Energy Efficiency and Infrastructure Resilience

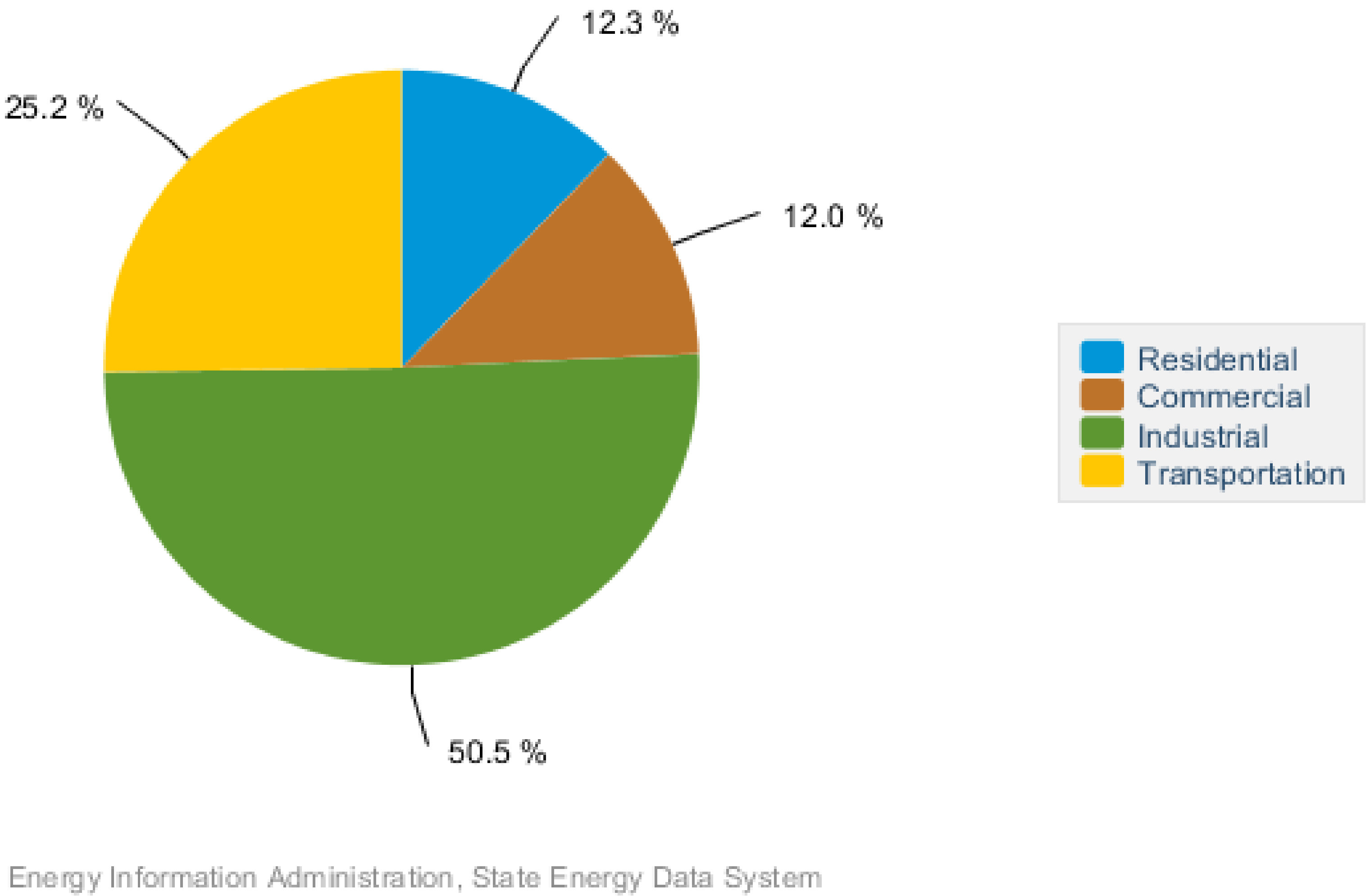
NORTH CENTRAL TEXAS COUNCIL OF GOVERNMENTS

AUGUST 28, 2019

North Central Texas
Council of Governments

Texas Energy Consumption by End-User Sector, 2017

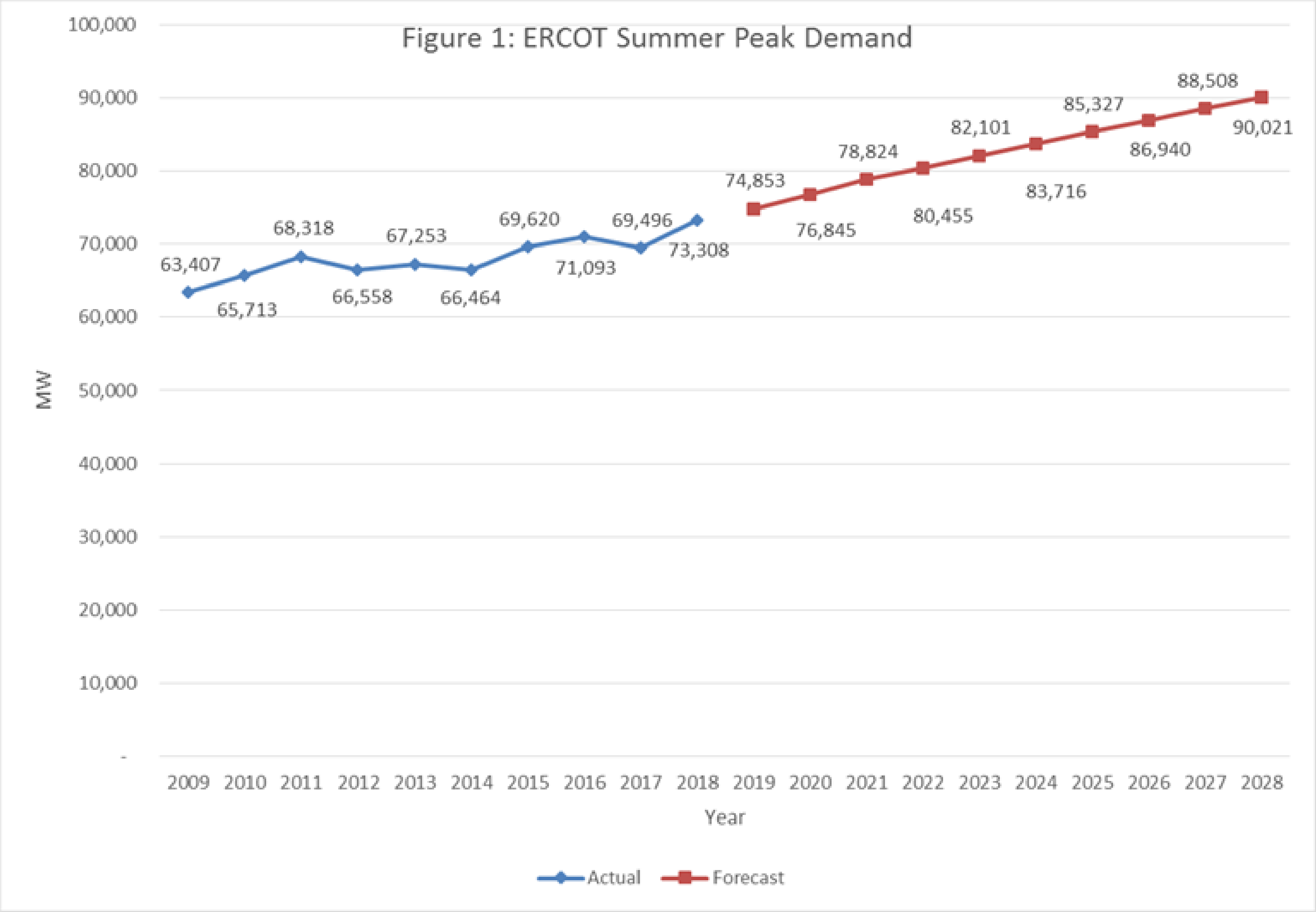
• Texas produces more electricity than any other state.
• Texas leads the nation in wind-powered generation and produced one-fourth of all the U.S. wind powered electricity in 2017.
•Texas is the largest energy-producing state and the largest energy-consuming state in the nation.



Source: Energy Information Agency
Last Updated: February 21, 2019

Electric Reliability Council of Texas Projected Peak Demand

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.

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.”

Bloomberg

Power blows past $9,000 cap in Texas as heat triggers emergency

Christopher Martin and Naureen S. Malik 8/13/2019

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

https://www.msn.com/en-us/money/markets/power-blows-past-dollar9000-cap-in-texas-as-heat-triggers-emergency/ar-AAFL62t

BRIEF

ERCOT calls 2 energy emergencies in one week, 3rd in 5 years

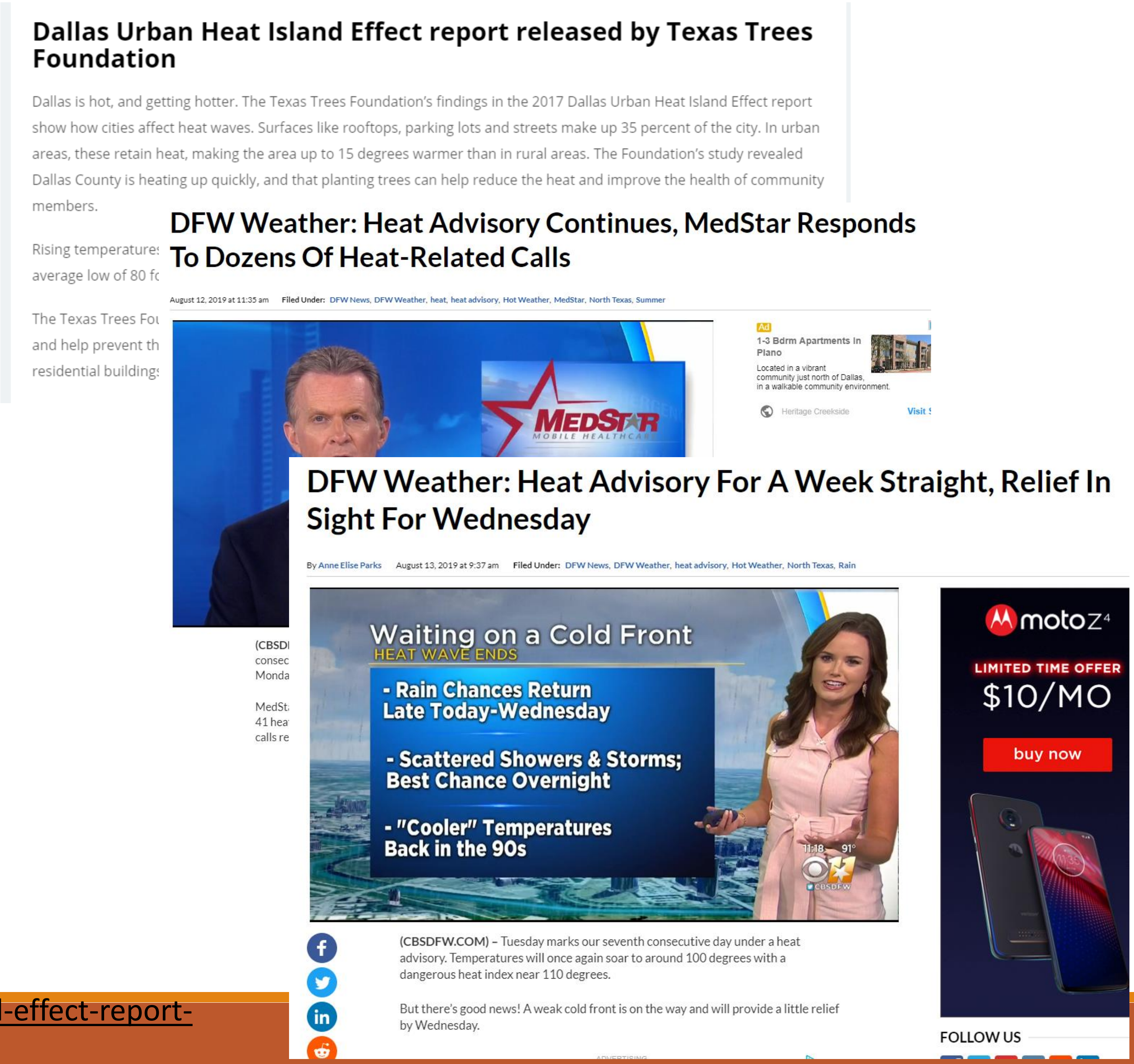
https://www.utilitydive.com/news/ercot-calls-2nd-energy-emergency-this-week-3rd-in-5-years/561065/

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/



Dallas Urban Heat Island Effect report released by Texas Trees Foundation

Dallas is hot, and getting hotter. The Texas Trees Foundation’s findings in the 2017 Dallas Urban Heat Island Effect report show how cities affect heat waves. Surfaces like rooftops, parking lots and streets make up 35 percent of the city. In urban areas, these retain heat, making the area up to 15 degrees warmer than in rural areas. The Foundation’s study revealed Dallas County is heating up quickly, and that planting trees can help reduce the heat and improve the health of community members.

DFW Weather: Heat Advisory Continues, MedStar Responds To Dozens Of Heat-Related Calls

August 12, 2019 at 11:35 am Filed Under: DFW News, DFW Weather, heat, heat advisory, Hot Weather, MedStar, North Texas, Summer

DFW Weather: Heat Advisory For A Week Straight, Relief In Sight For Wednesday

By Anne Elise Parks August 13, 2019 at 9:37 am Filed Under: DFW News, DFW Weather, heat advisory, Hot Weather, North Texas, Rain

(CBSDFW.COM) – Tuesday marks our seventh consecutive day under a heat advisory. Temperatures will once again soar to around 100 degrees with a dangerous heat index near 110 degrees.

But there’s good news! A weak cold front is on the way and will provide a little relief by Wednesday.

http://www.dallascitynews.net/dallas-urban-heat-island-effect-report-released-texas-trees-foundation

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.
Ian Muttoo/Flickr

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 can interfere with everyday efforts to keep the lights on. pan denim/Shutterstock.com

Email
Twitter 21
Facebook 59
LinkedIn
Print

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

Author

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Director of Energy Studies, University of Florida

Disclosure statement

Theodore Kury directs of Energy Studies at the University of Florida's Public Utility Research

https://theconversation.com/russians-hacked-into-americas-electric-grid-heres-why-securing-it-is-hard-94279

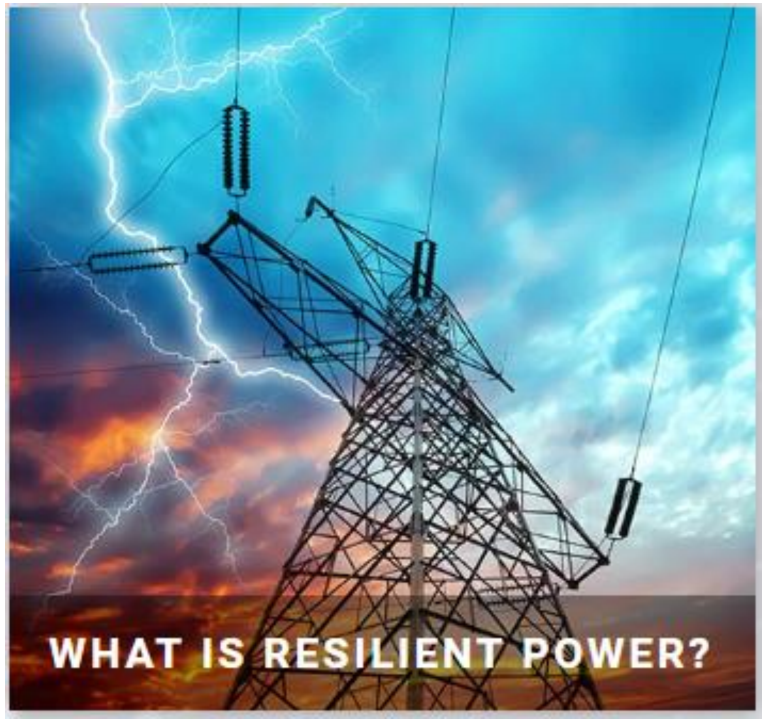
Generic Interdependency Among Critical Infrastructure Sectors

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

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

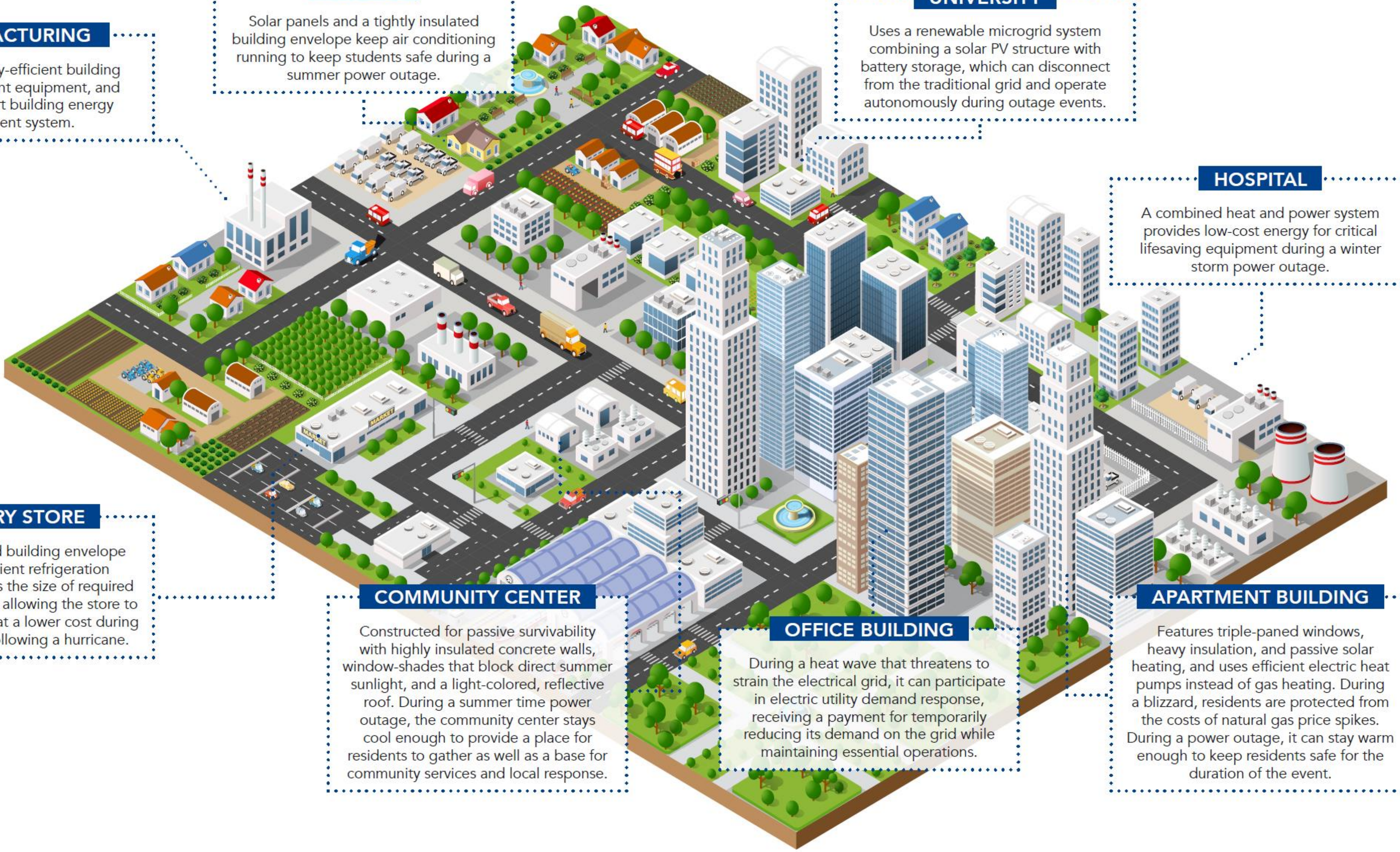
Solar panels and a tightly insulated building envelope keep air conditioning running to keep students safe during a summer power outage.

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-paned 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.

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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

Communications Infrastructure	Support Needed[4]	Design Hazard Performance								
		Phase 1 Short-Term			Phase 2 Intermediate			Phase 3 Long-Term		
		Days			Weeks			Months		
		0	1	1-3	1-4	4-8	8-12	4	4-24	24+
Power - Electric Utilities										
Community Owned or Operated Bulk Generation										
Generation Requiring Fuel Transport (Coal, Gas, Oil fired)										
In Place Fueled Generation (Hydro, solar, wind, wave, compressed air)										
Storage (Thermal, Chemical, Mechanical)										
Community Owned or Operated Distributed Generation										
Generation Requiring Fuel Transport (Coal, Gas, Oil fired)										
In Place Fueled Generation (Hydro, solar, wind, wave, compressed air)										
Storage (Thermal, Chemical, Mechanical)										
Transmission and Distribution (including Substations)										
Critical Facilities										
Hospitals, Police and Fire Stations / Emergency Operations Centers										
Debris / recycling centers/ Related lifeline systems										
Emergency Housing										
Public Shelters / Nursing Homes / Food Distribution Centers										
Emergency shelter for response / recovery workforce/ Key Commercial and Finance										
Housing/Neighborhood										
Essential city services facilities / schools / Medical offices										
Houses of worship/meditation/ exercise										
Buildings/space for social services (e.g., child services) and prosecution activities										
Community Recovery										
Commercial and industrial businesses / Non-emergency city services										
Residential housing restoration										

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

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

Table ES2. Energy efficiency measures that reduce vulnerability and increase capacity to cope

Energy efficiency measure	Resilience implications
CHP	Provides backup power, allows facilities receiving backup power to double as shelter for displaced residents, reduces overall net emissions, and potentially increases cost savings
Microgrids	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
Transportation alternatives	Multiple transportation modes that can be used during evacuations and everyday disruptions
District energy systems	Provides heating, cooling, and electricity using local energy sources and reduces peak power demand through thermal energy storage
Utility energy efficiency programs	Increases reliability and reduces utility costs
Energy-efficient buildings	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
Green infrastructure	Reduces localized flooding due to storms, reduces energy demand, and reduces urban heat island (UHI) effect in cities and electricity demand
Cool roofs and surfaces	Reduces UHI effect and electricity demand and reduces overall net emissions
Transit-oriented development	Increases economic development opportunities; provides transportation cost savings and reduces impacts of price volatility; and may improve air quality

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North Central Texas
Council of Governments

Practical Approaches to Keeping the Lights On with CHP Microgrids

U.S. DOE CHP Deployment Program
CHP Technical Assistance Partnerships

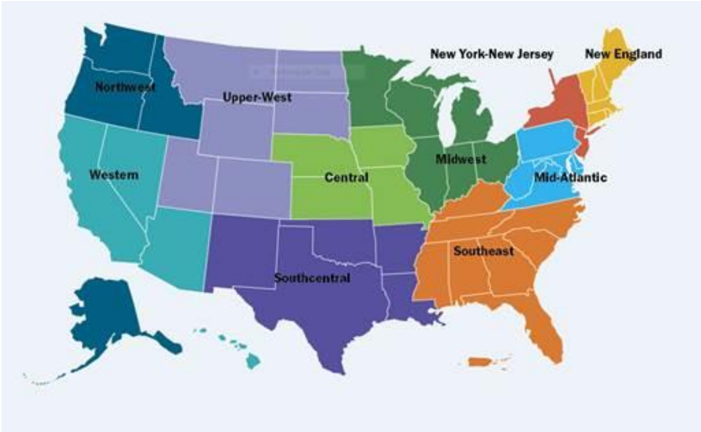
Gavin Dillingham, PhD
Director Southcentral CHP TAP
August 28, 2019

Outline

- CHP Overview
- The State of CHP
- Microgrids with CHP
- Need for Resilient Critical Infrastructure
- Resilience Improved with Microgrids
- Resilience Planning with DOE
- Project Snapshots
- Implementing a Project with CHP TAP

DOE CHP Technical Assistance Partnerships (CHP TAPs)

- **End User Engagement**
  Partner with strategic End Users to advance technical solutions using CHP as a cost effective and resilient way to ensure American competitiveness, utilize local fuels and enhance energy security. CHP TAPs offer fact-based, non-biased engineering support to manufacturing, commercial, institutional and federal facilities and campuses.
- **Stakeholder Engagement**
  Engage with strategic Stakeholders, including regulators, utilities, and policy makers, to identify and reduce the barriers to using CHP to advance regional efficiency, promote energy independence and enhance the nation's resilient grid. CHP TAPs provide fact-based, non-biased education to advance sound CHP programs and policies.
- **Technical Services**
  As leading experts in CHP (as well as microgrids, heat to power, and district energy) the CHP TAPs work with sites to screen for CHP opportunities as well as provide advanced services to maximize the economic impact and reduce the risk of CHP from initial CHP screening to installation.



www.energy.gov/chp

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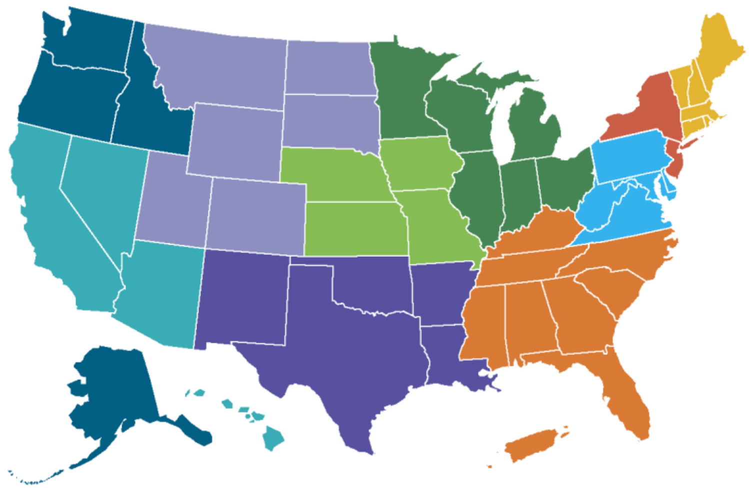

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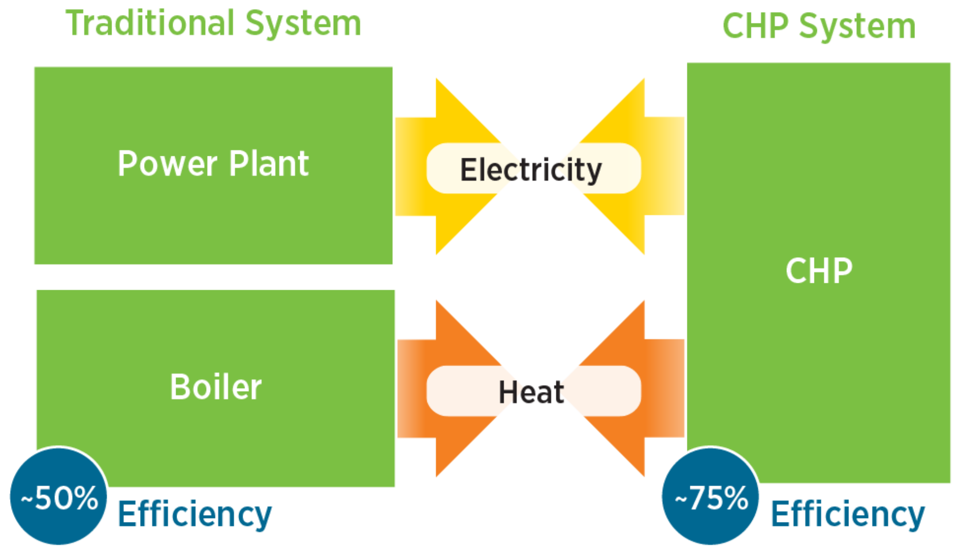
CHP Overview

CHP: A Key Part of Our Energy Future

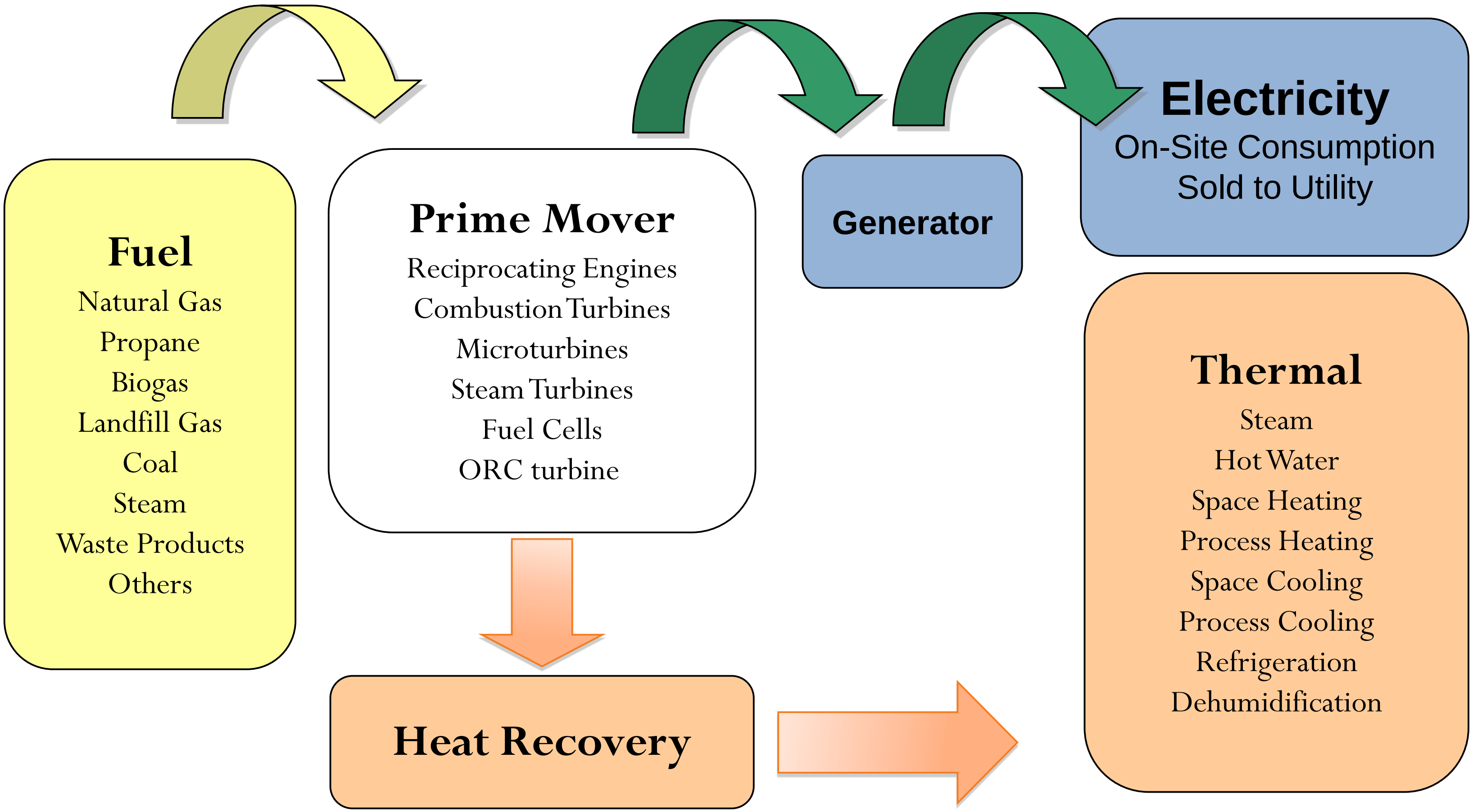
- Form of Distributed Generation (DG)
- An integrated system
- Located at or near a building / facility
- Provides at least a portion of the electrical load and
- Uses thermal energy for:
  - Space Heating / Cooling
  - Process Heating / Cooling
  - Dehumidification



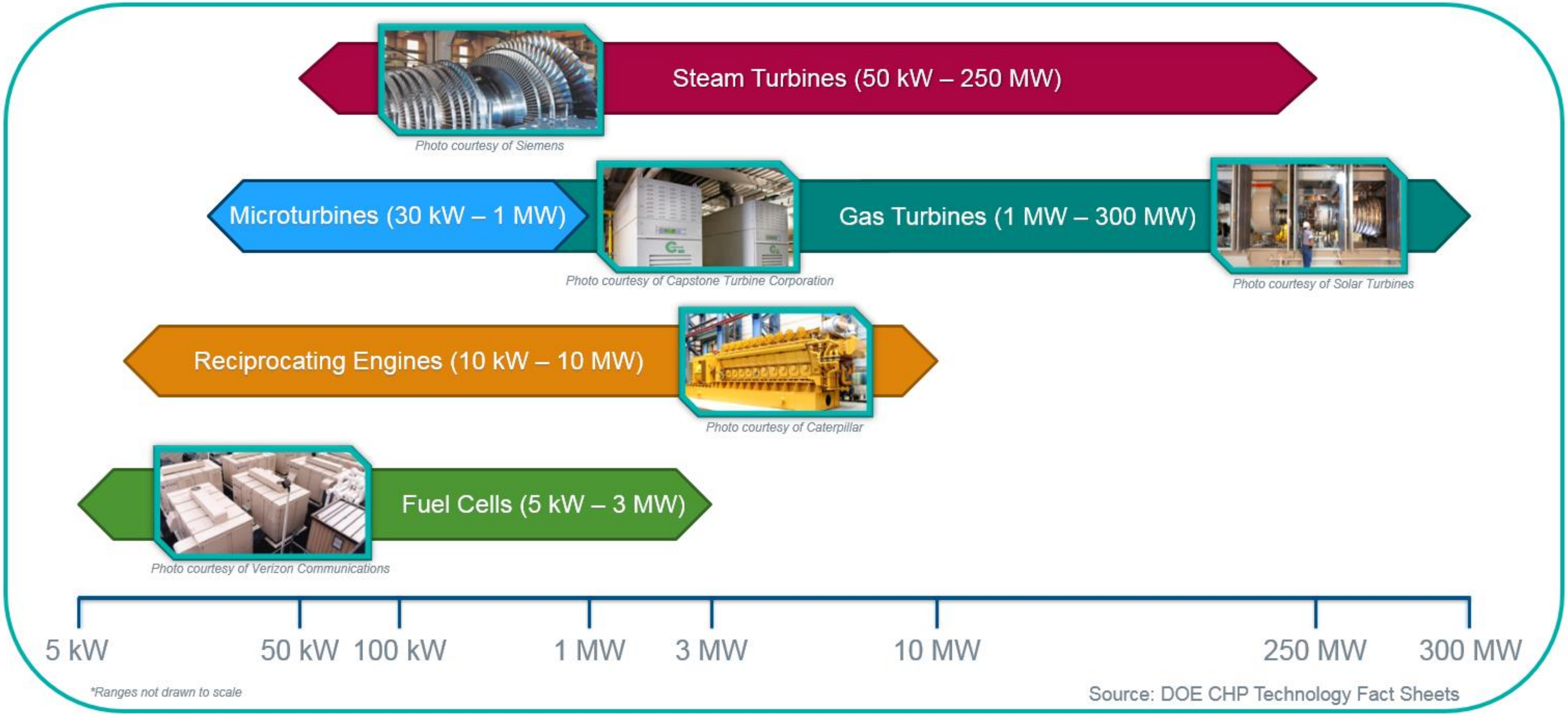
CHP provides efficient, clean, reliable, affordable energy – today and for the future.

Source: www.energy.gov/chp

CHP System Schematic



Common CHP Technologies and Capacity Ranges

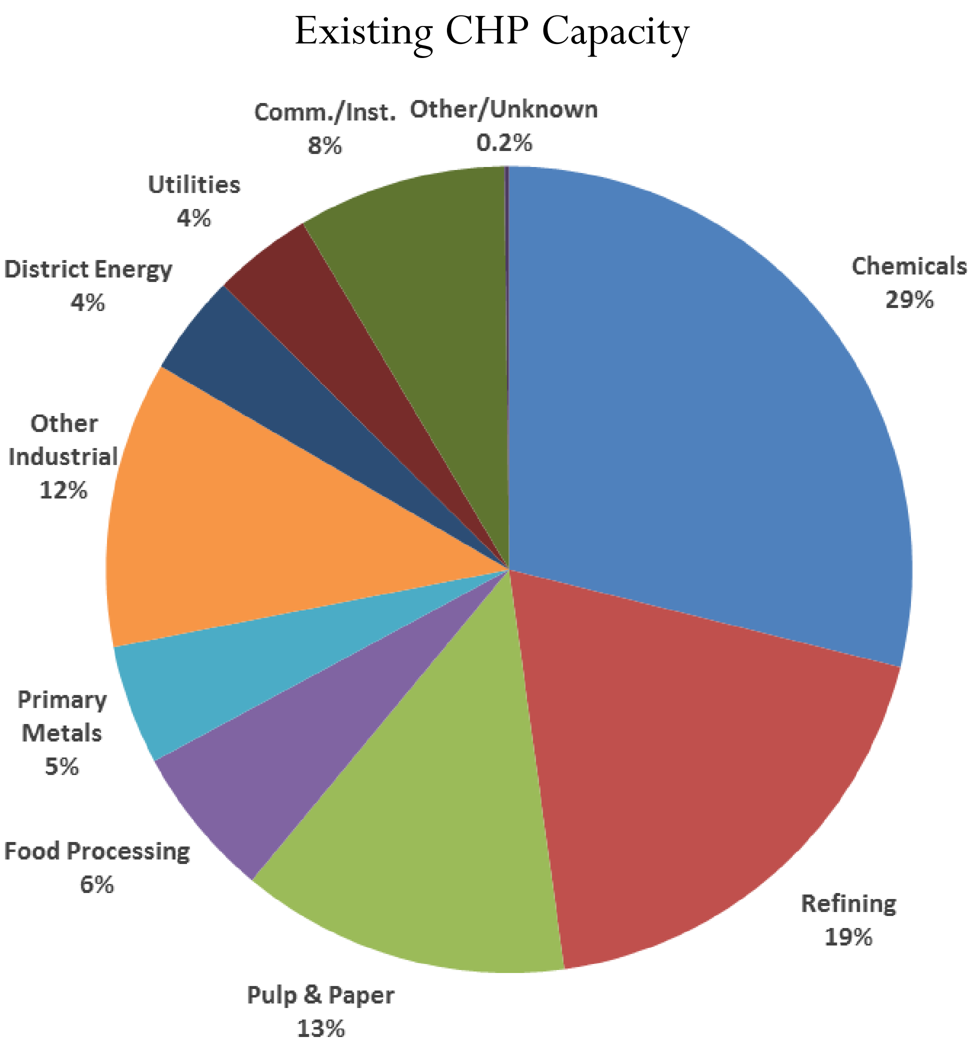


What Are the Benefits of CHP?

- CHP is **more efficient** than separate generation of electricity and heating/cooling
- Higher efficiency translates to **lower operating costs** (but requires capital investment)
- Higher efficiency **reduces emissions** of pollutants
- CHP can also increase **energy reliability and resiliency** and enhance power quality
- On-site electric generation can **reduce grid congestion** and avoid distribution costs.

The State of CHP

CHP Today in the United States

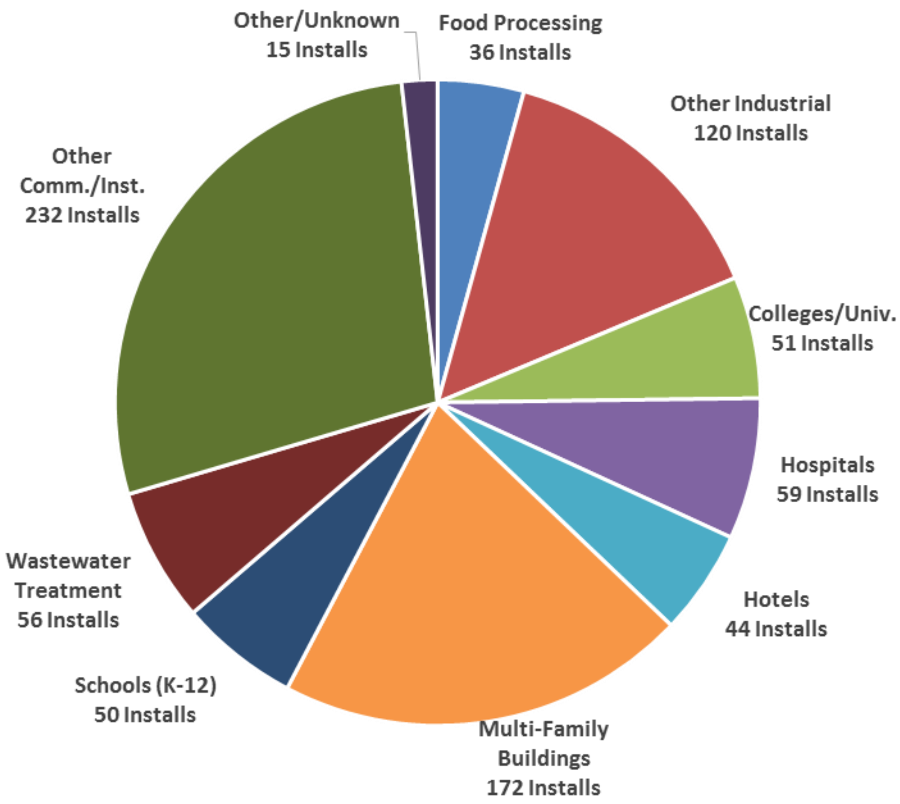


Source: DOE CHP Installation Database (U.S. installations as of Dec. 31, 2018)

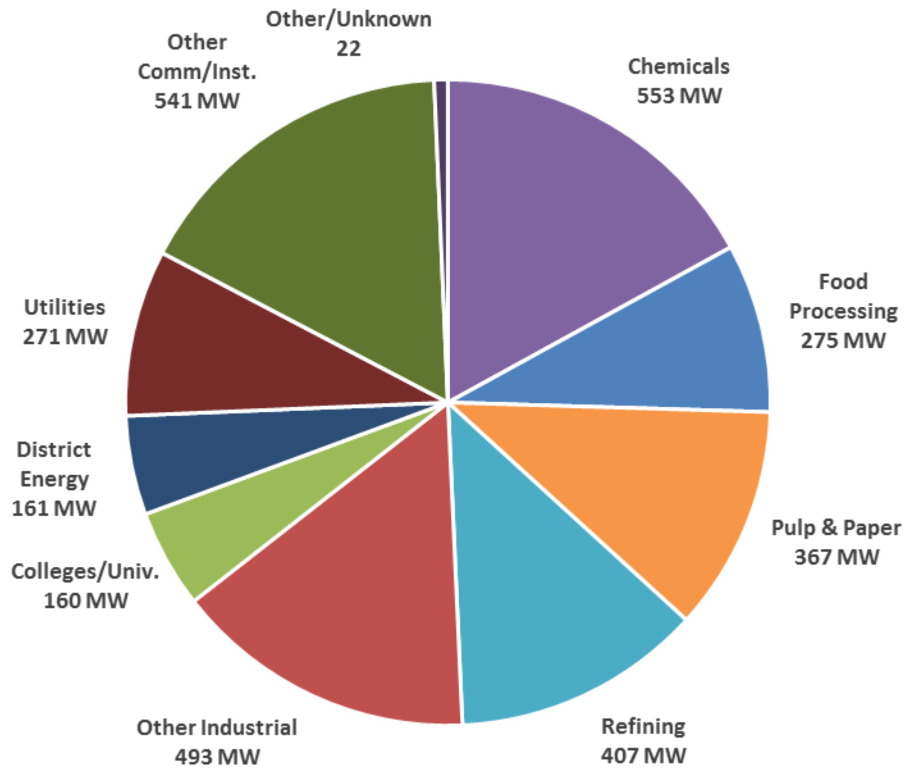
- **80.7 GW** of installed CHP at more than 4,500 industrial and commercial facilities
- 8% of U.S. Electric Generating Capacity; 14% of Manufacturing
- Avoids more than **1.8 quadrillion Btus** of fuel consumption annually
- Avoids **241 million metric tons of CO_2** compared to separate production

CHP Additions by Application (2014-2018)

By Installations – 835 Installs



By Capacity – 3.3 GW

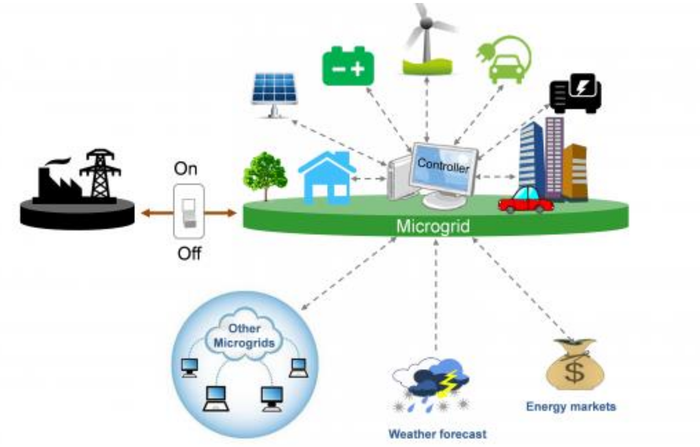


Source: DOE CHP Installation Database (U.S. installations as of Dec. 31, 2018)

Microgrids with CHP

Microgrid Definition

A microgrid is a **group of interconnected loads and distributed energy resources** within clearly defined electrical boundaries that acts as a **single controllable entity** with respect to the grid.

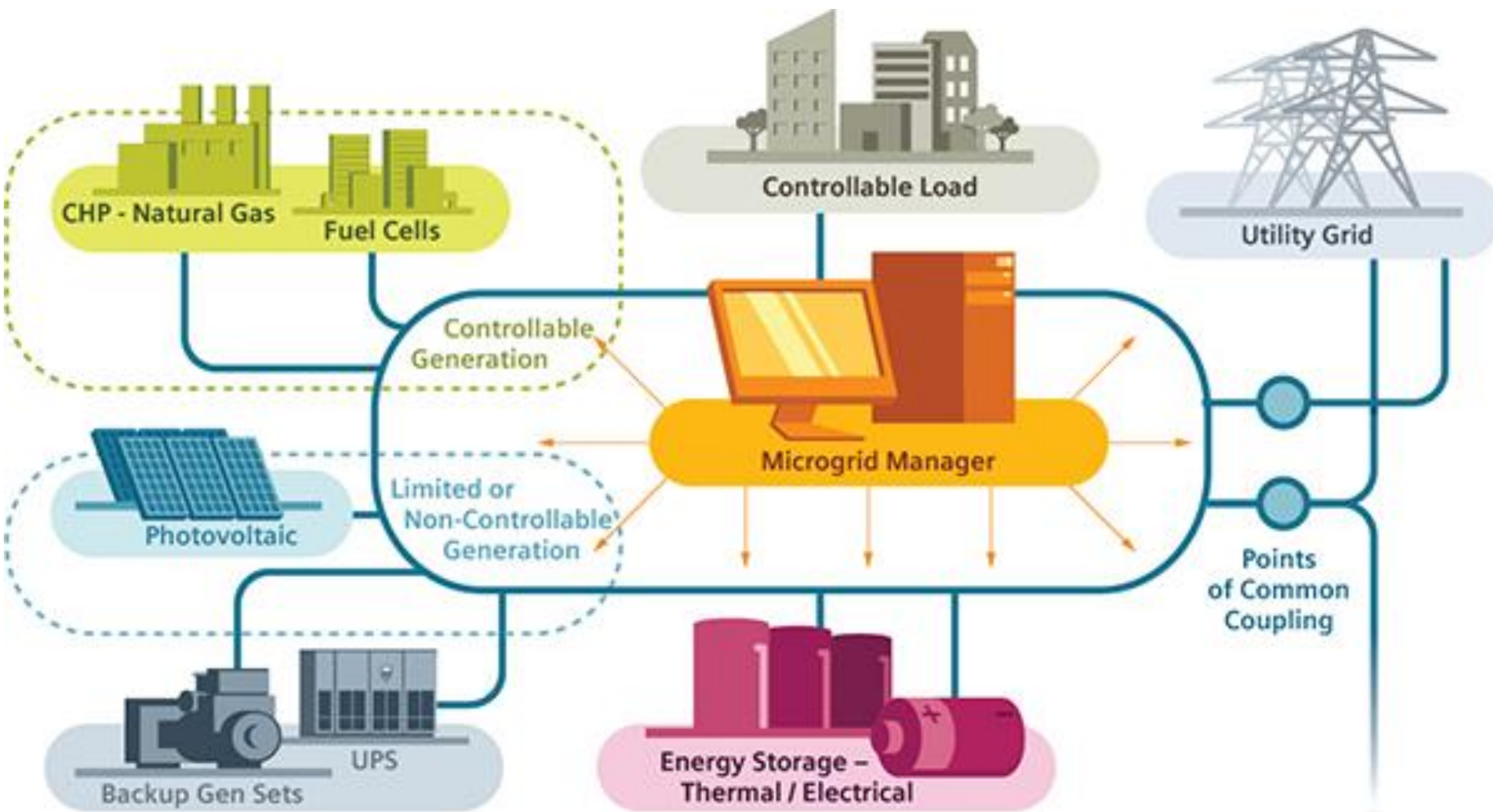


A microgrid can **connect and disconnect** from the larger utility grid to enable it to operate in both **grid-connected** or **island-mode**.

- Microgrids can use *any combination* of distributed energy resource (DER) technologies
  - Can be a single technology, such as combined heat and power (CHP), serving multiple buildings
  - Can be a group of connected DER technologies serving a single facility
- Microgrids are *designed to improve resiliency* of the delivery of electricity to connected facilities in order to perform critical functions when the larger utility grid is down

Source: U.S. Department of Energy Microgrid Exchange Group

Microgrids Can Incorporate Many Technologies



Microgrid Applications

- **Microgrids are most often deployed in institutional campus settings, like military facilities, government buildings, hospitals, and universities**
  - All buildings owned/operated by a single entity
  - Backup power and ability to sustain grid outages for critical facilities
- **Microgrids could be tied to district energy "downtown loops", providing steam, hot/chilled water *and electricity* to various commercial/industrial facilities**
  - More challenging when each facility is owned and operated by separate entities with different requirements and goals

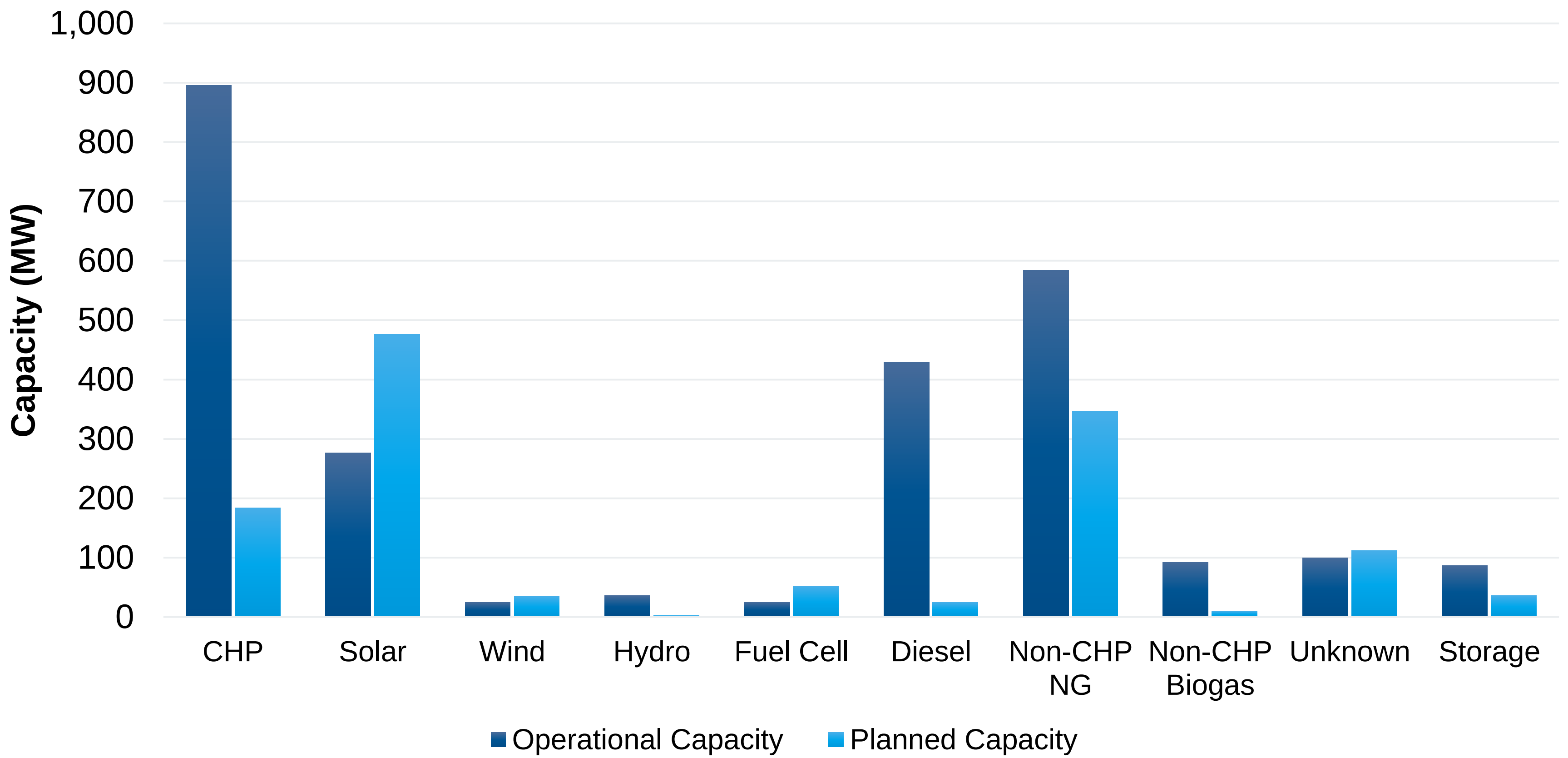
Current Microgrid Market

- As of October 2018, **331 total microgrid projects** in U.S.
  - **211 operational microgrids** identified, with 3.85 GW of total capacity
  - **104 planned microgrid projects** with 1.55 GW of expected capacity
  - 16 microgrids that have been stalled, or whose status is unknown

- CHP serves as resilient baseload anchor for many microgrids – most operational capacity by technology
- Microgrid market is growing fast, with solar PV increasing compared to current operational capacity

Source: ICF Microgrid Database – microgrids used for more than emergency/standby backup power

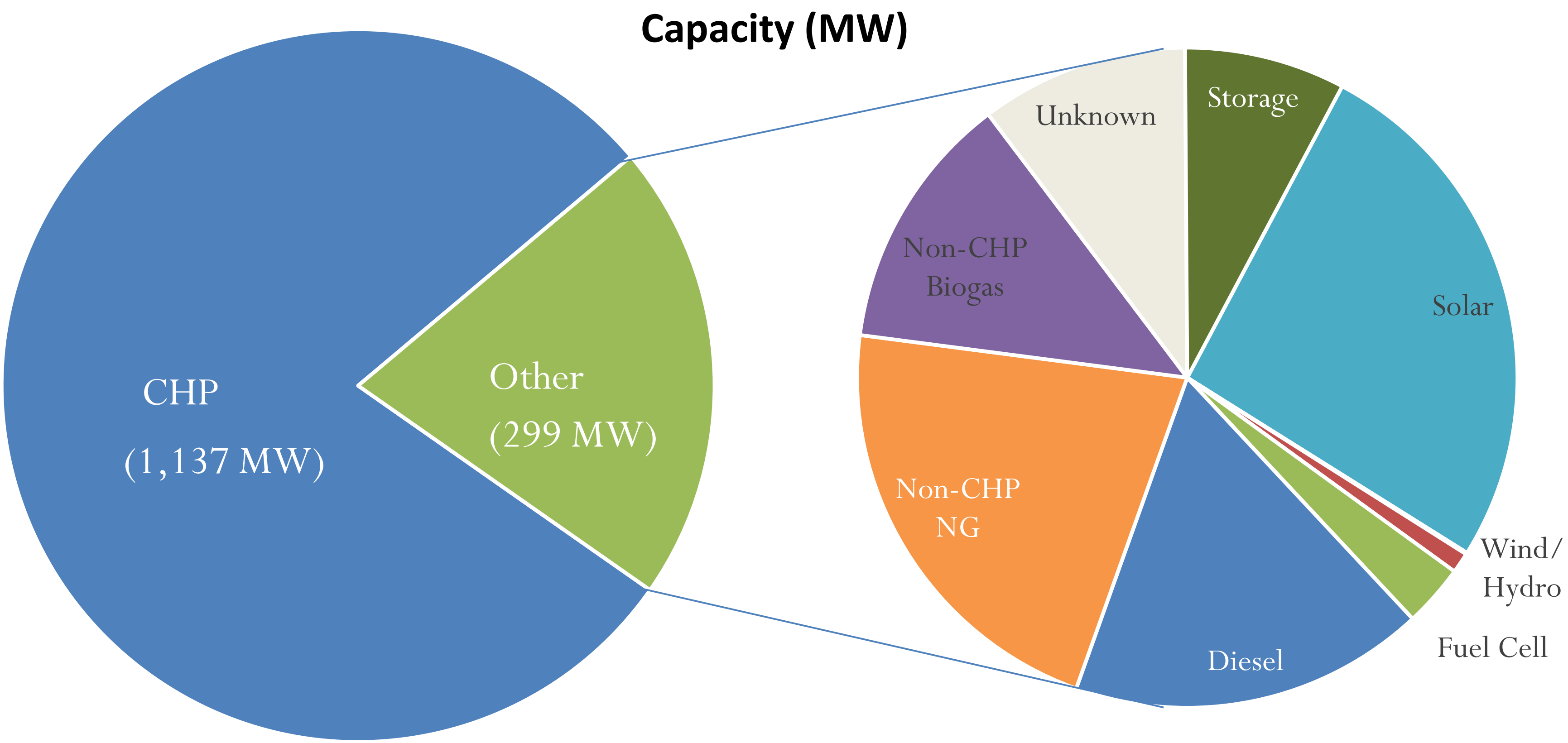
U.S. Microgrid Capacity by Technology



Source: ICF Microgrid Database

CHP Technical Assistance Partnerships
SOUTHCENTRAL

Technologies Used with CHP in Operational Microgrids*



*Only operational microgrids with CHP

Source: ICF Microgrid Database

CHP Technical Assistance Partnerships
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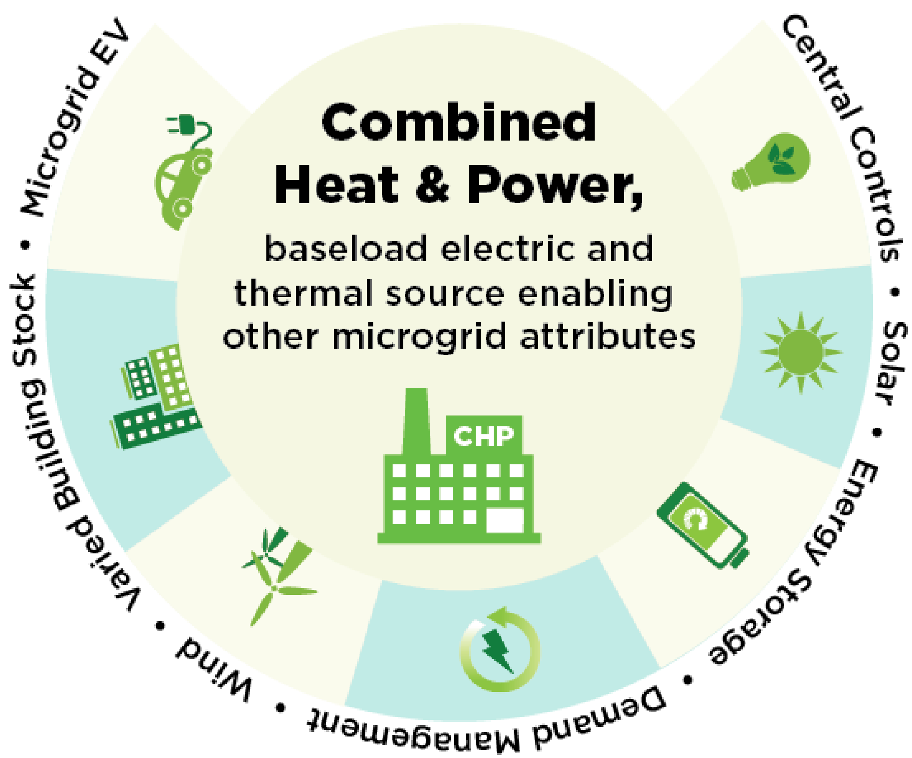
CHP Microgrids: Status and Benefits

- **For planned and operational microgrids, only 75 out of 314 microgrids use CHP**
  - Twice as many microgrids (150) use solar PV
  - CHP may not be applicable for every microgrid, but *more microgrids could be incorporating CHP*
- **Microgrids with CHP can produce baseload power 24/7 and continue critical operations indefinitely during extended utility outages**
  - Efficient operation, emission reductions, reliable fuel supply
  - Improved power quality, increased resilience, and potential for ancillary services

CHP Can Enable Other Microgrid Technologies



- With a CHP system providing baseload electric and thermal energy, microgrids can add:
  - Solar and wind resources
  - Energy storage
  - Demand management
  - Central controls
  - Electric vehicle charging
- Flexible CHP systems can ramp up and down as needed to balance renewable loads and provide grid services

DER Technologies Work Better Together in Microgrids

- CHP can work together with PV, wind, energy storage, and other technologies in resilient microgrids with diverse resources and multiple value streams
  - Active management system with programmable logic controllers to strategically utilize all microgrid resources
- Compared to a single DER technology, a microgrid with multiple DERs can provide:
  - Stronger resilience
  - Higher operational flexibility
  - More use cases
- ***For utilities***, microgrids can offer locational value, increased grid reliability, power quality, ancillary services, and demand response functionality
- ***For end users***, microgrids provide reliable and resilient power with the potential for energy and emissions savings

Microgrid Implementation Drivers

- **End-users choose to install microgrids due to a combination of site-specific factors or *implementation drivers***
  - **Clean Power**
    - Cut emissions through the use of efficient and/or zero-carbon microgrid technologies
  - **Economics**
    - Reduce electricity, heating, cooling, and other costs through various mechanisms, such as self-generation (avoided utility costs), shared operation and maintenance, and lower fuel prices
  - **R&D**
    - Conduct research on new technologies, microgrid configurations, and financing arrangements

Microgrid Implementation Drivers (continued)

- **Reliability & Resilience**
  - Improve electricity and thermal energy reliability and resilience during grid outages and other major disruptive events
  - Especially important for critical infrastructure facilities
- **Remote Grid**
  - Provide power to remote locations that cannot rely on the power grid, such as an island community
- **Renewables Integration**
  - Incorporate renewable technologies into power generation mix while using other technologies to offset the intermittency of renewables

New Business Models: Microgrids as a Service

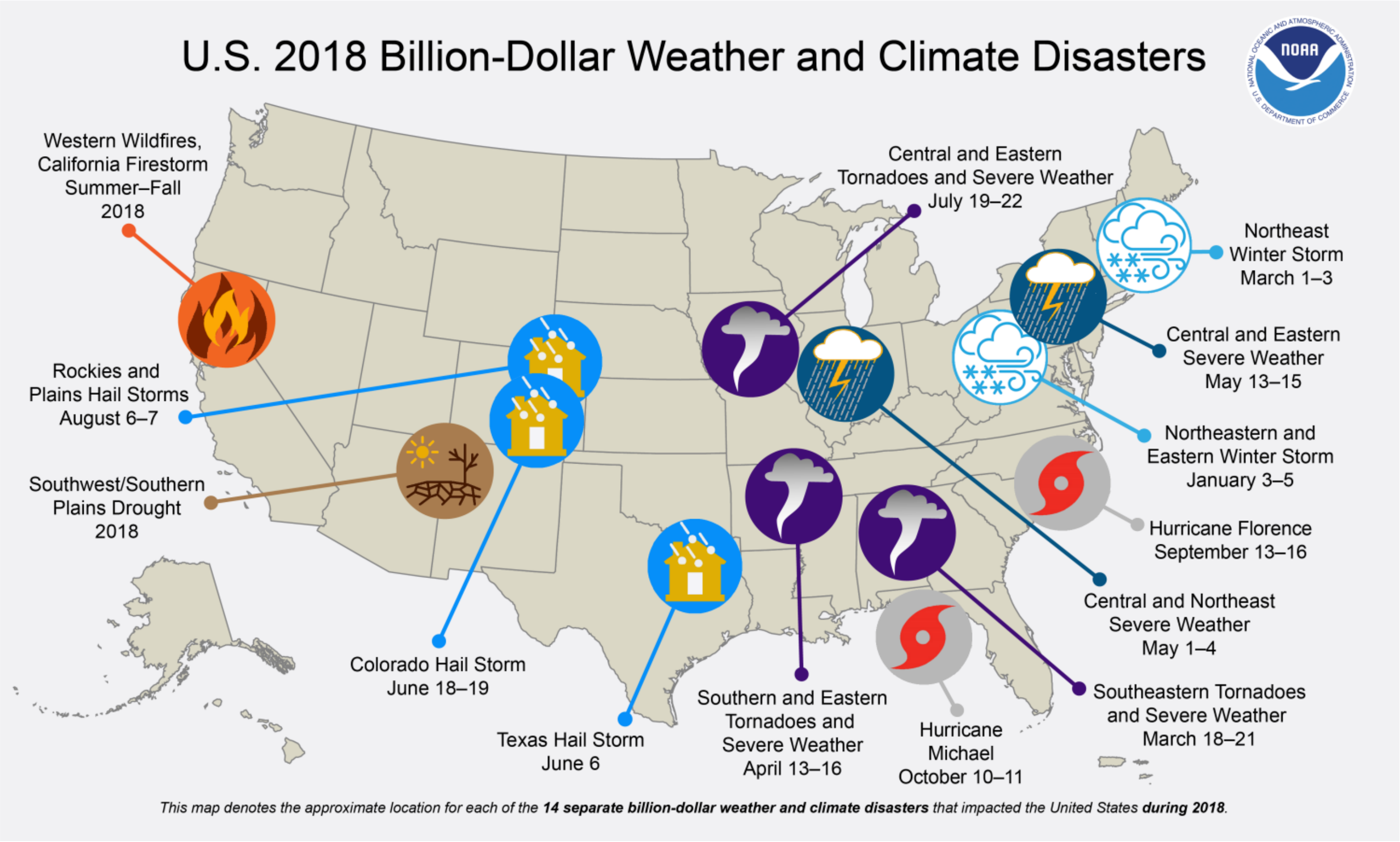
- **Microgrids are complex, with multiple energy resources serving variable loads**
  - Custom-engineered logic controller with inverters, relays, and switchgear to respond to loads and utility signals
- **Business owners do not understand the complexity**
- **Large capital investment, multiple parties involved**
- **Developers are beginning to offer "microgrids as a service"**
  - Power purchase agreements with long-term contracts
  - Developers engineer, finance, install, operate and maintain the microgrid
  - Schneider Electric, PowerSecure (Southern Company), Siemens and more
  - Carlyle Group set up Dynamic Energy Networks for this offering, with $500M initial backing

Utilities can Benefit from CHP Microgrids

- **Utilities could potentially offer microgrids as a *rate-based* service**
  - Benefits for both utilities and customers in local, resilient power
  - Utilities continue to serve their customers' full power needs
  - Several utilities are exploring CHP microgrids for large customers
    - Customer keeps current rate for electricity, with added resiliency benefits
    - Steam is sold to the customer at a discount, producing additional revenue for utility
    - CHP acts as a grid resource for the utility, with excess electricity supplied to grid
- **Unlike other DER technologies, CHP can contribute towards *energy efficiency* goals for both utilities and end-users**
  - CHP produces significant energy efficiency savings compared to separate heat and power

Need for Resilient Critical Infrastructure

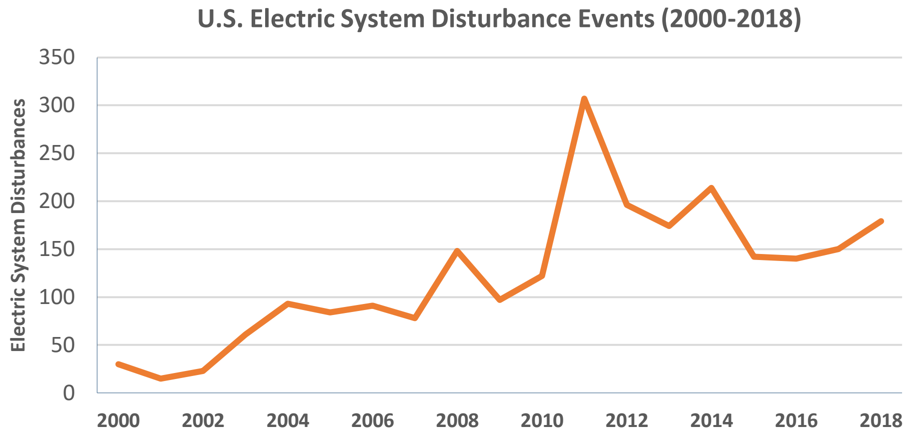
Power Outages are Costly



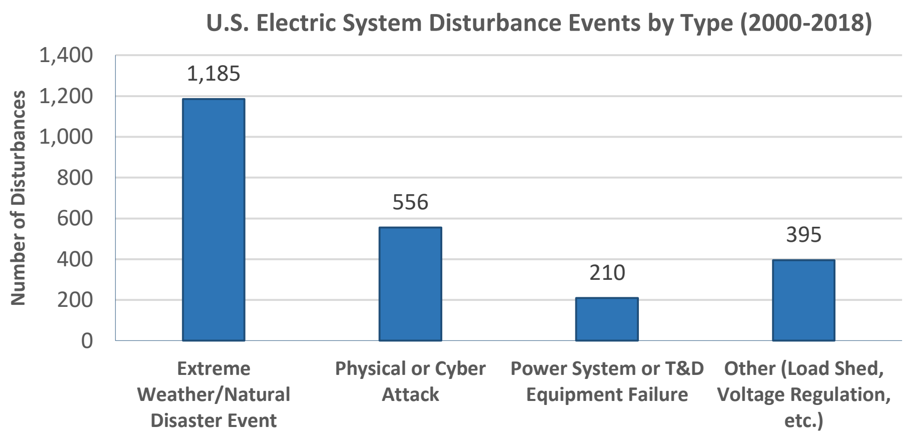
CHP Technical Assistance Partnerships
SOUTHCENTRAL

Electric System Disturbances

Electric system outages are increasingly frequent…



And outages are increasingly caused by natural disasters and storm events



Source: U.S. DOE Office of Cybersecurity, Energy Security, and Emergency Response, Electric Disturbance Events (OE-417) Annual Summaries

Reliability and Resilience: Outage Costs by Customer Class

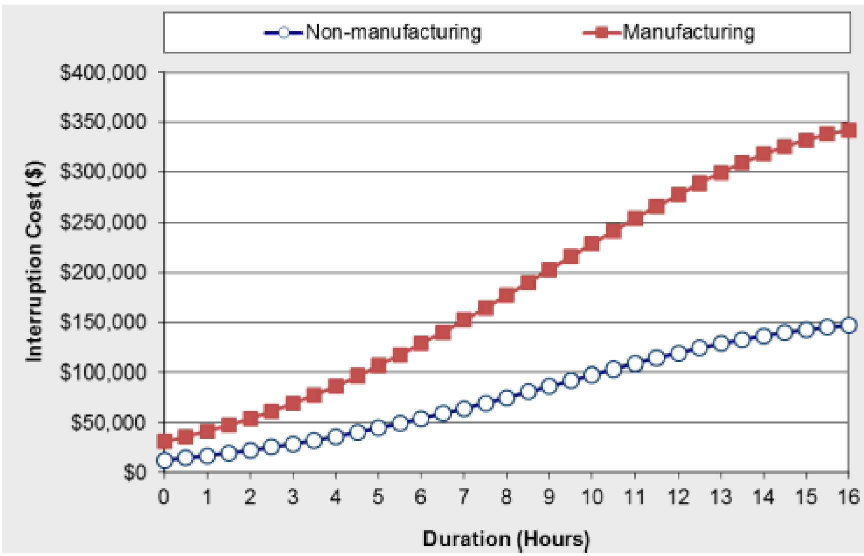
Customer class	Momentary	30 min.	1 hour	4 hours	8 hours	16 hours
Medium and large commercial and industrial (C&I) facilities						
Cost per event	$12,952	$15,241	$17,804	$39,458	$84,083	$165,482
Cost per average kW	$16	$19	$22	$48	$103	$203
Cost per unserved kWh	$190	$37	$22	$12	$13	$13
Small C&I						
Cost per event	$412	$520	$647	$1,880	$4,690	$9,055
Cost per average kW	$187	$237	$295	$857	$2,138	$4,128
Cost per unserved kWh	$2,254	$474	$295	$214	$267	$258
Residential						
Cost per event	$4	$5	$5	$10	$17	$32
Cost per average kW	$3	$3	$3	$6	$11	$21
Cost per unserved kWh	$31	$6	$3	$2	$1	$1

Cost figures in 2013$. Source: Sullivan, Schellenberg, and Blundell 2015.

Medium and Large C&I facilities suffer the highest absolute outage costs, while Small C&I facilities have the highest per-unit outage costs.

Source: *Valuing Distributed Energy Resources: Combined Heat and Power and the Modern Grid. Chittum and Relf, April 2018. ACEEE White Paper. Available at https://aceee.org/white-paper/valuing-der*

Reliability and Resilience: C&I Outage Costs by Sector



Cost figures in 2013$. Source: Sullivan, Schellenberg, Blundell 2015.

Sector	Momentary	30 min.	1 hour	4 hours	8 hours
Medium and large C&I					
Agriculture	$4,382	$6,044	$8,049	$25,628	$41,250
Mining	$9,874	$12,883	$16,366	$44,708	$70,281
Construction	$27,048	$36,097	$46,733	$135,383	$214,644
Manufacturing	$22,106	$29,098	$37,238	$104,019	$164,033
Telecommunications & utilities	$11,243	$15,249	$20,015	$60,663	$96,857
Trade & retail	$7,625	$10,113	$13,025	$37,112	$58,694
Finance, insurance, real estate	$17,451	$23,573	$30,834	$92,375	$147,219
Services	$8,283	$11,254	$14,793	$45,057	$71,997
Public administration	$9,360	$12,670	$16,601	$50,022	$79,793

Sector	Momentary	30 min.	1 hour	4 hours	8 hours
Small C&I					
Agriculture	$293	$434	$615	$2,521	$4,868
Mining	$935	$1,285	$1,707	$5,424	$9,465
Construction	$1,052	$1,436	$1,895	$5,881	$10,177
Manufacturing	$609	$836	$1,110	$3,515	$6,127
Telecommunications & utilities	$583	$810	$1,085	$3,560	$6,286
Trade & retail	$420	$575	$760	$2,383	$4,138
Finance, insurance, real estate	$597	$831	$1,115	$3,685	$6,525
Services	$333	$465	$625	$2,080	$3,691
Public administration	$230	$332	$461	$1,724	$3,205

Cost figures in 2008$. Source: Sullivan et al. 2009.

Manufacturing facilities generally experience higher outage costs than other Large C&I customer segments.

Critical Infrastructure Resilience

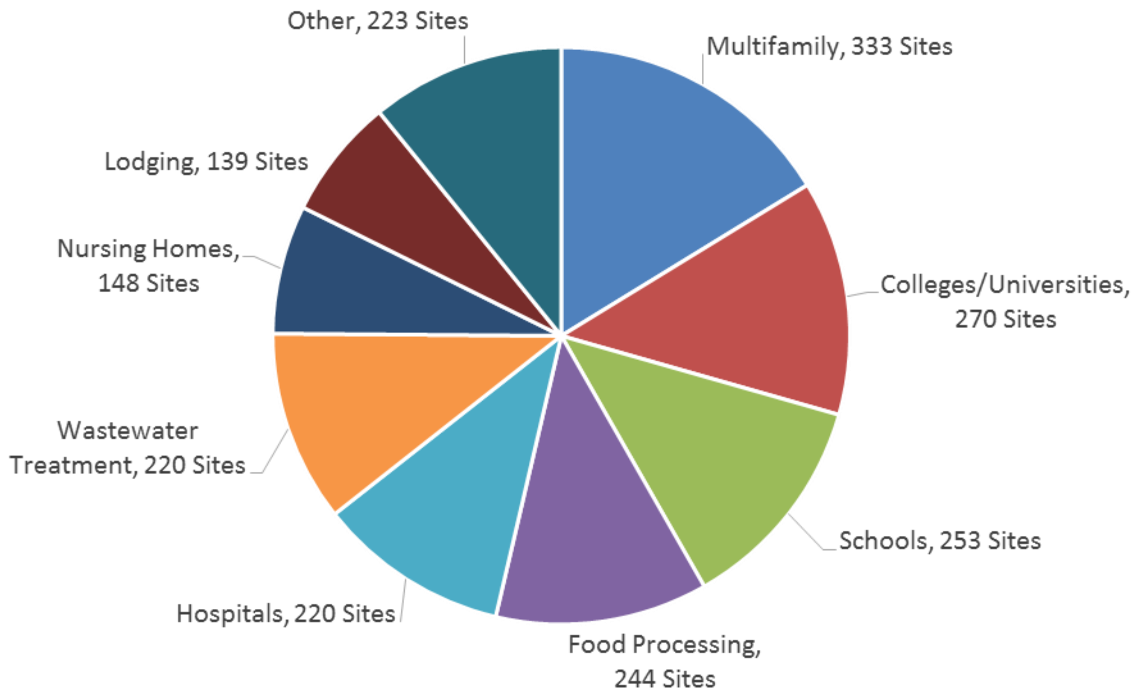
- Critical infrastructure refers to assets, systems, and networks that, if incapacitated, would have a substantial negative impact on national security, economic security, or public health and safety
- Many critical infrastructure facilities have consistent electric and thermal loads that can support CHP
- Microgrid with CHP offers many benefits to critical infrastructure:
  - Improve power quality, reliability, and resiliency
  - 24/7 power and heat with continuous benefits and cost savings
  - Can continue to operate during utility outages, providing uninterrupted electricity and heating/cooling to host facility

Critical Infrastructure Sectors Conducive to CHP

- Host facilities must have a consistent electric and thermal demand, and a reliable source of fuel (pipeline natural gas, anaerobic digester gas, etc.)

Who Can Use CHP?				
Airports	Chemicals & Pharmaceuticals	Colleges & Universities	Critical Manufacturing	Datacenters
Distribution Centers	Fire Stations	Food Processing	Food Sales & Supermarkets	Government Facilities
Hospitals & Healthcare	Hotels & Lodging	Laundries	Military Bases	Multifamily
Nursing Homes	Police Stations	Prisons	Schools	Wastewater Treatment Plants

CHP in Critical Infrastructure Installations by Sub-Sectors



More than 8.5 GW of CHP is installed at over 1,300 sites identified as critical infrastructure

Source: CHP Installation Database, 2018 - https://doe.icfwebservices.com/chpdb/

Natural Gas Distribution Service Reliability

Survey Overview

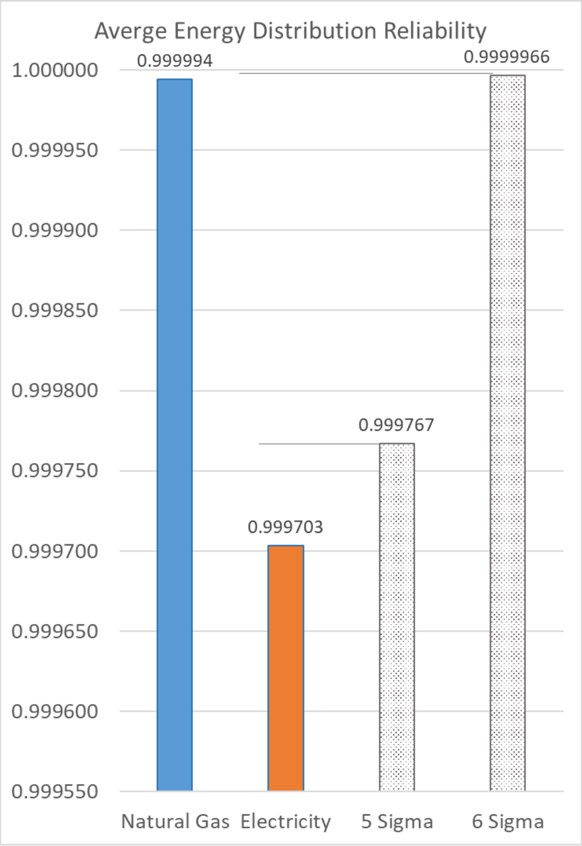
- Gas Technology Institute (GTI) conducted a survey of several North American natural gas distribution companies to obtain data on:
  - Distribution service reliability/availability. That is, the percent of time in any given year when natural gas service might not be available.
  - Annual outage rates. That is, the likelihood in a year time period that a customer could expect a disruption in natural gas service
- These data were compared with representative data from electric distribution service, using metrics that align with IEEE 1366 Electric Distribution Reliability Indices

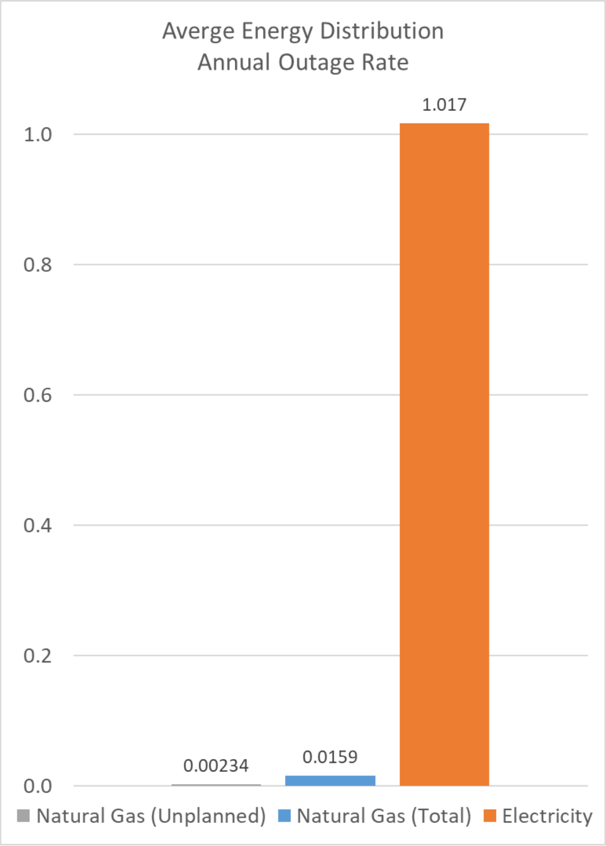
Source: Gas Technology Institute (GTI)

Energy Distribution Service Reliability

Summary of Survey Results

- Electric distribution approaches "five sigma" reliability with demonstrably higher annual outage rates (mainly unplanned)
- Natural gas distribution achieves "six sigma" reliability levels and exceptionally low outage rates
    - Most outages are due to planned maintenance
    - Third-party excavation leading cause of unplanned outages





Source: Gas Technology Institute (GTI)

Resilience Improved with Microgrids

Microgrids Improve Power Reliability and Resilience

- **Microgrids provide a variety of reliability and resilience benefits to customers located both within and outside the microgrid**
  - Microgrid customers can benefit from immediate continuation of service in the event of a utility-system outage
  - By removing dependence on the utility power, microgrids also benefit other utility customers by reducing demands on local grid infrastructure, decreasing the likelihood of equipment failure on the utility system
- **CHP systems are ideal for resilient baseload power**
  - CHP systems operate 24/7 and efficiently utilize heat that would otherwise be wasted, leading to significant energy and emissions savings
  - Natural gas generators are resilient to weather events, with a reliable fuel supply
  - Can be configured to automatically transition to island mode and support renewable generation during a utility power outage

Reliability, Resilience, and Power Quality Benefits of CHP Microgrids

Reliability	Resilience	Power Quality
▪ CHP systems located closer to loads than central generators, reducing likelihood of outages ▪ Fast-ramping capabilities **allow quick response** to changes in grid-supplied power, flexibility to serve dynamic loads ▪ CHP systems **reduce stress** on local distribution grid, extending life of grid components **and reducing risk of outage** caused by individual distribution equipment failure	▪ CHP systems operate near-continuously, can **provide firm backup generation** during outages ▪ **Island-capable systems** can maintain heat/power service to loads within the microgrid network during outages, fulfill **load shedding** requests during high demand periods ▪ During Hurricane Sandy in 2012, every islanding-capable CHP that received NYSERDA incentives stayed online	▪ CHP microgrids serving large, power quality-sensitive C&I customers such as data centers, and high-tech manufacturing **provide high-quality power** without service interruptions or voltage dips ▪ By locating generation closer to loads, CHP and district energy systems **prevent voltage fluctuation and other power quality issues** that typically arise on the distribution system

Sources: Same as previous slide

Factoring Outage Costs into Microgrid Planning

- **Based on the cost of power outages and the historical frequency of local outages, microgrid planners can estimate the value that resilient microgrids will provide**
  - Based on frequency and duration of outages, convert to expected mitigation of outage costs on an annual basis
  - Incorporate annual mitigated outage costs into financial pro forma
- **The impact that mitigated outage costs will have on a microgrid project depends on several factors**
  - Customer class and sector
  - Frequency and duration of outages
  - Relative cost of microgrid equipment and installation

How Does CHP Increase Resilience?

- For end users:
  - Provides continuous supply of electricity and thermal energy for critical loads
  - Can be configured to automatically switch to “island mode” during a utility outage, and to “black start” without grid power
  - Ability to withstand long, multiday outages
- For utilities:
  - Enhances grid stability and relieves grid congestion
  - Enables microgrid deployment for balancing renewable power and providing a diverse generation mix
- For communities:
  - Keeps critical facilities like hospitals and emergency services operating and responsive to community needs

Resilience Planning with DOE

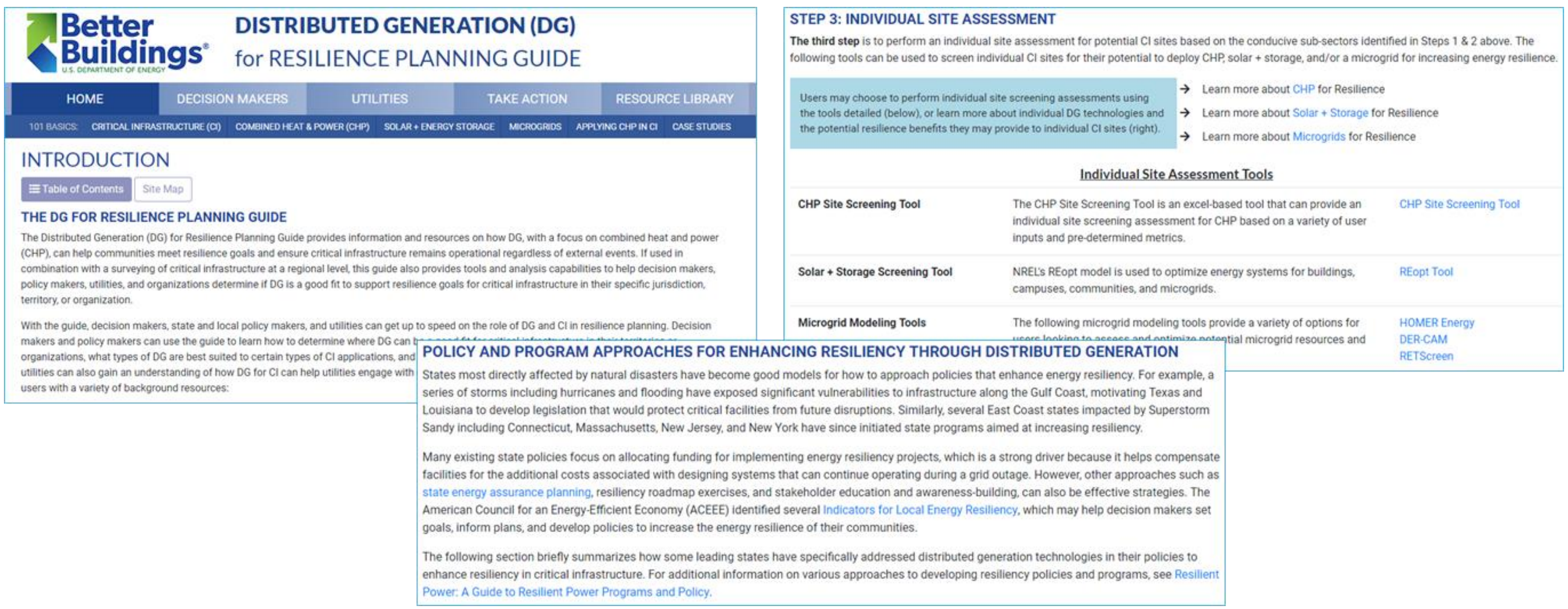
Resilience Planning with DOE Resiliency Accelerator

- The DOE Resiliency Accelerator includes resources and tools designed to assist with resilience planning efforts
  - Distributed Generation for Resiliency Planning Guide
  - CHP for Resilience Screening Tool
  - Issue Brief on Performance of DERs in Disaster Events
  - Partner Profiles

https://betterbuildingsinitiative.energy.gov/accelerators/combined-heat-and-power-resiliency

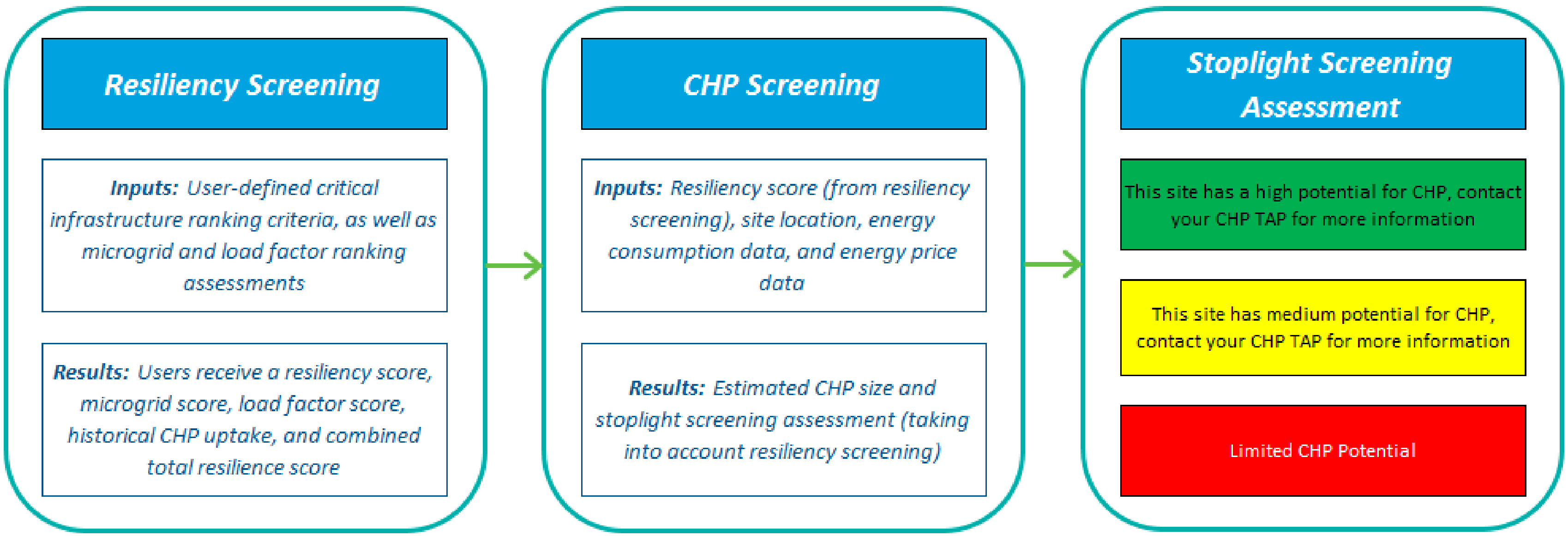
Distributed Generation (DG) for Resilience Planning Guide

- **Provides information and resources on how DG (w/a focus on CHP), can help communities meet resilience goals and ensure critical infrastructure remains operational regardless of external events**



https://resilienceguide.dg.industrialenergytools.com/

The CHP for Resilience Screening Tool



Resiliency Screening Factors: Government Continuity, Locational Ranking, Leverage/Scalability, Life Safety, Economic Impact, Microgrid, and Load Factor

Access the tool at the accelerator website under “Featured Resources”:
https://betterbuildingsinitiative.energy.gov/accelerators/combined-heat-and-power-resiliency

Issue Brief – Examining the Performance of Different DERs in Disaster Events

- Different DERs are impacted by various types of natural disasters (flooding, high winds, extreme temperature, etc.)
- Goal: To assist stakeholders in evaluating the technology options best able to meet their resilience priorities

Ranking Criteria

Four basic criteria were used to estimate the vulnerability of a resource during each type of disaster event. They include the likelihood of experiencing:

1. *a fuel supply interruption,*
2. *damage to equipment,*
3. *performance limitations, or*
4. *a planned or forced shutdown*

○ *indicates the resource is unlikely to experience any impacts*

◒ *indicates the resource is likely to experience one, two, or three impacts*

● *indicates the resource is likely to experience all four impacts*

https://betterbuildingsinitiative.energy.gov/sites/default/files/attachments/DER_Disaster_Impacts_Issue%20Brief.pdf

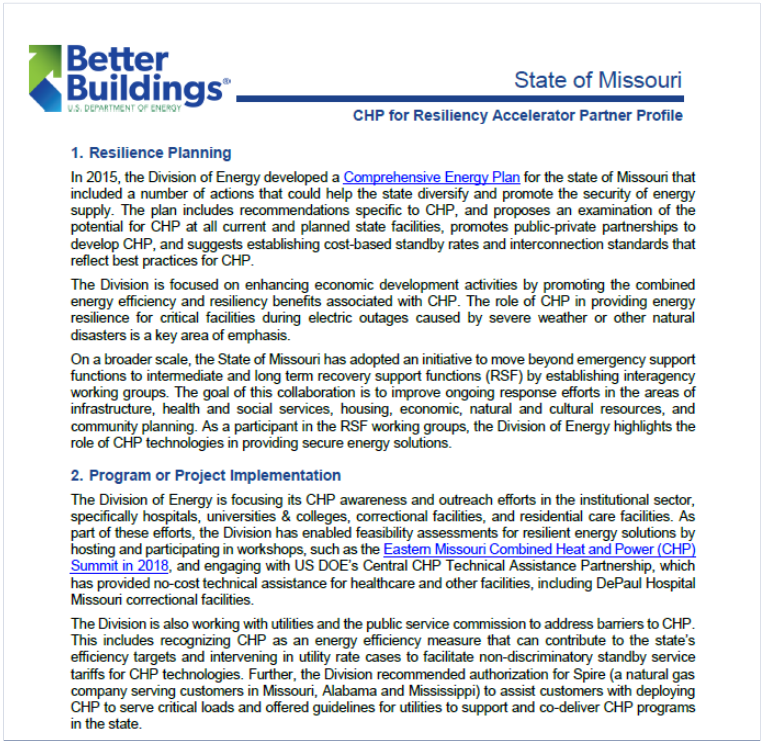
Issue Brief – Examining the Performance of Different DERs in Disaster Events

Natural Disaster or Storm Events	*Flooding*	*High Winds*	*Earthquakes*	*Wildfires*	*Snow/Ice*	*Extreme Temperature*
Battery Storage	◒	○	◒	●	○	◒
Biomass/Biogas CHP	◒	◒	◒	●	○	○
Distributed Solar	○	◒	◒	●	◒	◒
Distributed Wind	○	◒	◒	◒	◒	◒
Natural Gas CHP	○	○	◒	◒	○	○
Standby Generators	◒	○	◒	●	◒	○

https://betterbuildingsinitiative.energy.gov/sites/default/files/attachments/DER_Disaster_Impacts_Issue%20Brief.pdf

CHP for Resiliency Accelerator Partner Profiles

- 20 partner profiles
  - Resilience Planning
  - Program or Project Implementation
  - Lessons Learned
  - Additional Information
- Discussions with a wide variety of partners including: city and state energy managers/planners, PUC employees, utility engineers, and many more



Better Buildings® U.S. DEPARTMENT OF ENERGY

State of Missouri

CHP for Resiliency Accelerator Partner Profile

1. Resilience Planning

In 2015, the Division of Energy developed a Comprehensive Energy Plan for the state of Missouri that included a number of actions that could help the state diversify and promote the security of energy supply. The plan includes recommendations specific to CHP, and proposes an examination of the potential for CHP at all current and planned state facilities, promotes public-private partnerships to develop CHP, and suggests establishing cost-based standby rates and interconnection standards that reflect best practices for CHP.

The Division is focused on enhancing economic development activities by promoting the combined energy efficiency and resiliency benefits associated with CHP. The role of CHP in providing energy resilience for critical facilities during electric outages caused by severe weather or other natural disasters is a key area of emphasis.

On a broader scale, the State of Missouri has adopted an initiative to move beyond emergency support functions to intermediate and long term recovery support functions (RSF) by establishing interagency working groups. The goal of this collaboration is to improve ongoing response efforts in the areas of infrastructure, health and social services, housing, economic, natural and cultural resources, and community planning. As a participant in the RSF working groups, the Division of Energy highlights the role of CHP technologies in providing secure energy solutions.

2. Program or Project Implementation

The Division of Energy is focusing its CHP awareness and outreach efforts in the institutional sector, specifically hospitals, universities & colleges, correctional facilities, and residential care facilities. As part of these efforts, the Division has enabled feasibility assessments for resilient energy solutions by hosting and participating in workshops, such as the Eastern Missouri Combined Heat and Power (CHP) Summit in 2018, and engaging with US DOE's Central CHP Technical Assistance Partnership, which has provided no-cost technical assistance for healthcare and other facilities, including DePaul Hospital Missouri correctional facilities.

The Division is also working with utilities and the public service commission to address barriers to CHP. This includes recognizing CHP as an energy efficiency measure that can contribute to the state's efficiency targets and intervening in utility rate cases to facilitate non-discriminatory standby service tariffs for CHP technologies. Further, the Division recommended authorization for Spire (a natural gas company serving customers in Missouri, Alabama and Mississippi) to assist customers with deploying CHP to serve critical loads and offered guidelines for utilities to support and co-deliver CHP programs in the state.

https://betterbuildingssolutioncenter.energy.gov/accelerators/combined-heat-and-power-resiliency/chpr-partner-profiles

Examples of CHP Policies and Programs for Resilience

Policy, Program or Organization	Details and Accomplishments
Texas State Legislature	• Passed HB 1831 and HB 4409 in 2009, requiring the state to identify all critical infrastructure assets and conduct an economic feasibility analysis of CHP for all major renovations and new construction
Louisiana State Legislature	• Passed Resolution No. 171 in 2012 – similar to Texas State Legislature HB 1831 & HB 4409
The Missouri Department of Economic Development, Division of Energy	• Published the Missouri Comprehensive State Energy Plan – includes recommendations to incorporate CHP based on energy savings, meeting state energy goals, and providing energy security benefits • Participated in the US DOE CHP Resiliency Accelerator and identified hospitals as a target market sector for outreach • Further identified target hospital CI sites throughout the state
The Illinois State Energy Assurance Plan	• Supports the use of CHP in creating resiliency benefits for critical infrastructure and the grid as a whole
The Michigan Agency for Energy	• Sponsored the "CHP Roadmap for Michigan," – models future CHP penetration given a number of different scenarios and possible policies including efficiency incentives, utility rate reform and resiliency benefits

Source: CHP Policies and Incentive Database (dCHPP). https://www.epa.gov/chp/dchpp-chp-policies-and-incentives-database;
DG for Resilience Planning Guide, U.S. DOE. 2018. https://resilienceguide.dg.industrialenergytools.com/

Project Snapshots

Resilience and Reliability with CHP

Project Snapshot: Dell Children's Medical Center

- **Location:** Austin, TX
- **Microgrid Equipment & Technologies**
  - 4.3 MW gas turbine CHP
  - 1.5 MW backup diesel generator
- **Key Characteristics**
  - CHP Plant (Mueller Energy Center), is owned and operated by Austin Energy
  - During a disaster, the hospital can become a place of refuge, due to the extended power supply
  - CHP provides excess chilled water to surrounding facilities
- **Benefits**
  - CHP provides efficient steam generation for critical hospital procedures
  - Microgrid helped medical center to achieve LEED certification
  - Beneficial partnership between medical center campus and local utility (Austin Energy)

dell children's
medical center of central texas

Dell Children's Medical Center, photo courtesy of Seton/Ascension

Project Snapshot: Colorado College Tutt Library

Location: Colorado Springs, CO

Application/Industry: College/University

Capacity (MW): 130 kW

Prime Mover: Microturbine

Fuel Type: Natural Gas

Thermal Use: Space heating

Installation Year: 2017

Emissions Savings: Net-zero energy building

Key Characteristics

While transforming Tutt Library to meet academic demands, including new lab and classroom space, Colorado College installed an array of technologies at the site to establish the largest net-zero academic library. With a CHP system, geothermal field, and two solar arrays, the library can generate all the power needed for its on-site facilities.

Source:
https://www.coloradocollege.edu/newsevents/newsroom/cc-s-net-zero-energy-library-opens#.XD33kFVKipo

Project Snapshot: University of Texas Medical Branch at Galveston

- **Location:** Galveston, TX
- **Application/Industry:** Hospital
- **Capacity:** 11.9 MW
- **Prime Mover:** Combustion turbine
- **Fuel Type:** Natural gas
- **Thermal Use:** Steam for steam, DHW
- **Installation Year:** 2016
- **Resilience Benefits**
  - Hurricane Ike severely damaged UTMB campus and energy/steam infrastructure
    - Hospital unable to operate for 90 days, $2 million loss of business revenue/day, lost research materials, etc.
  - Converted buildings to DHW, distributed steam overhead to buildings, elevated boilers and chillers, and built flood wall around CHP system
  - During Harvey, CHP system operated throughout in island mode, and all infrastructure was well protected

utmb Health

The UTMB CHP systems protected by a flood wall, photos courtesy of Affiliated Engineers

Project Snapshot: Village Creek Water Reclamation Plant

- **Location:** Fort Worth, TX
- **Application/Industry:** WWTP
- **Capacity:** 5.2 MW
- **Prime Mover:** Combustion turbine
- **Fuel Type:** Natural gas
- **Thermal Use:** Steam turbines to drive
- centrifugal blower, Digester heat
- **Installation Year:** 2012

"I highly recommend this type of project. Not only do you save money but you reduce your footprint and utilize resources that were once wasted." -Ana Julia Peña-Tijerina, Sr. Professional Engineer

Project Snapshot: University of California, San Diego

Location: San Diego, CA

Microgrid Equipment & Technologies

- 33 MW CHP ((2) 13.5 MW combustion turbines, 3 MW steam turbine, 2.8 MC fuel cell)
- 3.8 million gallon thermal energy storage + 2.5 (5 MWh) Battery storage
- 2.9 MW solar PV, 300 kW solar thermal
- 4,000 smart-controllable thermostats

Key Characteristics

- Microgrid control at central utilities plant
- Automatic Substation Control System allows CHP system to island in the event of a grid outage
- High-end maser controller provides microgrid optimization

Benefits

- Improved energy security on campus
- Arbitrage opportunities from DERs has provided significant economic benefits to UCSD, in addition to significant peak demand reduction
- Advanced controls and monitoring allow advanced outage detection for enhanced resilience

Microgrid CHP and solar generation, photos courtesy of LBNL and UC San Diego

How to Implement a CHP Project with the Help of the CHP TAP

CHP TAP Role: Technical Assistance

Screening and Preliminary Analysis

Quick screening questions with spreadsheet payback calculator; Advanced technical assistance to explore equipment or operational scenarios.

Feasibility Analysis

Perform 3rd Party reviews of site feasibility assessments: Estimates on savings, installation costs, simple paybacks, equipment sizing, and type.

Investment Grade Analysis

Perform 3rd Party reviews of Engineering Analysis. Review equipment sizing and choices.

Procurement, Operations, Maintenance, Commissioning

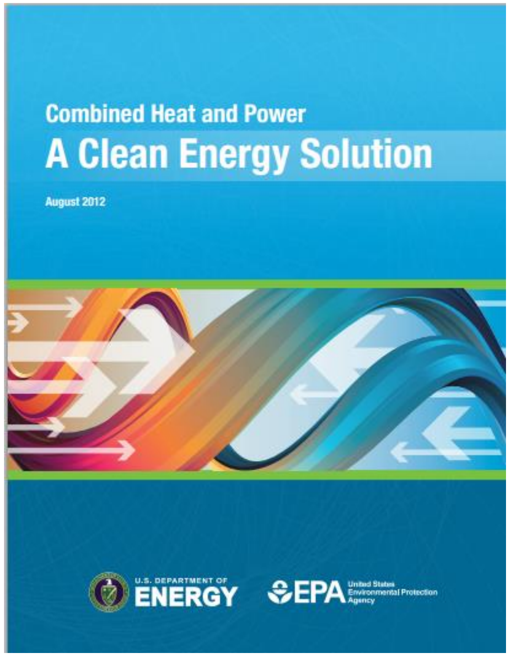
Review specifications and bids.

CHP Project Resources

DOE CHP Technologies Fact Sheet Series

www.energy.gov/chp-technologies

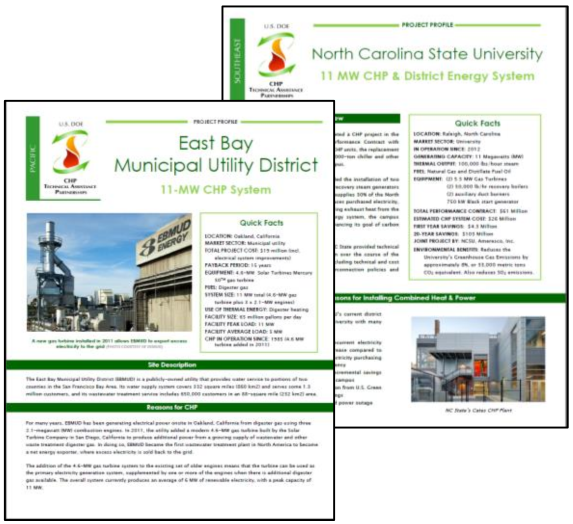
Good Primer Report



www.eere.energy.gov/chp

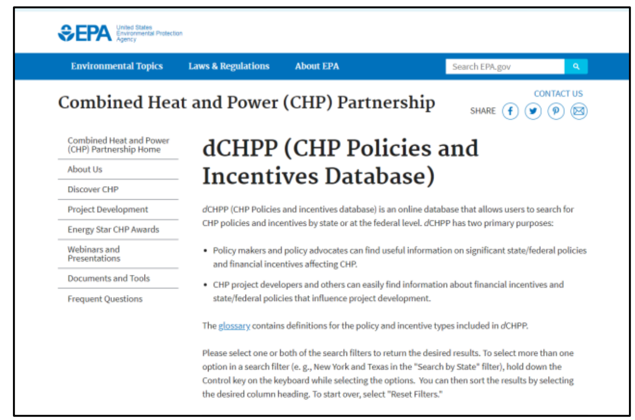
CHP Project Resources

DOE Project Profile Database



energy.gov/chp-projects

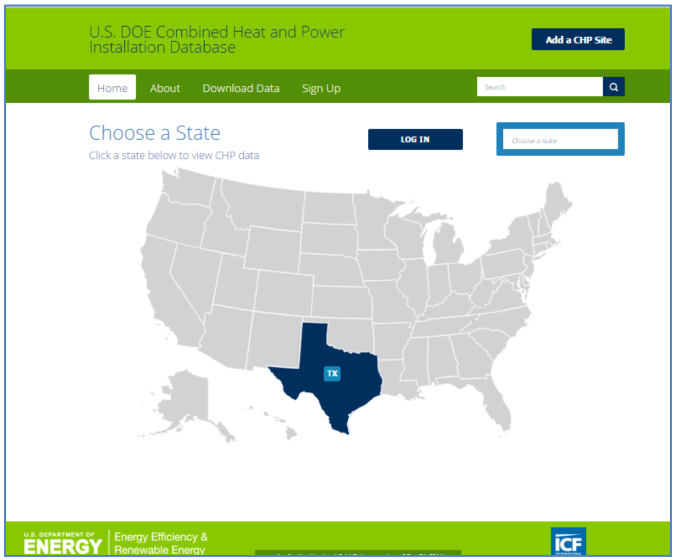
EPA dCHPP (CHP Policies and Incentives Database



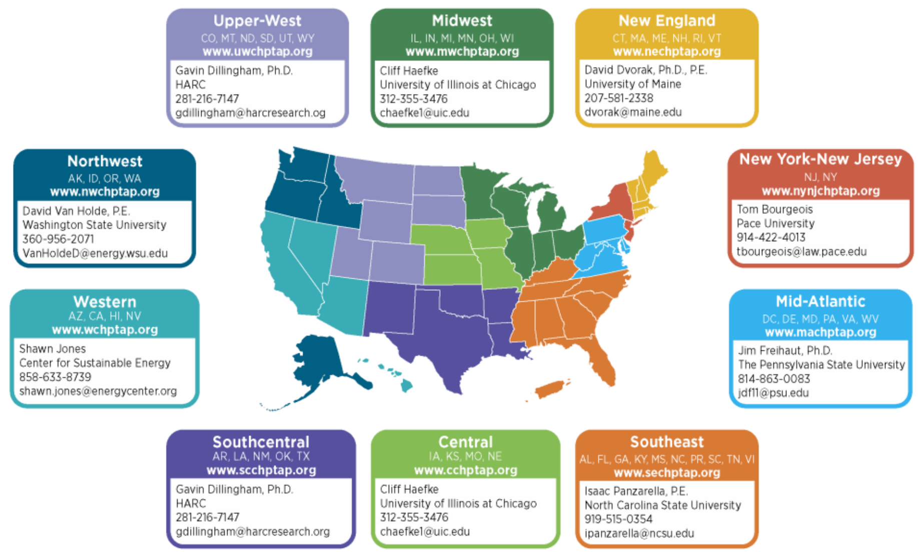
www.epa.gov/chpdchpp-chp-policies-and-incentives-database

CHP Project Resources

DOE CHP Installation Database (List of all known CHP systems in U.S.)



And of course… No Cost CHP Screening and Other Technical Assistance from the CHP TAP



Next Steps

Resources are available to assist in developing CHP Projects.

Contact the Southcentral CHP TAP to:

- Perform Microgrid with CHP Qualification Screening for a particular facility
- Conduct a resilience assessment
- Identify existing CHP sites for Project Profiles
- Advanced Technical Assistance

Summary

- Microgrids with CHP is a proven technology providing energy savings, reduced emissions, and opportunities for resiliency
- Emerging drivers are creating new opportunities to evaluate microgrids with CHP and numerous example exist to learn more how sites have incorporated this technology
- Engage with the US DOE Southcentral CHP TAP to learn more about the technical assistance offerings in evaluating microgrids with CHP

Thank You!

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281-216-7147

EMERGENCY RESPONSE PLAN COORDINATION

Jerry Looper
System Operations Manager
Denton Municipal Electric

City of DENTON

- Located 35 miles north of the DFW
- Population of 136,000 residents
- Two Universities, two hospitals, and industrial district

DENTON MUNICIPAL ELECTRIC

The Electric Department of the City of Denton

- Service area of 108 square miles
- Serving 55,000 customers
- 370 MW of load
- Owns 33.5 miles of transmission line and operates another 34 miles

DME CONTINUED

DENTON MUNICIPAL ELECTRIC

- 893 miles of distribution lines with 60% underground
- 225 MW of gas fired quick response power plant, Denton Energy Center (DEC)
- Registered with North American Electric Reliability Corporation (NERC) as a GO, GOP, TO, TOP, DP, QSE, and RE
- Distributed Generation Program
  - Solar only rebates range from .40¢ to .80¢ /watt depending on the size of the unit
  - Solar with storage rebates range from .60¢ to $1.20 /watt depending on the size of the unit
  - Full usage price is paid for all power generated back to the system
  - 310 customer owned PV systems installed totaling 3,500 KW
- 70% renewable energy
  - 180MW from wind
  - 30 MW from solar

WHY COORDINATE EMERGENCY PLANS

Last year was the first year that Electric System Operations was ask to review the City of Denton's Emergency Management Plan.

The Electric Emergency Operations plan and the City's plans did not complement each other and in some ways contradicted each other:

- The non-electric staff did not recognize that the electric department has regulations that have to be complied with during emergency situations
- Electric resources may not be available to other City departments as previously understood by Emergency Management
- Electric staff did not have a full understanding of police and fire procedures
- DME did not fully include other city departments needs or expectations in our plans
- DME underestimated non-electric staff's general knowledge of how the electric system functions.

IDENTIFIED AREAS OF CONCERN

- Create a common list of priorities and strategies
- Identify critical facilities and customers
- Assign roles and responsibilities
- Identify priority facilities for restoration
- Address any backup generation needs
- Efficient allocation of resources
- Include business continuity plans
- Review and revise all emergency plans that may be affected

WHY COORDINATION IS NEEDED DURING POWER CAPACITY SHORTAGES

- Cities need an overall understanding of how an electric company is required to respond to capacity shortages and blackout events
  - What to expect from each level of Energy Emergency Alerts
  - How rotating outages are planned for and executed, or how blackout events are restored
  - How electric resources will be utilized to support local critical loads
- Establishing critical loads and identify backup generation
  - Which critical facilities have backup generation or lack resources
  - Which of these facilities need priority
- Need for security of electric and city facilities
  - Protection of electric staff during travel to stations
  - Protection of electric facilities
- What to do with staff
  - Business continuity

ENERGY EMERGENCY ALERT PROCESS

- Energy Emergency Alert 1-Physical Responsive Capability falls below 2,300 MW
  - Media Alert may be issued detailing the situation and asking for energy conservation
  - Deployment of contracted ERS Resources
- Energy Emergency Alert 2-Physical Responsive Capability falls below 1,750 MW
  - Media Alert will be sent detailing the situation and asking for energy conservation
  - Reduction of load by using distribution voltage reduction measures, if beneficial
  - Implementation of Load Management Plans to reduce customer load, if available
  - Deployment of contracted ERS Resources
- Energy Emergency Alert 3-Physical Responsive Capability can not be maintained above 1375 and frequency falls below 59.91 HZ.
  - In addition of all the measures taken in EEA 1 and 2 Rotating outages may be requested
    - Implement load shed based off of the Load Shed Obligation established by ERCOT.

EMERGENCY LOAD SHED PROCESS

- Excludes facilities that protect the safety and health of the community and essential human needs of the citizens (Critical Loads)
  - Critical load may only be used to save the interconnection from collapse
- Open breakers to interrupt customer load to meet Load Shed Obligation
  - Rotate interrupted load every 30 minutes
  - Try not to affect the same customers for 1.5 hours

IDENTIFY CRITICAL FACILITIES

- Water and waste water plants
  - Lift stations
- Fire and Police stations
  - Emergency Operations Center
- Hospitals and Surgery Centers
  - Senior, Nursing Centers
- Electric Control Room
  - Substations
- Fueling stations
  - Natural Gas pressurizing stations
  - Vehicle fueling stations
  - Backup Generator fueling solutions

EMERGENCY PLAN COORDINATION EFFORTS

Last year the City of Denton hosted a tabletop exercise about an active shooter that started at one of the colleges and then concluded at the DME campus.

Identified improvements:

- DME had a employee emergency notification system but the rest of the City did not
  - The City of Denton is now addressing this by providing an employee emergency notification system across all departments, including upgrading DME to the new system.
- Facility lockdown efforts needed improvements
  - DME had a campus lockdown system, but it interfered with police and fire response.
    - Facility lock down prevented first responder access

FUTURE EMERGENCY PLAN COORDINATION EFFORTS

This year the City of Denton is hosting a tabletop exercise about an extended total blackout of the ERCOT electric grid.

We plan to address the issues we have identified so far and expose potential issues that may have been overlooked.

IN SUMMARY

- ❖Cities need to make sure that emergency plans are coordinated at all levels with electric providers
  - ❖Cities may use identification of critical facilities to start coordination efforts
- ❖ Emergency plans must comply with local, regional, and federal regulations
- ❖Cities and electric providers must have strategic and prioritized action plans in place prior to contingency events
- ❖Mutual understanding of the roles and responsibilities of each entity involved is essential to success
- ❖Continuous detailed review and coordinated training exercises will improve collaboration and identify deficiencies

QUESTIONS?

Resources for Energy Efficiency and Infrastructure Resilience

NORTH CENTRAL TEXAS COUNCIL OF GOVERNMENTS

AUGUST 28, 2019

North Central Texas
Council of Governments

Resiliency Planning Resources & Tools

North Central Texas Council of Governments

Local Government Energy Assurance Guidelines

Public Technology Institute

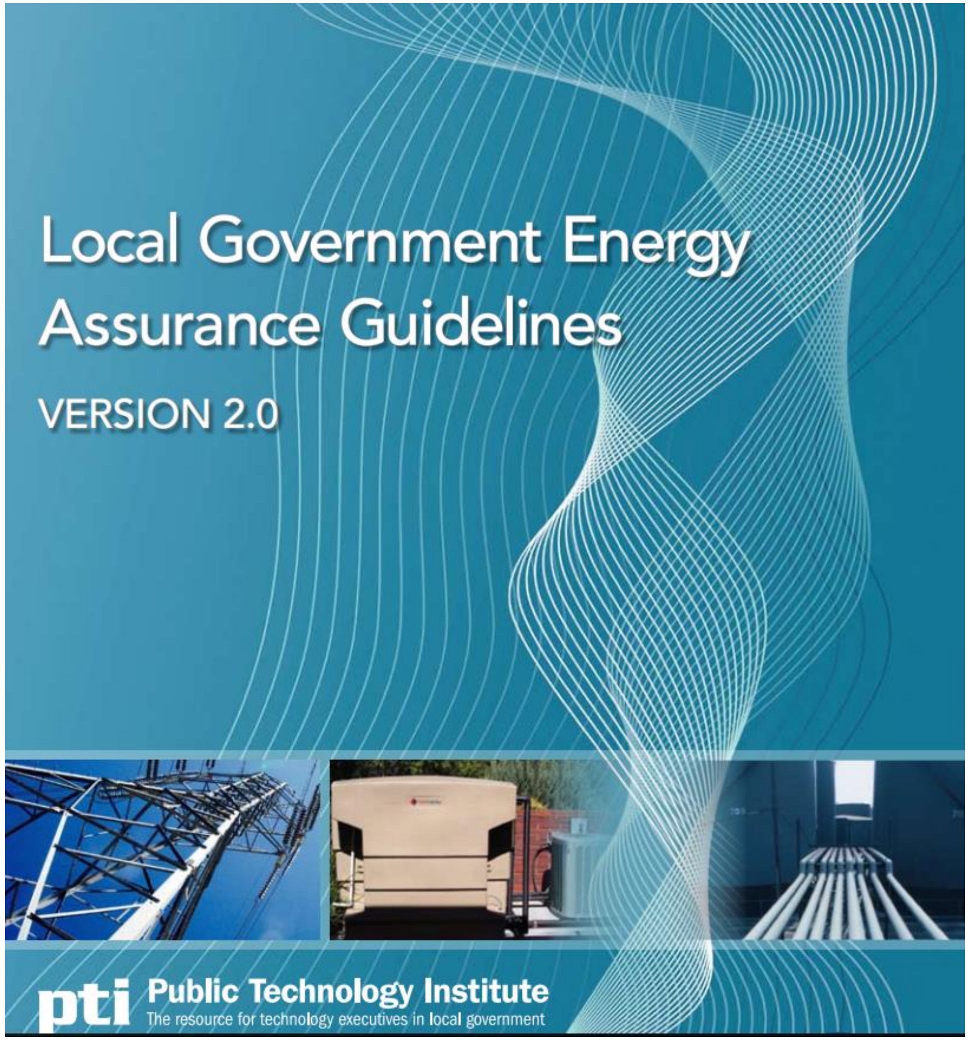
- The goal is to enable communities to make the transition to a pre-disaster planning and risk reduction approach.

- Assist local governments in planning for as well as responding to natural and man-made events and emergencies, often resulting in a decrease or total outage of energy that is needed to sustain critical functions and essential services within a community.

- Assist jurisdictions in the recovery phase, in which energy services vital to the health, welfare, and safety of the resident population are restored.

- Produced because very few local governments have a response and recovery plan that is specific to energy emergencies.

https://www.naseo.org/Data/Sites/1/documents/energyassurance/documents/pti_local_governement_energy_guidelines.pdf



Local Government Energy Assurance Planning Resources

https://sites.google.com/site/ptileap/publications http://www.energyassurance.us/

American Council for an Energy-Efficient Economy (ACEEE):

Enhancing Community Resilience through **Energy Efficiency**

[Enhancing Community Resilience through Energy Efficiency](https://aceee.org/sites/default/files/publications/researchreports/u1508.pdf) : Discusses ways in which energy efficiency can increase the resilience of energy systems and the communities they serve. It reviews the resilience-related benefits of:

- efficiency measures
- incorporation of efficiency into resilience planning
- presents four case studies showing how local governments and utilities can leverage energy efficiency to increase community resiliency

Table ES1. Resilience benefits of energy efficiency

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

https://aceee.org/sites/default/files/publications/researchreports/u1508.pdf

National Institute of Standards and Technology (NIST) Community Resilience Planning Guide for Buildings and Infrastructure Systems

Helps communities develop consistent resilience goals into their comprehensive, economic development, zoning, mitigation, and other local planning activities that impact buildings, public utilities, and other **infrastructure systems**

Volume I

Describes the six-step planning process

Volume II

Elaborates on how to characterize the social and economic dimensions of the community, any potential impacts and the infrastructure/building performance.

https://www.nist.gov/topics/community-resilience/planning-guide

Department of Energy (DOE) Better Buildings

Distributed Generation for Resilience Planning Guide

The U.S. Department of Energy Better Buildings Initiative developed the Distributed Generation (DG) for Resilience Planning Guide to provide information on how DG, with a focus on combined heat and power (CHP), can aid communities to meet their resiliency goals. The guide can be used by a variety of users, including decision makers, state and local policy makers and utilities to gain a better understanding on the role that DG and critical infrastructure (CI) in resiliency planning.

The Efficiency-Resilience Nexus

The Better Buildings Efficiency-Resilience Nexus describes energy-efficient technologies and practices that contribute to and increase resiliency.

Department of Energy (DOE)

Southcentral Technical Assistance Program with HARC

Promotes Combined Heat and Power (CHP) technology solutions for the industrial and manufacturing sector, critical infrastructure, institutions, commercial facilities, and utilities seeking to reap the many benefits of CHP.

CHP is increasingly recognized as a way to make facilities more resilient against power outages.

Houston Advanced Research Center (HARC) in The Woodlands, Texas has been awarded funding from the U.S. Department of Energy (DOE) to assist public and private entities considering CHP.

More information or to fill out interest survey:
https://www.harcresearch.org/work/CHP_TAP

Department of Homeland Security
Energy Sector – Specific Plan - 2015

National Infrastructure Protection Plan (NIPP) – 2015

The Energy Sector-Specific Plan details how the National Infrastructure Protection Plan risk management framework is implemented within the context of the unique characteristics and risk landscape of the sector

The Department of Energy is designated as the Sector-Specific Agency for the Energy Sector for NIPP.

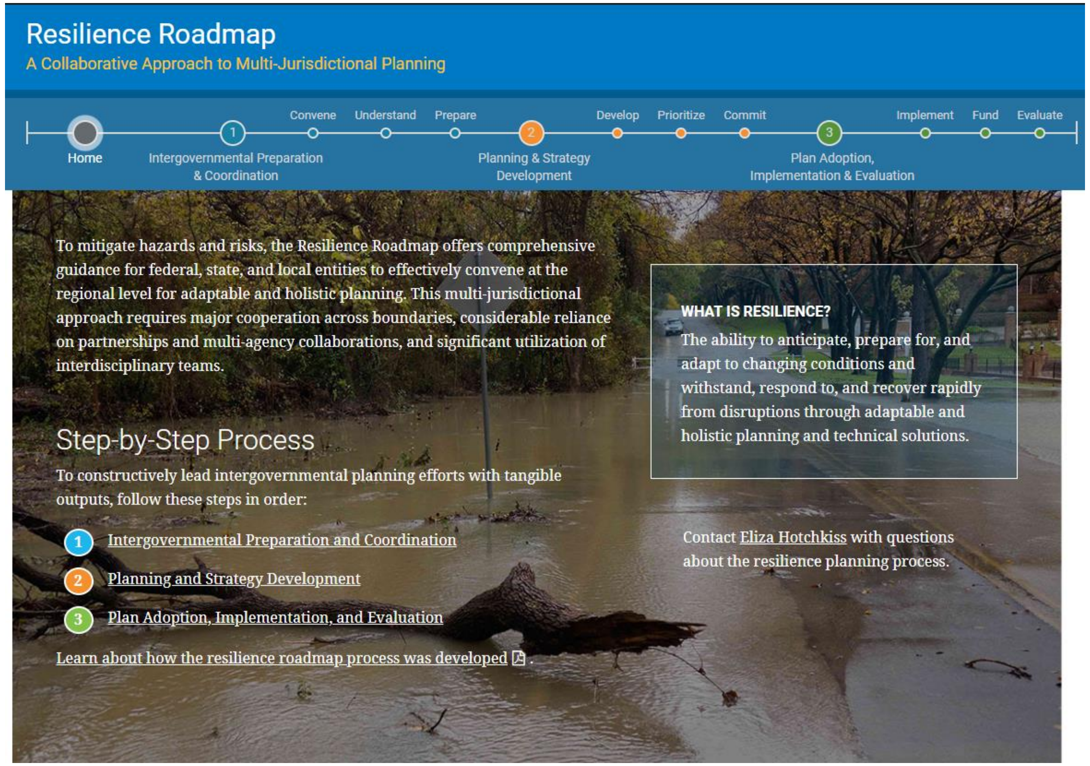
https://www.dhs.gov/cisa/energy-sector

https://www.dhs.gov/sites/default/files/publications/nipp-ssp-energy-2015-508.pdf

Department of Energy (DOE)

National Renewable Energy Laboratory (NREL)

Resilience Roadmap – A Collaborative Approach to Multi-Jurisdictional Planning



https://www.nrel.gov/resilience-planning-roadmap/

Complete Energy Profile

Completing an energy profile for critical operations or a community is essential for developing resilient infrastructure strategies. Beyond documenting energy consumption patterns and generation assets there are benefits associated with documenting existing utility service provider agreements and long-term regional forecasts for meeting needs in changes to population, demographics, and the economy, for example. One of the most important parts of the energy profile is a clear assessment of what kind of energy is used and how it is used within the jurisdiction. Gathering and evaluating this information also provides a baseline for measuring future progress toward energy reliability.

Stakeholders should gather geographic data related to critical infrastructure systems or facilities which provide daily operations, serve the community as a whole, or provide mission critical services. Desirable information on critical infrastructure could include:

- Data or locations of electric transmission lines, substations, and distribution networks
- Natural gas lines and distribution networks
- Critical community and emergency operations facilities
- Water and wastewater treatment facilities
- Water distribution networks and pumping stations
- Storm-water collection network and treatment/outflow locations
- Fueling station networks
- Fuel types and emergency evacuation routes
- Cellular tower locations, service providers and fiber networks
- Public transportation networks
- Low-income and elderly housing locations
- Emergency shelters, schools, vulnerable populations.

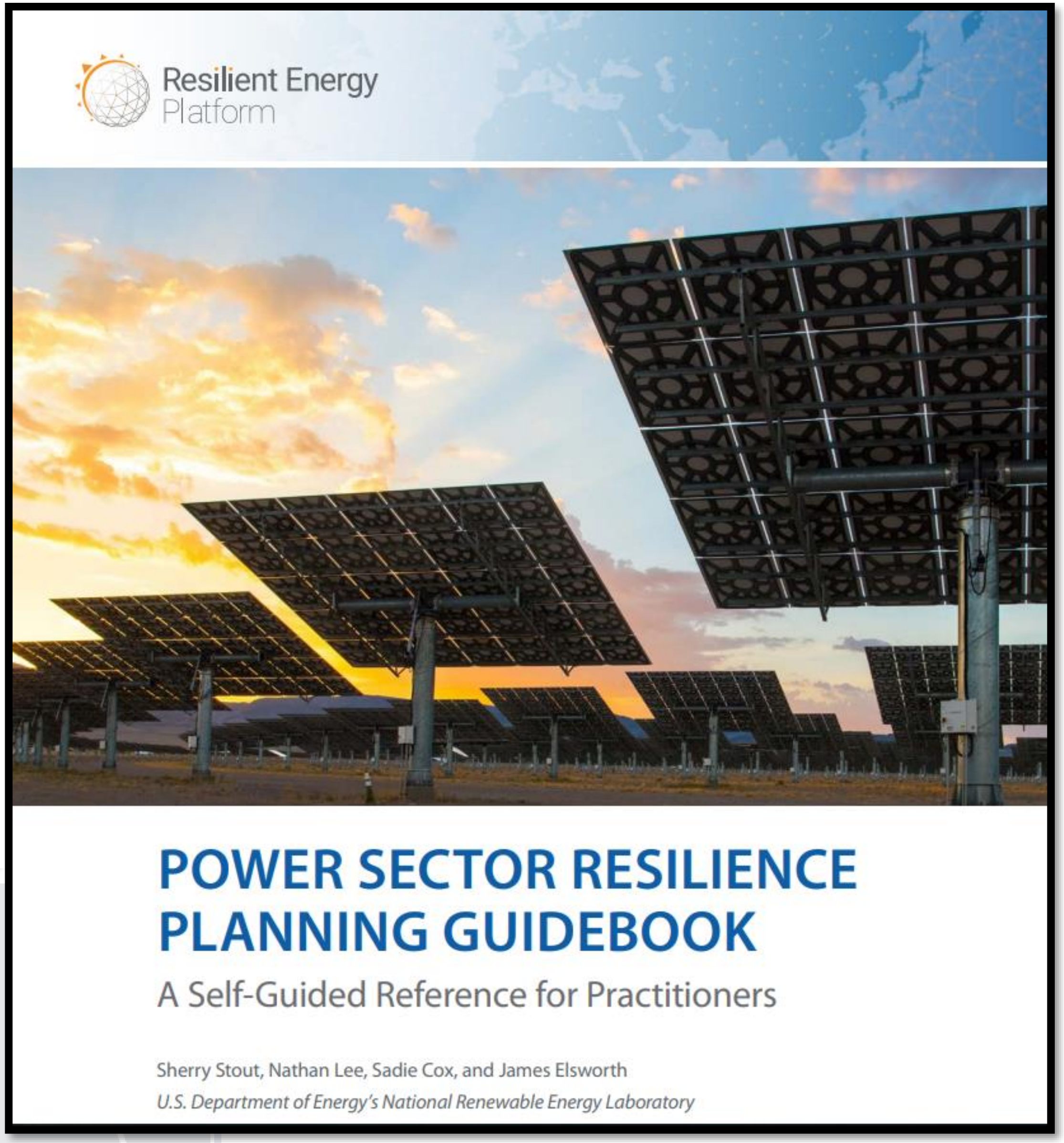
A community or government entity will have different priorities depending on operational needs and critical activities, so this data should be collected with input from the various stakeholders. Some information may be considered sensitive, so access to data or sharing of information may be limited. Understanding where evacuation priorities exist or where energy should be focused due to infrastructure needs will help formulate resilience strategies.

Resilient Energy Platform

NREL, USAID

Resilient Energy Platform provides expertly curated resources, training materials, data, tools, and direct technical assistance in planning resilient, sustainable, and secure power systems.

The platform enables decision makers to assess power sector vulnerabilities, identify resilience solutions, and make informed decisions to enhance power sector resilience at all scales.



Identify Threats
Identify the potential threats to the power sector and score the likelihood of occurring.

Define Impacts
Define the potential impacts on the power sector that may result from these threats.

Assess Vulnerabilities
Assess the vulnerabilities of the power sector and score their potential severity.

Calculate Risks
Calculate the risks resulting from linked threats and vulnerabilities in a risk matrix.

Develop Solutions
Develop and prioritize resilience action plans based on impact, ability to implement, and cost..

https://resilient-energy.org/guidebook

Department of Energy (DOE)

Office of Electricity

North American Energy Resilience Model - July 2019

“Our Nation’s prominence is largely enabled by broad access to abundant, reliable, and affordable energy. Our modern electric power system drives our digital economy and elevates our health, safety, and overall standard of living. Without a functioning power grid, nearly every type of critical infrastructure in the U.S.—from banking and water distribution to telecommunications—would grind to a halt. Yet as our Nation’s dependence on the power grid grows, so does the breadth and severity of threats against it.”

A collaboration between DOE, its National Laboratories, and industry, the NAERM will develop a comprehensive resilience modeling system for the North American energy sector infrastructure.

- Enable prediction of the impact of threats
- Evaluation and identification of effective mitigation strategies
- Support for black start planning

U.S. DEPARTMENT OF ENERGY

Office of Electricity

North American Energy Resilience Model

July 2019

United States Department of Energy
Washington, DC 20585

https://www.energy.gov/sites/prod/files/2019/07/f65/NAERM_Report_public_version_072219_508.pdf

Financial Tools & Resources

BETTER BUILDINGS FINANCING NAVIGATOR

THIS NAVIGATOR HELPS YOU AVOID THE COMPLEXITY ASSOCIATED WITH SECURING APPROPRIATE FINANCING FOR YOUR ENERGY EFFICIENCY PROJECTS

Commercial property assessed clean energy (CPACE) Financing for Resiliency Toolkit

LEARN ABOUT AVAILABLE FINANCING THAT CAN BE USED TO FUND RESILIENCY IMPROVEMENTS TO MAKE BUILDINGS MORE RESISTANT TO NATURAL DISASTERS OR THREATS

ENERGY SAVINGS PERFORMANCE CONTRACTING (ESPC) TOOLKIT

A COLLECTION OF RESOURCES FOR STATE AND LOCAL GOVERNMENTS TO LEARN ABOUT IMPLEMENTING PERFORMANCE CONTRACTING

National Association of State Energy Officials (NASEO)

Resources

North Central Texas Council of Governments

About NASEO

- **National non-profit association for the governor-designated energy officials from each state and territory**

Facilitates Peer Learning Among State Officials	A Resource For and About State Energy Offices	Advocates the Interests of the State Energy Offices to Congress

Initiative for Resiliency in Energy through Vehicles (iREV)

NASEO's Initiative for Resiliency in Energy through Vehicles (iREV) is a nationwide effort to provide resources and tools to emergency planners that addresses the potential for shortages and disruptions in motor fuels during times of emergency through the integration of **alternative fuels** into emergency response activities.

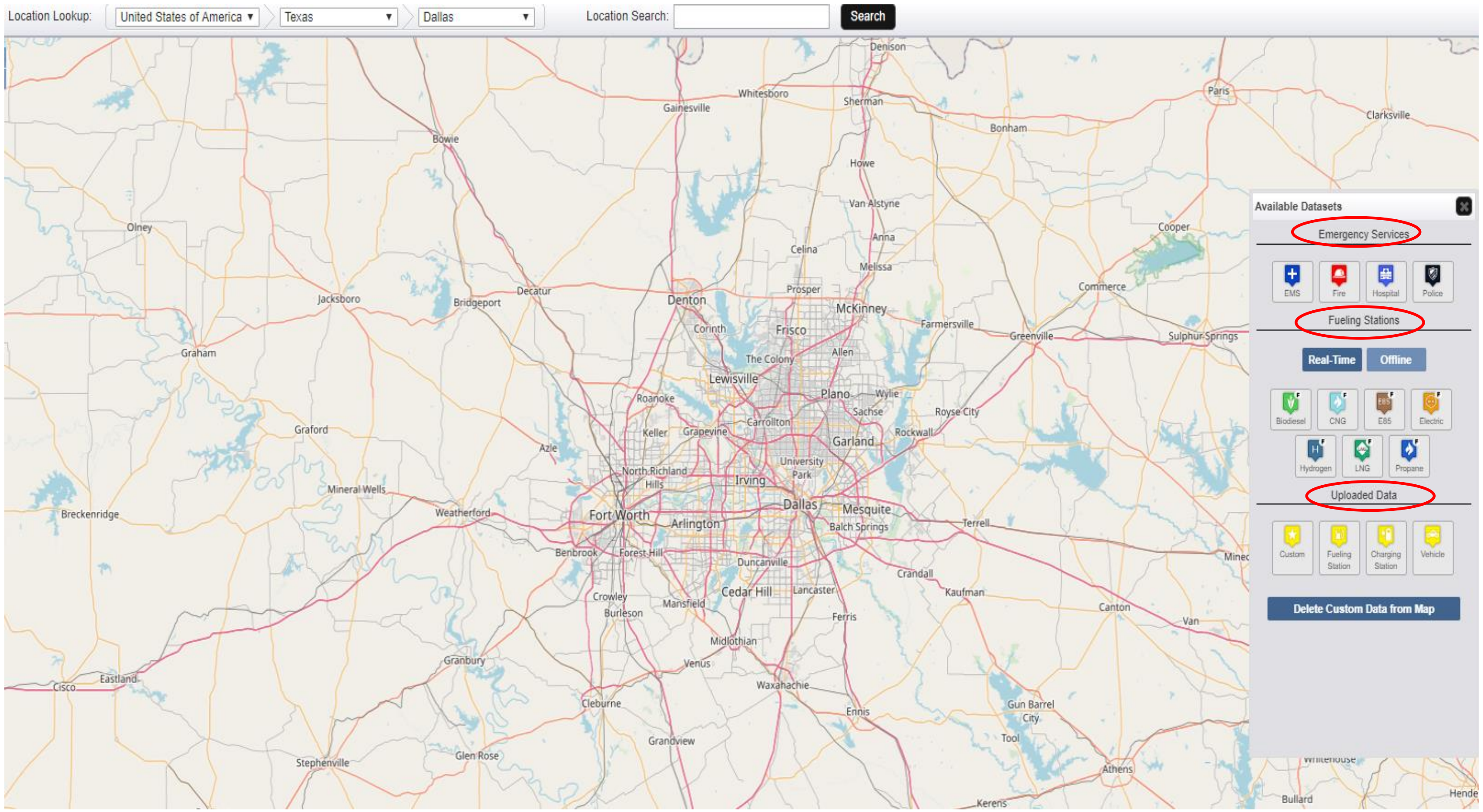
Why Alternative Fuels?
Incorporating alternative fuels into emergency response fleets helps to diversify fuel sources, reduce the potential for fuel shortages or disruptions and decrease harmful exhaust emissions from traditional fuels.

NASEO Resource: iREV Tracking Tool

NASEO National Association of State Energy Officials

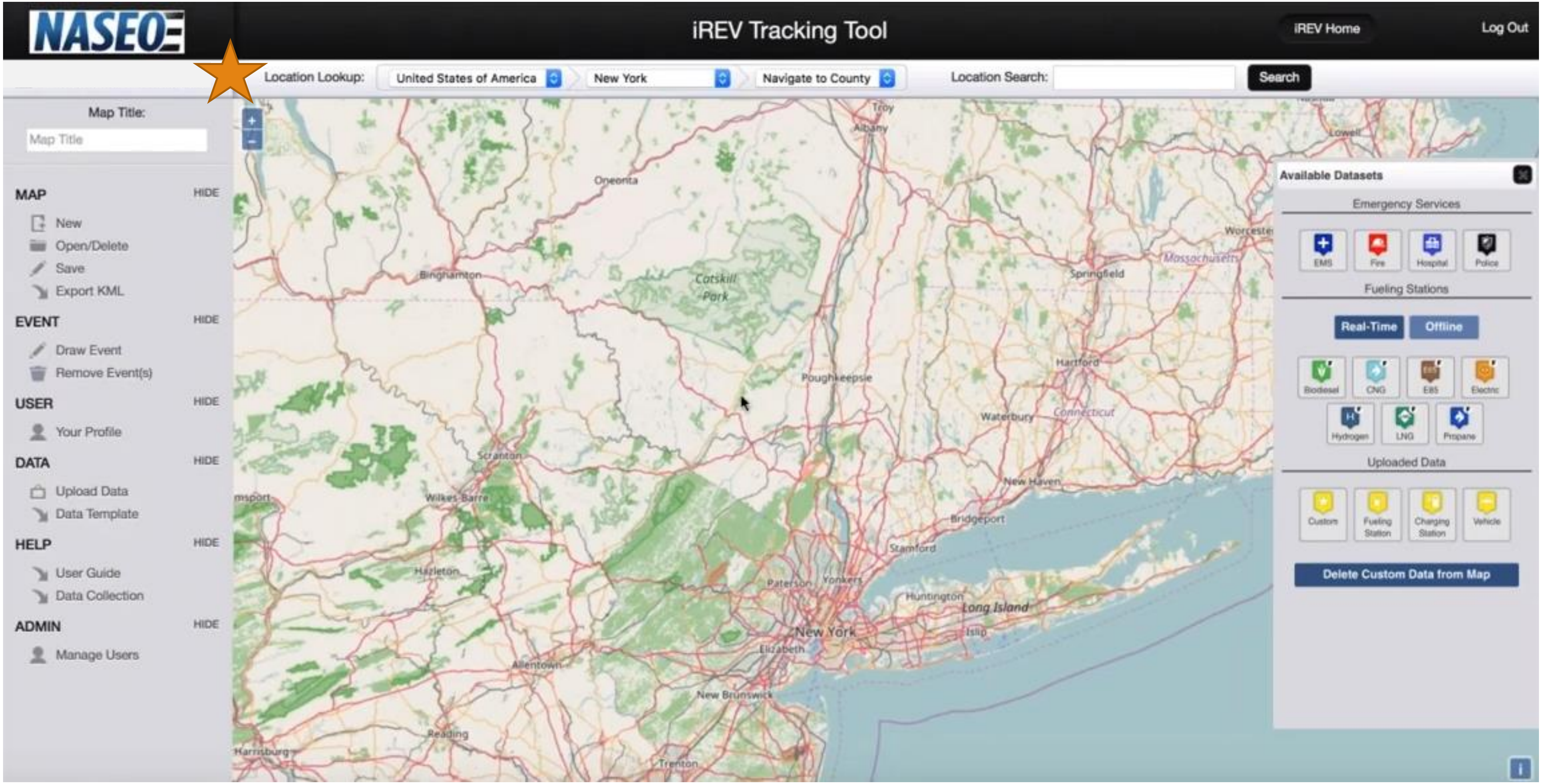
iREV Initiative for Resiliency in Energy through Vehicles Tracking Tool

As part of the iREV initiative, NASEO developed a free mapping application known as the "[iREV Tracking Tool](#)".
This tool identifies where alternative fuel vehicles and infrastructure are located within their communities to optimize their planning and investments based on their specific fuel supply, geography and risk profile.

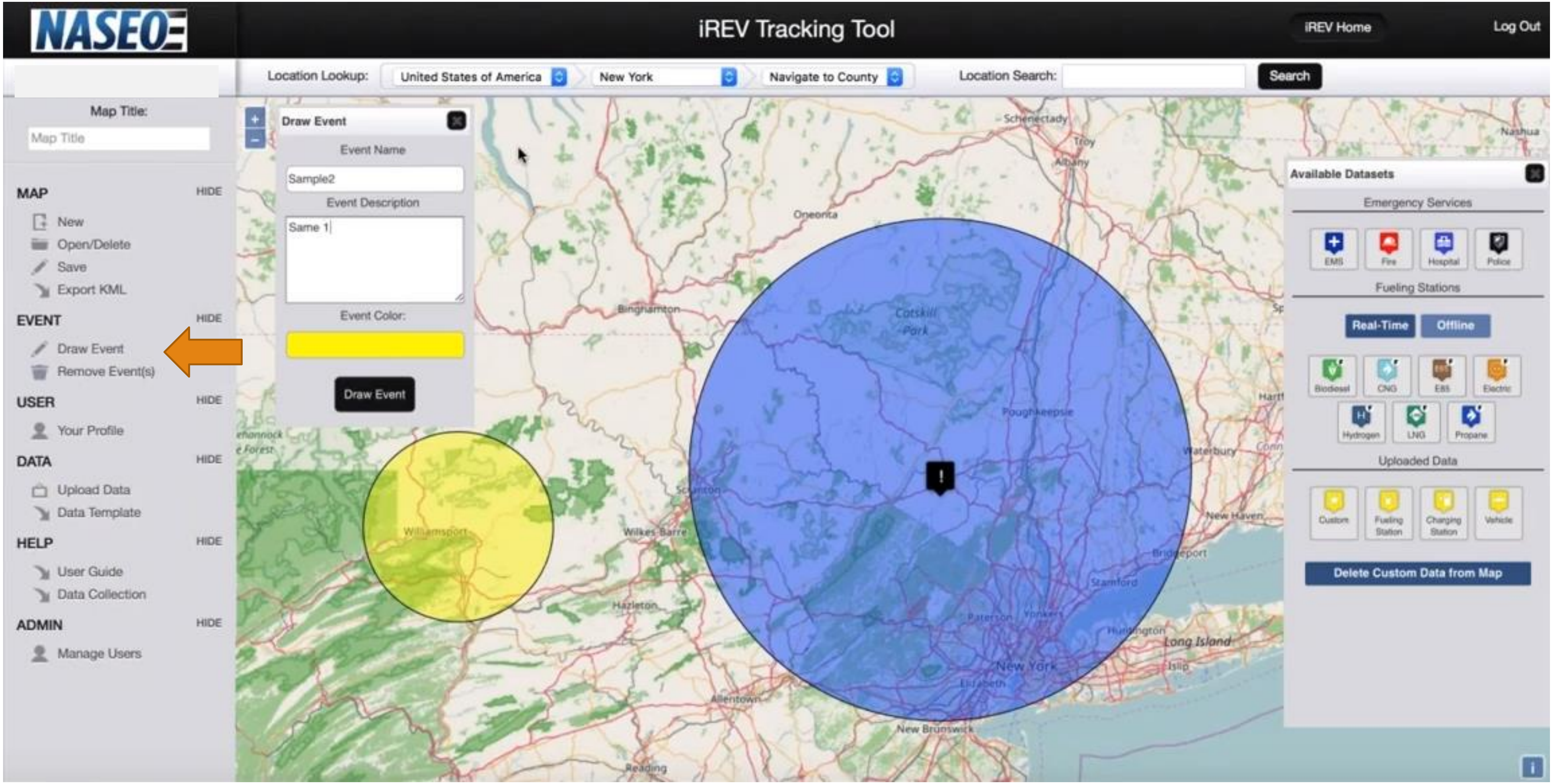


iREV
Tracking Tool Overview

North Central Texas
Council of Governments



iREV Tracking Tool
iREV Home
Log Out
Location Lookup:
United States of America
New York
Navigate to County
Location Search:
Search
Map Title:
MAP
HIDE
New
Open/Delete
Save
Export KML
EVENT
Draw Event
Remove Event(s)
USER
Your Profile
DATA
Upload Data
Data Template
HELP
User Guide
Data Collection
ADMIN
Manage Users
Available Datasets
Emergency Services
Fueling Stations
Real-Time
Offline
Uploaded Data
Delete Custom Data from Map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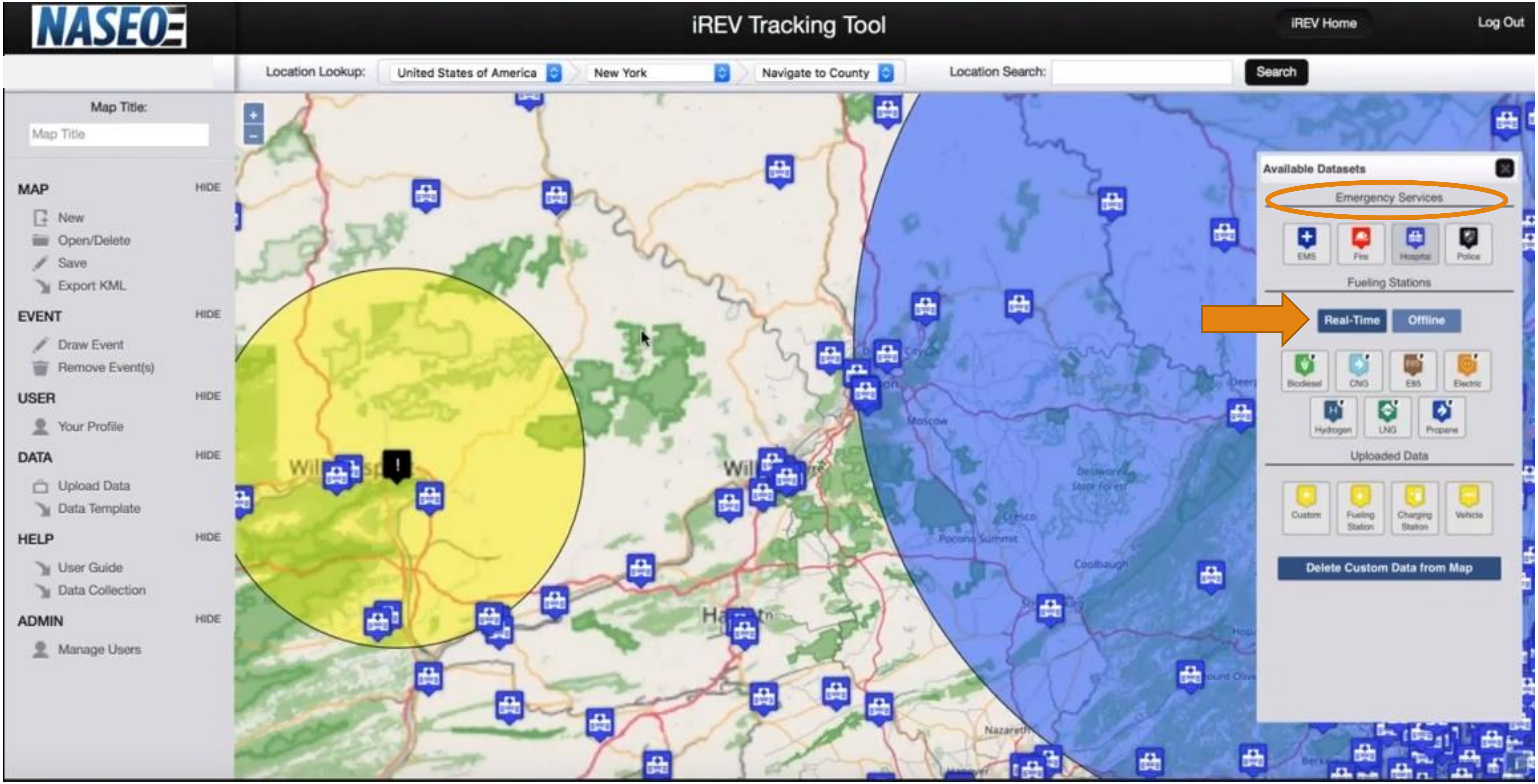
Data Collection
ADMIN
HIDE
Manage Users
Draw Event
Event Name
Sample2
Event Description
Same 1
Event Color:
Draw Event
Available Datasets
Emergency Services
EMS
Fire
Hospital
Police
Fueling Stations
Real-Time
Offline
Biodiesel
CNG
E85
Electric
Hydrogen
LNG
Propane
Uploaded Data
Custom
Fueling Station
Charging Station
Vehicle
Delete Custom Data from Map
Schenectady
Troy
Albany
Oneonta
Binghamton
Catskill Park
Poughkeepsie
Waterbury
New Haven
Bridgeport
Stamford
Scranton
Wilkes-Barre
Williamsport
Hazleton
Paterson
Yonkers
New York
Long Island
Islip
Elizabeth
Allentown
New Brunswick
Reading
Nashua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Offline
Biodiesel
CNG
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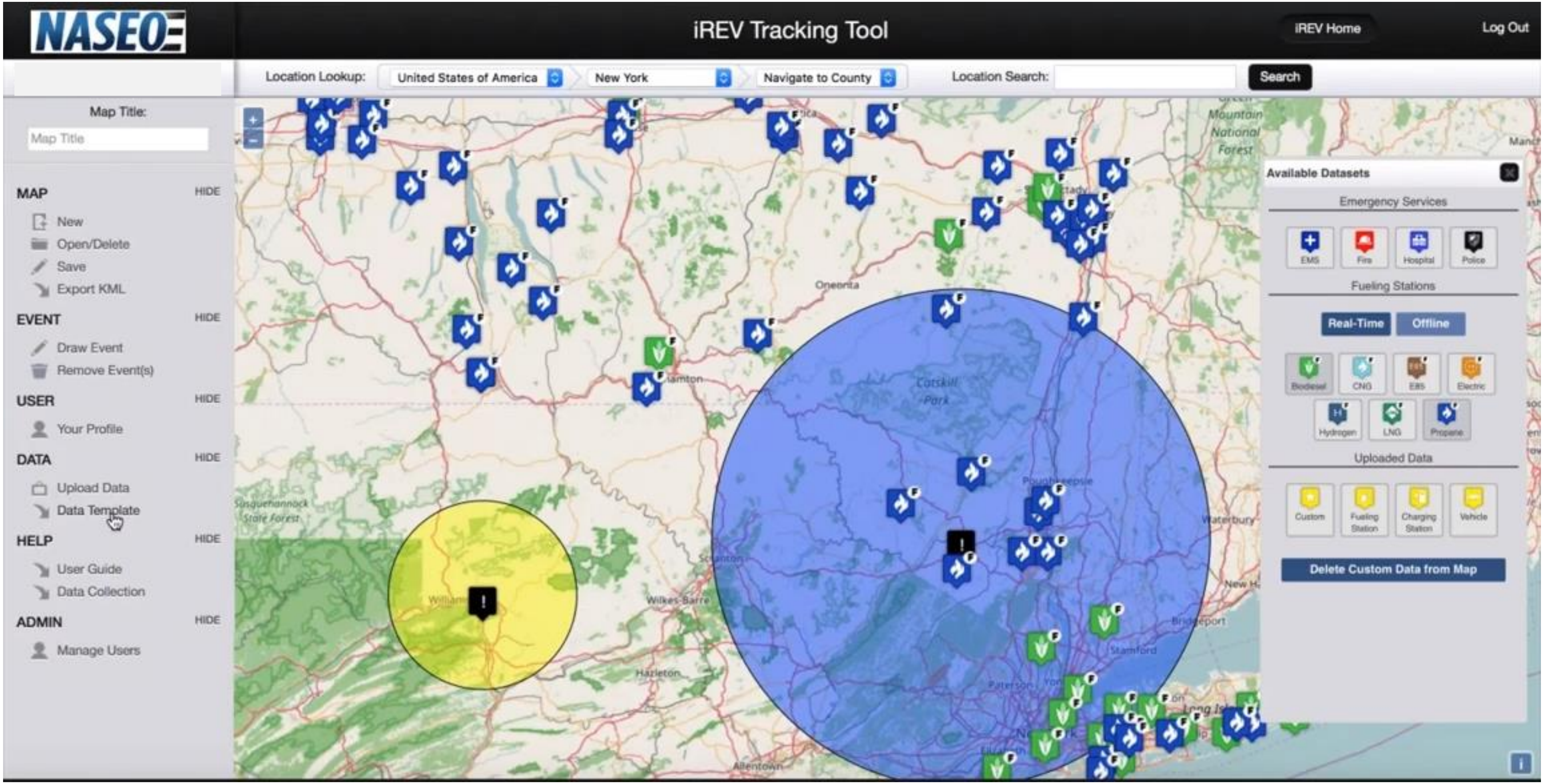
Electric
Hydrogen
LNG
Propane
Uploaded Data
Custom
Fueling Station
Charging Station
Vehicle
Delete Custom Data from Map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Save
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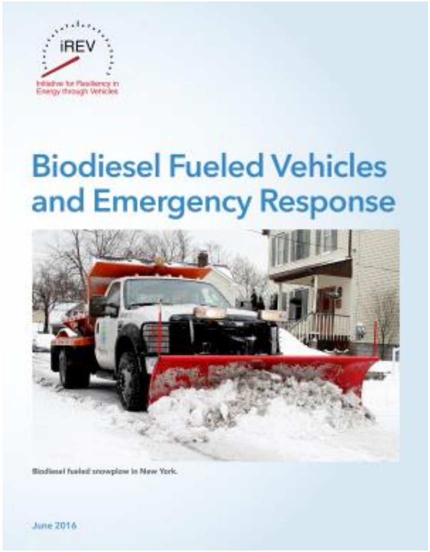
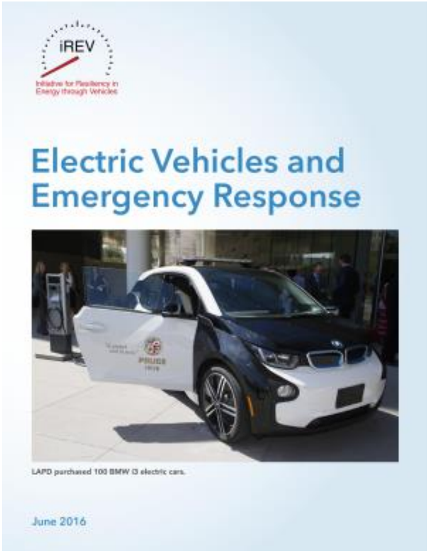
EVENT
HIDE
Draw Event
Remove Event(s)
USER
HIDE
Your Profile
DATA
HIDE
Upload Data
Data Template
HELP
HIDE
User Guide
Data Collection
ADMIN
HIDE
Manage Users
Available Datasets
Emergency Services
EMS
Fire
Hospital
Police
Fueling Stations
Real-Time
Offline
Biodiesel
CNG
E85
Electric
Hydrogen
LNG
Propane
Uploaded Data
Custom
Fueling Station
Charging Station
Vehicle
Delete Custom Data from Map

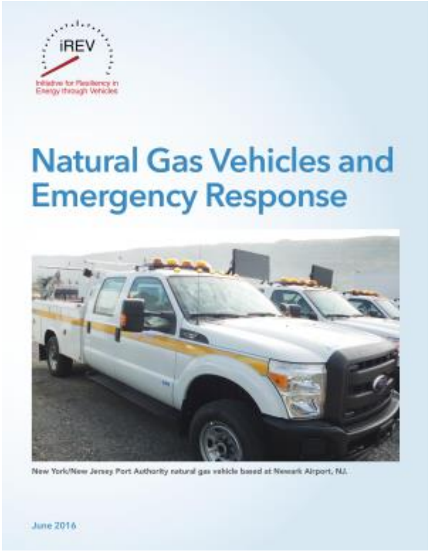
iREV Case Studies: Alternative Fuel Vehicles and Emergency Response



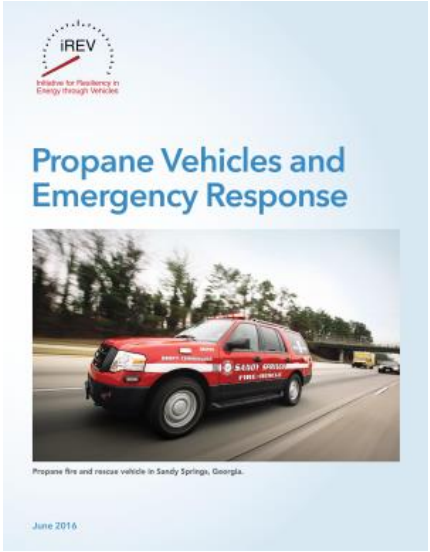
On-site storage tanks can provide fuel to emergency services



Ability to export power when the grid is not functioning



Natural Gas is normally supplied via underground pipeline, which is more resilient



Mobile fueling capacity allows fuel to be delivered to remote or inaccessible areas

Additional Resources

Department of Energy (DOE) State and Local Solution Center

- Explore resources related to energy planning, financing energy initiatives, accessing energy data and designing energy programs.

National Renewable Energy Laboratory's REopt Lite Tool

- This free tool evaluates the viability of on site grid-connected photovoltaic, wind, and battery storage, potential battery dispatch and size, and the critical load a system can sustain during a grid outage.

SECO Resources

About SECO

Mission Statement: To Increase the Efficient Use of Energy and Water While Protecting the Environment

Focus on Public Sector Facilities – Indirectly Benefitting Taxpayers

Support for Energy and Water Efficiency Project Implementation

- Education and Training
- Technical Assistance
- Project Financing

U.S. Department of Energy State-Level Program Conduit

- State Energy Program (SEP)
- Pantex/Waste Isolation Pilot Plant (WIPP)

SECO Support

Training/Education

- Energy Codes (Workshops & Adoption Toolkit)
- WattWatchers

Technical Assistance

- Preliminary Energy Audits (K-12 & Local Governments)
- Virtual Energy Audits

Financing

- LoanSTAR Revolving Loan Program
- Energy Savings Performance Contract Guidelines & Education

https://comptroller.texas.gov/programs/seco

Programs

SECO State Energy Conservation Office

STATE ENERGY CONSERVATION OFFICE

SECO partners with Texas local governments, county governments, public K-12 schools, public institutions of higher education and state agencies, to reduce utility costs and maximize efficiency. SECO also adopts energy codes for single- family residential, commercial, and state-funded buildings.

Funding & Incentives

- SECO Funding Opportunities
- LoanSTAR Revolving Loan Program
- Other Funding Resources

Programs

- Alternative Fuels Program
- Clean Energy Incubators
- Industrial Energy Efficiency
- Innovative Energy Demonstration Program
- Local Governments Program
- Schools Program
- State Agency and Higher Ed. Program
- Pantex Program

Energy Codes

- Training & Code Compliance
- Energy Code Adoption Process
- Code Contacts
- Commercial & Multi-Family Construction
- Single-Family Construction
- State-Funded Buildings
- Local Ordinances
- Texas Water Conservation Standards

Energy Reporting

- State Agencies and Institutions of Higher Ed
- Local Government
- Utilities
- Schools

Resources

- Combined Heat and Power in Texas
- Energy Efficiency Best Practices Guide
- Energy Savings Performance Contracting
- SECO Reports

About Us

- Contact Us
- Sign up to receive updates

North Central Texas Council of Governments

LoanSTAR Revolving Loan

Finances Projects that Reduce Energy/Water/Utility Costs

- Simple Payback Period of 15 Years or Less
- 2% Loan Interest Rate; 1% if Choose ARRA Funds with More Reporting

Open Enrollment Through **August 30, 2019**

- Maximum $8 Million Loan Per Application
- Maximum 3 Loans per Entity

Program Overview:
https://www.youtube.com/watch?v=4IFuj_5ZeGI

North Central Texas Council of Governments

Other Resources, Funding, & Incentives

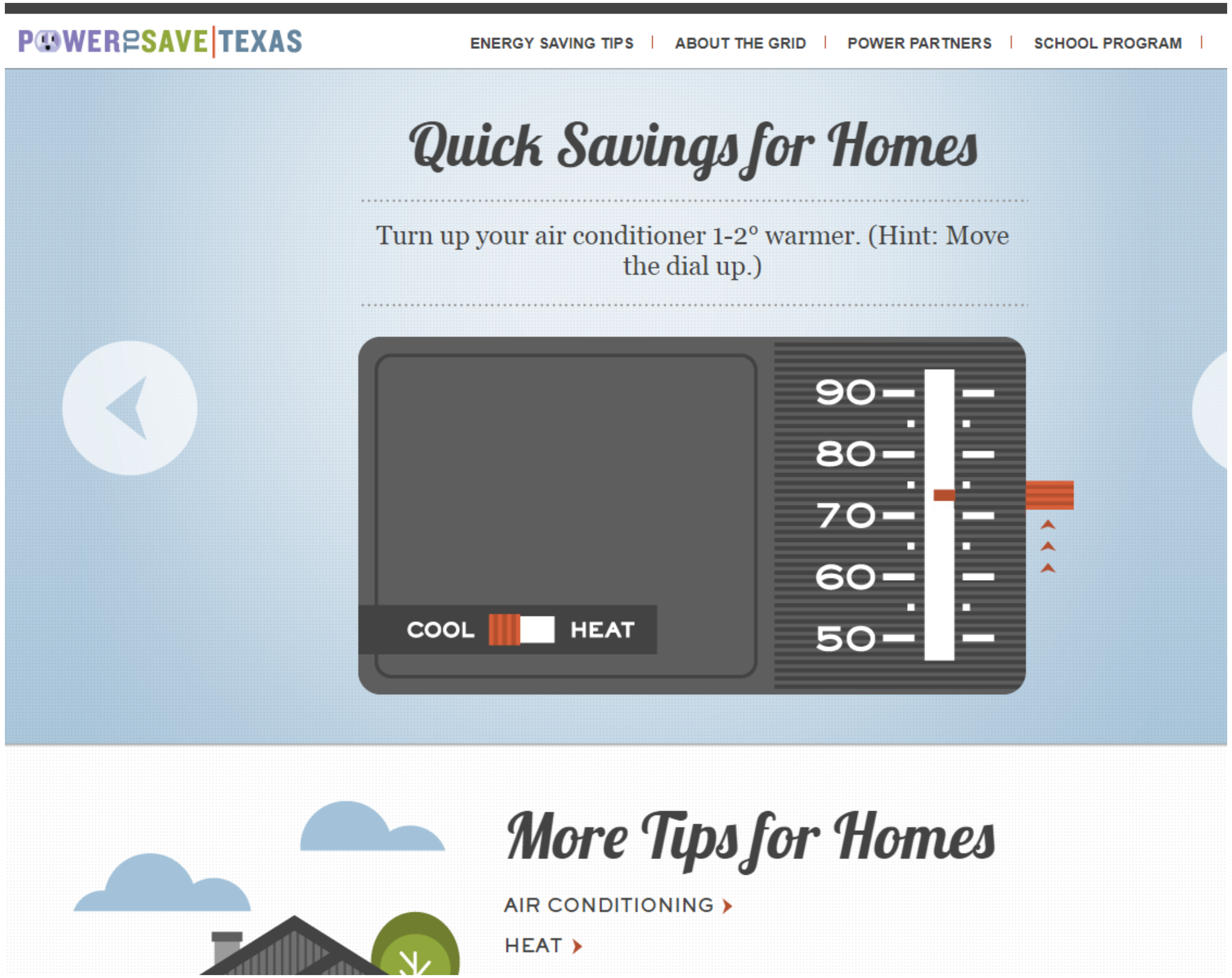
Database of State Incentives for Renewable Energy:
Local, Utility, State, Federal
www.dsireusa.org

Texas Department of Agriculture:
City Population < 50,000; County Population <200,000
Water / Wastewater infrastructure; Street / Drainage; Housing
Awards Range from $75,000 - $800,000
www.texasagriculture.gov/GrantsServices

Texas Water Development Board:
Financial Assistance Programs
Loans, Grants, Deferred Interest, Combination Grant/Loan
Political Subdivisions, non-Profit and Community Water Supply Corporations, Private
www.twdb.texas.gov/financial/programs

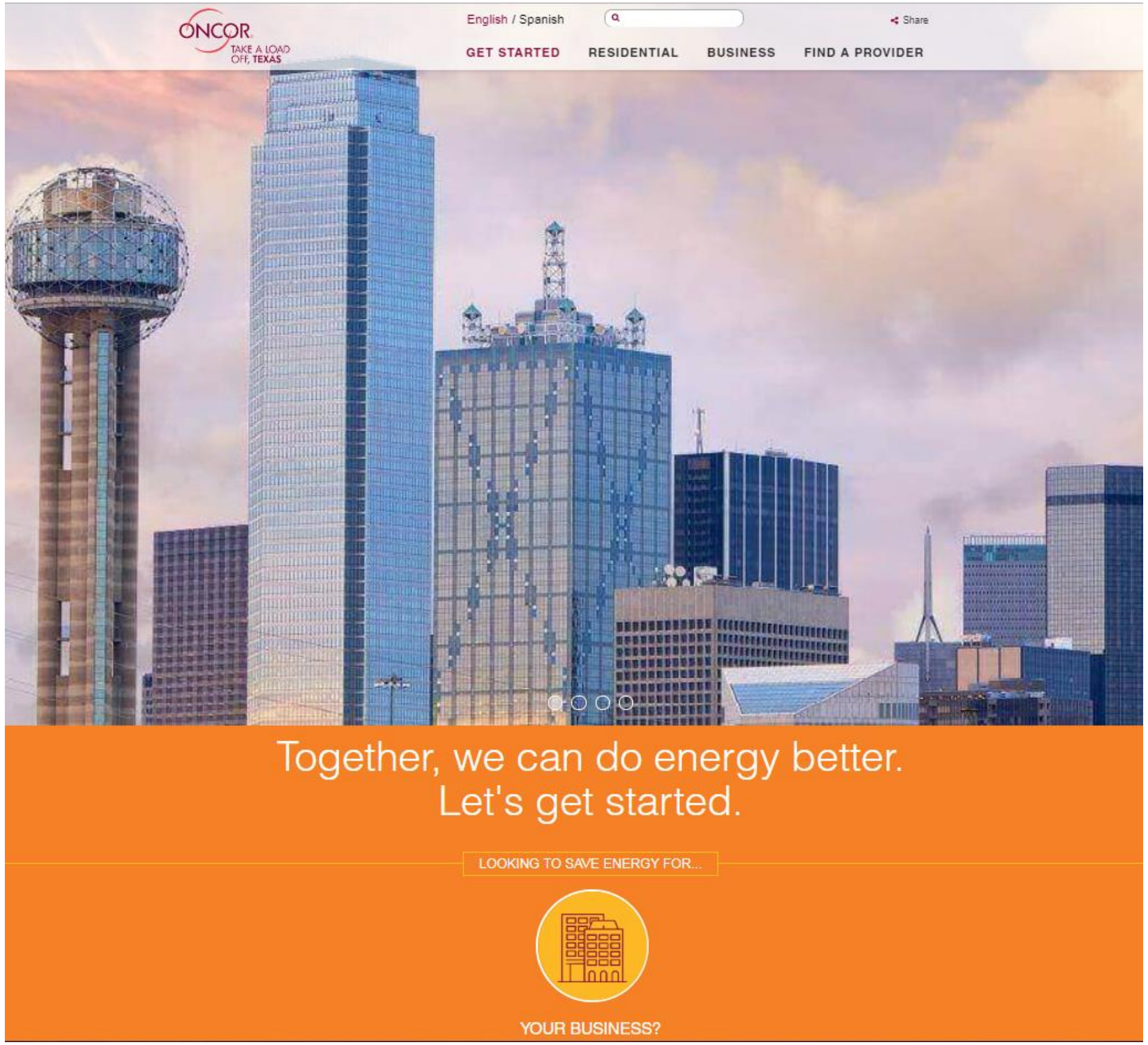
Consumer Resources – Cities can Advertise to Residents

PUC Power to Save Website



http://www.powertosavetexas.net/Home/QuickSavingsHome

ONCOR Take a Load Off Texas



https://www.takealoadofftexas.com/en/Pages/Home.aspx

Texas Property Assessed Clean Energy (TX-PACE) Program

TX-PACE facilitates the use of private capital to finance water conservation**, energy efficiency**, resiliency, and distributed generation projects to eligible properties

As of August 2019, PACE in North Texas Programs:

- Corinth
- Dallas
- Farmers Branch
- Princeton
- Prosper
- Navarro County
- Tarrant County

PACE is a voluntary program that can be used for the following property types.

ELIGIBLE PROPERTIES

COMMERCIAL REAL PROPERTY

Including non-profit real property such as private schools, medical facilities, churches, etc.

INDUSTRIAL REAL PROPERTY

Including privately owned agricultural real property.

Industrial Flyer

MULTIFAMILY RESIDENTIAL REAL PROPERTY

Residential real property with five or more dwelling units.

Eligible Improvements:

Chillers, boilers, and furnaces • HVAC, BMS, BAS, EMS controls • Lighting • Water heating systems • Energy management systems and controls • Roofing • Windows • Doors • Insulation • Elevator modernization • Pool equipment • Cogeneration or combined heat and power • Heat recovery and steam traps • Solar panels • Wind turbines • Water management systems and controls • Irrigation equipment • Rainwater collection systems • Toilets • Faucets • Greywater systems... and more!

NCTCOG Resources

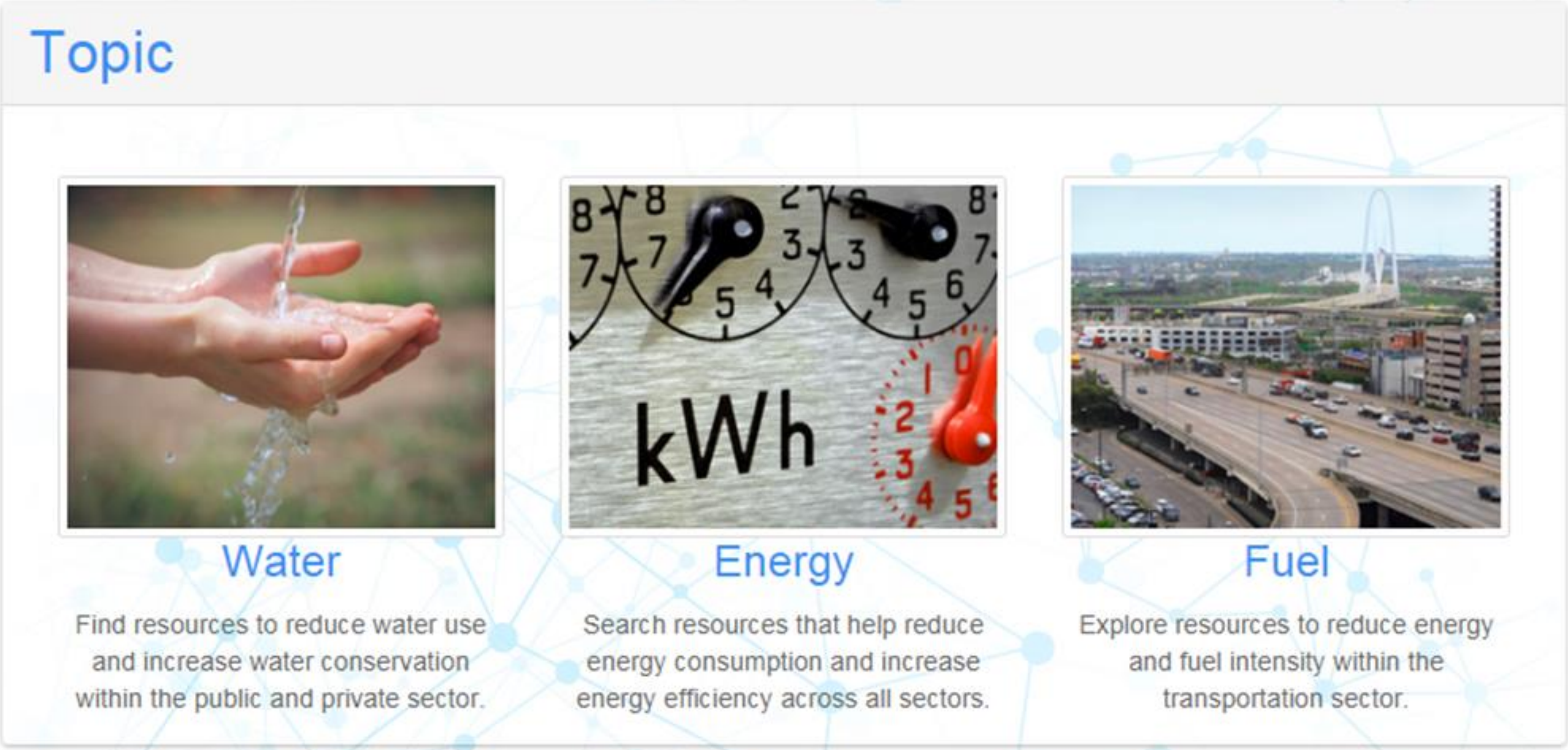
North Central Texas
Council of Governments

Conserve North Texas

Clearinghouse of Energy Efficiency, Water Conservation, and Transportation Resources

Resource Types:

- Programs
- Tools
- Calculators
- Case Studies



www.conservenorthtexas.org

Go Solar Texas

Texas-Specific Information about Solar

Key Resource Types:

- Best Management Practices
- Cost Benefit Analysis
- Trainings
- Case Studies
- Meeting-in-a-Box

www.gosolartexas.org

FOR MORE INFORMATION

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

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