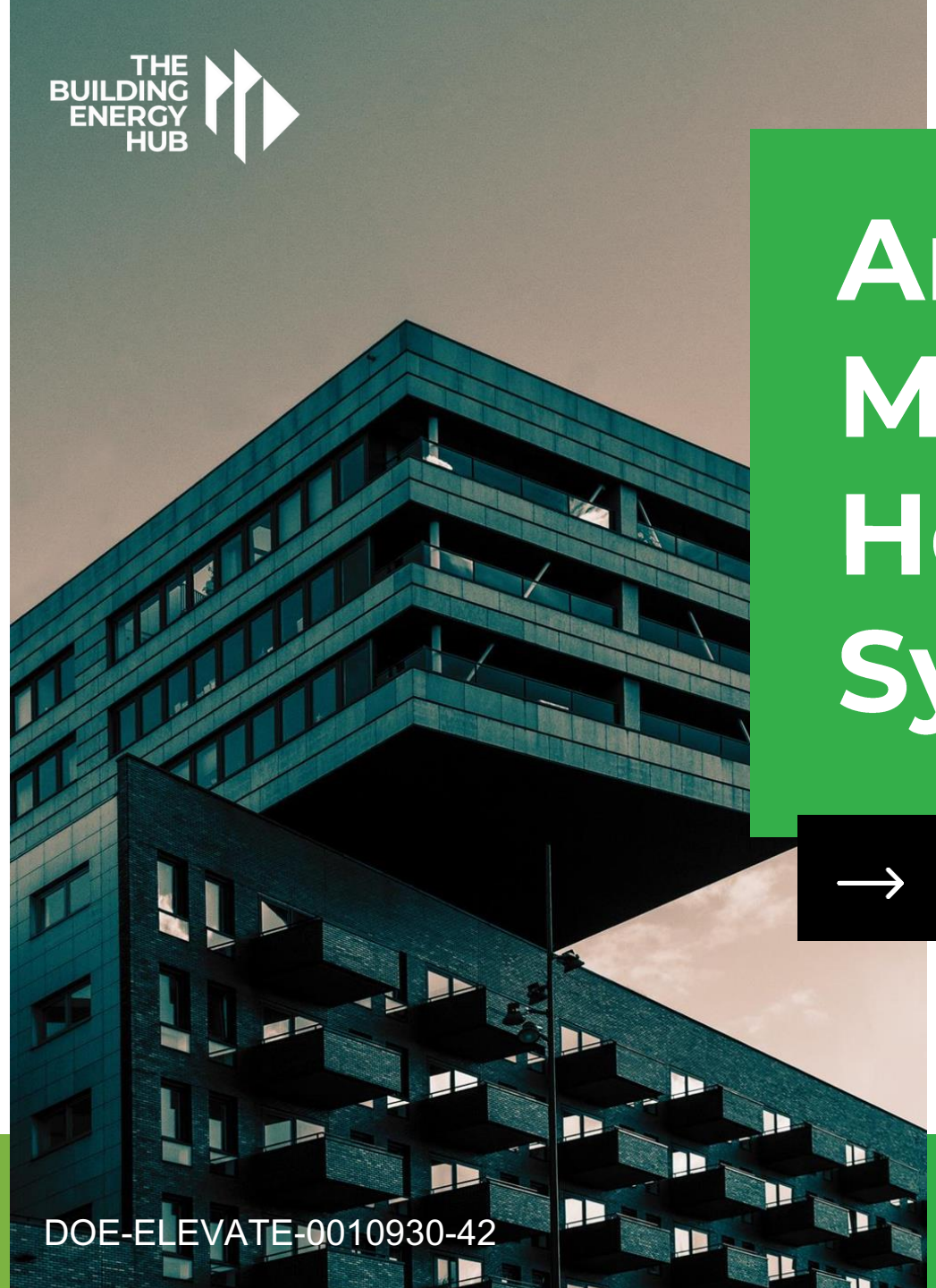


An Introduction to Micro Combined Heat & Power Systems

August 11, 2026

DOE-ELEVATE-0010930-42

The Building Energy Hub is a project of Illinois Green Alliance

The Goals of the Hub are to:

- Educate & train building professionals
- Support diverse contractors
- Connect contractors to a project pipeline
- Build capacity for advanced codes and policies
- Streamline access to financial resources



The Hub is Illinois' trusted resource center for building professionals seeking practical solutions to improve building performance.

Today's Speaker



Thomas Manjarres, Technical Lead, Peoples Gas and North Shore Gas Energy Efficiency Programs

Peoples Gas and North Shore Gas

Improving Efficiency and Reducing Costs

Micro Combined Heat and Power Systems

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Energy Efficiency Program Overview

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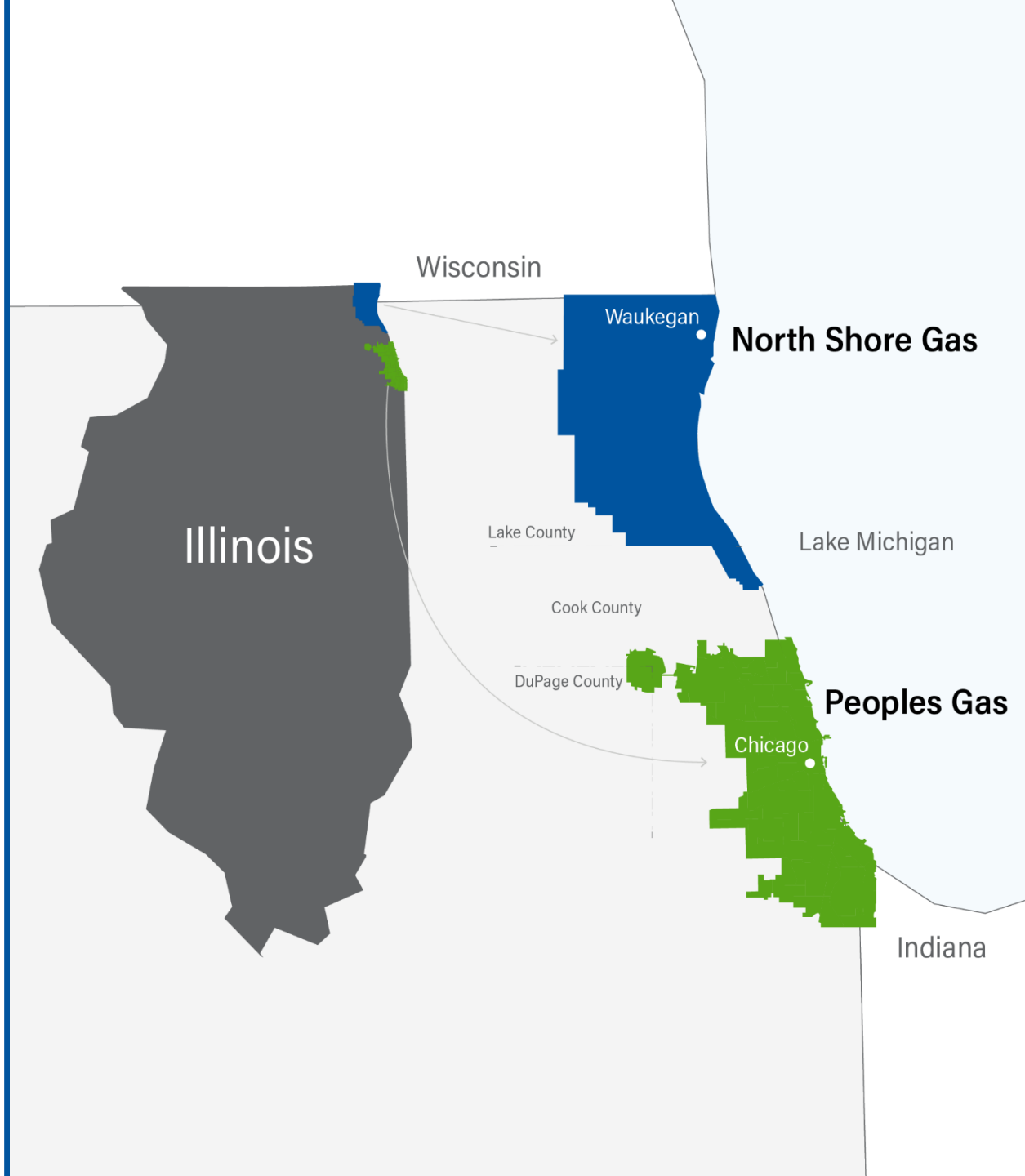
Who We Serve

Customers in North Shore Gas Territory

- 54 communities north of Chicago to the Wisconsin border
- 165,000 residential and business customers
- **126 years**

Customers in Peoples Gas Territory

- City of Chicago
- 891,000 residential and business customers
- **176 years**



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Business and Public Sector Energy Efficiency

- Privately owned business customers
  - ✓ Manufacturers, office buildings, hotels
  - ✓ Small businesses like dry cleaners, restaurants, churches and nonprofits
- Public buildings
  - ✓ Schools, municipal buildings, transit, hospitals
- Example offerings
  - ✓ Efficient appliance rebates
  - ✓ Boiler and HVAC system optimization and upgrades
  - ✓ Steam trap replacement
  - ✓ Industrial system optimization (heat recovery projects, pipe insulation, etc.)
  - ✓ Energy assessments and engineering studies to identify custom opportunities for gas savings

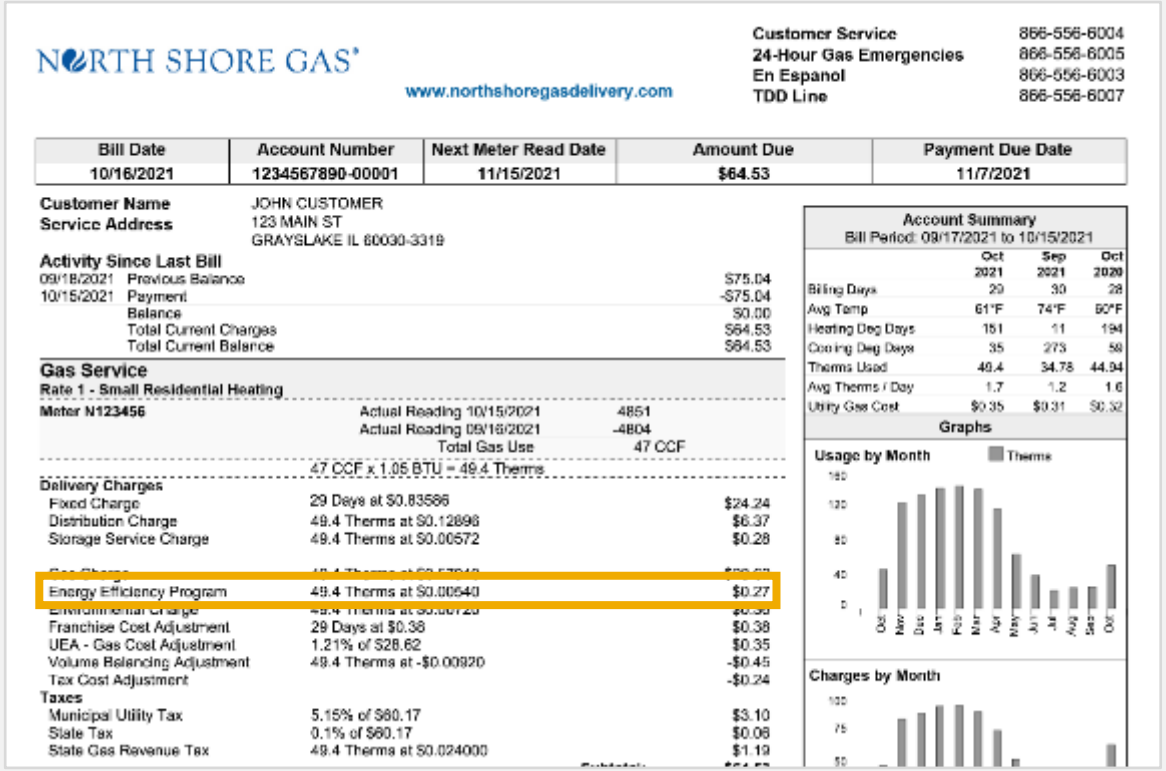
PeoplesGasDelivery.com/Savings



PEOPLES GAS® ENERGY EFFICIENCY PROGRAM | NORTH SHORE GAS® ENERGY EFFICIENCY PROGRAM

Why Participate?

- Rate-payer funded
- You save natural gas and money
- Use the money saved to invest in your organization
- Good for the environment
- Opportunity for your project(s) to be featured in a case study or recognition event



NORTH SHORE GAS®

www.northshoregasdelivery.com

Customer Service	866-556-6004
24-Hour Gas Emergencies	866-556-6005
En Espanol	866-556-6003
TDD Line	866-556-6007

Bill Date	Account Number	Next Meter Read Date	Amount Due	Payment Due Date
10/16/2021	1234567890-00001	11/15/2021	$64.53	11/7/2021

Customer Name JOHN CUSTOMER
Service Address 123 MAIN ST
GRAYSLAKE IL 60030-3319

Activity Since Last Bill

09/18/2021	Previous Balance	$75.04
10/15/2021	Payment	-$75.04
	Balance	$0.00
	Total Current Charges	$64.53
	Total Current Balance	$64.53

Gas Service
Rate 1 - Small Residential Heating

Meter N123456

Actual Reading 10/15/2021	4851	
Actual Reading 09/16/2021	-4804	
Total Gas Use	47 CCF	
47 CCF x 1.05 BTU = 49.4 Therms		

Delivery Charges		
Fixed Charge	29 Days at $0.83586	$24.24
Distribution Charge	49.4 Therms at $0.12898	$6.37
Storage Service Charge	49.4 Therms at $0.00572	$0.28
Energy Efficiency Program	49.4 Therms at $0.00540	$0.27
Franchise Cost Adjustment	29 Days at $0.38	$0.38
UEA - Gas Cost Adjustment	1.21% of $28.62	$0.35
Volume Balancing Adjustment	49.4 Therms at -$0.00920	-$0.45
Tax Cost Adjustment		-$0.24
Taxes		
Municipal Utility Tax	5.15% of $60.17	$3.10
State Tax	0.1% of $60.17	$0.06
State Gas Revenue Tax	49.4 Therms at $0.024000	$1.19

Account Summary
Bill Period: 09/17/2021 to 10/15/2021

	Oct 2021	Sep 2021	Oct 2020
Billing Days	29	30	28
Avg Temp	61°F	74°F	60°F
Heating Deg Days	151	11	194
Cooling Deg Days	35	273	58
Therms Used	49.4	34.78	44.94
Avg Therms / Day	1.7	1.2	1.6
Utility Gas Cost	$0.35	$0.31	$0.32

Graphs

Usage by Month — Therms

Charges by Month

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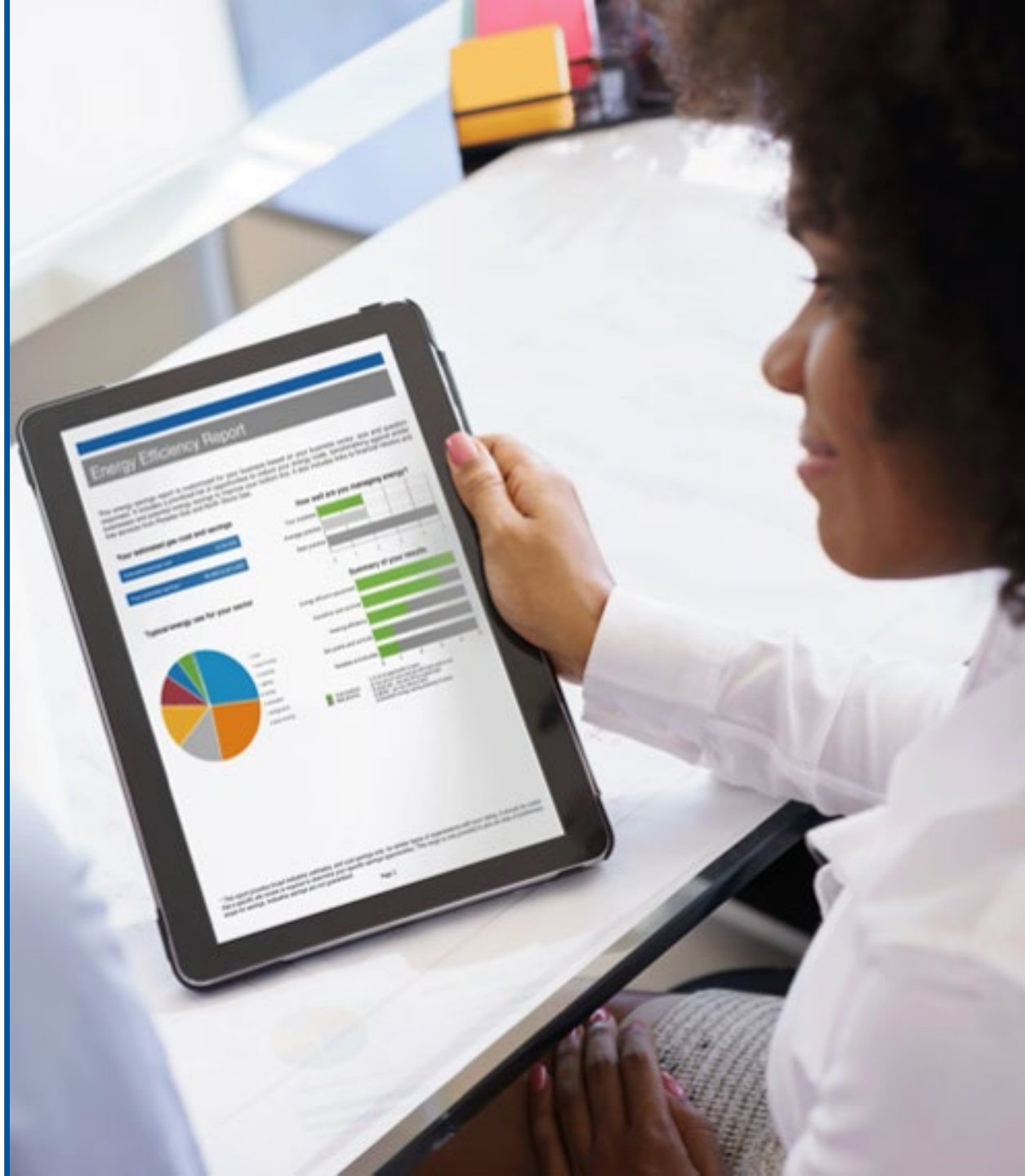
Making It Easy

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Overcoming Market Barriers: The Program Framework

- **Defeating High Capital Expenditure:** Strategic utility incentive programs provide upfront custom technical rebates shortening asset payback horizons.
- **Solving Technical Load Mismatches:** System integrators leverage advanced operating profiles—such as **thermal, electrical, or highest load tracking**—to optimize operational uptime regardless of seasonal fluctuations.
- **Expert Support:** Expert engineering support which can help proactively identify potential improvements to installed solutions.
- **Bridging Infrastructure & Service Gaps:** Trusted trade allies deliver turnkey mechanical engineering design, specialized technical solutions and support customers in understanding how to reduce their site usage.



Engineering Studies

- CHP feasibility study incentives available today
  - ✓ 2kW – 200kW+ systems
- Engineering studies
  - ✓ In-depth analysis specific to project or process
  - ✓ Program pays up to $20,000 of study costs
  - ✓ Investment-grade audit/drawings/feasibility study
- Gas Optimization Studies
  - ✓ No cost to customers
  - ✓ 3rd Party Study Provider
  - ✓ ASHRAE Level 2 Audit

innovativewaystosave.com/combined-heat-and-power



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Micro Combined Heat and Power Technology

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Combined Heat & Power

- Generates both electricity and useful heat from a single fuel source — like natural gas, biogas or hydrogen.
- The excess heat created during the electricity generation process is used to either heat the facility or heat water.
- **Conventional cycle CHP** - integrated system which utilizes a primary mover to produce useful thermal energy and electricity.
- **Waste heat to power CHP** - generates electricity from either the pressure drop or exhaust heat within an industrial process.



Photo credit: Tedom

Micro Combined Heat & Power

- mCHP units have higher efficiencies than traditional CHP systems.
- It is generally accepted that any co-generation system that produces under 100 kW is considered “micro”
- System compatibility with biogas, RNG and Hydrogen fuel.
- Net metering allows the consumer to sell power back into the grid.
- A 4.4 kW Axiom mCHP system can replace a 210,000 Btu/hr boiler



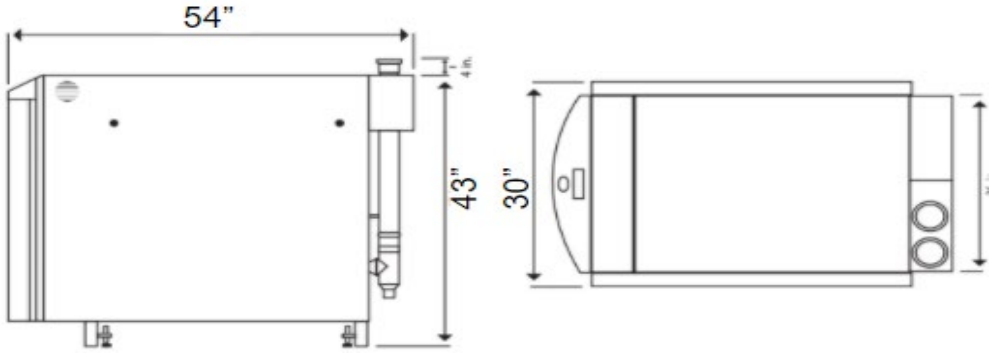


Photo credit: Axiom Energy Group (link)

A Look at Installed Systems

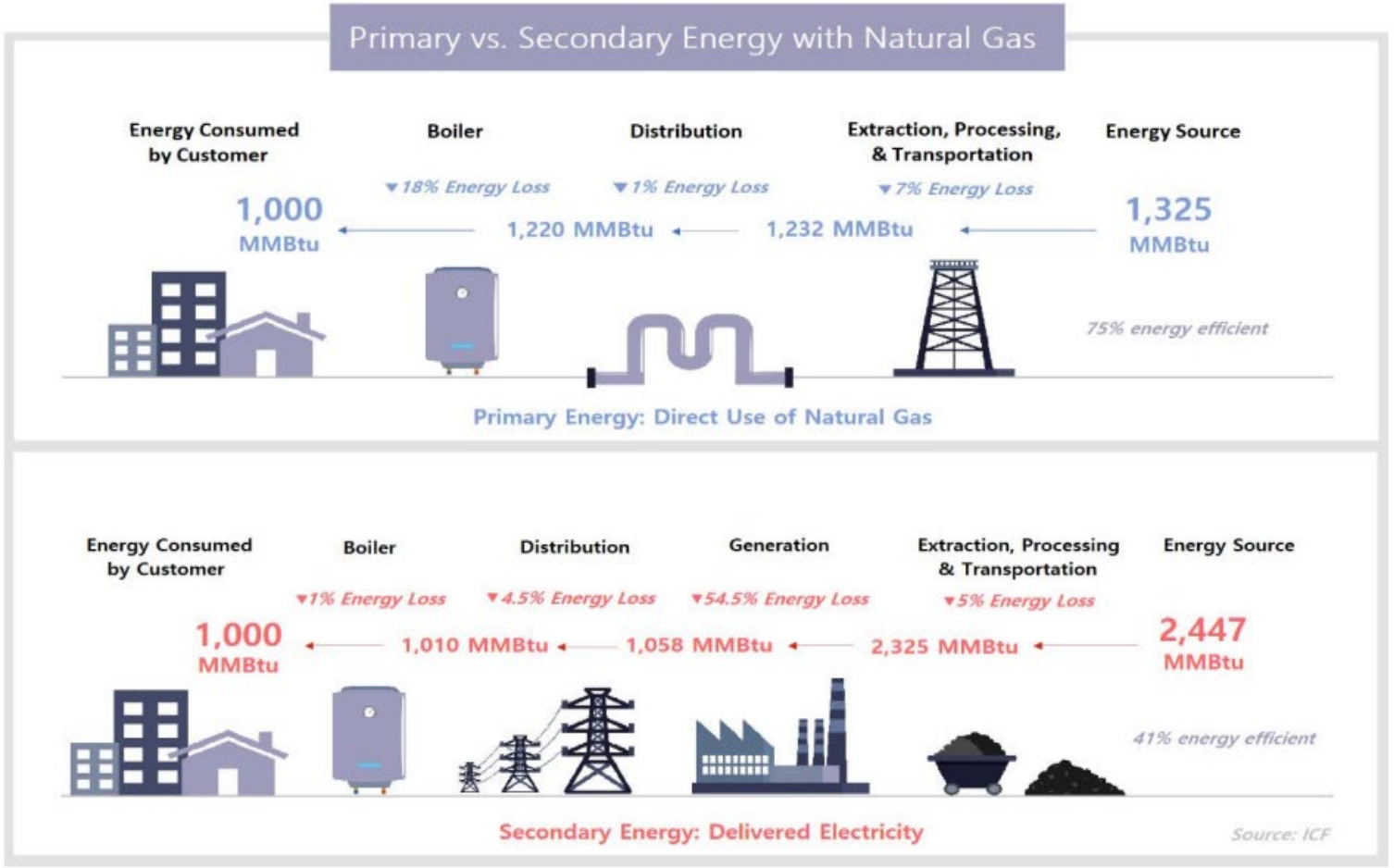


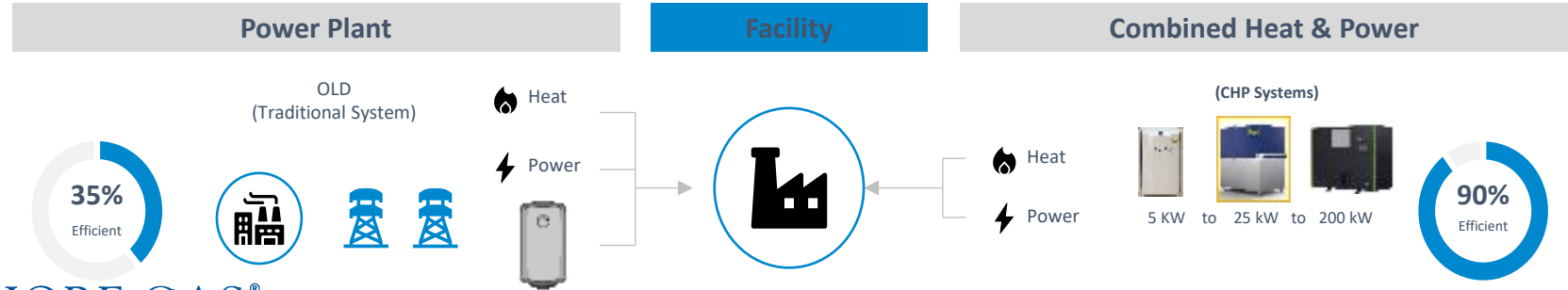




mCHP Advantage: Energy Efficiency

- Increase efficiency up to 95%
- Reduce emissions (≥40%)
- On-site energy generation using natural gas helps shrink your facility's carbon footprint.
  - ✓ No Line Losses (5% national Average)





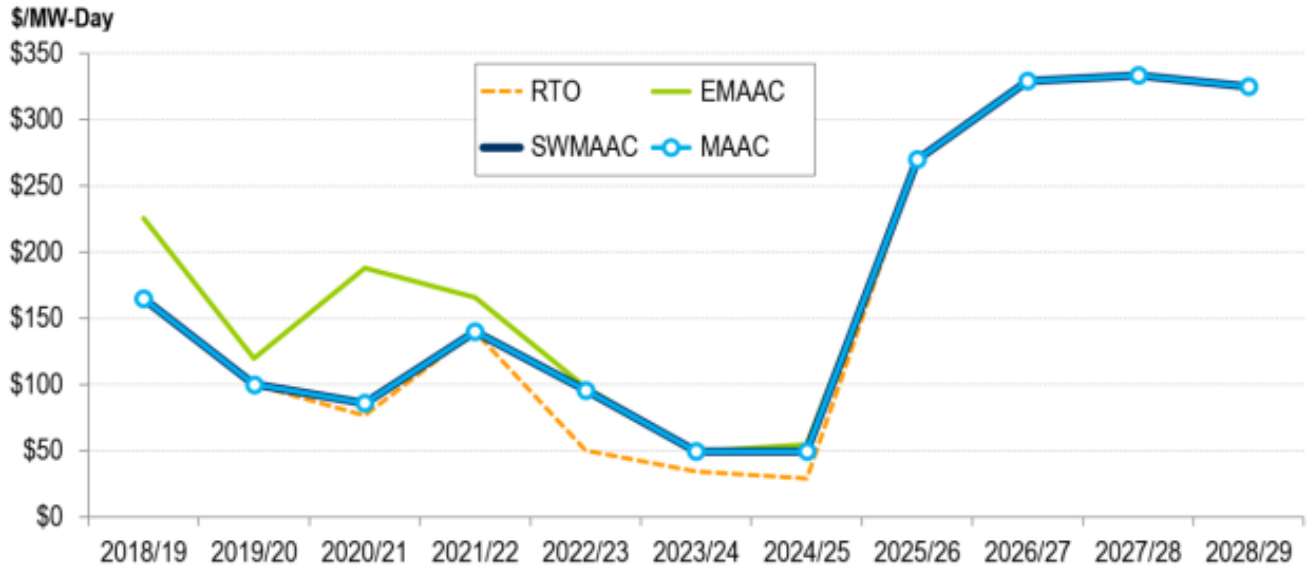
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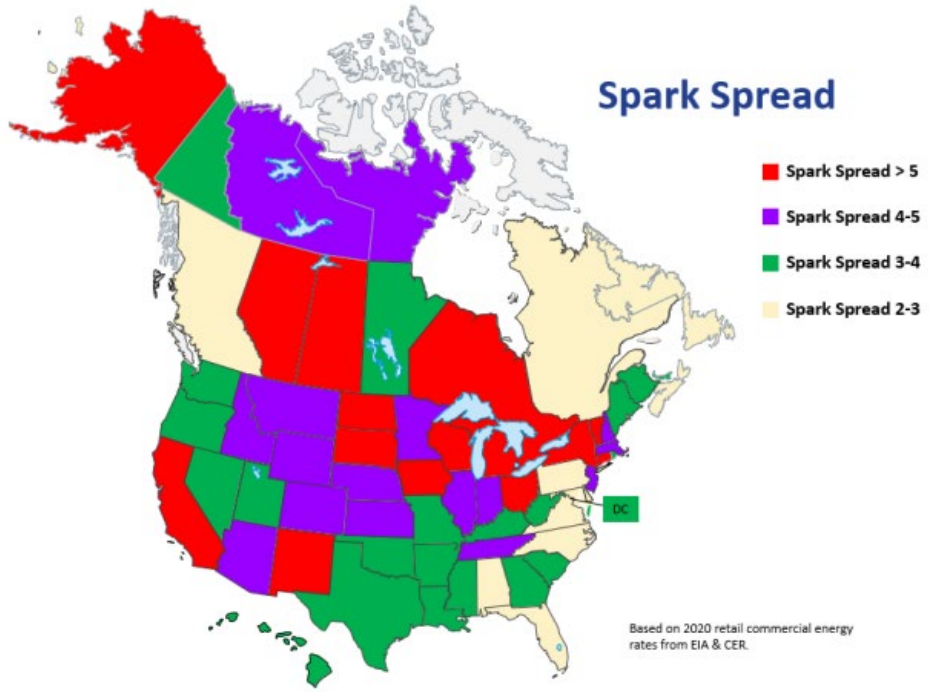
mCHP Advantage: Cost Savings

- Spark spread is the relative difference between the price of fuel and the price of electricity
- Onsite generation can lower operating costs
- Reduce utility costs
  - ✓ 800% increase to PJM capacity charge in 2025
  - ✓ Excess power can be sold to the grid
- Excess generated power can be sold back to the grid.

**depending on local utility regulations.*

Figure 1. BRA Clearing Prices by Delivery Year for Major LDAs





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mCHP Advantage: Reliability

- mCHP can decentralize the power grid and make it more resilient
- Resistant to Black Outs – Critical for facilities which can't afford downtime
- Black Start capabilities
- mCHP systems can be operated in parallel/cascade, allowing for more flexibility where heat loads fluctuate to fall below the threshold necessary to activate larger CHP systems
  - ✓ Can operate as a primary or backup system.

mCHP Products

- Award-winning
- Green
- Affordable
- Practical
- Tested and validated
- Patent Cooperation Treaty ("PCT")
- Multi fuel mix, including hydrogen

Target Markets and Applications

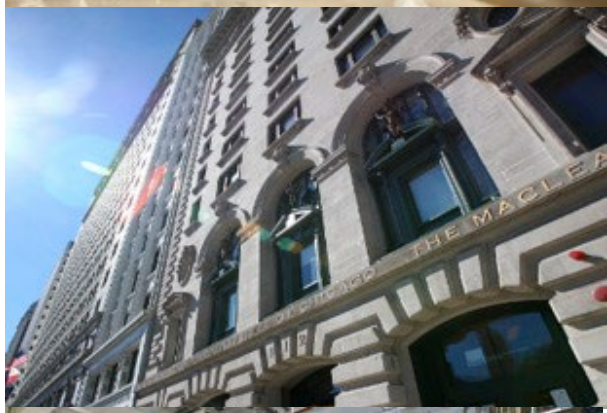
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Market Opportunities

- **Multi-Family Housing Ecosystems**: Assures tenant safety and baseline thermal comfort across multiple low-to-mid-rise environments:
  - ✓ Apartments, condominiums, and mixed-use properties
  - ✓ Senior living and student housing networks
  - ✓ Decarbonized affordable and subsidized developments
- **Commercial & Hospitality Verticals**: Optimizes volatile operational margins for hotels, restaurants, office parks, and retail centers.
- **Health & Wellness Facilities**: Guarantees critical, resilient 24/7 runtime for healthcare facilities, hospitals, recreation centers, and gyms.
- **Small Industrial & Food Retail**: Meets energy-intensive process line requirements for industrial plants and groceries.
- **Educational Institutions**: Maximizes campus decarbonization goals with robust, localized dual-output energy systems.







AXIOM ENERGY GROUP

South Milwaukee – Case Study



South Milwaukee Specs

- **Property Type:** 32-unit, two-story multifamily residential building.
- Two (2) 4.4 Kw Axiom Energy mCHP units.
- **Grid Network:** Launched January 2022 via the local utility We Energies.
- The existing 210,000 Btu/hr boiler remained onsite as backup.
- **Electrical Range:** Modulating electrical output scales from 1.2 to 4.4 kW.
- **Thermal Production:** Delivers 13,000 to 42,000 Btu/hr of 160°F hot water.
- **Maintenance Schedule:** Long service cycles requiring 4,000-hour service intervals.



Milwaukee Multifamily Results

- **System Efficiency:** Surpassed a 90% total system energy efficiency rating.
- **First-Year Savings:** Returned $6,400 in net operational savings.
- **Common Area Expenses:** Erased master common-area electrical utility costs down to $0.
- **Thermal Displacement:** Met 100% of the property's domestic hot water demand.
- **Weather Resiliency:** Allowed backup boilers to stay completely offline during record-cold weather.
- **Electrical Generation:** Produced 36,106 kilowatt hours of electricity, 5,429 of which was excess and sold back to the grid.



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South Milwaukee Building

Case Study

Location
South Milwaukee, Wisconsin

Market sector
Multifamily residential

Facility size
32-unit, two-story building

Prime mover
Single cylinder, 8 HP, liquid-cooled, Marathon reciprocating engine (1,200 to 3,400 rpm)

Engine maintenance
4,000 hr intervals

Fuel type
Natural gas

Electric output
1.2 to 4.4 kW

Thermal output
13,000 to 42,000 Btu/hr (160° F hot water)

CHP operation began
January 2022

CHP system efficiency
Over 90%

Local utility
We Energies, a sister company of Peoples Gas and North Shore Gas

How a South Milwaukee Building saved $6,400 in a year with a micro combined heat and power (mCHP) system

The Peoples Gas and North Shore Gas Energy Efficiency Programs can work with you to save money on natural gas and electric bills with micro combined heat and power (mCHP). Learn how this Milwaukee building reduced overall energy costs and increased the reliability of utility service for residents with an mCHP system.

Key takeaways

In January 2022, a 4.4-kilowatt (kW) mCHP system was installed in a 32-unit, two-story multifamily residential building located in South Milwaukee, Wisconsin. The owner of the building selected the mCHP system as the best option for reducing their overall energy costs, while providing increased reliability of utility service for the tenants.

The thermal energy recovered from the mCHP system replaces the operation of a 210,000 British thermal units per hour (Btu/hr) natural gas-fired boiler to provide domestic hot water to the entire building. The existing boiler is now used as backup for increased reliability.

The on-site electricity generated by the mCHP system is used to offset electricity normally provided by the We Energies grid to meet the electrical demand in the common areas (entrance, hallways, laundry room) of the building. Any excess electricity generated on-site is sold back to We Energies.

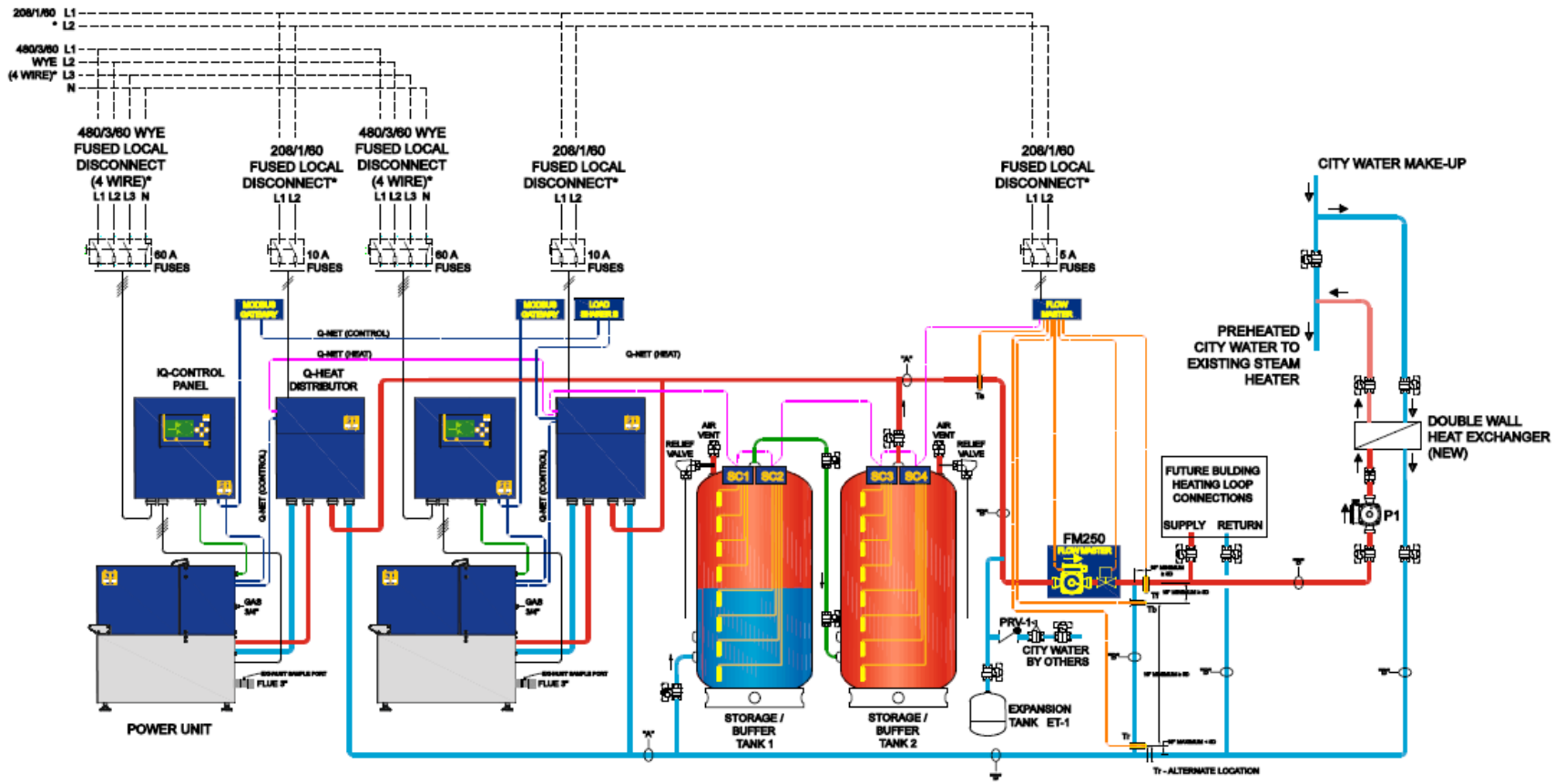
Half Acre Beer Company Pilot



Half Acre Beer Company

- **Profile:** Energy-intensive commercial craft brewery located in Chicago, Illinois.
- **Installed equipment:** Two EC POWER XRGI® 25 Power Units, two 415-gal hot water storage tanks
- **Thermal Application:** Process and domestic hot water
- **Anticipated project impacts:**
  - ✓ Net operating savings: $17,900 $/yr
  - ✓ % hot water load met: 60%
  - ✓ Peak power output: 48 kW
  - ✓ Average power output: TBD
  - ✓ Electricity generated: 138,000 kWh/yr
  - ✓ % electric load (kWh) offset: 14%
  - ✓ Overall system efficiency: 93%





Technical Specifications

MODEL XRGI 25	2 UNITS
KW OUTPUT	48
FLA @ 100%	82
Recommended Natural Gas Pressure Range	8 - 10" w.c.
Combustion Air Net Free Area	48 sq. in.
INPUT MBH @100%	524
OUTPUT MBH @100%	326
MANIFOLD A SIZE - MINIMUM	2"
MANIFOLD B SIZE - MINIMUM	2"
STORAGE CONTROL - PANELS / SENSORS	4 / 16
TANK RELIEF VALVE SIZE / PRESS	3/4" / 60 PSI

Bill of Material

ITEM	DESCRIPTION
P1	PUMP B&G PL-45 C.I./S.S. 1/6 HP 1.5" Flanges 115/60/1 *
P2	
P3	
ST1 & 2	NILES TANK - Model S-36-102 415 GALLON BUFFER TANK. SC sensors to be field installed. To be field insulated
HX1	HEXONIC - Safety Plate Double Walled Brazed Plate Heat Exchanger LB47SP-60H-1"-UM approx 336 MBH
ET-1	AMTROL SX-90V OR EQUAL
PRV-1	B&G MODEL B-38 OR EQUAL SET TO 12 PSI
FM 250	FLOW MASTER MODEL FM 250 208/1/60*
*	Provide ground per NEC and local electric code

SCOPE:

The goal of this project is to reduce electrical consumption and reduce the electrical demand charge for the facility. All the heat provided by the CHP units will reduce the heat generated by the existing steam boiler.

19 WEST COLLEGE DRIVE
ARLINGTON HEIGHTS, IL 60004
(847) 253-1040
BOILERSOURCE.COM

DRAWN BY: AGR
CHECKED BY:
SCALE: NONE

PROJECT: HALF ACRE BEER COMPANY

DRAWING TITLE: EC POWER 2 - XRGI 25 SYSTEMS, 2 - BUFFER TANKS, HEATING, & DHW HX

REVISION: 12
DATE: 10/30/25
SHEET:



5550 Dorchester – Pilot

5550 Dorchester

- **Profile:** 124-unit multifamily residential property managed by Fernwood Property Management.
- **Installed equipment:** Two (2) 4.4 Kw Axiom Energy mCHP units.
- **Thermal Application:** Domestic hot water
- **Project impacts:**
  - ✓ Net operating savings: $5,000/yr
  - ✓ % hot water load met: 55%
  - ✓ Peak power output: 8.8 kW
  - ✓ Average power output: 5.7 kW
  - ✓ Electricity generated: 50,000 kWh/yr
  - ✓ % electric load (kWh) offset: 20%
  - ✓ Overall system efficiency: 93%



Interested in learning how mCHP can work for your building?
Contact us at:
innovative-solutions@peoplesgasdelivery.com
to learn more



Thomas Manjarres

Technical Lead — Peoples Gas and North Shore Gas Energy Efficiency Programs
thomas.manjarres@wecenergygroup.com

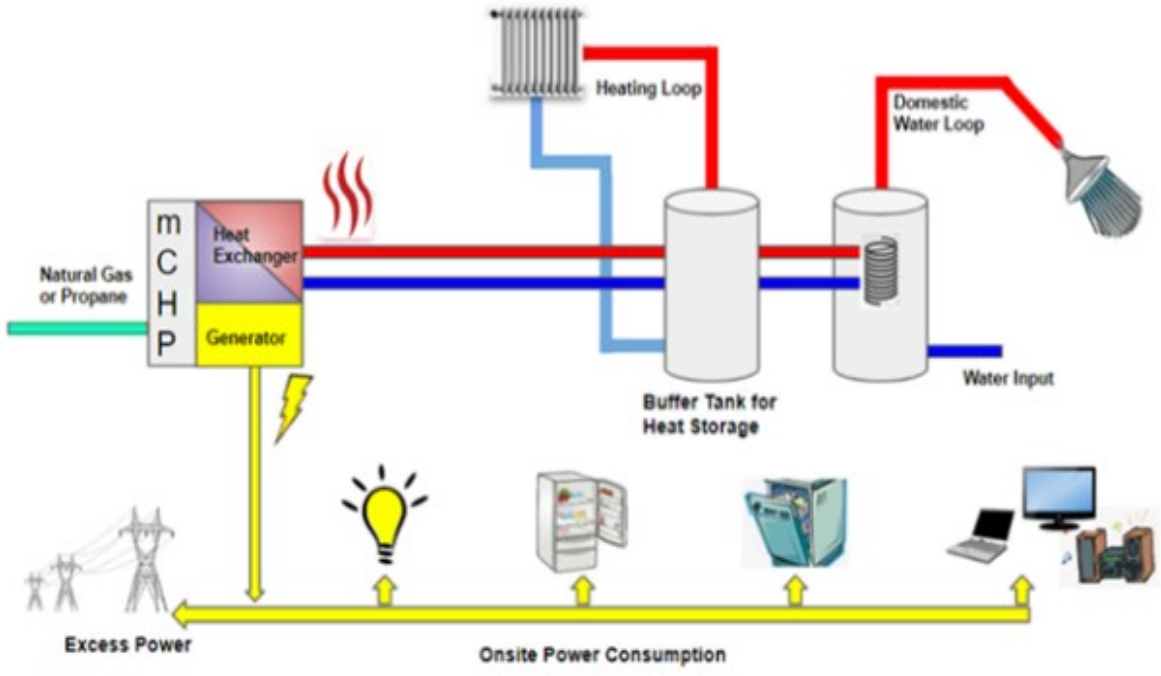
Appendix

PEOPLES GAS®
ENERGY EFFICIENCY PROGRAM

NORTH SHORE GAS®
ENERGY EFFICIENCY PROGRAM

Operating Methodology

- **Thermal Load Tracking** - The mCHP operates up to its maximum capacity to generate full thermal load, with electricity supplemented by the grid.
- **Electrical Load Tacking** - The mCHP operates up to its maximum capacity to generate full electrical load, with thermal generation supplemented by the existing heater.
- **Highest Load Tracking** – The mCHP operates up to its maximum capacity to generate the highest load between thermal and electrical. The unit is supplemented by the grid and existing heater, with excess thermal energy dumped by a radiator.
- **Maximum mCHP Load** – The mCHP always operates at its maximum output, excess electricity is net-metered, excess heat is dumped by a radiator.



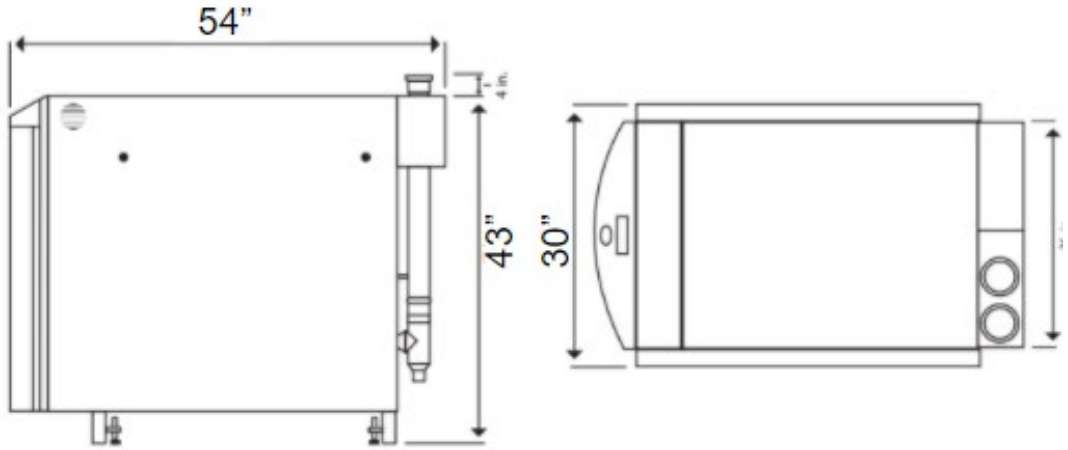
Axiom Energy mCHP System Overview



- Marathon Engine
- Heat Exchanger
- Power Inverter
- System Controller
- Engine Controller
- Control Interface

MADE in WISCONSIN
From U.S. and Foreign Parts

Compact & Modular



1.2 - 4.4 kWh of electricity (single phase)
15,000 - 47,000 btu/hr of heat - Propane
13,000 - 42,500 btu/hr of heat - NG
Exhaust Gas Temperature 180^0 F
Overall efficiency = 93%
55dB

Product Overview

ENGINUITY POWER SYSTEMS

Consumer CHP Products

- E|8 and E|20 consumer CHP systems
- Replaces traditional consumer furnace and water heater while providing power generation
- Natural gas powered



E|8
Launch Q4 2025

E|20
Launch Q1 2027

Commercial CHP Products

- E|100 and E|200 commercial CHP systems
- Large scale power generation
- Replaces traditional furnace and water heater in large, commercial buildings
- Supports high thermal load businesses
- Natural gas powered



E|100 CHP



E|200 CHP

Government Systems

- Portable generator capable of producing 2 – 10 kw of power
- Significant military and emergency relief applications
- DoD contracts have supported development funding over time



RIHGS 5kW OP4S



M1 Abrams APU



RIHGS 5kW – T/R



GVSC 30 kW V-APU

Flexible Power Solutions

- Portable Power Stations
- Add-on Battery Modules
- Mobile Solar Panels
- Products are in market today across multiple e-commerce sites



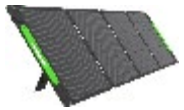
3600W Portable Power Station



300W Portable Power Station



1000W Portable Power Station



Portable Solar Panels

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PRODUCT BASICS - SYSTEM AND



12 - 24 kWh of electricity (480/3/60)
112,000 - 163,000 BTUH of heat - NG
Water Supply Temperature ~185^0 F
Total overall efficiency = 93%
49dB

* Storage tank is not included in the basic price

STORAGE TANK

- Stores excess heat in the event of high demand for electricity
- Reserve in the event of high demand for heat

POWER UNIT

- Engine drives generator
- Generator produces electricity
- Heat exchanger transfers heat to the Q-Heat Distributor

Q-HEAT DISTRIBUTOR

- Absorbs heat from the Power Unit
- Distributes heat to the water circuit and/or Storage Tank

iQ-CONTROL PANEL

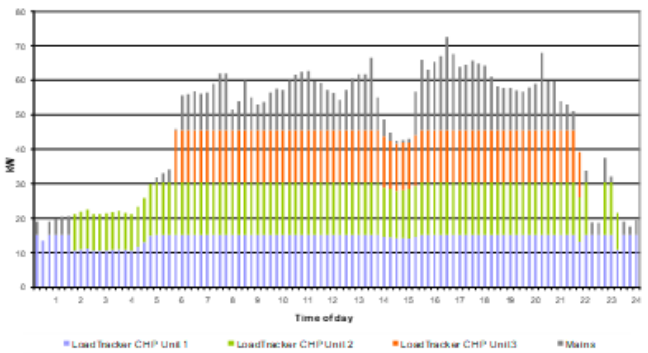
- Controls the system to meet requirements
- Analyses in real-time your consumption patterns and optimises operation fully automatically

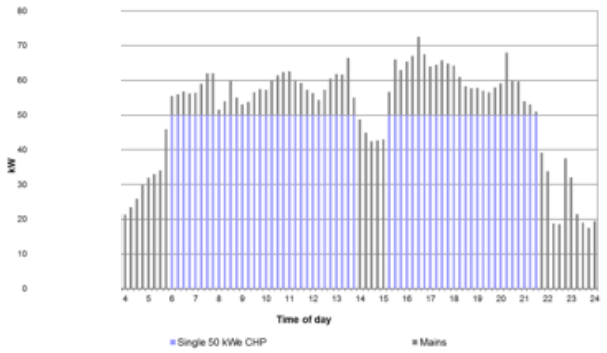
CASCADED INSTALLATION

- The modular design of the XRGI® enables cascaded installations
- 3+ XRGI® units
- Up to and beyond 72 kW

- Varying energy demand
- Higher efficiency than one large CHP
- Load Sharer ensures equal operating hours

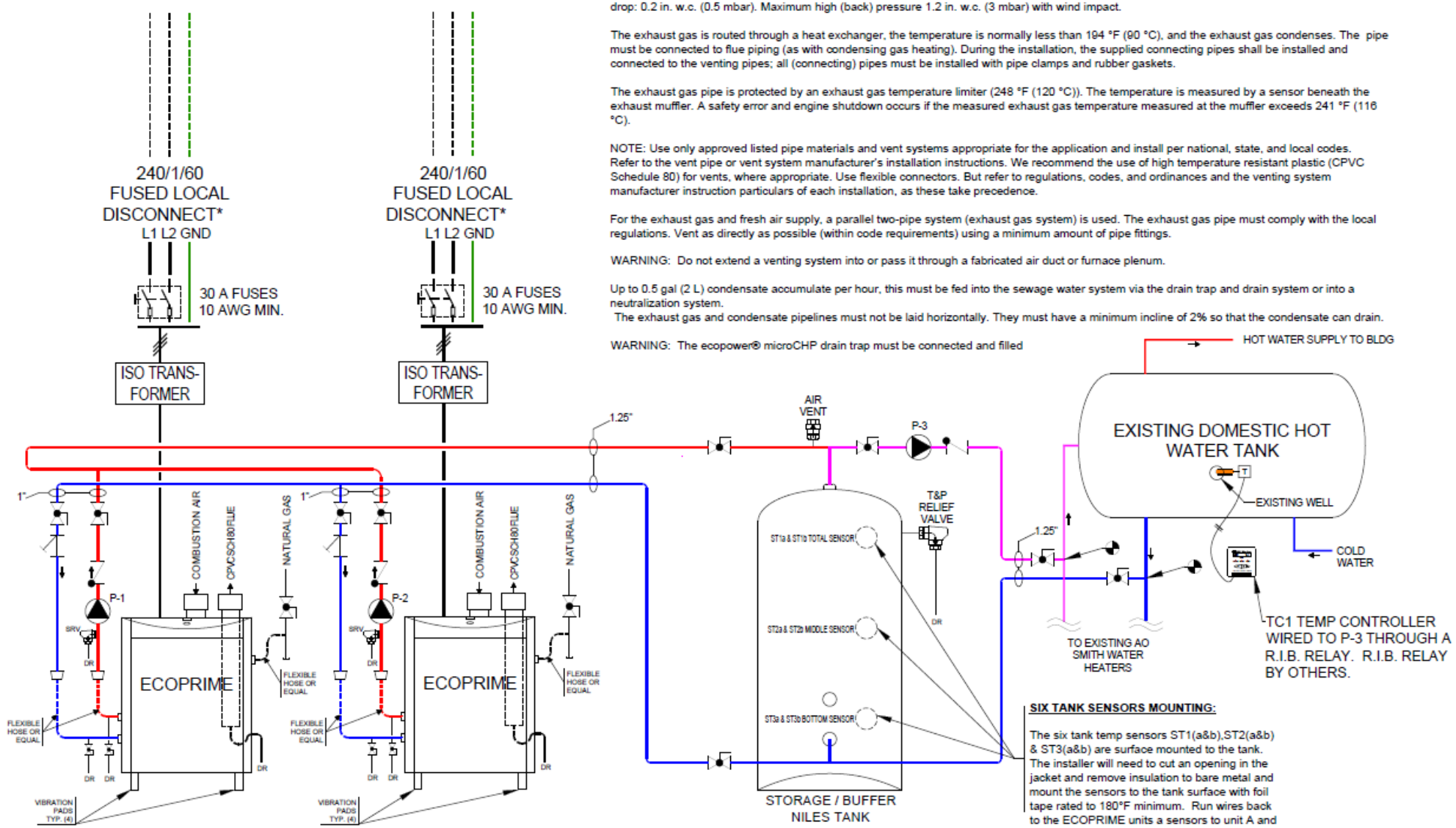






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ENERGY EFFICIENCY PROGRAM



P-1 B&G NBF-22 1/25 HP 110/1/60 Lead-Free Bronze
P-2 B&G NBF-22 1/25 HP 110/1/60 Lead-Free Bronze
P-3 B&G NBF-22 1/25 HP 110/1/60 Lead-Free Bronze

VENTING NOTES:

A trained installer must install the connections. The fresh air supply and the exhaust gas pipes and vents must comply with NFPA 54 (ANSI Z223.1) installation guidelines or state and local codes. The rules and regulations of the respective country and locality must be observed.
Maximum length of the air intake path: 65 ft. (19.8 m) minimum inner diameter 2.76 in. (70mm) with a maximum of six 90 degree bends. Maximum length of the exhaust system: 65 ft. (19.8 m) at minimum inner diameter 2.76 in. (70 mm), with a maximum of six 90 degree bends. Total pressure drop: 0.2 in. w.c. (0.5 mbar). Maximum high (back) pressure 1.2 in. w.c. (3 mbar) with wind impact.

The exhaust gas is routed through a heat exchanger, the temperature is normally less than 194 °F (90 °C), and the exhaust gas condenses. The pipe must be connected to flue piping (as with condensing gas heating). During the installation, the supplied connecting pipes shall be installed and connected to the venting pipes; all (connecting) pipes must be installed with pipe clamps and rubber gaskets.

The exhaust gas pipe is protected by an exhaust gas temperature limiter (248 °F (120 °C)). The temperature is measured by a sensor beneath the exhaust muffler. A safety error and engine shutdown occurs if the measured exhaust gas temperature measured at the muffler exceeds 241 °F (116 °C).

NOTE: Use only approved listed pipe materials and vent systems appropriate for the application and install per national, state, and local codes. Refer to the vent pipe or vent system manufacturer's installation instructions. We recommend the use of high temperature resistant plastic (CPVC Schedule 80) for vents, where appropriate. Use flexible connectors. But refer to regulations, codes, and ordinances and the venting system manufacturer instruction particulars of each installation, as these take precedence.

For the exhaust gas and fresh air supply, a parallel two-pipe system (exhaust gas system) is used. The exhaust gas pipe must comply with the local regulations. Vent as directly as possible (within code requirements) using a minimum amount of pipe fittings.

WARNING: Do not extend a venting system into or pass it through a fabricated air duct or furnace plenum.

Up to 0.5 gal (2 L) condensate accumulate per hour, this must be fed into the sewage water system via the drain trap and drain system or into a neutralization system.
The exhaust gas and condensate pipelines must not be laid horizontally. They must have a minimum incline of 2% so that the condensate can drain.

WARNING: The ecopower® microCHP drain trap must be connected and filled

SIX TANK SENSORS MOUNTING:

The six tank temp sensors ST1(a&b),ST2(a&b) & ST3(a&b) are surface mounted to the tank. The installer will need to cut an opening in the jacket and remove insulation to bare metal and mount the sensors to the tank surface with foil tape rated to 180°F minimum. Run wires back to the ECOPRIME units a sensors to unit A and b sensors to unit B.

BOILERSOURCE Going Beyond the Boilerplate	19 WEST COLLEGE DRIVE ARLINGTON HEIGHTS, IL 60004 (847) 253-1040 BOILERSOURCE.COM	DRAWN BY: AGR CHECKED BY: SCALE: NONE	PROJECT: 5550 S DORCHESTER, CHICAGO, IL. DRAWING TITLE: TWO AXIOM ECOPRIME mCHP WITH BUFFER TANK FOR DHW ONLY	REVISION: 4 DATE: 1/8/26 SHEET:

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