Webinar:

District Cooling & Heating

with CHP and Microgrid Systems

January 26, 2022

CHP Technical Assistance Partnerships
SOUTHCENTRAL

CenTrio

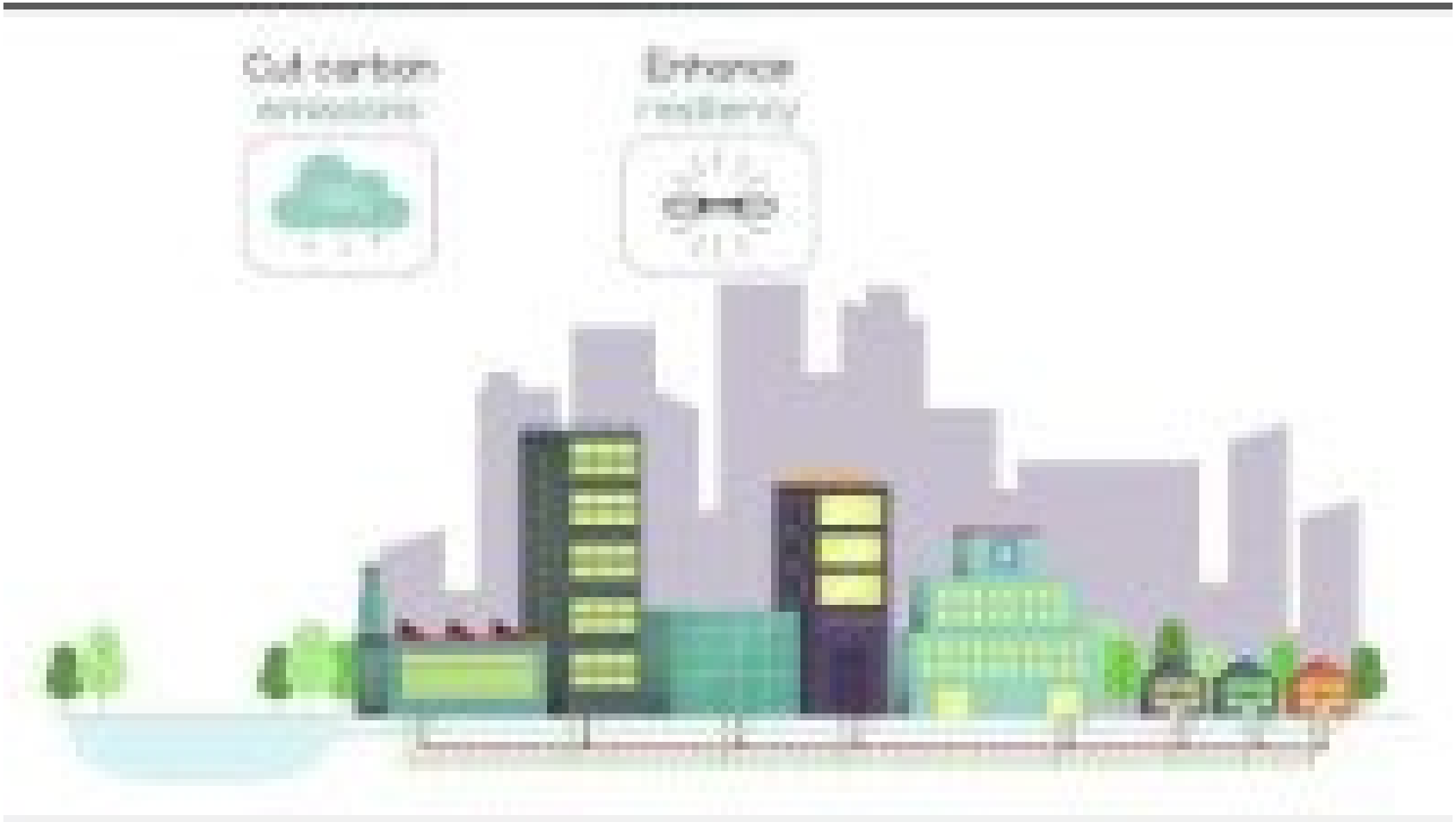
Why District Energy?

District Energy is district cooling & heating plus energy combined

"70% of the world's energy is consumed in cities, half the energy is used for heating and cooling. District Energy is one of the most effective ways to deal with climate change."

District Energy in Cities Initiative – United Nations Environment

How Does it Work?



District Cooling & Heating in History

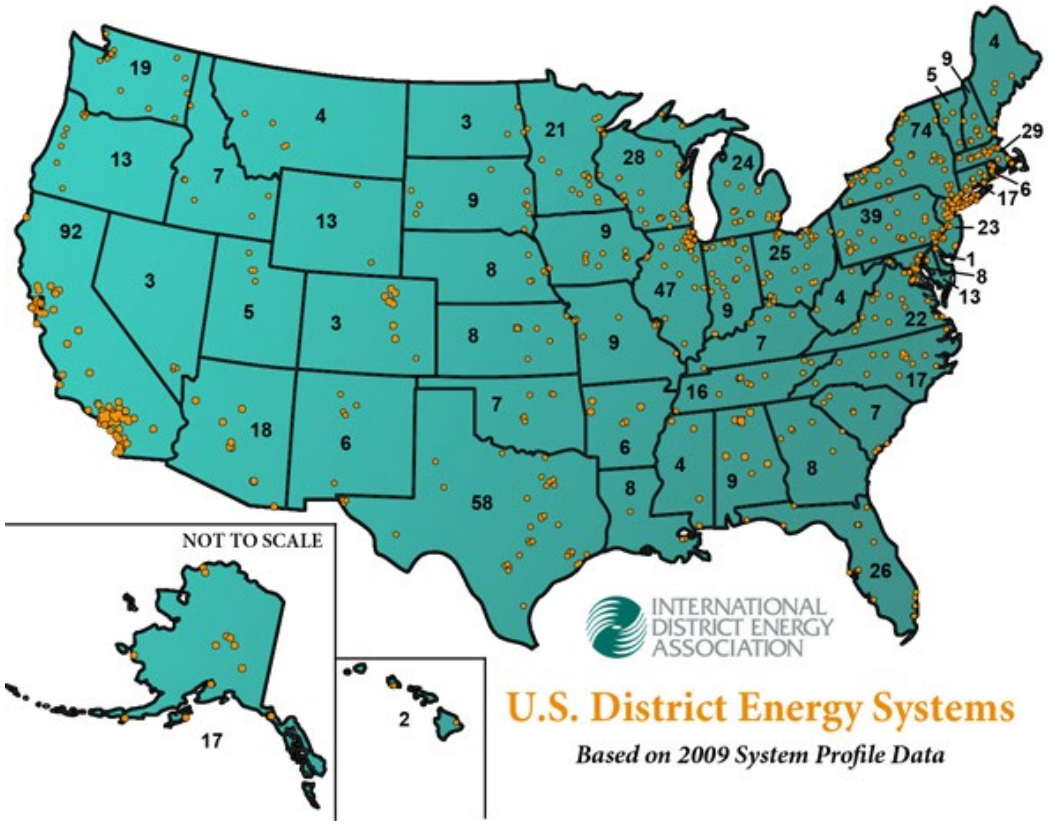
- Early attempts in the US date back to the 1880s (Pierce 1994). The development of DE was confined mostly to North America---Primarily the United States---for a number of decades.
- Recent years have seen DE, in particular, district cooling take off in middle eastern countries where the demand for large scale cooling in desired.
- Colder climates have seen the use of district heating for decades as well.
- Newer adoption is introducing microgrids for more diverse application.

District Cooling with Combined Heat & Power

District energy systems produce steam, hot water or chilled water at a central plant that is then piped underground to individual buildings for space heating, domestic hot water heating and air conditioning. With CHP DE systems produce electricity for connected buildings.

Benefits from CHP with DE*:

- Improved energy efficiency
- Ease of operation and maintenance
- Reliability
- Enhanced environmental protection
- Fuel flexibility
- Decreased building capital costs
- Comfort and convenience for customers



*According to the International District Energy Association, http://www.districtenergy.org

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)
- CHP can also increase energy reliability and resiliency and enhance power quality
- On-site electric generation can reduce grid congestion and avoid distribution costs.
- Higher efficiency reduces emissions of pollutants
- Less on-site equipment (ex. chillers & evaporators) means less maintenance and more room for tenants.

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 and provide advanced services to maximize the economic impact and reduce the risk of CHP from initial CHP screening to installation.

www.energy.gov/chp

DOE CHP Technical Assistance Partnerships (CHP TAPs)

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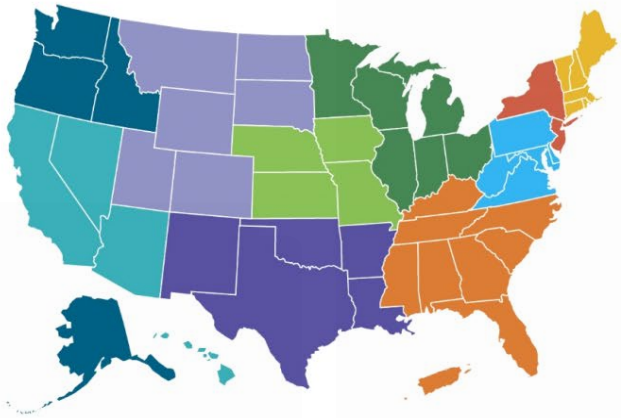

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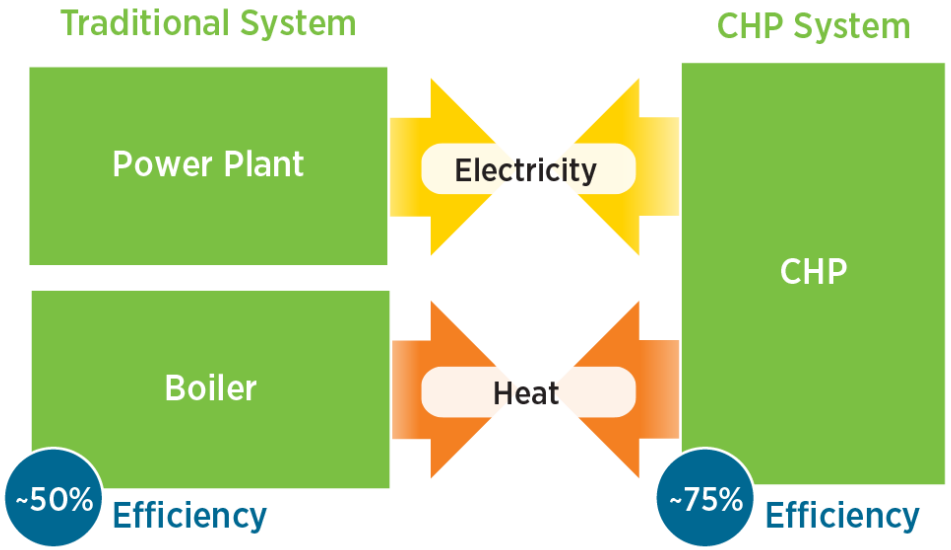
CHP: A Key Part of Our Energy Future

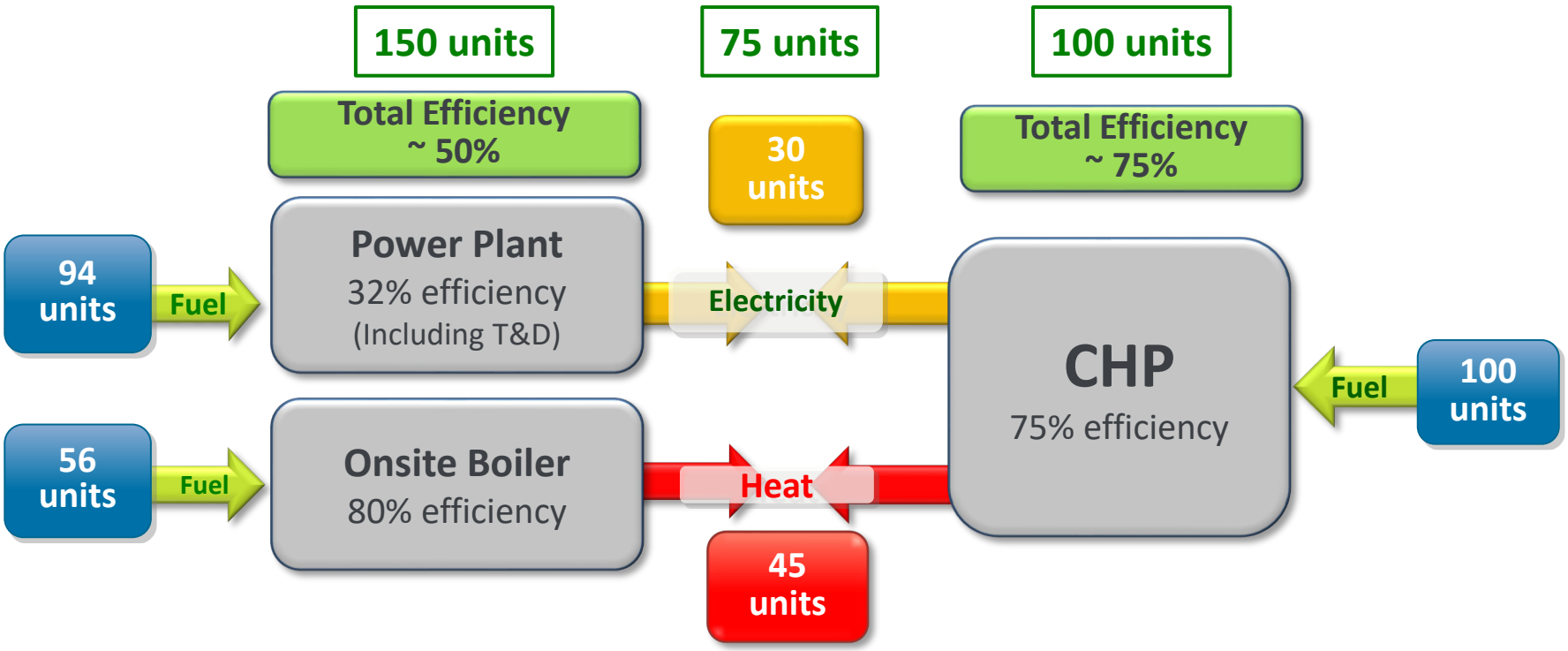
- Form of Distributed Generation (DG)
- An integrated system
- Located at or near a building / facility
- Provides at least a portion of the electrical load and
- Uses thermal energy for:
  - Space Heating / Cooling
  - Process Heating / Cooling
  - Dehumidification



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

Source: http://www1.eere.energy.gov/manufacturing/distributedenergy/pdfs/chp_clean_energy_solution.pdf

CHP Recaptures Much of the Heat, Increasing Overall Efficiency of Energy Systems and Reducing Greenhouse Gas Emissions



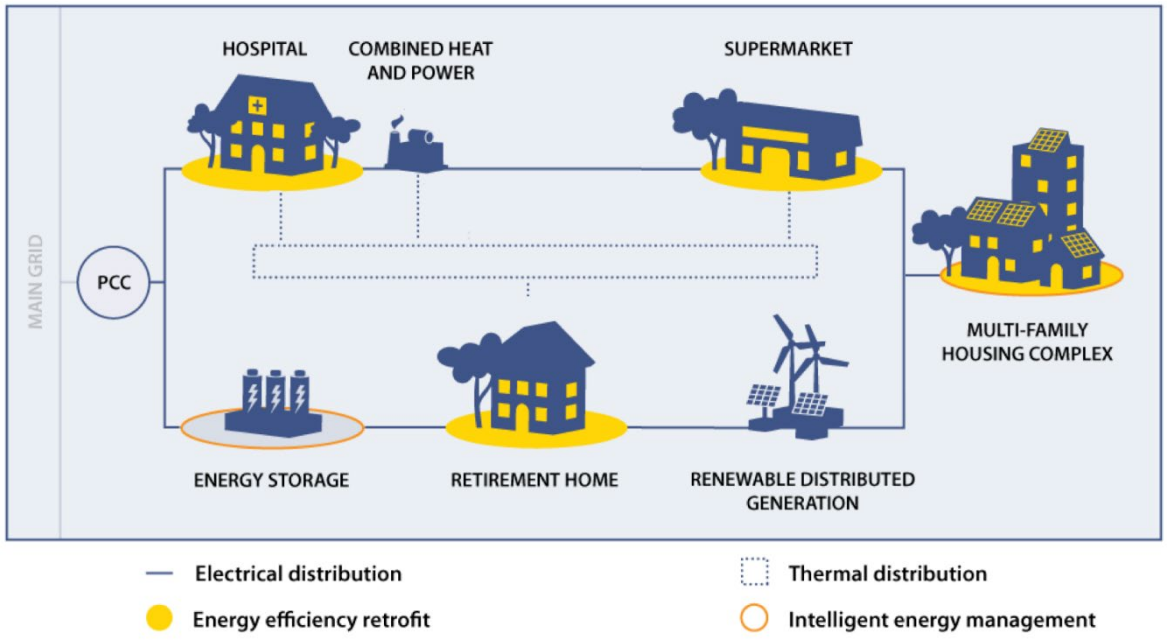
30% to 55% less greenhouse gas emissions per unit

What is a Microgrid?

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

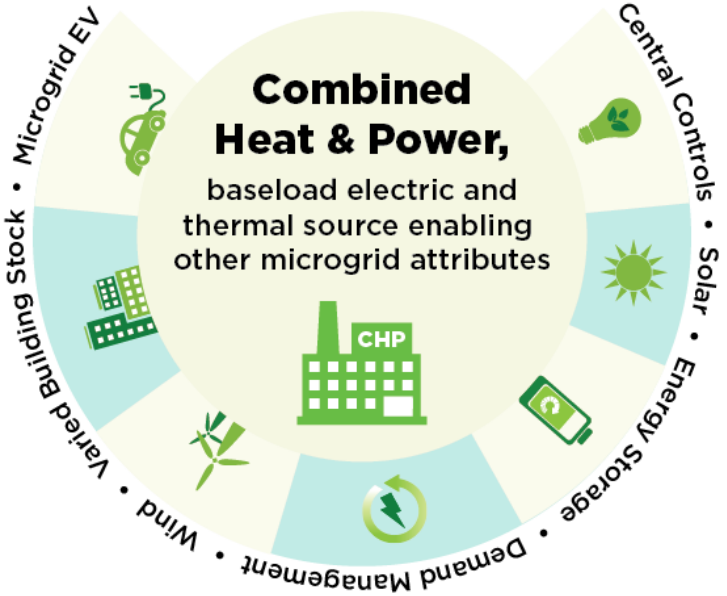
CHP Can Be The Centerpiece of a Community Microgrid

- Provide resilient base load continuous power
- Supplies thermal energy for cooling and heating
- Supports other resources such as solar PV
- Can provide grid services



Source: Pace Energy and Climate Center, "Community Microgrids: Smarter, Cleaner, Greener."

CHP Can Enable Other Microgrid Technologies



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

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

- 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

Making it Work for You

- Who are some of the influencer in this industry?
- What are sample applications of District Energy Systems?
- How are systems benefiting my community now?
- How can I influence the increased use of DE systems?

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CenTrio Houston – Union Station Chilled Water Plant

1401 Rusk St.
Houston, TX 77002

- Began providing service to Minute Maid park in 1999
- 5.45 miles of chilled water piping in service

CenTrio

* 99.99% uptime

*370+ Customers

*130+ Million SF served

CenTrio

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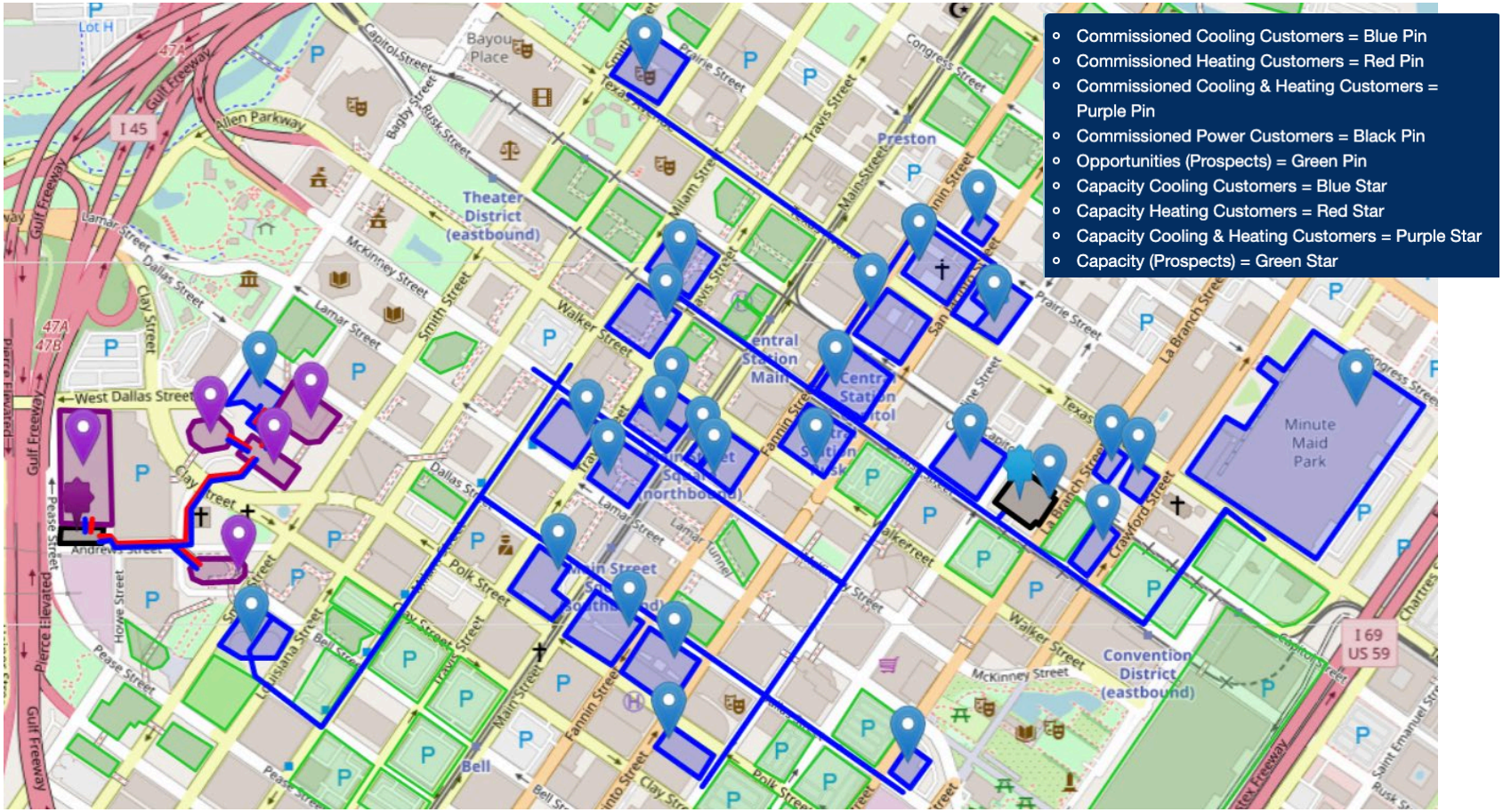
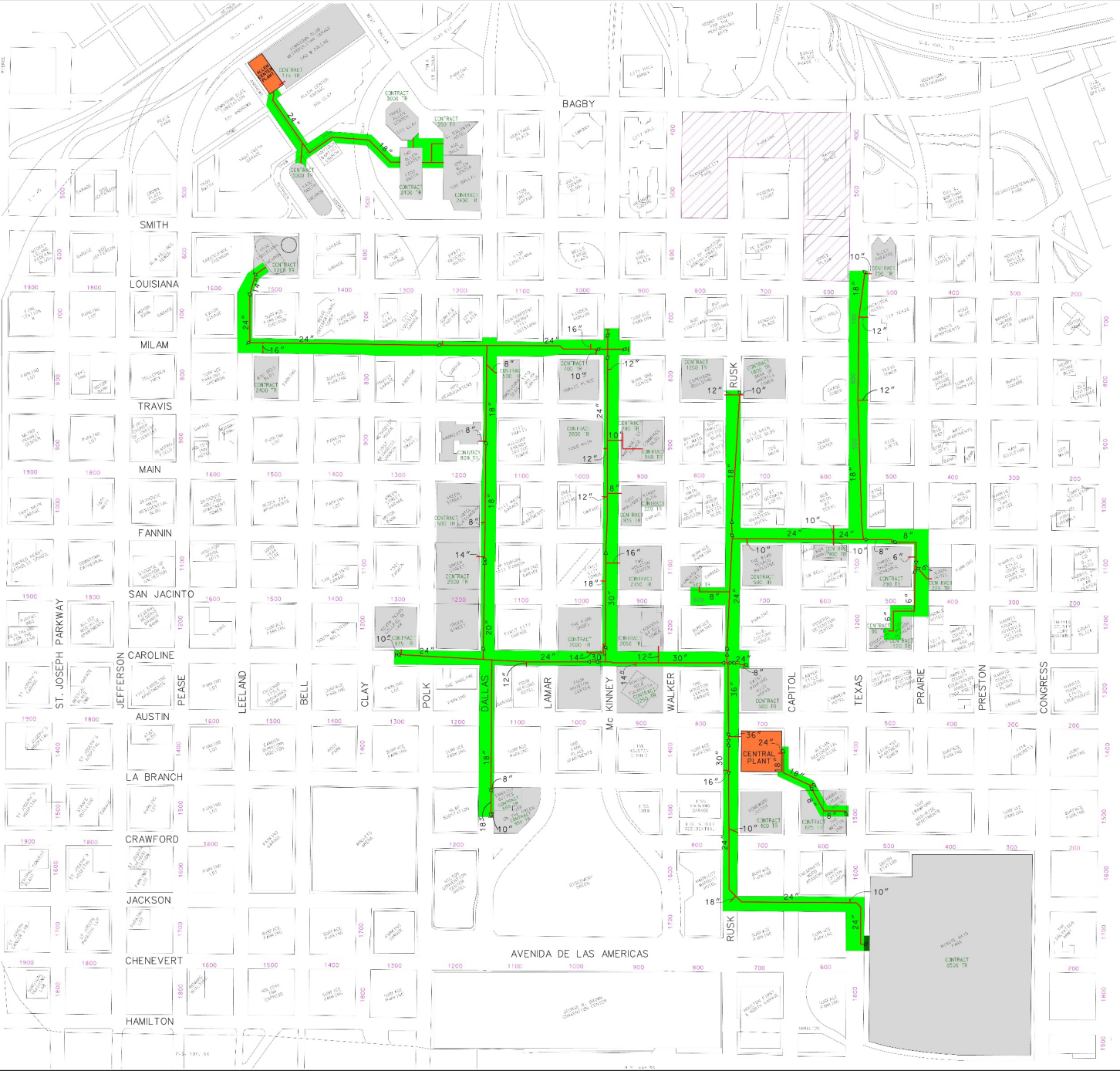
Houston – Customers, Plants, Infrastructure Pipes





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HOUSTON DOWNTOWN DISTRIBUTION PLAN

LEGEND

- INSTALLED PIPING
- PROPOSED PIPING
- BUILDING CUSTOMER

REVISED 8-6-21

PGAL
3131 Briarpark Dr.
Suite 200
Houston, Texas 77042
Phone (713) 622-1444
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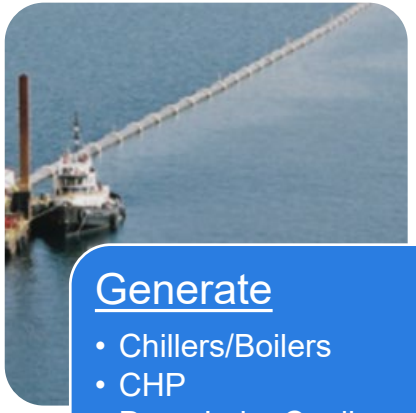
PGAL TBPE REG. NO. F-2742

CenTrio

CenTrio's Operating Systems has significant portfolio and experience with core/sustainability energy technologies.

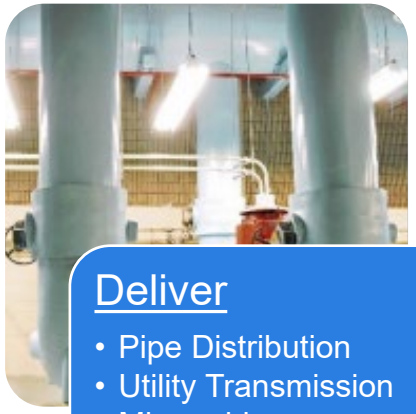


Generate

- Chillers/Boilers
- CHP
- Deep Lake Cooling
- Biomass
- Geothermal
- Heat Pumps
- Waste Heat Recovery

Store

- Ice Battery
- Chilled Water Storage
- Hot Water Storage
- Geothermal
- Electricity Storage Batteries



Deliver

- Pipe Distribution
- Utility Transmission
- Microgrid
- Ambient Loop

CenTrio

Who we Serve

- ***Commercial & Industrial***
- ***Developers***
- ***Municipalities***
- ***Health Care & Research***
- ***Campuses***
- ***Residential***

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HOUSTON DURING HURRICANE HARVEY

Resilient and Sustainable

- Union Station plant remained operational during hurricane Harvey and others before it.
- Most connected buildings were able to open right away for business.
- Major medical buildings experienced little to no shutdown
- Emergency backup power generation was possible due to redundant systems
- Hotels remained open to accommodate rescue personnel.

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Let’s take a live view of the operations at Union Station in downtown Houston, TX.

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Case Study: LSU Medical District

Dr. Merv Trail, Chancellor:
"CenTrio has been a true partner in the development of our Medical campus."

New Chiller Plant

- N+1 Redundancy
- Disaster Resistant
- Flood Mitigation
- Fuel and Water Storage
- Backup Generation
- Overhead pass to Campus
- Additional Parking Structure

New Steam Plant

- N+1 Redundancy
- Dual Fuel Boilers
- Feed Water Economizers
- Variable Speed Pumping
- Fuel and Water Storage
- Flood Mitigation
- Backup Generation
- Personnel Bunkroom
- Food and Fuel Storage

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Case Study: Syracuse University

- 40 yr Exclusive PPP agreement with meaningful committed capital and significant long term upside potential; provides launch pad for future opportunities in PPP market
- Won RFP in September 2020
- Success attributed to CenTrio's reputation as a best-in-class, specialized energy partner that was well positioned to execute the significant modernization program
- Base Modernization project contemplates capital spending of ~US$210MM+

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Case Study: LSU Baton Rouge Campus

Project Description

- LSU is seeking to modernize its Central Utility Plant and Utilities Infrastructure • Launched a market sounding in which CenTrio participated
- LSU issued a Request for Negotiation and Final Offers Late 2020
- LSU Awarded contract to CenTrio

Competitive Advantage

- Excellent relationship with LSU since 1998 vis a vis LSU Medical campus operation in New Orleans
- CEA is proven and easily adaptable to this project
- Synergies with existing operation in New Orleans

Opportunity Summary	
Timeline	2021 Concession Agreement 2023 Modernization Completion 2061 Term of Agreement
Concession Agreement Length	40 years
Status & Next Steps	Contract Negotiations

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Summary – Q & A

- District Energy Systems have been around for over 100 years.
- District Energy Systems provide efficient and resilient platforms for delivering cold or hot water for moderate to dense communities.
- Combined with CHP (Combined Heat & Power Plants) electricity can be produced economically and distributed to communities
- Microgrids can join more areas outside of a CHP DE zone to extend the deliverables to neighborhoods, industrial zones and new developments.
- District Energy Systems are already at work in your community.

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