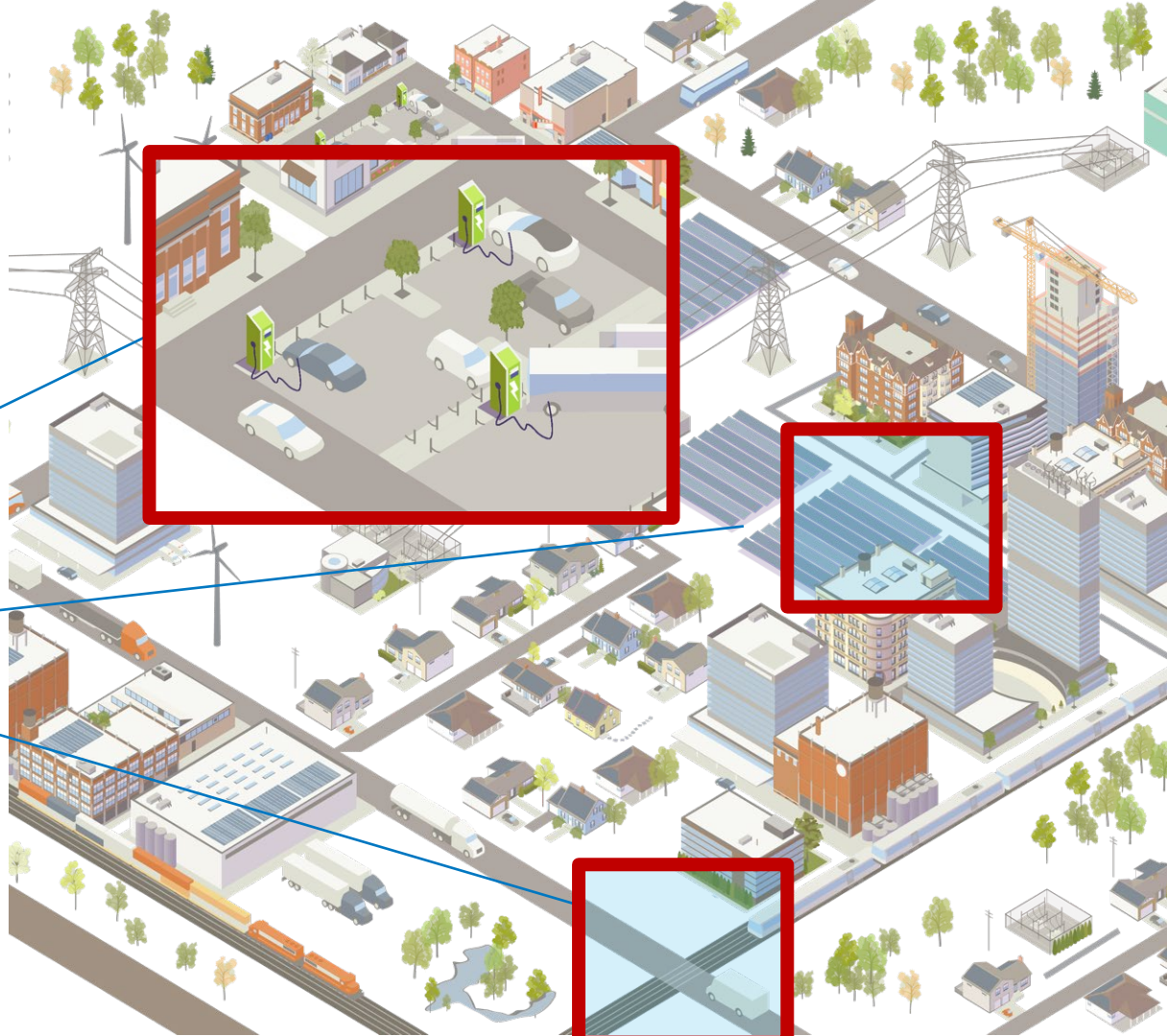
- **Distributed Energy Resources**
  Microgrids, islandable onsite energy generation (e.g., rooftop solar, wind, fuel cells) paired with energy storage solutions can provide power to buildings or systems during disruptive events when the grid system may not be operational.



Transportation

- **Fuel diversity**
  Multiple modes of transportation and fuels can enhance resilience during daily needs, but also during disruptive events. Electric vehicles, walkable cities, diversifying fuel etc. can help with transportation during disruptions by providing different modes of travel are available.

- **Resilient infrastructure**
  Hardened infrastructure, porous pavements, reinforced bridges, etc. will ensure that routes are sustained during and after severe storms and other types of hazards or threats.

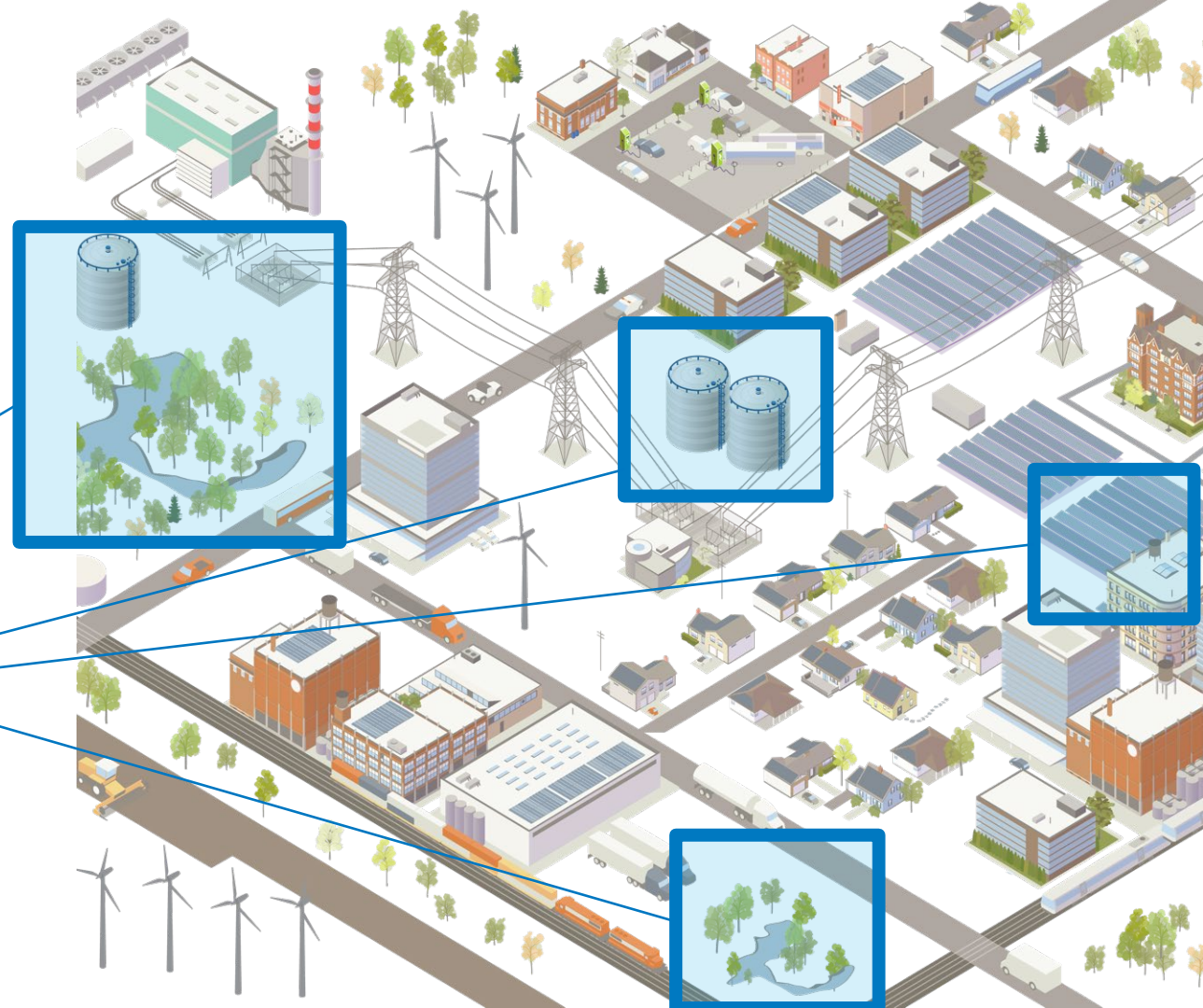


Water

- **Conservation and Storage**
  Reducing the amount of water used within a building or process and also having onsite water storage or a rainwater harvesting system will help meet water needs during a disruption to a municipal water supply.

- **Gravity Fed Systems**
  Using gravity to distribute water is a resilient solution in that energy will not be needed to use or dispose of water during normal operating conditions and during a disruptive event.

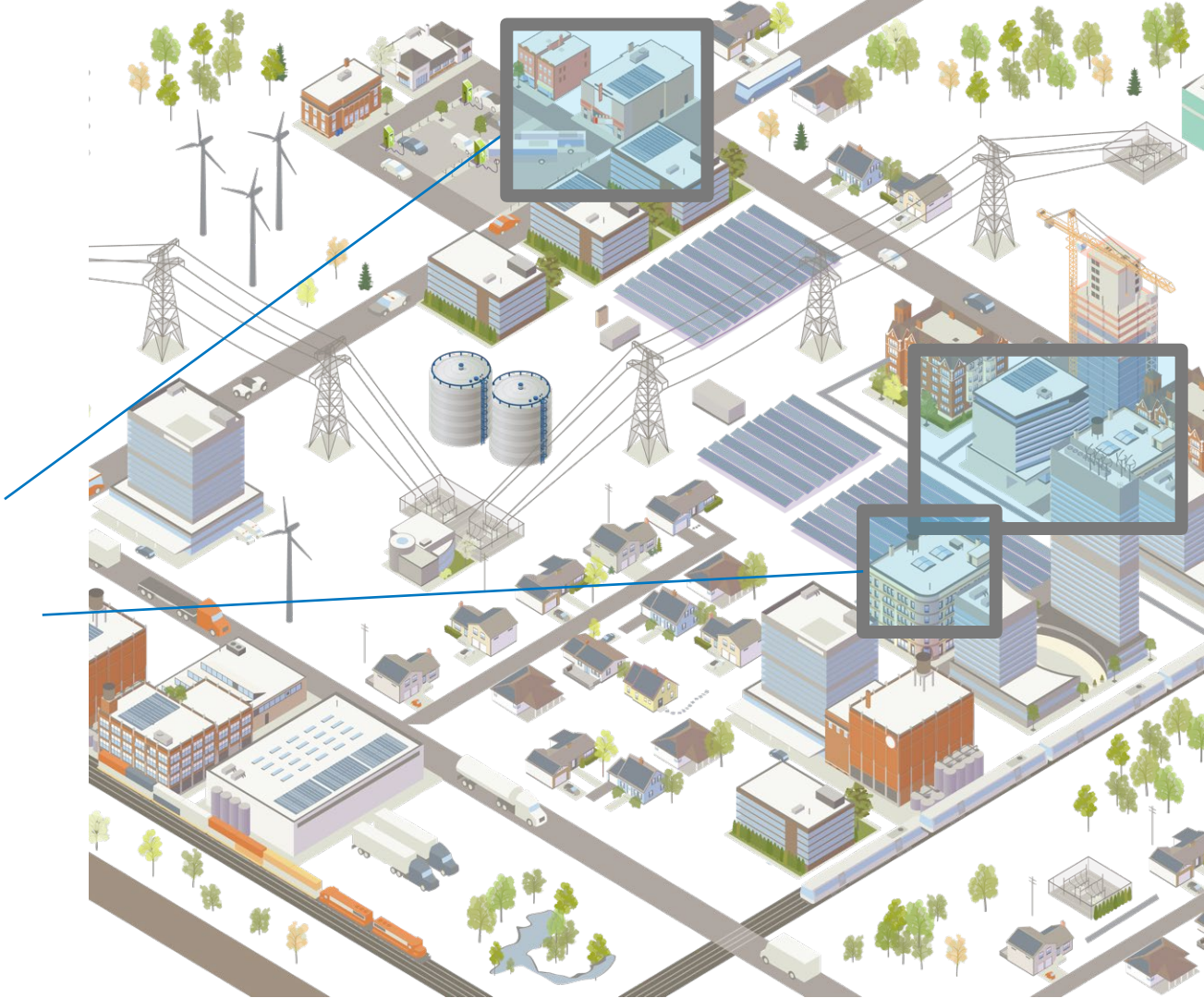
- **Green Infrastructure**
  Solutions such as using natural vegetation and bioswales can reduce localized flooding associated with storms and slow runoff rates.



Information and Communication

- **Cybersecurity**
  Ensuring a secure cyber architecture is built into communications and IT networks will reduce risks associated with attacks and hacking, ensuring systems are operational.

- **Redundancy and Resourcefulness**
  Analogue backup systems and controls, redundant nodes, and trained workforce can increase the resilience of communications networks to all sorts of threats and hazards.



FEMA

Interagency Recovery Coordination

CASE STUDY

Energy Generation

GALENA, ALASKA FLOOD RECOVERY

Learning Objective: Analyze the decision-making process utilized in Galena post-disaster to institute a sustainable and efficient energy generation project during the community's recovery period from a devastating flood.

Keywords: Recovery, Flood, Local Government, Tribal Government, Rural Community, Infrastructure Systems, Sustainability, Resilience

PART ONE

Background

During the spring break up[1] in May of 2013, flood waters carrying massive ice chunks from the Yukon River inundated nearly 90% of the homes, businesses, and government facilities in the small town of Galena, Alaska. An ice jam downriver caused floodwaters to rise and back up overbank in Galena. House-sized chunks of ice mowed down the native birch trees and ripped homes off of pilings. Most areas received between seven and nine feet of water. The event forced nearly all of the 472 residents to evacuate by air to Fairbanks and Anchorage as waters quickly rose and local roads became impassable.

Figure 1. Fuel and supplies are brought into Galena by plane.

Galena has experienced several major flooding events, with the Old Town neighborhood receiving the worst of the damage due to its location between the Yukon River and the levee constructed to protect the air strip. Community members have long recognized the town's vulnerability and were adamant in their desire to incorporate resiliency into all re-building and recovery efforts. For instance, after a major flood in 1971, the community rebuilt critical facilities, city offices, the health clinic, and many homes at a less vulnerable site 1.5 miles further from the river, locally called New Town.

The sustainability and growth of Galena depends on addressing critical energy challenges which include the need to find alternative, lower-cost sources of fuel. When the U.S. Air Force left Galena, it also left the air base to the community, along with approximately 1.5 million gallons of fuel for power generation. However, that supply has been dwindling and aging. Fuel is resupplied by barging diesel fuel up the Yukon River in the summer, resulting in energy costs of 67 cents/kilowatt hour (kWh) for the residents of Galena.

This situation forced a discussion about expensive fossil fuel reliance and a transition to a local, renewable energy source. Galena residents emphasized this desire for a long-term, sustainable energy solution for the community in recovery coordination meetings with local and state leadership. Galena residents identified "Improving energy generation and efficiency" as one of their top five priority goals for the flood recovery process.

Public support for increased energy efficiency was one of the main driving forces for leaders to study the possibility of replacing damaged energy systems with a community biomass power plant project, which was already in the planning stages prior to the flood. Community leaders set to work identifying partners that could help with determining the feasibility of building a biomass power plant, as well as other energy system improvements.

[1] The period of time in spring when the ice on the river physically breaks and the surface becomes free flowing again. Seasonal snow melt adds to the Yukon River's water level, and shifting pieces of ice pile up to create ice jams that break unpredictably.

Guidance Development Office, Interagency Coordination Division, Recovery, FEMA

This case study was originally published in May 2019.

[Energy Generation: Galena, Alaska Flood Recovery (fema.gov)]

Resilience

The ability to anticipate, prepare for, and adapt to changing conditions and withstand, respond to, and recover rapidly from disruptions through adaptable and holistic planning and technical solutions.

Resilience Roadmap (nrel.gov)

Thank you!

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Transforming ENERGY