

Packaged CHP Accelerator Webinar
CHP and Healthcare
May 26, 2021

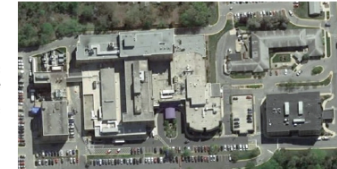
Agenda

- Introduction
- CHP Market Sector Analysis: Hospitals
Cliff Haefke, Midwest CHP TAP
- CHP for Hospitals: Lessons from the Field
Jack Sins, Unison Energy
- CHP from the Hospital Perspective
Mark Mears, Union Hospital

Better Buildings[®] U.S. DEPARTMENT OF ENERGY Combined Heat and Power Fact Sheet Series CHP MARKET SECTOR: HOSPITALS

CHP at Hospitals

Hospitals and healthcare systems are at the front line of responding to natural disasters, reducing mortality rates, and assisting with public health crises. It is imperative that these facilities, along with the patient health and critical life support systems they house, operate nonstop. Yet economic development continues to grow in regions that face extreme weather events—events whose intensity, duration, and geographic reach are on the rise. The trend affects even areas of the country not historically associated with severe weather. Furthermore, most communities are struggling with weak or outdated infrastructure. In the face of these natural hazards, healthcare organizations must improve the resilience of their facilities, including power delivery systems. One approach is the installation of combined heat and power (CHP) systems. Well suited to meet both resilience requirements and energy demands, CHP can provide electricity, hot water, and space heating and cooling during both normal operations and major outage events.



Doctors Community Hospital in Lanham, Maryland, installed two 600 kW reciprocating engines to provide 80% of the hospital's electrical load and 90% of the hospital's thermal load. Photo courtesy of Doctors Community Hospital

Characteristics of Energy Use in Hospitals

A hospital is one of the most energy-intensive commercial building types, using more than three times the energy per square foot compared to a typical office building. Hospitals require continuous power for their operations and have significant thermal demands for heating, hot water, steam for sterilization, cooling, dehumidification, and laundry services.

These coincident thermal and electric loads make CHP a good fit to provide year-round critical power and thermal energy. Figure 1 (next page) shows average monthly hospital electric and gas loads, modeled using DOE Commercial Reference Buildings for two different weather regions.²

Electric and gas loads are relatively consistent for facilities in both warm and cold climates, with some fluctuation due to space heating in winter and space cooling in summer. CHP can meet baseload thermal demand year-round and can provide cooling in warmer months, which could significantly decrease electricity costs and generate resilient space cooling on site.

Packaged CHP Systems eCatalog

Packaged CHP systems are standardized, prefabricated CHP systems built off site prior to installation, allowing customers to reduce installation time and cost. The Packaged CHP eCatalog from DOE provides tools for users to learn about, select, and compare packaged CHP systems and solutions that have been reviewed and recognized by DOE. The eCatalog is the product of a voluntary public-private partnership designed to validate packaged CHP technologies for growing commercial, institutional, multifamily, government, and light manufacturing markets. Visit the DOE CHP eCatalog at <https://chp.ecatalog.lbl.gov/>.

HOSPITAL CHP QUICK FACTS

- ▶ Hospitals have **24-7 energy loads** and significant thermal requirements (hot water, space heating/cooling).
- ▶ CHP's **reliability** independent of the electric grid makes it a good match for hospital needs as **critical infrastructure** in the event of disasters.
- ▶ **Over a quarter** of all existing CHP systems at hospitals were installed after 2012.
- ▶ Hospitals spend an average of **\$3.16 per square foot** on energy costs each year. CHP can help reduce these costs and free up resources for patient care.¹
- ▶ The current average CHP installation size at a U.S. hospital is **~3.3 MW**.

¹ Environmental Protection Agency, "CHP for Hospitals: Superior Energy for Superior Patient Care." Accessed 2020. <https://www.epa.gov/chp/chp-hospitals-superior-energy-superior-patient-care>.

² Data obtained from DOE Commercial Reference Buildings, modeled in EnergyPlus: <https://www.energy.gov/eere/buildings/commercial-reference-buildings>.

Learn more at <https://betterbuildingsolutioncenter.energy.gov>

U.S. DEPARTMENT OF
ENERGY

Cliff Haefke,
Director, Midwest CHP TAP

Combined Heat and Power (CHP) Market Sector Analysis: Hospitals

US DOE CHP Packaged Systems Webinar

Cliff Haefke

May 26, 2021



CHP Technical Assistance Partnerships

MIDWEST

Agenda

- Energy Use in Hospitals
- CHP Concept for Hospital Sector
- CHP Market Trends in Hospital Sector
- CHP Resources and Next Steps

CHP Testimonials from the Healthcare Sector



“A Hospital needs to function as a Hospital no matter what is happening to the power. An ice storm can leave you without reliable power from the utility for days. Now with the Cogen plant, patients and the community can depend on the hospital at all times.”

- Scott Humphrey, Plant Operations Manager, Eastern Maine Medical Center



“The CHP plant has a much higher efficiency than our previous boiler system and saves important operating costs. The CHP plant also provides increased resiliency as it will serve as a backup for us in case of an emergency or a power outage”

- Kevin Kanoff, C.E.M., Campus Energy Engineer, Hershey Medical Center



“One advantage of having an on-site cogen plant is that less energy is lost because it is distributed right here at the Medical Center...It’s a win-win proposition for both Albany Med and the environment.”

- Emilio Genzano, Assistant Vice President of Engineering and Construction, Albany Medical Center

CHP Testimonials from the Healthcare Sector



"This innovative project not only saves energy, but it increases tremendously our reliability in the event of an ice storm, a tornado, cybersecurity threats; anything happening on the grid. We can power critical operations despite those interruptions.

- John Loetscher, III Vice President of Facilities, Engineering and Construction,
Erlanger Health System



"The CHP system allows the University to operate as an energy island so that critical University services at our hospitals, clinics and research facilities can be maintained if there are external outage events."

- Jerome Malmquist, Director of Energy Management at the University of
Minnesota



"The University of Iowa Hospital and Clinics' research and residential services require continuous, uninterrupted supplies of steam. The new plant will not only ensure continuity of services to our most critical health and research facilities, but also provide back-up service to both sides of campus while providing the most flexibility in fuel sources."

- Glen Mowery, Director of Utilities and Energy Management, University of Iowa

Energy Use in Hospitals



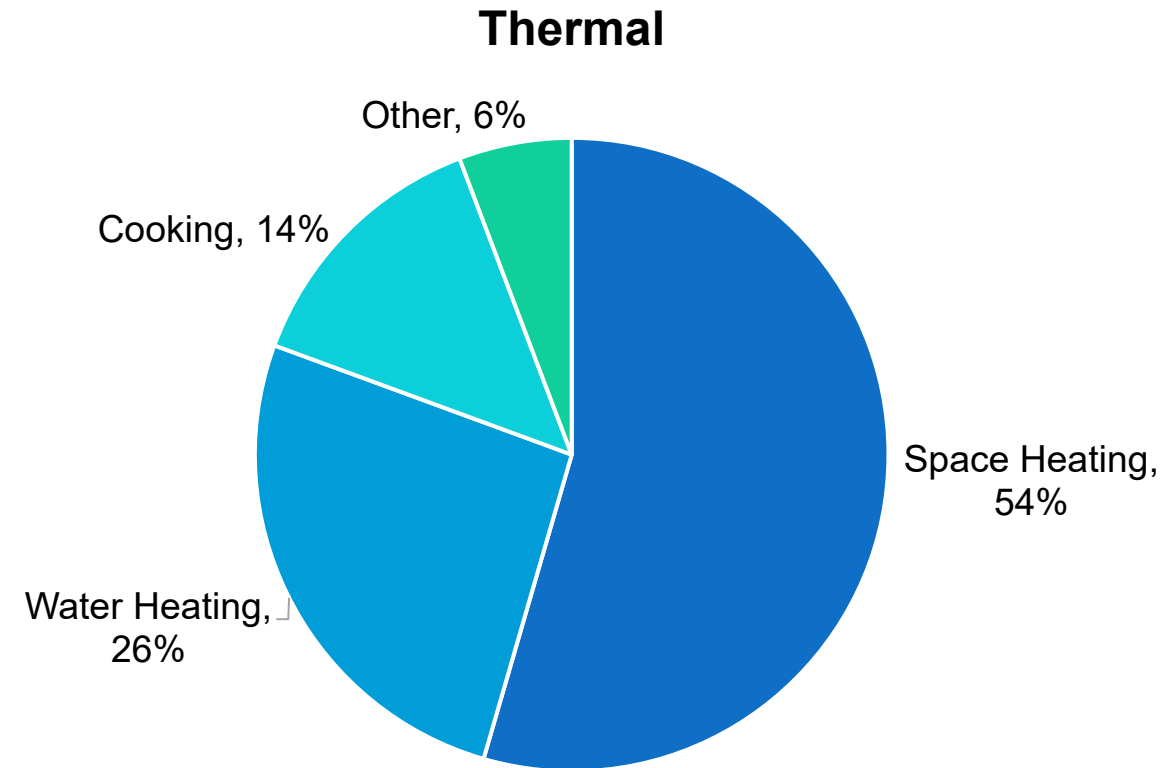
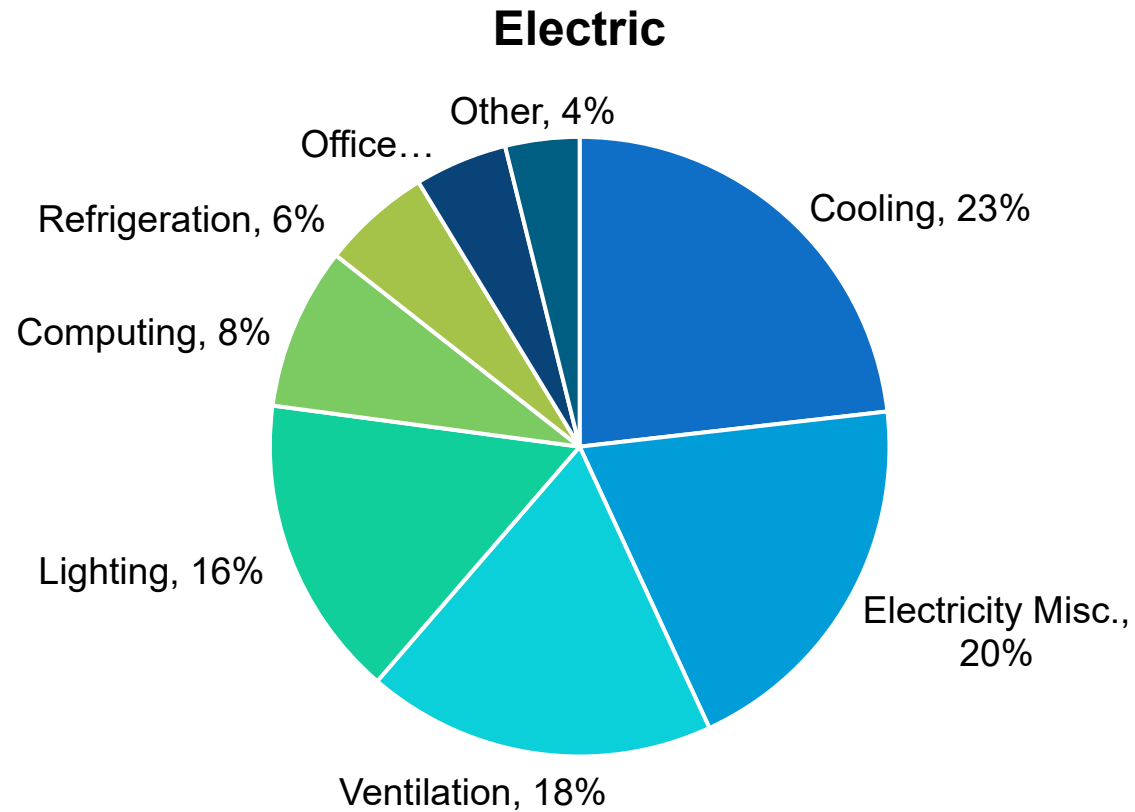
Energy Savings Impact in Hospitals

- Healthcare organizations spend > \$6.5B on energy annually
- Every \$1 a non-profit healthcare organization saves on energy is equivalent to generating \$20 in new revenues for hospitals
- For-profit hospitals can raise their earnings per share 1¢ by reducing energy costs just 5%
- Hospitals can reinvest savings from improved energy performance

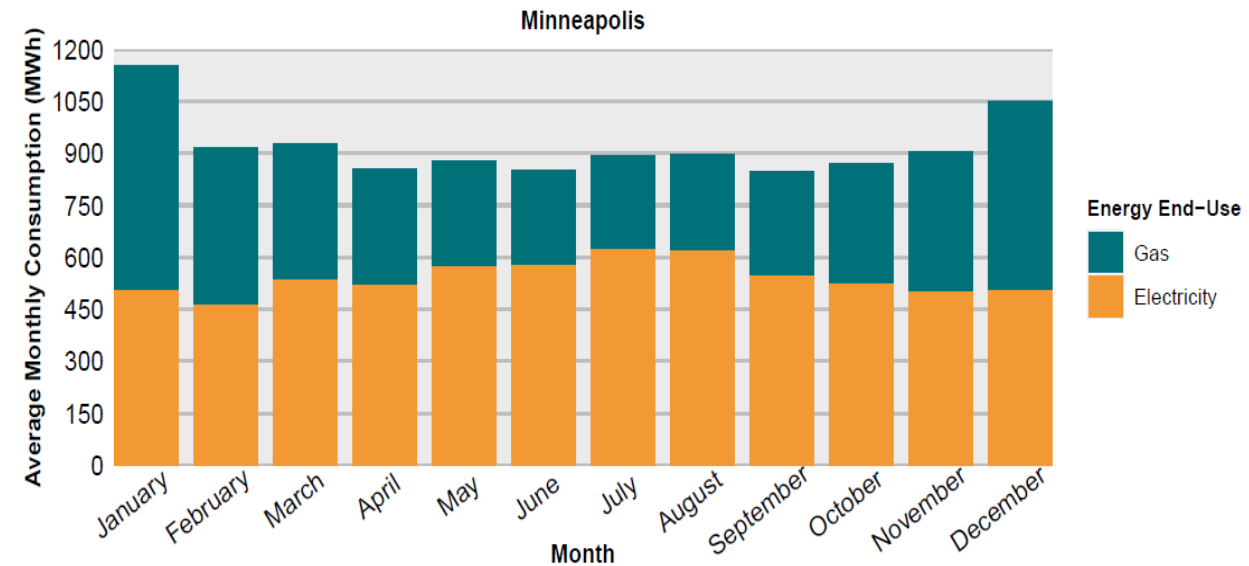
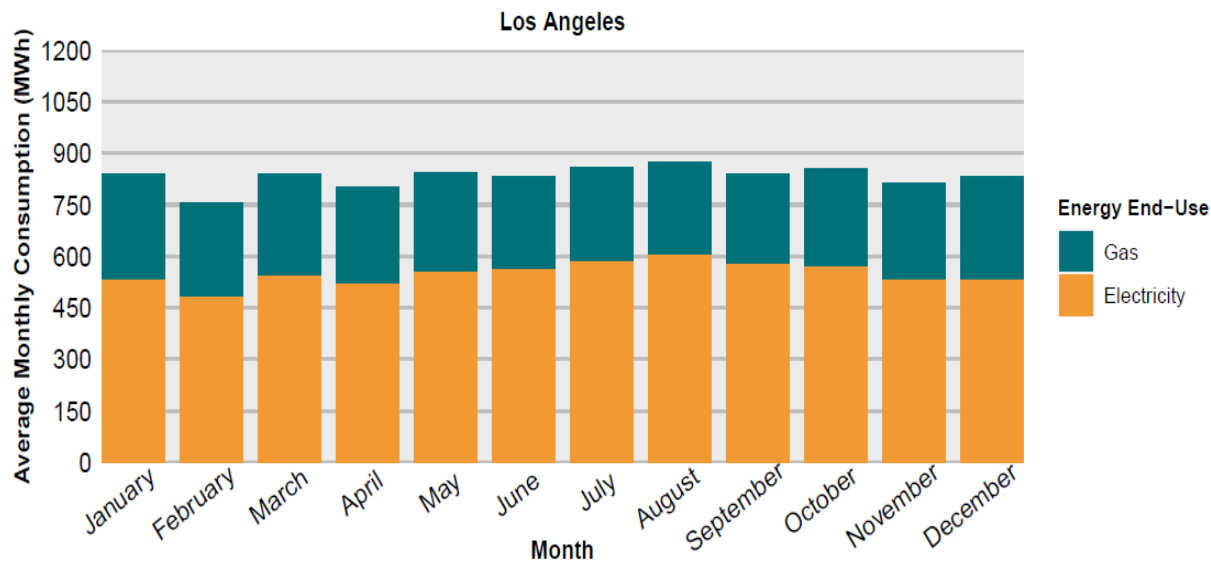
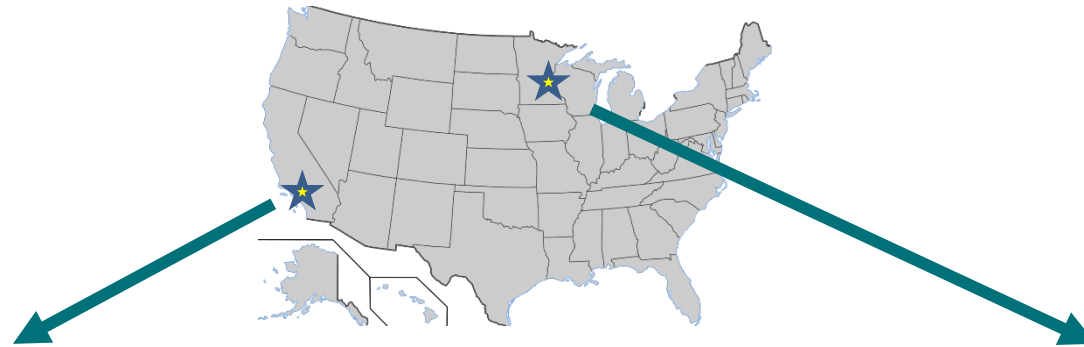


Source: ENERGY STAR - <http://www.energystar.gov/ia/partners/publications/pubdocs/Healthcare.pdf>

Annual Energy End-Use Breakdowns in Hospitals (Electric and Thermal Energy)



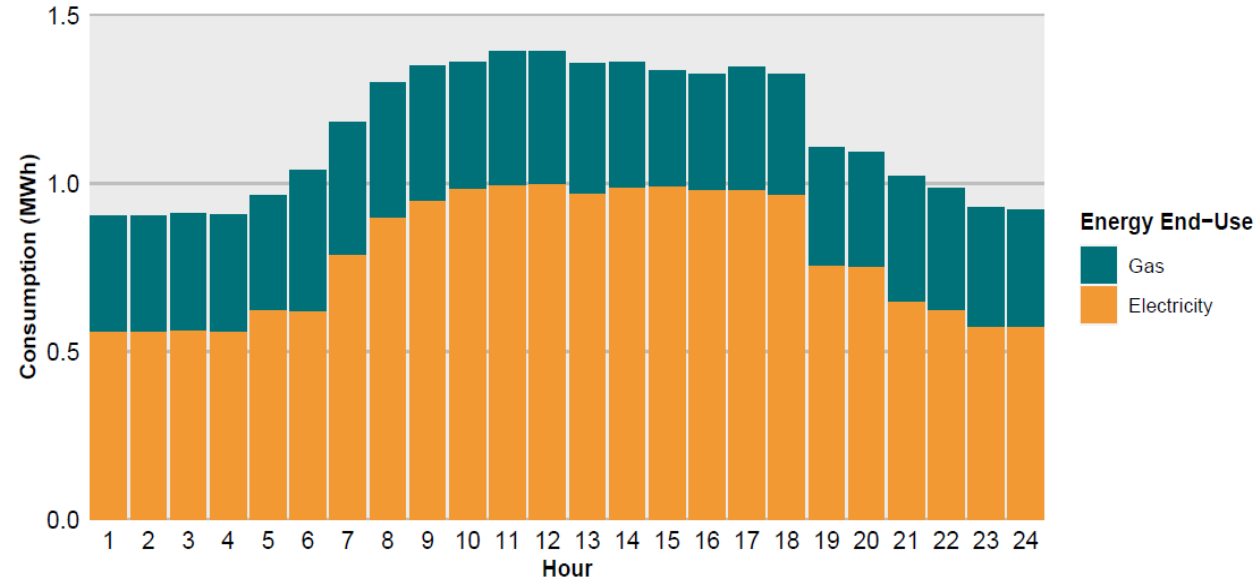
Monthly Average Electric and Gas Loads in Hospitals (Los Angeles and Minneapolis)



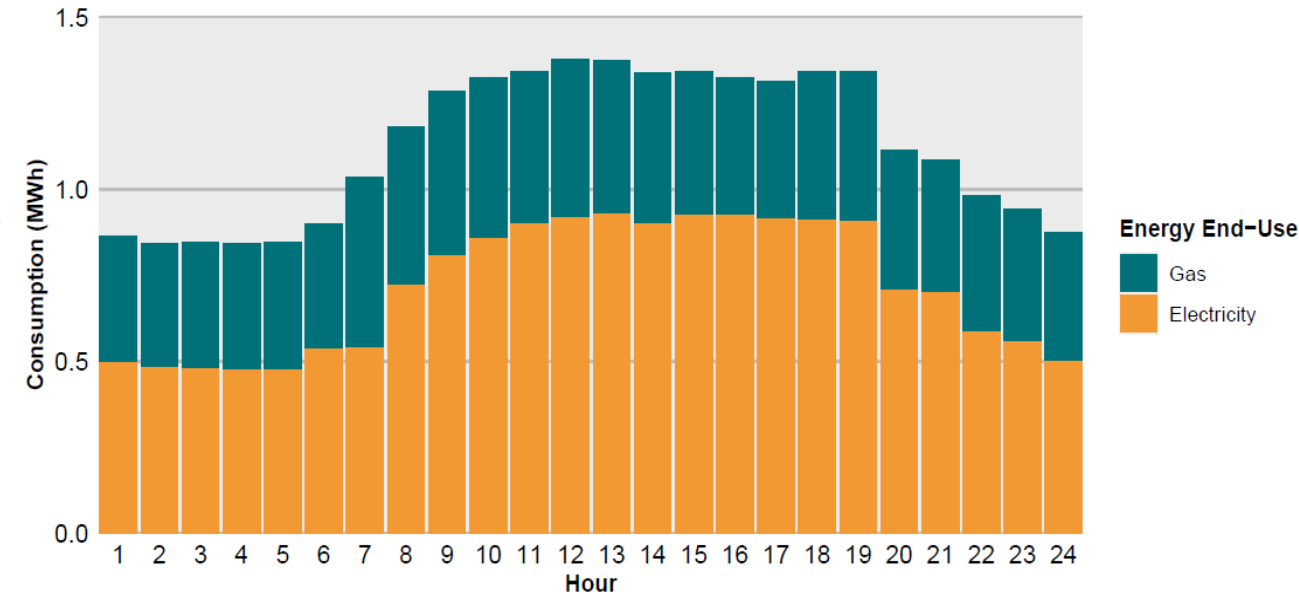
Comparing Average Summer/Winter Hourly Electric and Thermal Loads in Hospital – Los Angeles, CA



Summer



Winter



Source: U.S. DOE Commercial Reference Buildings

Why CHP in Hospitals?

Benefits of Operating CHP to a Hospital



Ideal Hospital Client for CHP

✓ Necessary Conditions

- High electric usage
- Coincidental major heat load
- High hours of operation

✓ Equipment Replacement

- Replacing chillers
- Replacing boilers
- Older back-up generator (non-life safety critical)

✓ Customer Motivation

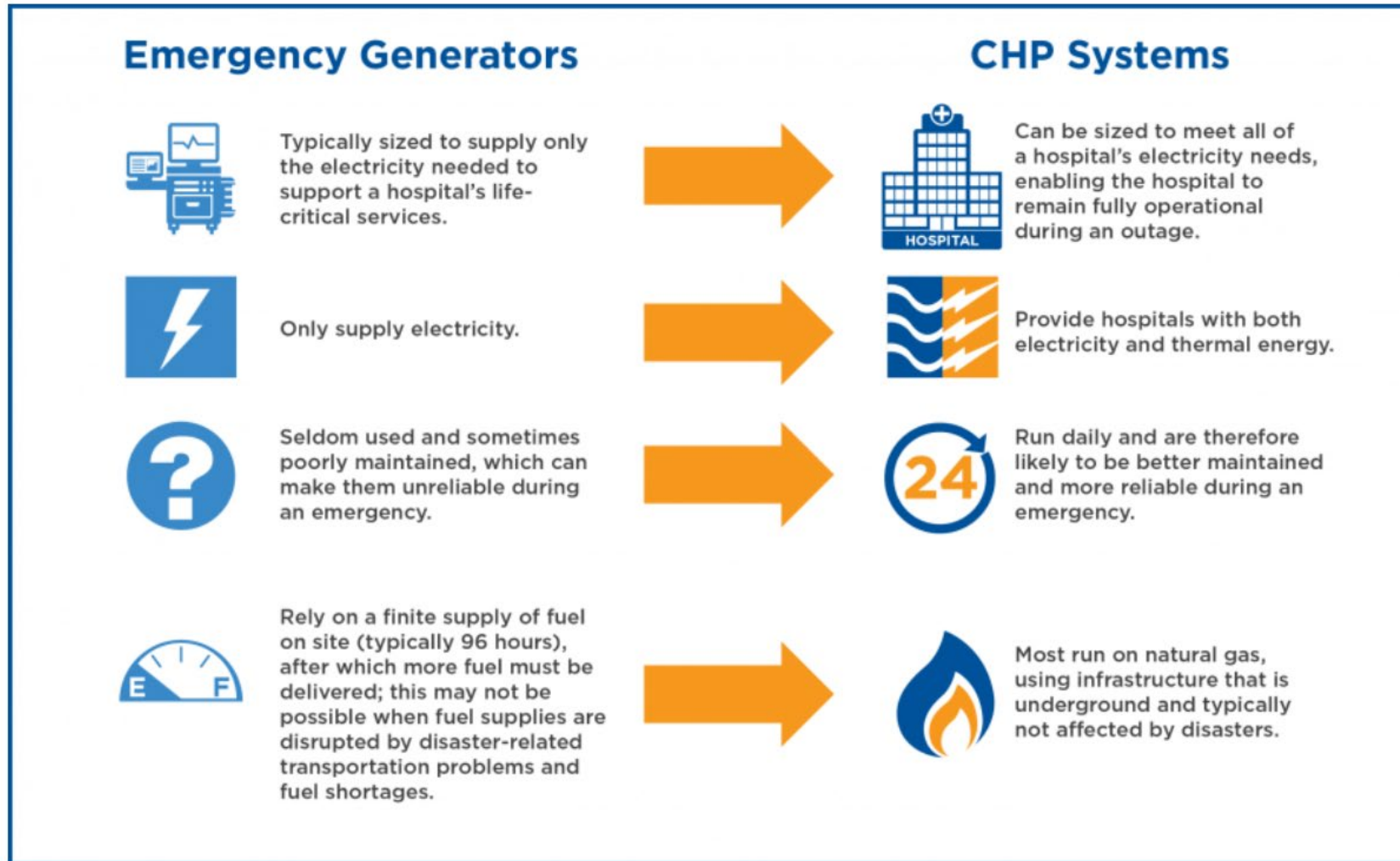
- Utility cost
- Power reliability
- Waste heat or biofuel untapped resource
- Sustainability & environmental
- Plans to expand facility

✓ Other Factors

- EE measures already implemented
- Centralized HVAC



CHP is Above and Beyond Emergency Generators

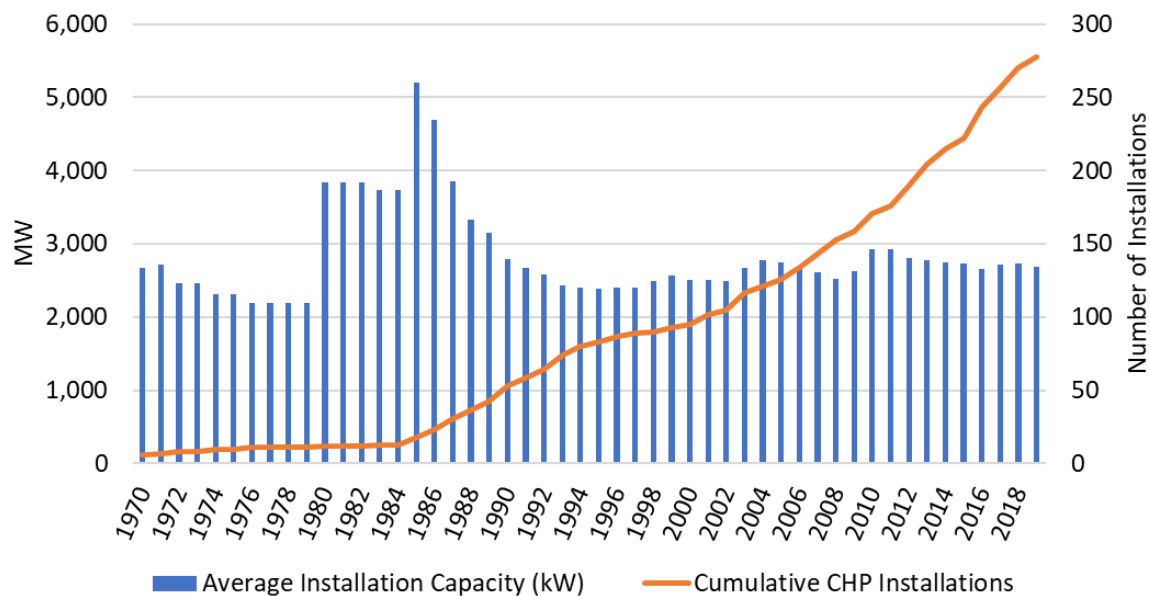


CHP Market Sector Analysis: Hospitals

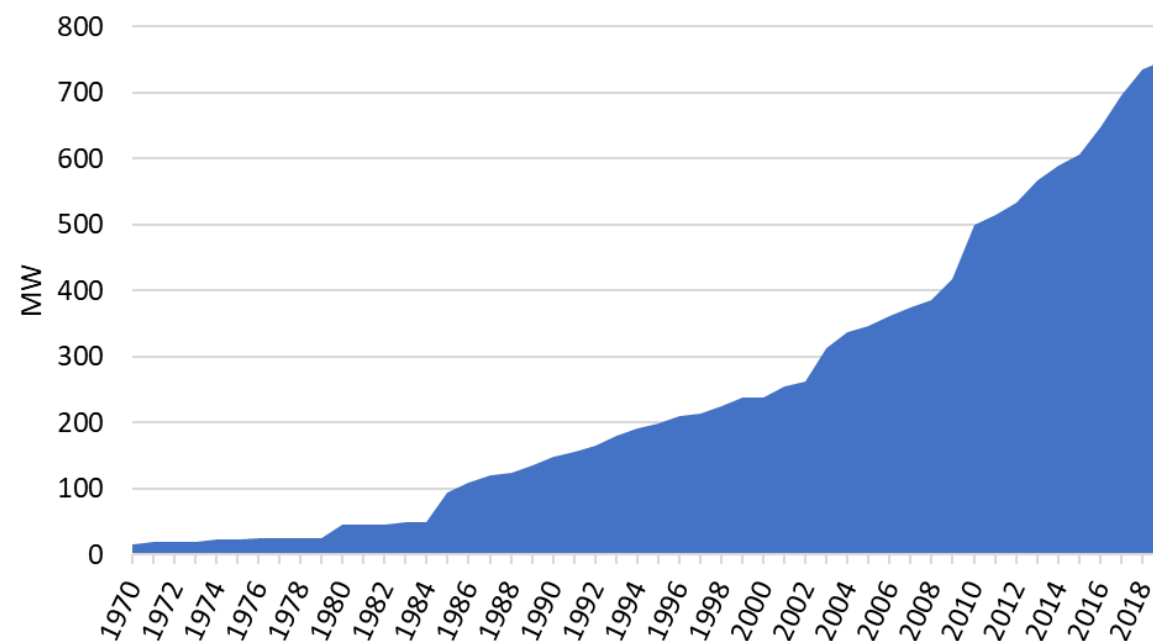
CHP Installation Trends in Hospitals

- Installed capacity steadily growing
- Installations trending towards slightly smaller systems (~2.7 MW in 2019)

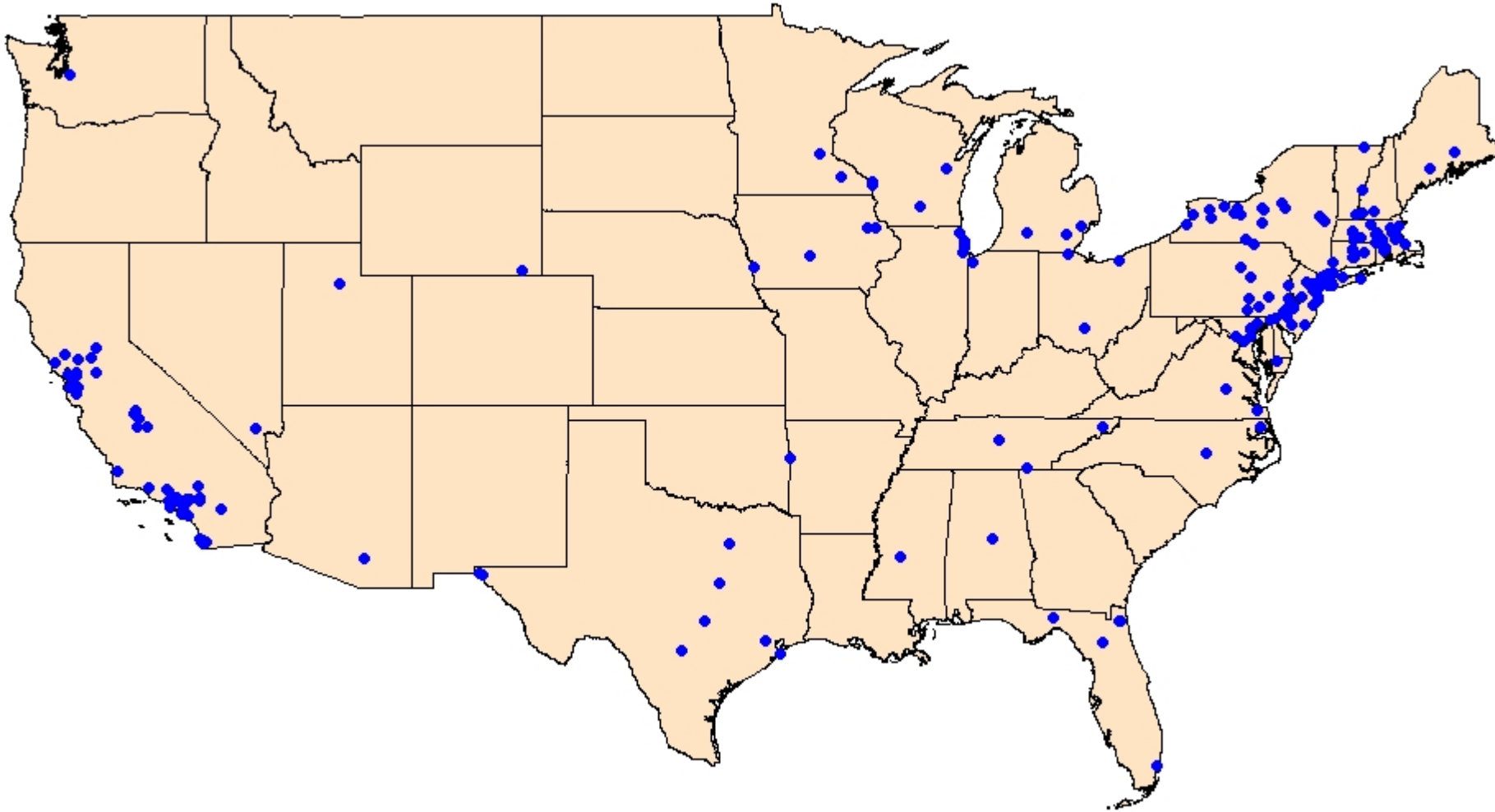
Average Hospital CHP Installation Size and Number of Hospital CHP Installations by Year



Cumulative Hospital CHP Capacity



Where are CHP Systems installed in U.S. Hospitals?



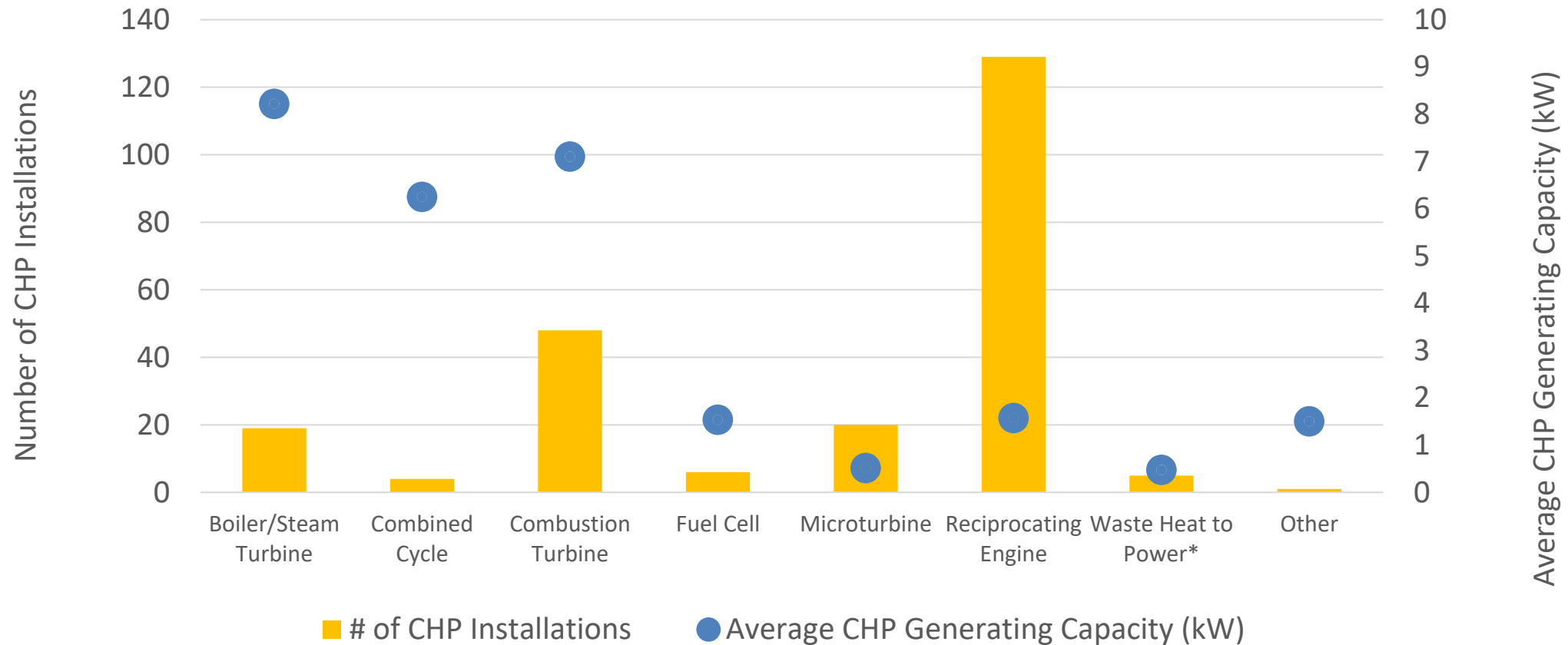
Source: DOE CHP Installation Database, accessed on 5/21/21

CHP Installation Numbers – By Prime Mover Type

232 CHP Installations – 748.0 MW Generating Capacity

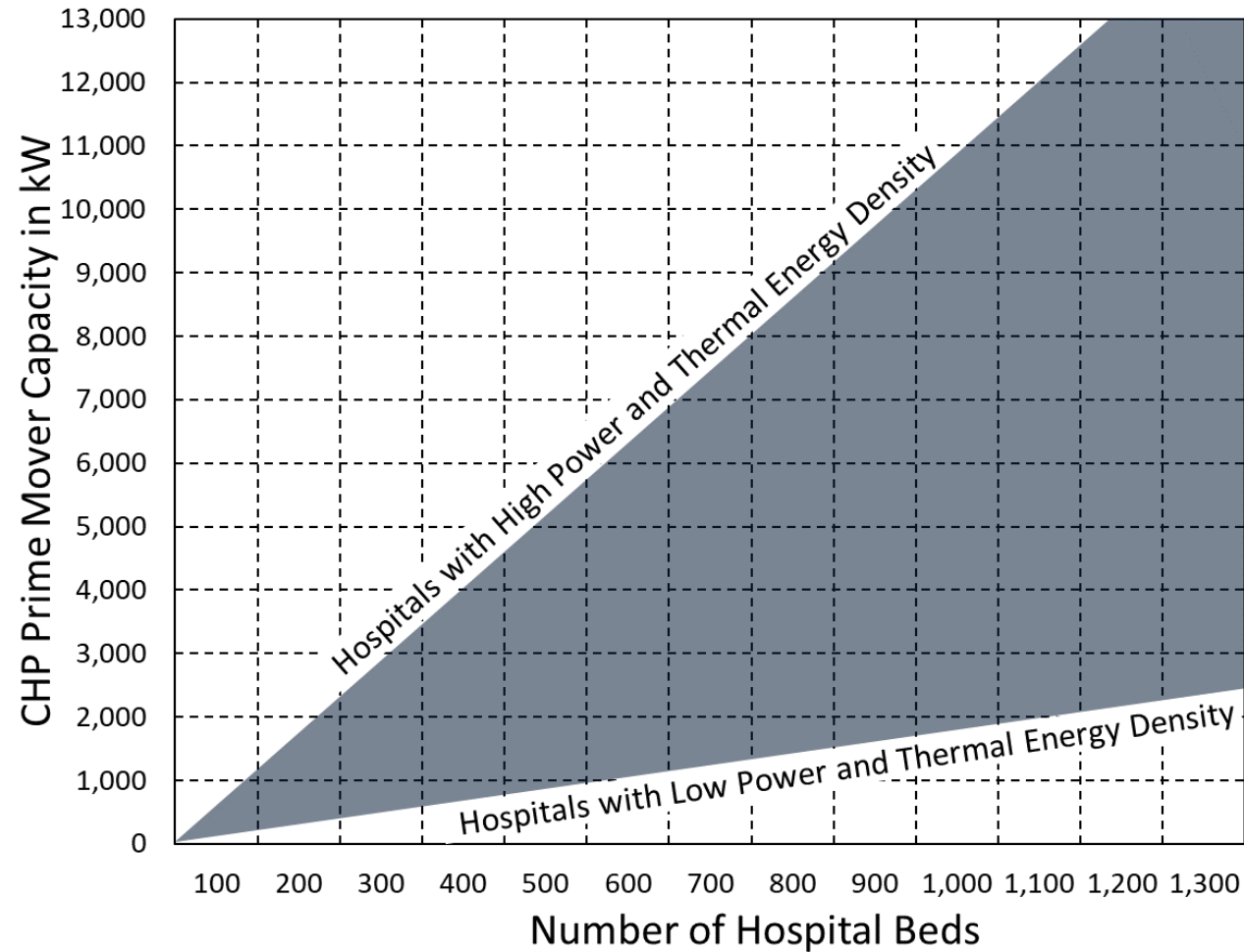
Installed CHP Systems in Hospitals

Number of CHP Systems and CHP Generating Capacity



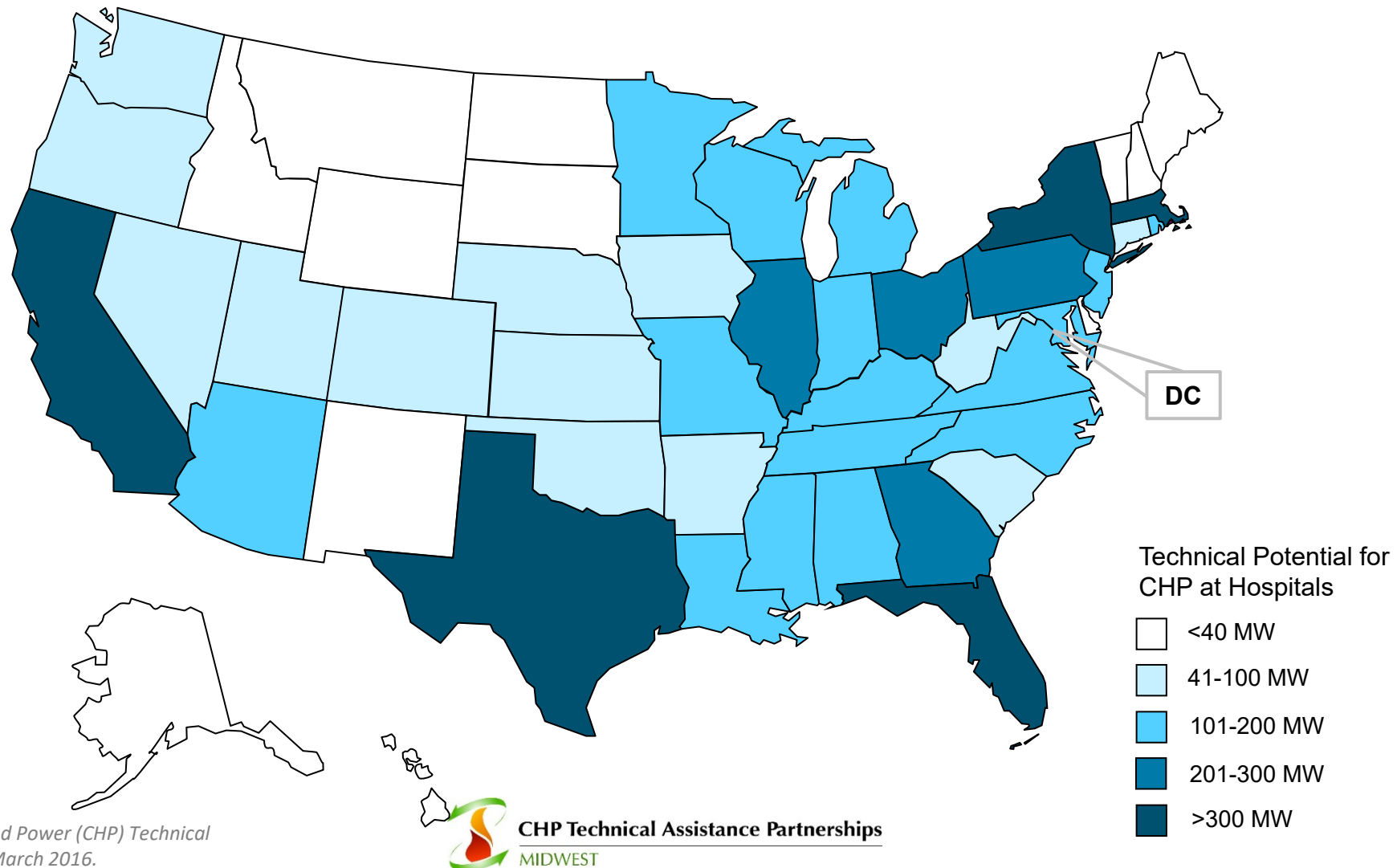
Source: DOE CHP Installation Database, accessed on 5/21/21

Estimating CHP Generating Capacity in a Hospital by Analyzing Number of Beds



Source: U.S. DOE Better Buildings Combined Heat and Power
Fact Sheet Series – CHP Market Sector: Hospitals

Where are the CHP opportunities in Hospitals by State in terms of Technical Potential?



Resources & Next Steps

Resources

- **Energy Efficiency in Hospitals**

- Energy Star Fact Sheet: [Healthcare: An Overview of Energy Use and Energy Efficiency Opportunities](#)
- American Hospital Association [Energy to Care](#)

- **CHP in Hospitals**

- US DOE [Combined Heat and Power \(CHP\) Fact Sheet Series: Hospitals](#)
- US DOE CHP [Project Profiles Database](#) (32 healthcare examples)
- US DOE [CHP Installation Database](#) (200 healthcare sites)
- US DOE [CHP Technical Assistance Partnerships](#)
- US EPA CHP Partnership Resources – [CHP for Hospitals: Superior Energy for Superior Patient Care](#)

- **Resiliency**

- US DOE [Combined Heat and Power for Resiliency Accelerator](#)
- US DOE CHP Technology Fact Sheet Series [CHP for Resiliency in Critical Infrastructure](#)
- Health Care Without Harm [Safe Haven in the Storm: Protecting Lives and Margins with Climate-Smart Health Care](#)
- Health Care Without Harm [Powering the Future of Healthcare: Financial and Operational Resilience: A Combined Heat and Power Guide for Massachusetts Hospital Decision Makers](#)
- EYP [Natural Disasters, Hospitals and Emergency Generators: A Natural Progression to Complete Energy Resiliency](#)



Next Steps

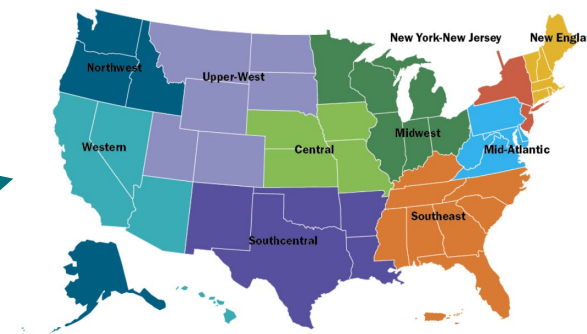
1. Education! Education! Education!

- Webinars, Events, Meetings, Tours, Highlighting Example Projects

2. Partner with Regional CHP TAP

- energy.gov/chptap

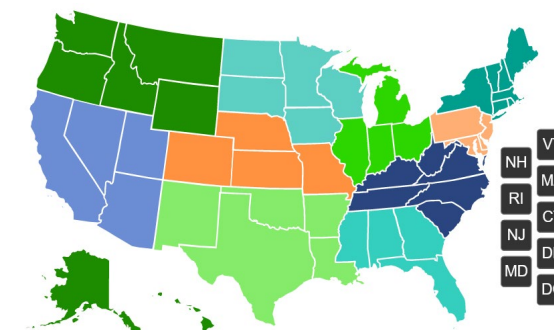
US DOE CHP TAPs



3. Coordinate with Local ASHE Chapter

- 10 Regional Chapters and 50+ state and/or local chapters
- <https://www.ashe.org/chapter-region-chapter-map>

Regional ASHE Chapters



4. Engage eCatalog Solution Providers and Packagers!

Summary

- CHP is a proven technology providing energy savings, reduced costs, emissions reduction, and opportunities for resiliency
- Hospitals are an ideal candidate for CHP
- To encourage CHP adoption in hospitals, coordinate with CHP TAPs, ASHE chapters, and eCatalog partners to promote targeted market CHP education

Thank You

Cliff Haefke

Director

Midwest and Central CHP Technical Assistance Partnerships

(312) 355-3476

chaefk1@uic.edu

Energy Resources Center

University of Illinois Chicago



CHP Technical Assistance Partnerships

MIDWEST

Jack Sins,
Vice President, Business Development
Unison Energy



CHP for Hospitals

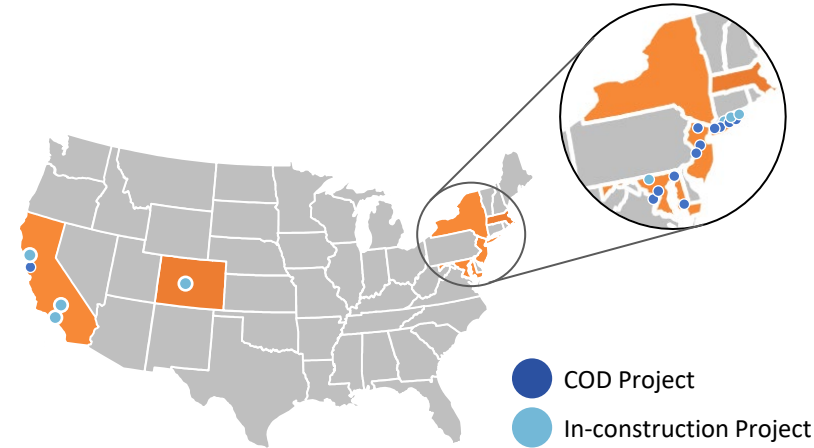
Some lessons from the field

May 26, 2021

Unison Energy Company Overview

Leading integrated develop / own / operate microgrid platform

- Unison Energy is an integrated distributed generation platform that develops, builds, owns, operates and maintains on-site microgrid generation solutions at C&I host customer locations financed through 15-20 year, no-money-down energy services agreements
- Current portfolio of 24 projects.



Unison's Core Business Activities

- 1 Sales**
 - Business development: lead generation (direct / cold call), pricing, feasibility study and system configuration
 - Target industries: healthcare, industrial / food & beverage, supermarkets / distribution centers, hospitality, universities, data centers
 - Target geographies: CA, MD, DE, NJ, NY, CT, MA, NH, VT, ME, CO, Midwest, TX, Ontario & Alberta CA
- 2 Project Development**
 - Engineering: outsourced EPC with internal microgrid engineering , design review, interconnect, incentive applications, emissions permit applications
 - Construction management: EPC management, major equipment purchasing, contractor management, schedule coordination and permit process management, and advantaged relation with 2G Energy
- 3 Operations**
 - Monitoring: 24 x 365 remote monitoring and client call servicing, PowerIQ for system performance management, remote problem resolution and restart, technician dispatch, monthly client billing and reporting
 - Field Service: on-site planned and unplanned maintenance, manage and source spare parts
 - Gas Purchasing: purchase natural gas (on pass-through basis) for clients if necessary

CHP Value Proposition



- Typically save 5-15% on total energy bill, including gas and electric

Savings



- Operate normally in grid parallel but shift to island mode during a grid outage
- Continue operating facility at full scale during an outage
- Improve redundancy at no capital cost using on-site power generation

Reliability & Business Continuity



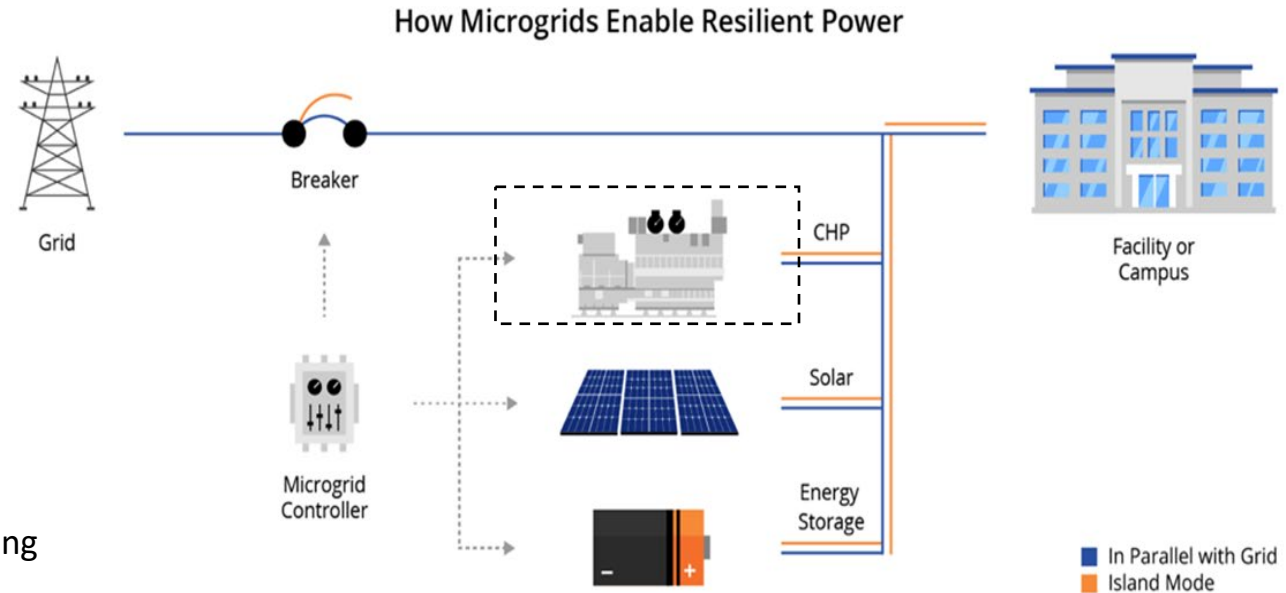
- Reduce your carbon footprint by an average of 20-60% per year depending on facility location and thermal load
- Path to facility becoming carbon neutral vs. purchasing “green electrons” or carbon credits from third parties

Sustainability

Microgrid Overview

A microgrid is a local, coordinated, electric network with on-site generation resources, powering one or more buildings.

- Microgrids generally operate in parallel with the local electric utility
- Microgrids can include and manage multiple Distributed Energy Resources (DERs) including, solar, storage, CHP, fuel cells, wind, etc.
- If more than one DER is operating on the microgrid, the microgrid controller (MC) will optimize dispatch of each DER resource for:
 - ✓ C&I operational resiliency
 - ✓ Time-of-day energy pricing and peak shaving
 - ✓ Power quality optimization
- During an outage, the microgrid can:
 - ✓ Isolate itself from the utility grid
 - ✓ Produce its own power to meet on-site demand
 - ✓ Maintain normal site operations
- When stable utility power returns, the microgrid can re-connect to the local utility.



Challenges to CHP Project

- **What is right solution?**

- Size?
- 2 engines versus 1?
- Steam or hot water?
- Microgrid?
- 10 firms, 10 different proposals – how to vet?

- **Internal champion**

- Competing priorities & projects (such as Covid)
- Many eyeballs - Finance, engineering, legal, facilities, C-suite

- **How to pay for it**

- Purchase, finance (ESA / PPA), 3rd party financing, EaaS
- “One throat to choke”

- **O&M**

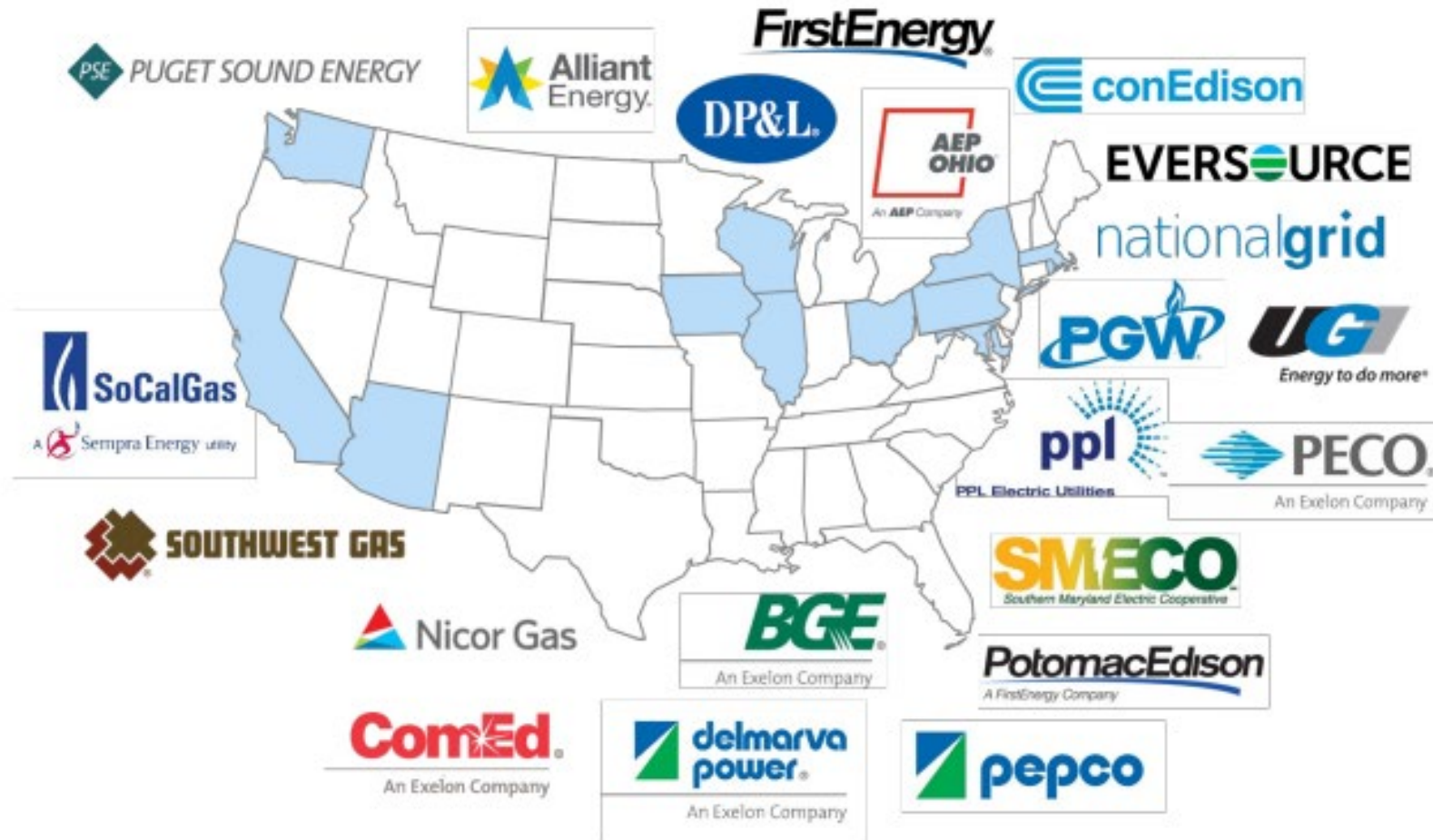
- **Physical space for system**

Complex architecture / often multiple additions

- **Utilities**

Rebates, incentives, interconnect process
60-65% efficiency, how to size
Electric rate/spark spread

Utility CHP Programs



Source: Map prepared by ICF. February 2020. Note: Shading highlights states with utilities that administer a CHP program.
https://betterbuildingsolutioncenter.energy.gov/sites/default/files/attachments/Issue_Brief_Utility_CHP_Programs_May2020.pdf

Peninsula Regional Medical Center

Salisbury, MD

Client goals: Provide patients and staff affordable and sustainable power, especially during weather-related outages

Unison Energy installed a 3.2 MW CHP microgrid system:

- Two 1,560 kW engines operating at 65% efficiency
- Load following and island mode capabilities
- Covers over 81% of the building's energy needs
- Carbon footprint reduced by 58% or 16,800 tons per year*
- 25 kV operating voltage with 3750 kVA step-up transformer

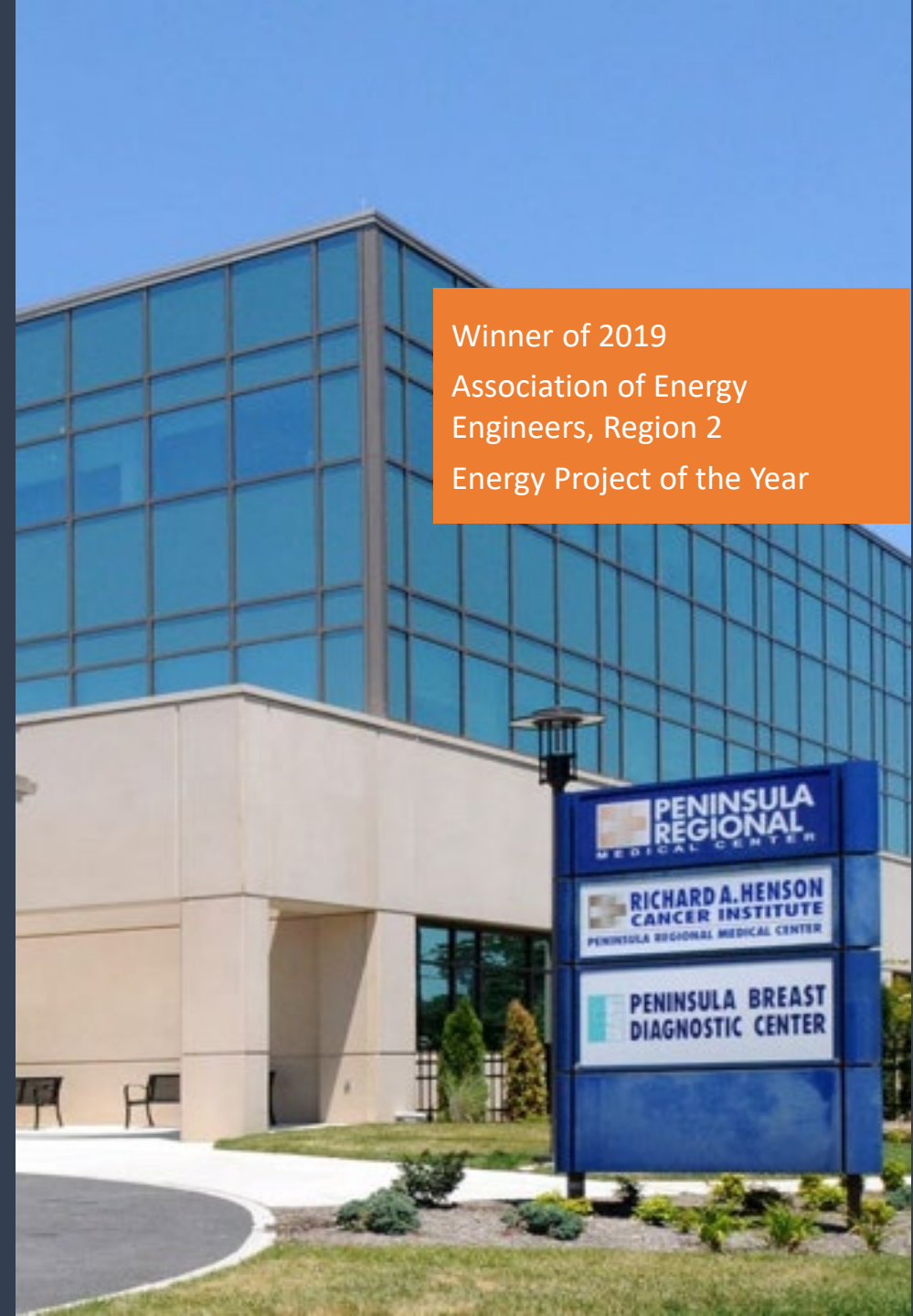
Unison Energy installed a custom thermal solution to connect the CHP system and boiler room:

- Over 4,000 linear feet of pre-insulated hot water piping with leak detection
- Pipes routed underground, on the roof, and along walls, with decorative covers
- Heat exchangers, pumps, valves, and digital controls

"By installing the CHP, we achieve both environmental and economic stewardship that is a benefit to our community."

— Dr. Naleppa, President, PRMC

Winner of 2019
Association of Energy
Engineers, Region 2
Energy Project of the Year



Doctors Community Hospital

Lanham, MD

Client goals: Update an old, overloaded electrical system to ensure successful island mode operations

Unison Energy installed a 1.2 MW CHP microgrid system:

- Two 600 kW engines operating at 63% efficiency (HHV)
- Two 2.5 MVA transformers
- 480 V, 3000 A, main-tie-main switchgear
- Waste heat used for space heating and domestic hot water
- Load following and automatic island mode capabilities
- Carbon footprint reduced by 57% or 6,400 tons per year*

To install the CHP system, Unison Energy needed to upgrade the hospital's electrical equipment:

- Brought in 2 MW of generation capacity to support hospital during installation process
- Updated utility transformers and switchgear lineup, including a 2000-amp tie breaker.

"It didn't cost the hospital a dime out of our pockets to do, and we're able to save about \$300,000 dollars a year on our electric bill."

— Jerry Dyer, Director of Plant Operations

*EPA non-baseload emissions data (eGRID 2016)



Union Hospital

Elkton, MD

Client goals: Install backup power within the limited space available to ensure patients have electric and AC during outages

Unison Energy installed a 1.2 MW CHP microgrid system:

- One 1,200 kW MWM engine operating at 76% efficiency
- Heat recovery 105 psi steam and domestic hot water
- Load following and island mode capabilities
- Covers over 87% of the building's energy needs
- Carbon footprint reduced by 60% or 7,300 tons of CO2 per year*
- 4,160 V operating voltage

Unison Energy met several design challenges to ensure patient comfort:

- Installed VFDs on chillers to ensure AC would function during an island mode event
- Placed the quiet, 65 db system behind a custom-built wall at the hospital's entrance

"Unison was without a doubt the best company that we could have partnered with."

— Mark Mears, Facilities Management Director

*EPA non-baseload emissions data (eGRID 2016)



Contact Information

- Jack Sins
- VP Business Development
- Jack.sins@unisonenergy.com
- (917) 974-7696



Mark Mears,
Director, Facility Management
Union Hospital of Cecil County

Mark Mears Union Hospital

Elkton, MD



Wrap Up

Accelerator Updates

- Upcoming Webinars
 - Renewable Natural Gas
 - Market Sector Deep Dives
 - Greenhouses
 - Wastewater Treatment Plants
- DOE Microgrid Database is now live!
 - Comprehensive listing of 461 operational microgrids
 - <https://doe.icfwebservices.com/index>

Advanced Manufacturing Office

Stakeholder Eblast

Department of Energy Releases New Tool Tracking Microgrid Installations in the United States

Today, the U.S. Department of Energy (DOE) announced the release of a new, interactive tool tracking microgrids installed throughout the United States.

A microgrid is a local grid with an independent source of energy capable of disconnecting or “islanding” from the utility grid. Microgrids improve resilience by allowing critical facilities to continue operating in the event of a utility-grid outage. For manufacturers and industrial facilities, microgrids can also help ensure delivery of the high-quality, reliable electricity necessary to maintain today’s increasingly digitized operations.

The [Microgrid Installation Database](#) includes a comprehensive listing of the U.S.’s 461 operational microgrids that provide a total of 3.1 gigawatts of reliable electricity. The information, which is updated [on a monthly basis](#), is presented in a tabular format to help users easily access and sort data. The site features:

- An interactive map of microgrid installations across the U.S.
- The ability to filter and search for sites by technology, end-user application, generation and storage capacity, and operating year
- Downloadable data files

The new Microgrid Installation Database is co-located with the complementary [Combined Heat and Power \(CHP\) Installation Database](#), which captures the nation’s CHP installations. CHP technologies allow facilities to generate on-site electric power and useful thermal energy from a single fuel source. The high efficiency and reliability of CHP systems decreases carbon emissions while offsetting the need to generate steam or hot water with a separate boiler. CHP technologies are an attractive anchor for multi-technology microgrids, particularly those incorporating renewable generation sources like solar PV or wind.

The Microgrid and Combined Heat and Power Installation Databases are sponsored by DOE’s [Advanced Manufacturing Office](#) and maintained by ICF. Visit <https://doe.icfwebservices.com/index> to explore the tools and learn more.

DOE Team

Anne Hampson, Program Manager, Technology Partnerships,
US DOE Advanced Manufacturing Office

Anne.hampson@ee.doe.gov

Packaged CHP Accelerator Coordinator	eCatalog Coordinator	Packaged CHP Accelerator Support
Bruce Hedman	Rich Sweetser	Trent Blomberg
Entropy Research	Exergy Partners	ICF
202-251-0017	703-707-0293	703-272-0346
bhedman.entropyresearch@gmail.com	rsweetser@exergypartners.com	trent.blomberg@icf.com

<https://betterbuildingssolutioncenter.energy.gov/accelerators/packaged-chp>

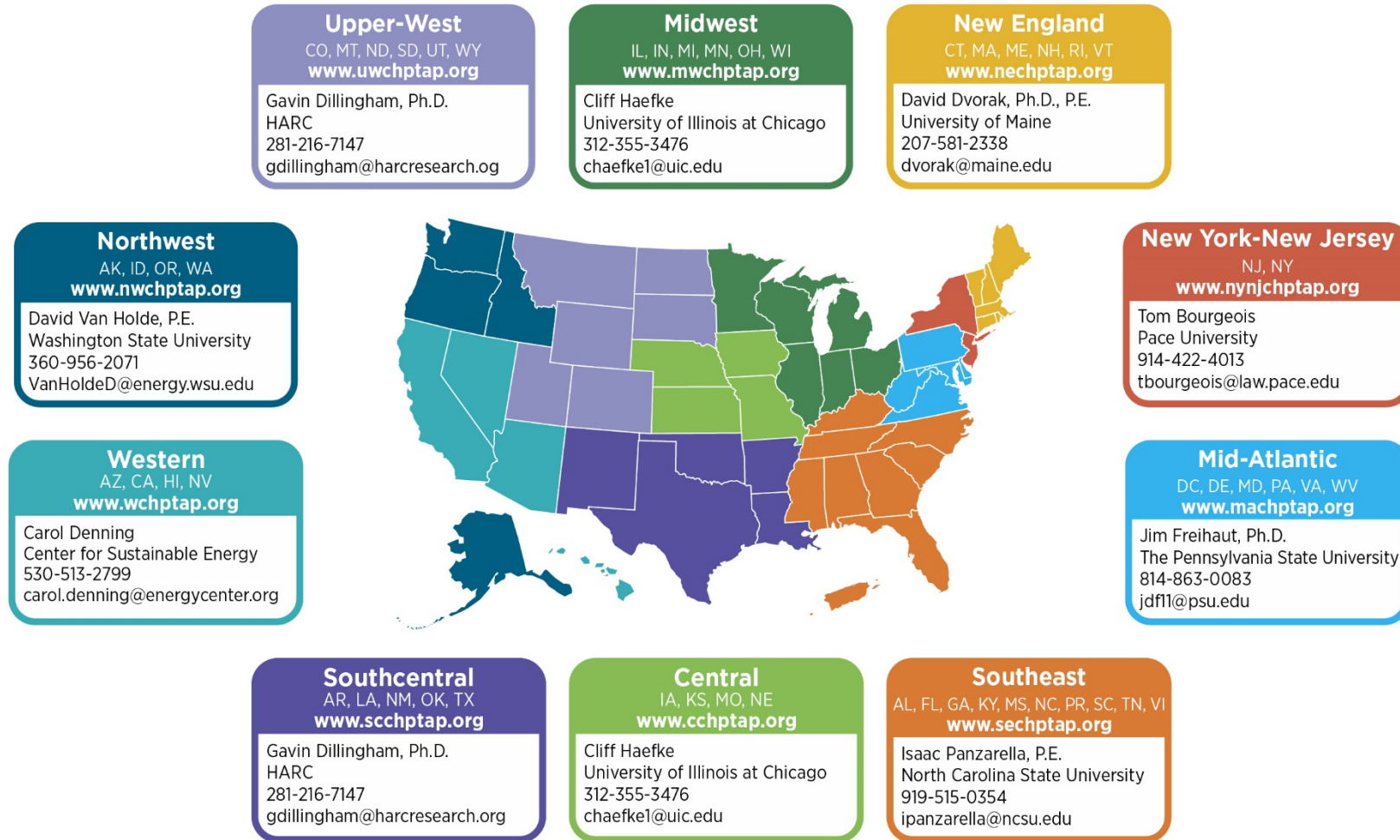
<https://chp.ecatalog.lbl.gov/>

Appendix

Appendix



DOE CHP Technical Assistance Partnerships (CHP TAPs)

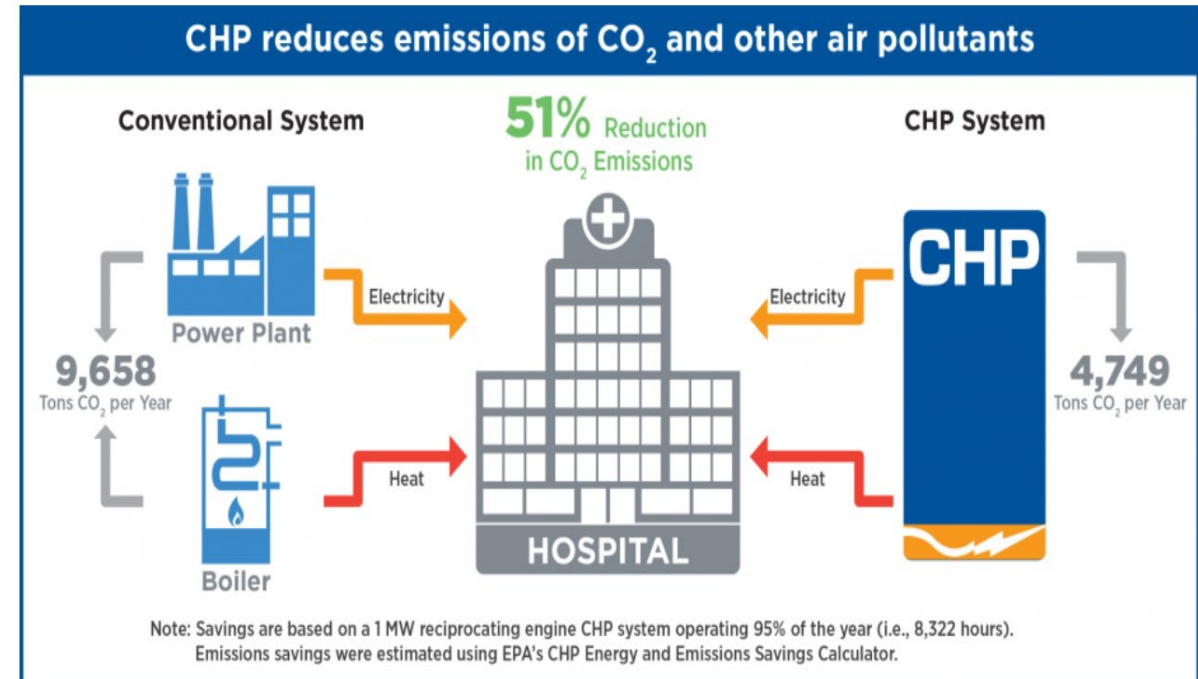
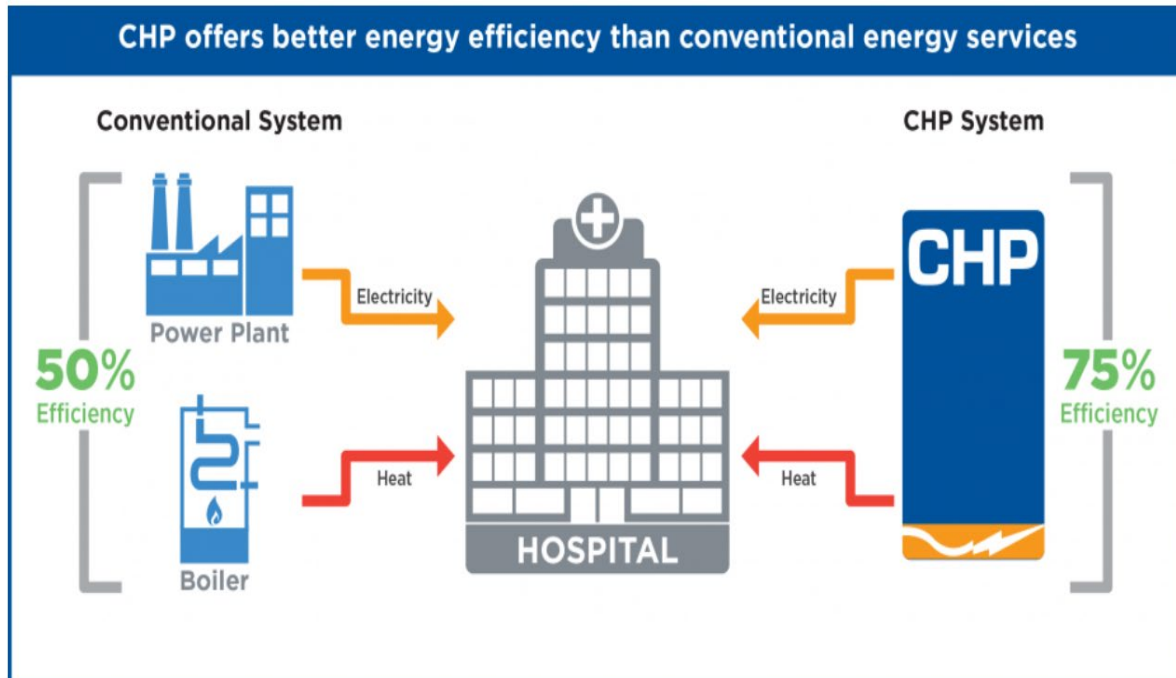


DOE CHP Deployment
Program Contacts
www.energy.gov/CHPTAP

Robert "Bob" Schmitt
Technology Manager
Office of Energy Efficiency and
Renewable Energy
U.S. Department of Energy
Robert.Schmitt@ee.doe.gov

Patti Garland
DOE CHP TAP Coordinator [contractor]
Office of Energy Efficiency and
Renewable Energy
U.S. Department of Energy
Patricia.Garland@ee.doe.gov

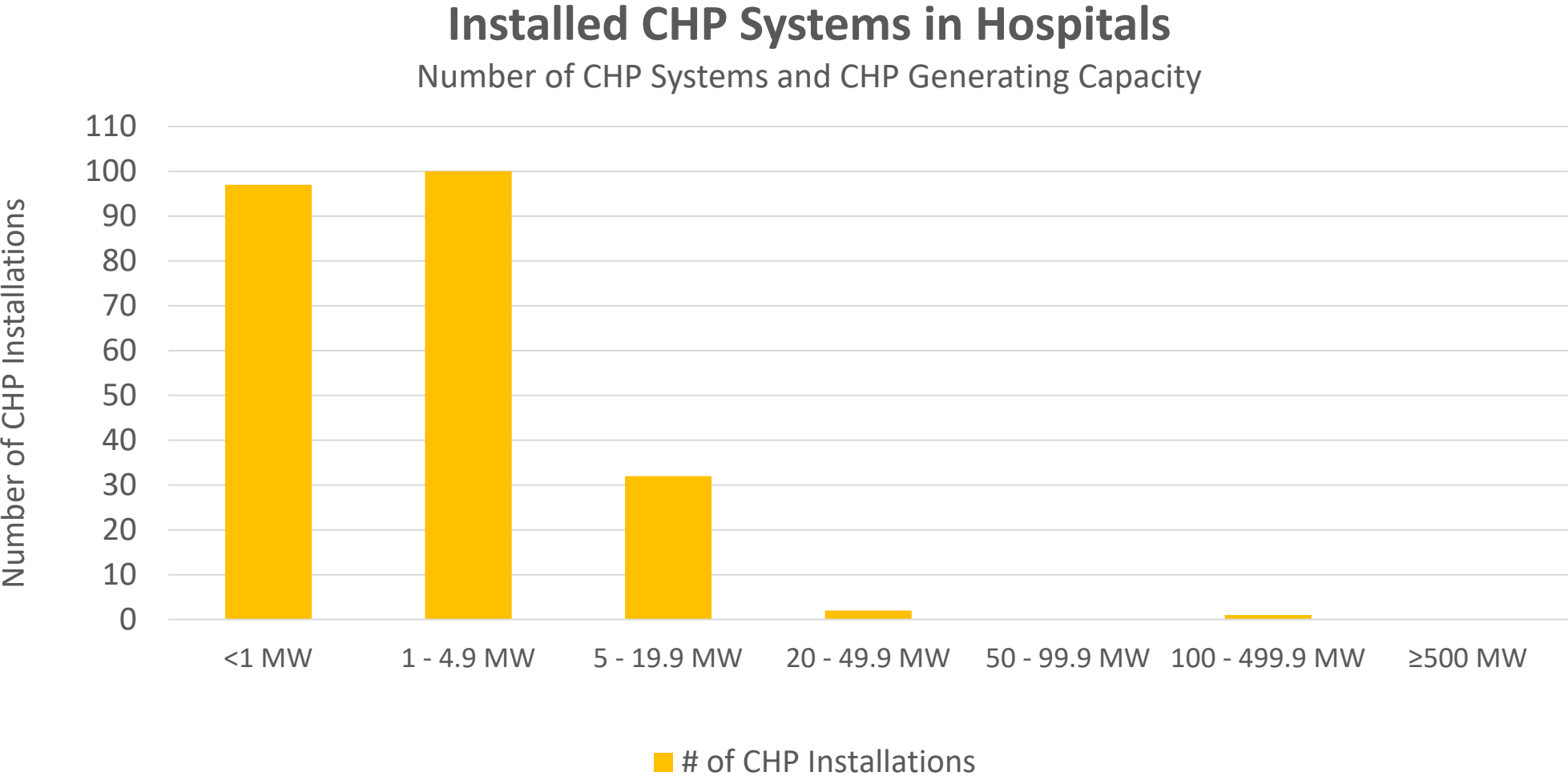
CHP Provides Energy Efficiency and Reduced Emissions of CO₂ and Other Air Pollutants



Source: <https://www.epa.gov/chp/chp-hospitals-superior-energy-superior-patient-care>

CHP Installation Numbers – By System Size

232 CHP Installations – 748.0 MW Generating Capacity



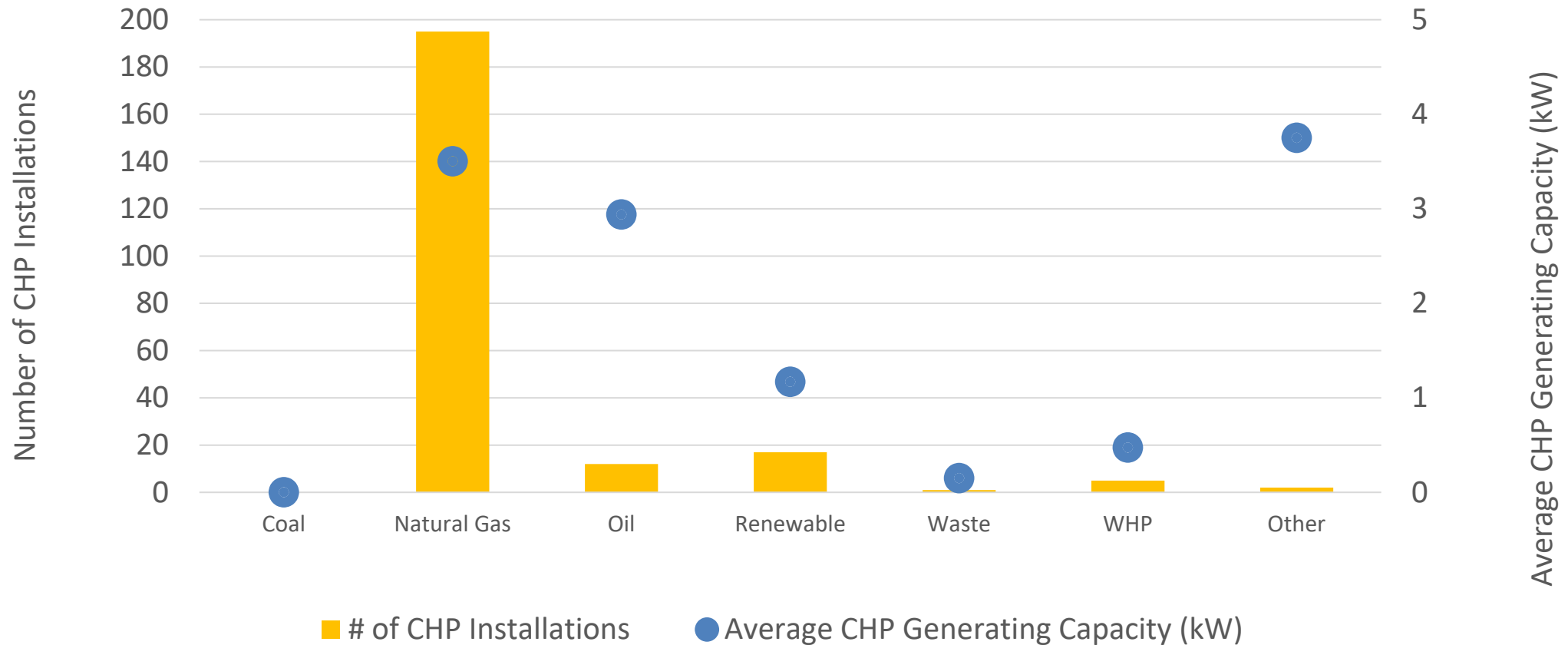
Source: DOE CHP Installation Database, accessed on 5/21/21

CHP Installation Numbers – By Fuel Type

232 CHP Installations – 748.0 MW Generating Capacity

Installed CHP Systems in Hospitals

Number of CHP Systems and CHP Generating Capacity



Source: DOE CHP Installation Database, accessed on 5/21/21

Project Snapshot:

Enhanced-Use Leasing of a CHP Project

Jesse Brown VA Medical Center
Chicago, IL

Application/Industry: Healthcare

Capacity: 3.4 MW

Prime Mover: Combustion turbine

Fuel Type: Natural gas

Thermal Use: Building heat and absorption cooling

Installation Year: 2003

Highlights: Reliable power is critical in hospitals to maintain patient safety and staff and patient satisfaction. The CHP system maintains an annual availability of over 98% and the remaining <2% of the time the system may be down for maintenance. This allows for the system to provide a reliable source of prime power to the medical center and another layer of electric redundancy in combination with the grid connection and emergency generators to ensure electricity is available when needed.



U.S. Department
of Veterans Affairs



Source: <http://www.midwestchptap.org/profiles/ProjectProfiles/JesseBrownVA%20.pdf>



CHP Technical Assistance Partnerships
MIDWEST

Project Snapshot:

Increased ENERGY STAR Building Score

ProMedica Health System Wildwood

Toledo, OH

Application/Industry: Hospital

Capacity: 130 kW

Prime Mover: Microturbine

Fuel Type: Natural gas

Thermal Use: Heating

Installation Year: 2013

Highlights: The microturbine CHP system at ProMedica Wildwood is equipped with a FlexSet control system. The control system is web-based, allowing the facility managers to monitor the system operation and performance on computers or cell phones.



Source: <http://www.gemenergy.com/wpcontent/uploads/2014/03/optimize-chp-flexset-ProMedicaWildwood-030414.pdf>

Project Snapshot:

1st Hospital to 100% Energy Independence

Gundersen Health System: Onalaska Campus
Onalaska, WI

Application/Industry: Healthcare

Capacity: 1.137 MW

Prime Mover: Reciprocating Engine

Fuel Type: Landfill Gas

Thermal Use: Space Heating and Hot Water

Installation Year: 2012

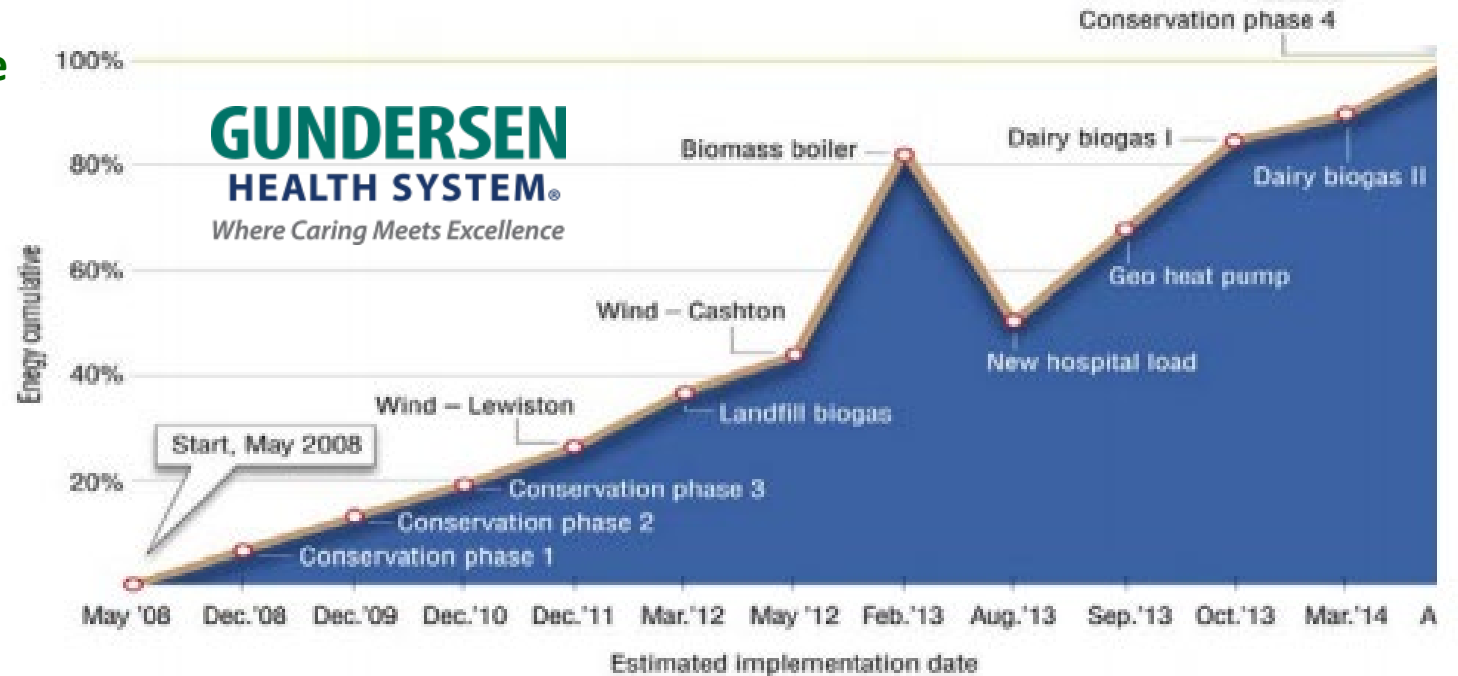
Energy Savings: \$400,000

Testimonials: *"The project should pay back quite nicely because it's offsetting a big portion of our electricity bill as well as our natural gas bill and we're providing a revenue stream for the county."*

- Jeff Rich, Executive Director, GL Envision, Gunderson Health System

"This is a great use of a previously unused natural resource and it is an excellent example of what a public-private partnership can achieve in our community."

- Hank Koch, Solid Waste Director, La Crosse County



Source: <http://www.midwestchptap.org/profiles/ProjectProfiles/GundersenLutheranOnalaska.pdf>

Project Snapshot:

CHP-Based Microgrid Built for Resiliency

University of Texas Medical Branch

Galveston, Texas

Application/Industry: University/Hospital

Capacity: 15 MW

Prime Mover: Combustion Turbines (2),
Condensing Extraction Steam Turbine

Fuel Type: Natural Gas, Diesel

Thermal Use: Hot Water, Steam
Distribution

Installation Year: 2016

Testimonial: *“The CHP system’s primary value to the University is the ability to provide sufficient chilled water, heating water and steam to maintain operations of critical buildings during the loss of electrical power from the local utility. An added benefit of CHP is the reduction in utility cost of approximately \$2 million per year.”* -Lynn Crawford



CHP Technical Assistance Partnerships
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