Energy Efficiency and Infrastructure Resilience

NORTH CENTRAL TEXAS COUNCIL OF GOVERNMENTS

AUGUST 28, 2019
Texas produces more electricity than any other state.
Texas leads the nation in wind-powered generation and produced one-fourth of all the U.S. wind powered electricity in 2017.
Texas is the largest energy-producing state and the largest energy-consuming state in the nation.

Source: Energy Information Agency
Last Updated: February 21, 2019
ERCOT schedules power on an electric grid that connects more than 46,500 miles of transmission lines and 650+ generation units.

https://youtu.be/9yKRz08buaA
Public Utility Commission of Texas
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News Release
August 13, 2019

Contact: Andrew Barlow [512-936-7048]

Public Utility Commission Urges Electricity Conservation

Austin, TX – The Public Utility Commission of Texas (PUC) urges Texans to conserve electricity this afternoon as record electricity demand meets higher than normal temperatures.

“When the energy demands of our state’s steadily growing population and booming economy intersect with hot summer temperatures, the supply of power can get a little tight, so we’re calling on Texans to help moderate demand for electricity with a few simple choices during the late afternoon hours this week,” said DeAnn Walker, Chairman of the Public Utility Commission of Texas.

The PUC advises residential and business customers alike to reduce their electricity usage with simple adjustments like bumping air conditioning thermostats up at least two degrees and turning off unnecessary lighting. Customers are also asked to wait until after sunset to run dishwashing and laundry appliances.
Power blows past $9,000 cap in Texas as heat triggers emergency

Electricity prices briefly surged past a $9,000 a megawatt-hour price cap in Texas as extreme heat sent power demand skyrocketing and forced the state’s grid operator to declare an emergency.

As temperatures in Dallas climbed to 103 degrees Fahrenheit (39 Celsius), the Electric Reliability Council of Texas issued an emergency alert, calling on all power plants to ramp up and asking customers to conserve. At one point on


Threats - Heat
Tuesday, August 13, 2019

• Electricity demand hit an all-time high of 74,531 megawatts as people blasted their air conditioners on Monday afternoon and totaled 74,310 megawatts at 4:34 p.m. local time Tuesday, according to ERCOT.

• Temperatures peaked at 103 degrees.

• “Extreme heat across the ERCOT region will continue to result in high loads,” ERCOT said in a statement. “We may set another new record today.”

Threats - Heat
Urban Heat Island Effect

“The ramifications of urban heat adversely affect public health, longevity of infrastructure, public opinion, and our economy. With rising temperatures come higher costs for energy and a threat to our energy supply.”

- Dallas Urban Heat Island Mitigation Study Website
  https://www.texastrees.org/projects/dallas-urban-heat-island-mitigation-study/
Threats – Cyber Attacks

SECURITY

Experts assess damage after first cyberattack on U.S. grid
Blake Sobczak, E&E News reporter
Energywire: Monday, May 6, 2019

Reports of an unprecedented grid “cyber event” caused a stir last week in power sector and cybersecurity circles.

Last week, the U.S. power sector marked a sober milestone: an anonymous Western utility became the first to report a malicious “cyber event” that disrupted grid operations.

The hack itself occurred two months ago, on March 5, when a “denial-of-service” attack disabled Cisco Adaptive Security Appliance devices ringing power grid control systems in Utah, Wyoming

https://www.eenews.net/stories/1060281821

Russians hacked into America's electric grid. Here’s why securing it is hard.
April 11, 2018 6:44am EDT   Updated July 24, 2018 12:47pm EDT

Hackers taking down the U.S. electricity grid may sound like a plot ripped from a Bruce Willis action movie, but the Department of Homeland Security has recently disclosed new details about the extent to which Russia has infiltrated “critical infrastructure” like American power plants, water facilities and gas pipelines.

This hacking is similar to the 2015 and 2016 attacks on Ukraine’s grid. While DHS has raised the number of the Russian utility-hacking

## Generic Interdependency Among Critical Infrastructure Sectors

<table>
<thead>
<tr>
<th>(Sub)sector Generating the Service</th>
<th>ONG</th>
<th>Electricity</th>
<th>Transportation</th>
<th>Water</th>
<th>Communication</th>
</tr>
</thead>
<tbody>
<tr>
<td>ONG</td>
<td></td>
<td>Fuel to operate power plant motors and generators</td>
<td>Fuel to operate transport vehicles</td>
<td>Fuel to operate pumps and treatment</td>
<td>Fuel to maintain temperatures for equipment; fuel for backup power</td>
</tr>
<tr>
<td>Electricity</td>
<td>Electricity for extraction and transport (pumps, generators)</td>
<td>Power for overhead transit lines</td>
<td>Electric power to operate pumps and treatment</td>
<td>Energy to run cell towers and other transmission equipment</td>
<td></td>
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<tr>
<td>Transportation</td>
<td>Delivery of supplies and workers</td>
<td>Delivery of supplies and workers</td>
<td>Delivery of supplies and workers</td>
<td>Delivery of supplies and workers</td>
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</tr>
<tr>
<td>Water</td>
<td>Production water</td>
<td>Cooling and production water</td>
<td>Water for vehicular operation; cleaning</td>
<td>Water for equipment and cleaning</td>
<td></td>
</tr>
<tr>
<td>Communication</td>
<td>Breakage and leak detection and remote control of operations</td>
<td>Detection and maintenance of operations and electric transmission</td>
<td>Identification and location of disabled vehicles, rails and roads; the provision of user service information</td>
<td>Detection and control of water supply and quality</td>
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</tbody>
</table>

Source: IEEE
Planning a Resilient Power Sector

- The power system is at risk from an array of natural, technological, and man-made threats that can cause everything from power interruption to chronic undersupply.
  - **Natural**: long-term climatic changes, such as variations in precipitation patterns and changes in air and water temperatures, as well as severe weather events, such as storms, flooding, and storm surges
  - **Technological**: unpredicted equipment and infrastructure failures
  - **Human-caused**: Accidents and malicious events

- Impacts from these threats include, but are not limited to:
  - Potential fuel supply shortages for transportation and energy generation,
  - Physical infrastructure damage (dam failure, faulty system equipment, etc.)
  - Shifts in energy demand
  - Disruption of electricity supply to the end user
  - System operations and targeting power control systems, generators, or critical data infrastructure

- It is critical for policymakers, planners, and system operators to safeguard their systems and plan for and invest in the improved resilience of the power sector.
- Planning for power sector resilience can happen at different geographic scales (local, national, or regional) and should be incorporated into existing power sector planning and policies to ensure effectiveness.

Source: https://www.nrel.gov/docs/fy19osti/73618.pdf
The Energy-Resilient City

Learn about the different ways a city can incorporate resilience:

**MANUFACTURING**
Built with a highly-efficient building envelope, efficient equipment, and a state-of-the-art building energy management system.

**SCHOOL**
Solar panels and a tightly insulated building envelope keep air conditioning running to keep students safe during a summer power outage.

**UNIVERSITY**
Uses a renewable microgrid system combining a solar PV structure with battery storage, which can disconnect from the traditional grid and operate autonomously during outage events.

**HOSPITAL**
A combined heat and power system provides low-cost energy for critical lifesaving equipment during a winter storm power outage.

**GROCERY STORE**
A tightly insulated building envelope and highly efficient refrigeration equipment reduces the size of required backup generators, allowing the store to preserve inventory at a lower cost during a power outage following a hurricane.

**COMMUNITY CENTER**
Constructed for passive survivability with highly insulated concrete walls, window-shades that block direct summer sunlight, and a light-colored, reflective roof. During a summer time power outage, the community center stays cool enough to provide a place for residents to gather as well as a base for community services and local response.

**OFFICE BUILDING**
During a heat wave that threatens to strain the electrical grid, it can participate in electric utility demand response, receiving a payment for temporarily reducing its demand on the grid while maintaining essential operations.

**APARTMENT BUILDING**
Features triple-pane windows, heavy insulation, and passive solar heating, and uses efficient electric heat pumps instead of gas heating. During a blizzard, residents are protected from the costs of natural gas price spikes. During a power outage, it can stay warm enough to keep residents safe for the duration of the event.
Example Electrical Energy Infrastructure Performance Goals

- Provides functional categories within the electric power infrastructure system (generation, transmission, and distribution)
- Community stakeholders, including representatives from the utility providers, need to work together to determine the functions needed during recovery and the performance goals tailored to their community needs and energy systems.

NIST, Community Resilience Planning Guide for Buildings and Infrastructure Systems, Volume II
https://nvlpubs.nist.gov/nistpubs/SpecialPublications/NIST.SP.1190v2.pdf
Energy Efficiency’s Role in Increasing Resilience

Energy efficiency can be a core strategy to reduce risks and enhance the resilience of the communities that energy systems serve.

### Table ES1. Resilience benefits of energy efficiency

<table>
<thead>
<tr>
<th>Benefit type</th>
<th>Energy efficiency outcome</th>
<th>Resilience benefit</th>
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<tbody>
<tr>
<td>Emergency response and recovery</td>
<td>Reduced electric demand</td>
<td>Increased reliability during times of stress on electric system and increased ability to respond to system emergencies</td>
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<td></td>
<td>Backup power supply from combined heat and power (CHP) and microgrids</td>
<td>Ability to maintain energy supply during emergency or disruption</td>
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<td></td>
<td>Efficient buildings that maintain temperatures</td>
<td>Residents can shelter in place as long as buildings’ structural integrity is maintained.</td>
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<td></td>
<td>Multiple modes of transportation and efficient vehicles</td>
<td>Several travel options that can be used during evacuations and disruptions</td>
</tr>
<tr>
<td>Social and economic</td>
<td>Local economic resources may stay in the community</td>
<td>Stronger local economy that is less susceptible to hazards and disruptions</td>
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<td></td>
<td>Reduced exposure to energy price volatility</td>
<td>Economy is better positioned to manage energy price increases, and households and businesses are better able to plan for future.</td>
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<tr>
<td></td>
<td>Reduced spending on energy</td>
<td>Ability to spend income on other needs, increasing disposable income (especially important for low-income families)</td>
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<td></td>
<td>Improved indoor air quality and emission of fewer local pollutants</td>
<td>Fewer public health stressors</td>
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<tr>
<td>Climate mitigation and adaptation</td>
<td>Reduced greenhouse gas emissions from power sector</td>
<td>Mitigation of climate change</td>
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<td></td>
<td>Cost-effective efficiency investments</td>
<td>More leeway to maximize investment in resilient redundancy measures, including adaptation measures</td>
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### Table ES2. Energy efficiency measures that reduce vulnerability and increase capacity to cope

<table>
<thead>
<tr>
<th>Energy efficiency measure</th>
<th>Resilience implications</th>
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<tbody>
<tr>
<td>CHP</td>
<td>Provides backup power, allows facilities receiving backup power to double as shelter for displaced residents, reduces overall net emissions, and potentially increases cost savings</td>
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<tr>
<td>Microgrids</td>
<td>May disconnect from grid during power outage, maintaining power supply; allows facilities receiving backup power to double as shelter for displaced residents; reduces overall net emissions; and potentially increases cost savings</td>
</tr>
<tr>
<td>Transportation alternatives</td>
<td>Multiple transportation modes that can be used during evacuations and everyday disruptions</td>
</tr>
<tr>
<td>District energy systems</td>
<td>Provides heating, cooling, and electricity using local energy sources and reduces peak power demand through thermal energy storage</td>
</tr>
<tr>
<td>Utility energy efficiency programs</td>
<td>Increases reliability and reduces utility costs</td>
</tr>
<tr>
<td>Energy-efficient buildings</td>
<td>Allows residents/tenants to shelter in place longer, reduces annual energy spending, and reduces overall net emissions. Can help vulnerable populations avoid dangerous and occasionally life-threatening situations in which weather and economics present a dual threat</td>
</tr>
<tr>
<td>Green infrastructure</td>
<td>Reduces localized flooding due to storms, reduces energy demand, and reduces urban heat island (UHI) effect in cities and electricity demand</td>
</tr>
<tr>
<td>Cool roofs and surfaces</td>
<td>Reduces UHI effect and electricity demand and reduces overall net emissions</td>
</tr>
<tr>
<td>Transit-oriented development</td>
<td>Increases economic development opportunities; provides transportation cost savings and reduces impacts of price volatility; and may improve air quality</td>
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</tbody>
</table>
FOR MORE INFORMATION

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https://www.nctcog.org/envir/natural-resources/energy-efficiency