

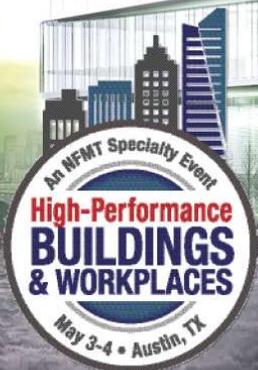
# HIGH-PERFORMANCE BUILDINGS & WORKPLACES

MAY 3 - 4, 2016 | AUSTIN, TX

## Why CHP is a Good Fit for Commercial Buildings and Workplaces

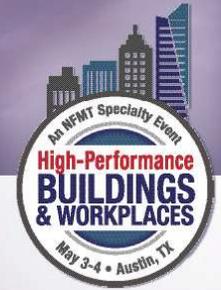
Presented by  
Gary McNeil

Program Manager, EPA CHP Partnership



[nfmt.com/highperformance](http://nfmt.com/highperformance)

# What Is CHP?

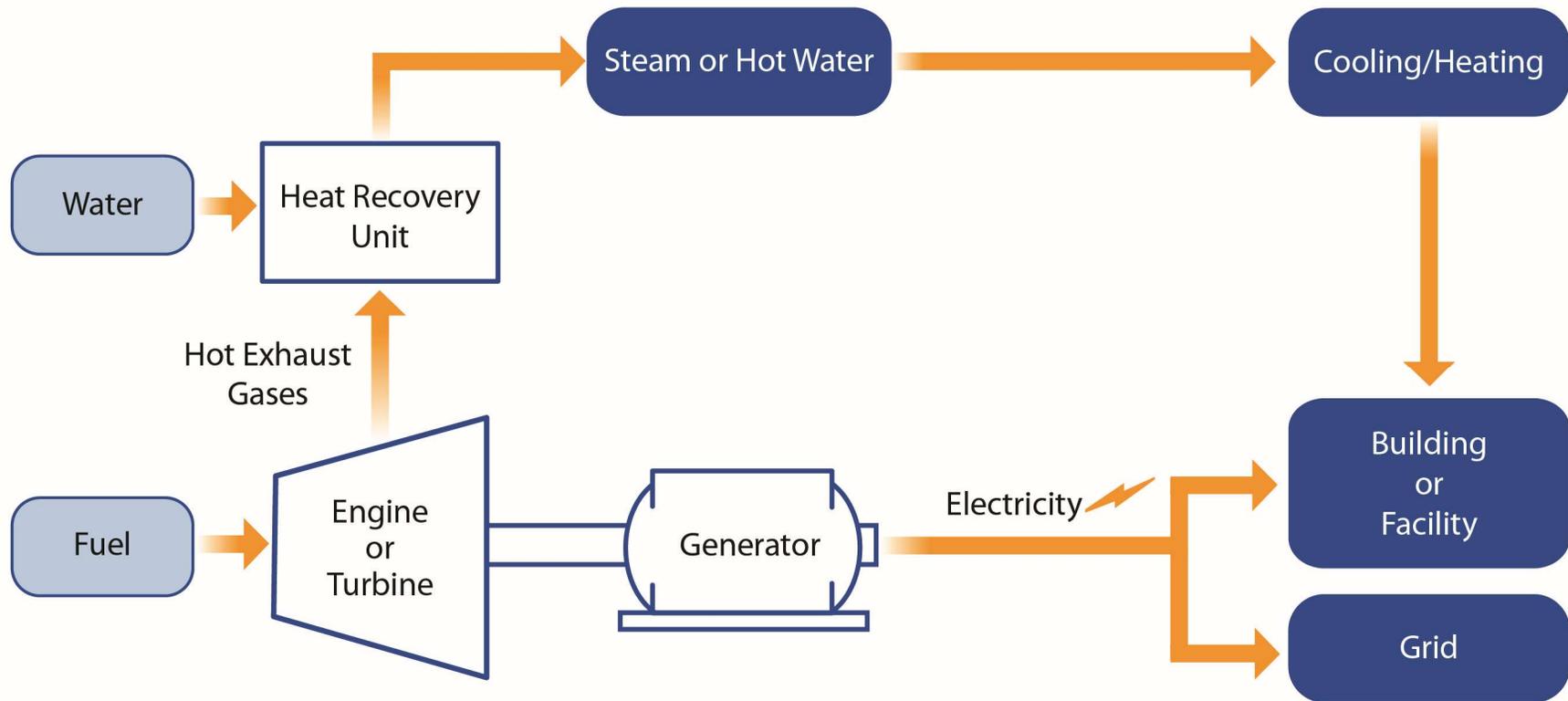
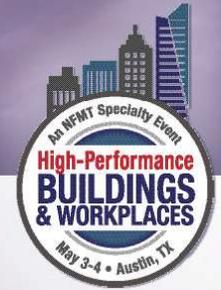


CHP is an *integrated energy system* that:

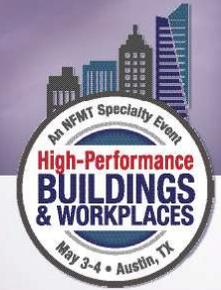
- Is located at or near a factory or building
- Generates electrical and/or mechanical power
- Recovers waste heat for
  - Heating
  - Cooling, dehumidification
- Can utilize a variety of technologies and fuels
  - E.g., turbines, reciprocating engines, fuel cells
  - Fossil fuels
  - Biomass (wood, wood waste, crop residues, crop plants)
  - Biogas



# Typical CHP Configuration

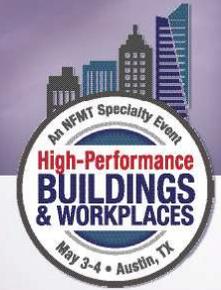


# CHP Benefits



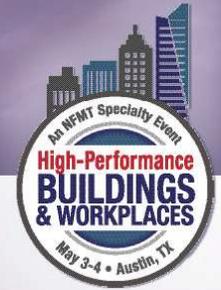
- Increased efficiency
- Lower energy costs
- Reduced emissions
- Reliable electricity supply
- Reduced grid congestion and avoided transmission and distribution costs/losses

# Favorable Conditions for CHP



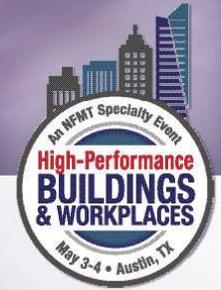
- Electricity costs higher than \$0.07/kWh
- Long hours of operation (>5,000 hours/year)
- Thermal loads throughout the year
- Concern about rising energy costs
- Concern about power reliability
- Desire to reduce emissions

# Current Trends Facilitating CHP for Commercial Building Owners



- Modular Packaged CHP
- 3<sup>rd</sup> Party Ownership Models
- Absorption Chillers
- LEED®

# Contact



**Gary McNeil**

U.S. Environmental Protection Agency

CHP Partnership

202-343-9173

[mcneil.gary@epa.gov](mailto:mcneil.gary@epa.gov)



[www.epa.gov/chp](http://www.epa.gov/chp)

# HIGH-PERFORMANCE BUILDINGS & WORKPLACES

MAY 3 - 4, 2016 | AUSTIN, TX

## Packaged CHP: Opportunities for Commercial Buildings

Diane Molokotos  
Project Engineer  
Aegis Energy Services, Inc.



[nfmt.com/highperformance](http://nfmt.com/highperformance)



Time to reach further?



Energy Efficiency is no longer an option...  
but an obligation.

# Aegis Energy Services, Inc.

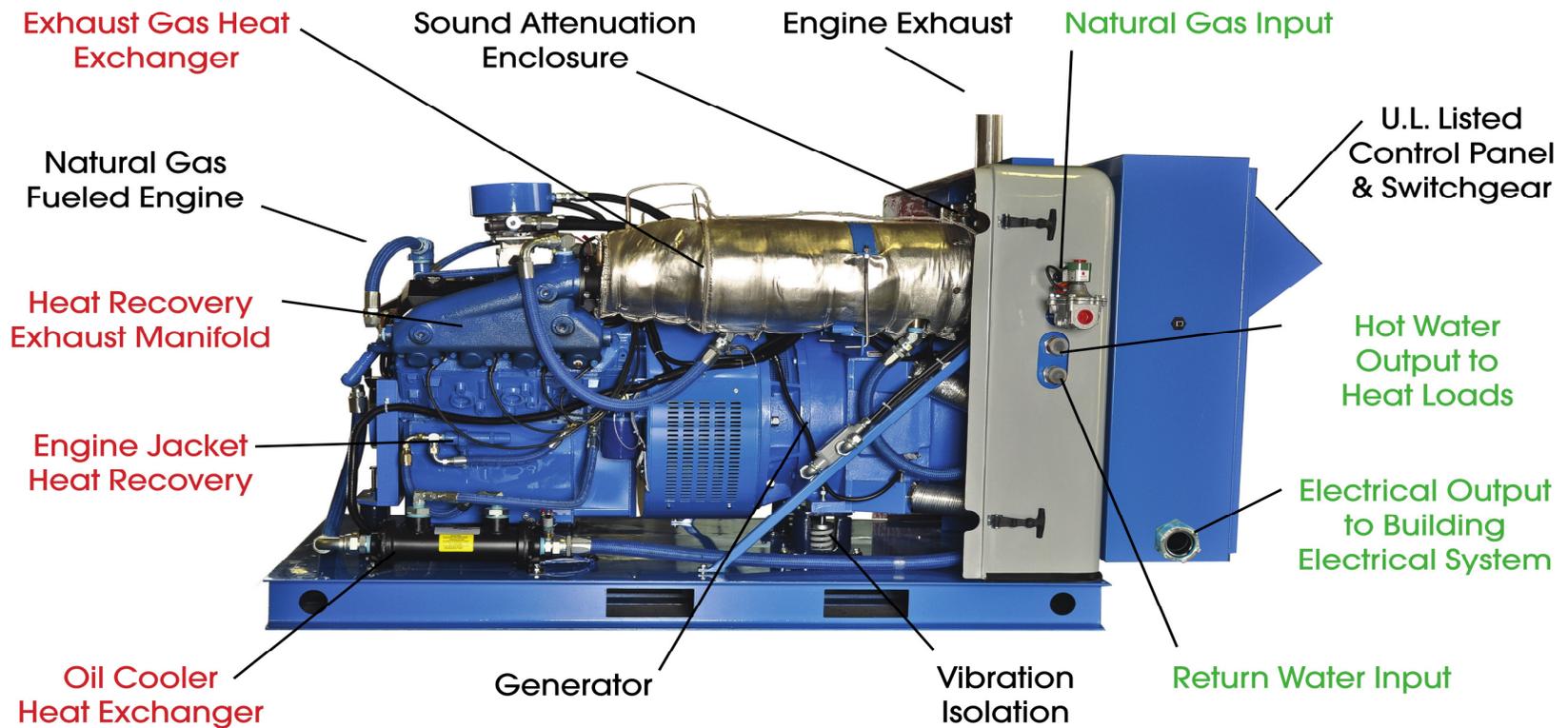


- Large developer of small modular CHP in the Northeast and Mid-Atlantic
- In business for 30+ years
- Installer of 500+ CHP systems
- Privately held company headquartered in MA
- Total Vertical Integration
- Owners/operators of 3<sup>rd</sup> party CHP systems

# Aegen Thermopower 75 LE Modules



# Product Architecture



# Modular and Scalable



## Single



## Multiple



# Markets Served



## Hotels



## Healthcare



## Museums



## Recreational



## Multi-Family



## Education



# Financing Options



- Revenues=Savings +REC credits +Net metering
- ROI 3-5 years
- Grants and Incentives
- Tax Credits
- Third Party Ownership Models



# Modular packaged CHP: a good fit for commercial buildings



- System size and multiples
- Normal gas pressure
- Pre-assemblies
- Simplified permitting
- Off site monitoring
- Maintenance packages
- Easily adaptable to 3<sup>rd</sup> party ownership
- In NYC, packaged systems pre-qualified for grants/incentives
- May be able to replace diesel gen set

# Shared Savings Model



## Energy Savings with Zero Capital!

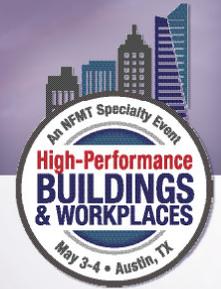
- Aegis installs, owns, operates and maintains system.
- No capital outlay or maintenance fees for facility.
- Heat/Hot water at market rate.
- Electricity at discount to market.
- 15 year agreement
- Host site can purchase equipment at a decreasing cost.

# Good CHP Projects



- Building heated by hot water
- 40,000 + therms of gas annually
- 100+ apartments, beds or residents
- One electric and one gas meter
- High electric rates
- Heated pools
- Proper sizing of CHP modules

# To Maximize Energy Savings..



Design system to be **“thermal load following”**

- Size overall CHP system to match thermal needs
- Employ hot water storage tanks for peaks
- Aegis CHP modules adjust power (30kw-75kw) to match building heat/hot water
- If thermal demand below set point, system pauses to avoid heat dump
- Only time heat dump may occur is if performing electric peak shaving



# Energy Savings



## Before

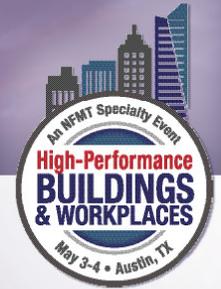
Date	kWh	kW cost	therms	Therms cost	Total Cost	% Electric	% Heat
2015	1,880,760	\$299,786	71,746	\$42,203	\$341,998	0%	0%

## After

Date	kWh	kW cost	therms	Therms cost	Total Cost	% Electric	% Heat
2015	1,442,866	\$237,783	88,116	\$45,382	\$283,165	23.28%	50.34%

Savings= \$58,824=17% reduction in cost

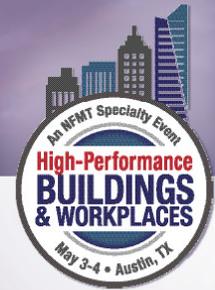
# Health Care



## Nursing Home- Cambridge, MA

- 132 bed skilled nursing facility
- Built in 1968

# Energy Savings



## Before

Date	kWh	kW cost	therms	Therms cost	Total Cost	% Electric	% Heat
2015	2,052,125	\$377,055	187,578	\$145,468	\$522,533	0%	0%

## After

Date	kWh	kW cost	therms	Therms cost	Total Cost	% Electric	% Heat
2015	1,668,000	\$317,407	196,305	\$152,186	\$469,593	18.7%	%

Savings= \$52,940=10% reduction in cost

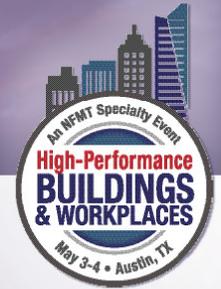
# Multi-Family Residential



## 315 on A - Boston

- 255,000 square feet
- Completed 2013
- LEED GOLD Certified

# Thank you!



Contact me at (413)536-1156

[dianem@aegisenergyservices.com](mailto:dianem@aegisenergyservices.com)

Visit us at [aegisenergyservices.com](http://aegisenergyservices.com)

# HIGH-PERFORMANCE BUILDINGS & WORKPLACES

MAY 3 - 4, 2016 | AUSTIN, TX

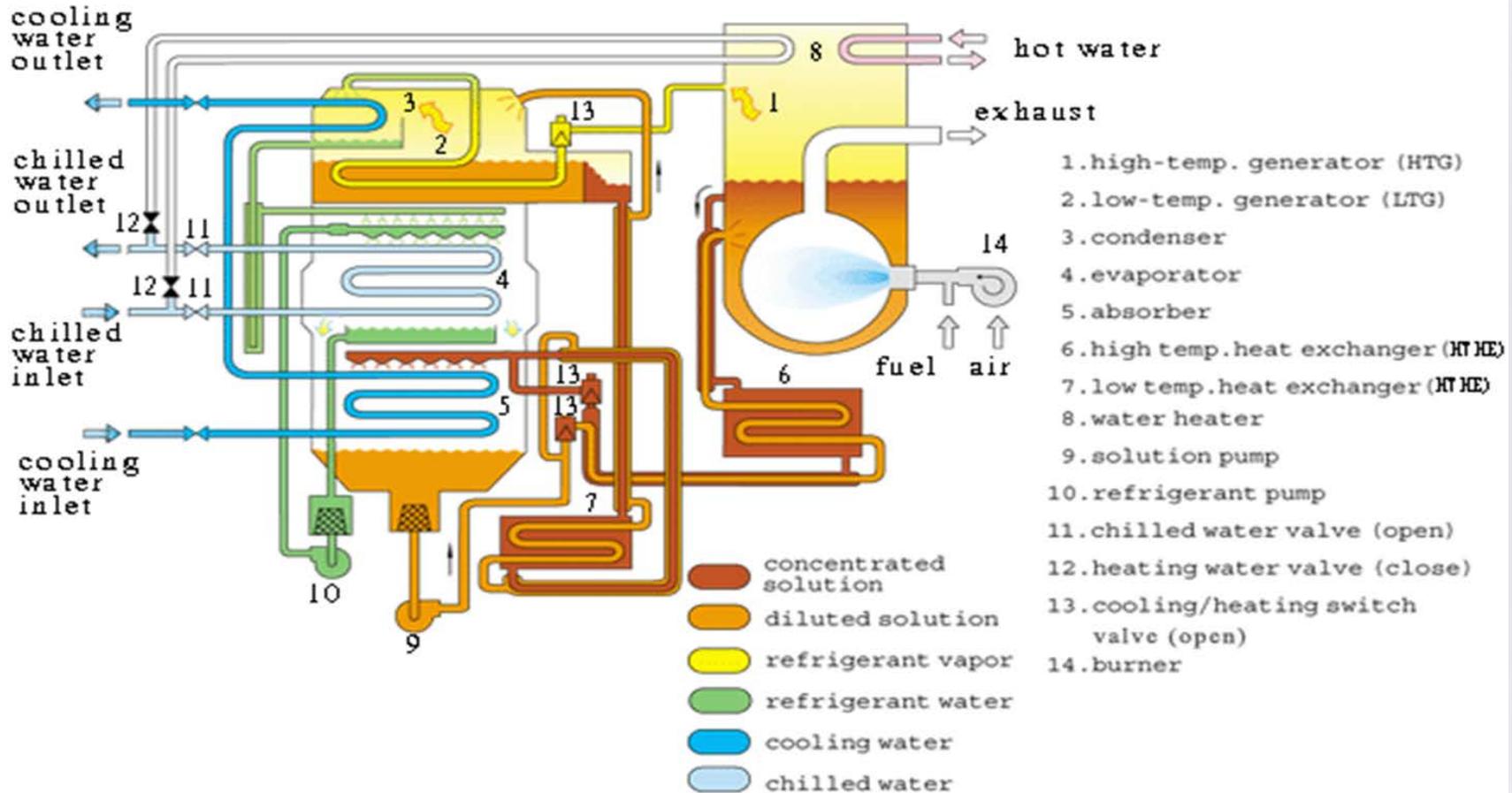
## Facilitating CHP with Modern Absorption Chillers

Presented by  
Douglas Davis  
Director Broad USA  
(201)951-5713  
davis@broadusa.com

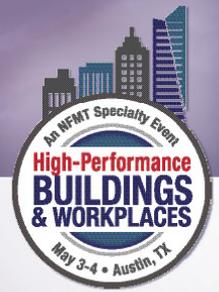


[nfmt.com/highperformance](http://nfmt.com/highperformance)

# Modern Absorbers aka “chillers” can use any form(s) of heat to make AC or HVAC ( common in CHP )

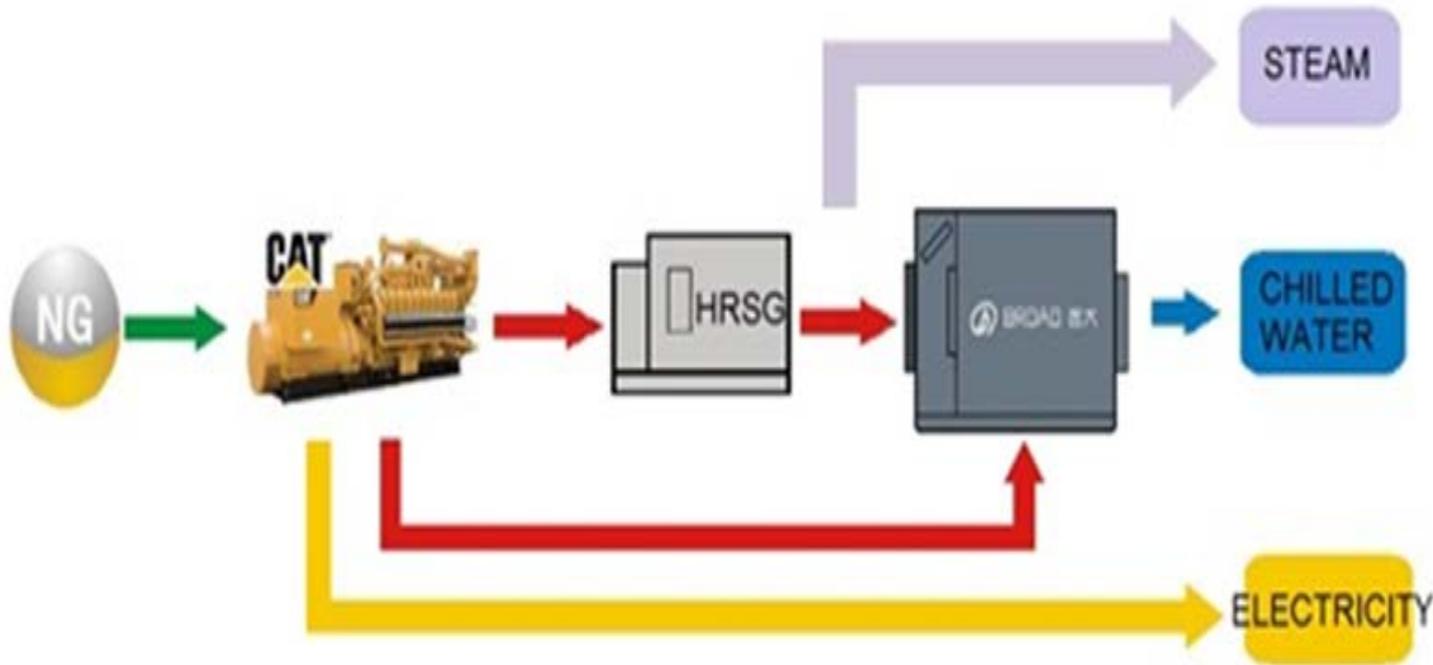
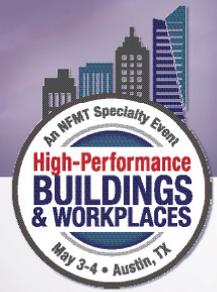


# What is an Absorber – What's new?



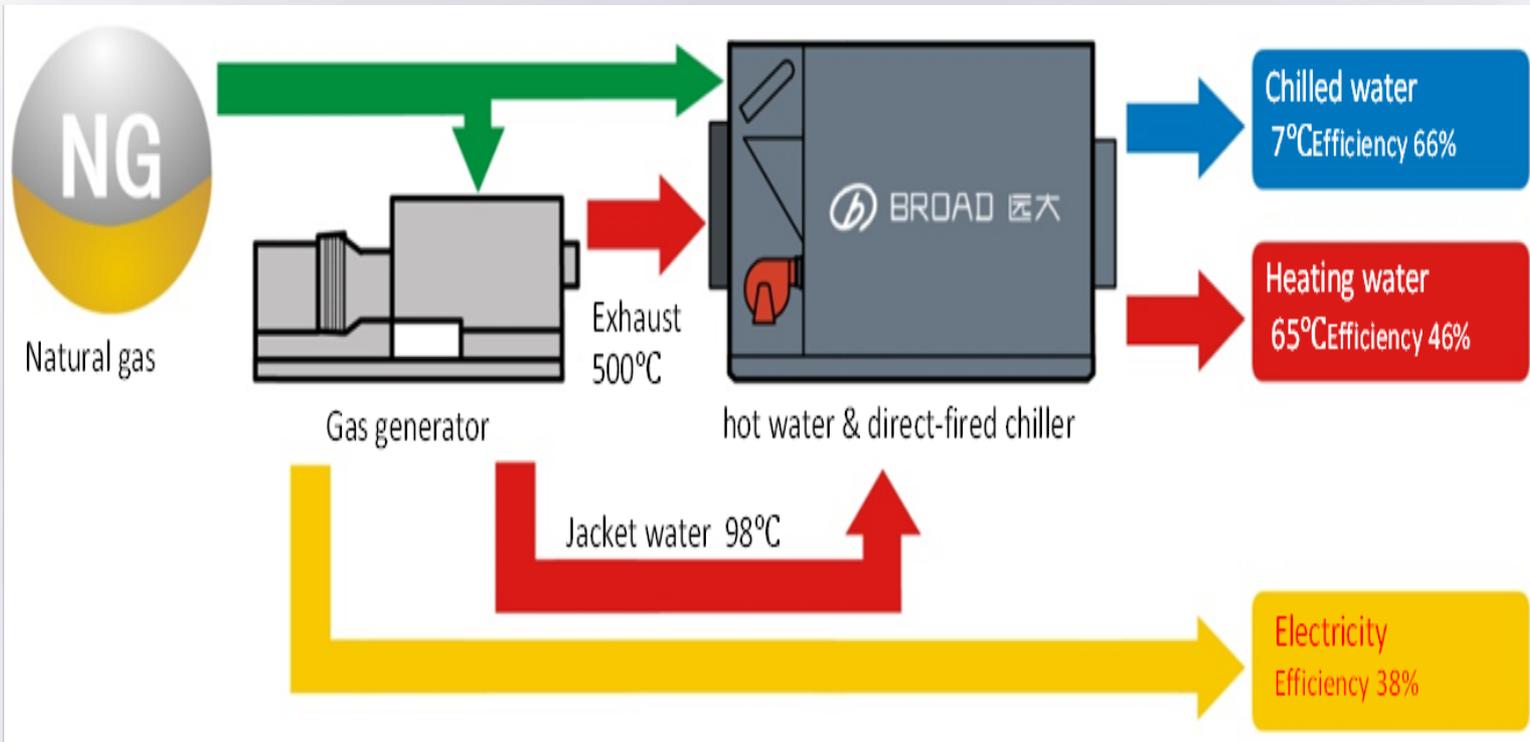
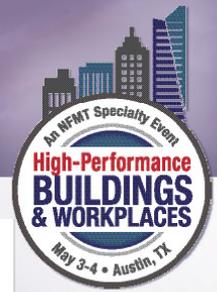
- Thermally Driven Chiller that makes cold water
- Typical application is 44 F ( + or - ) “HVAC”
- Commonly applied in chilled water systems for HVAC in almost any type of building
- AKA “absorption chillers” or “Chiller/Heaters”
- What’s different with Modern Units?
- Better part load COP/NPLV and unloading ..10%
- Better materials, controls & vacuum standards

# Typical methods to recover waste heat in CHP



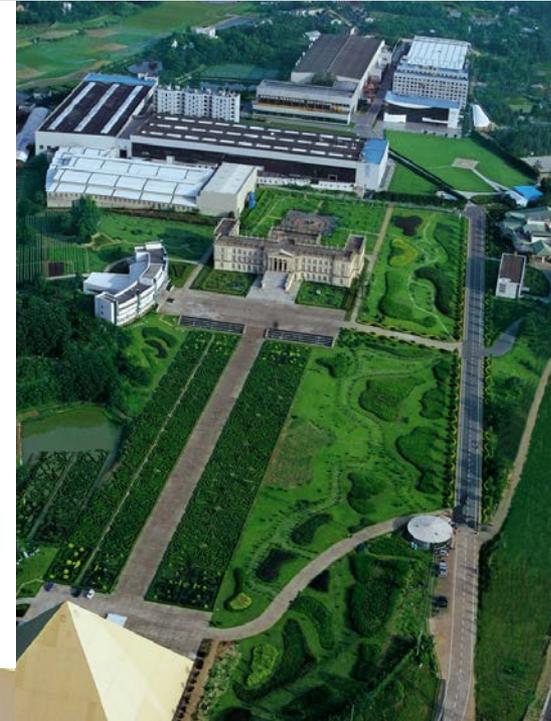
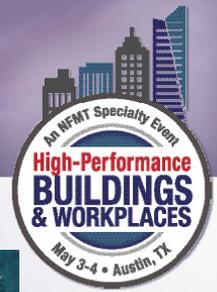
**MODERN ABSORBERS MAKE HEAT RECOVERY SIMPLE TO DO IN A WIDE VARIETY OF CHP SYSTEMS.**

# Great Modern method to recover waste heat

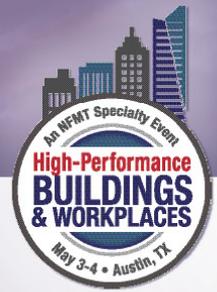


**ABSORBERS CAN PROVIDE BOTH CHILLED AND HOT WATER FOR BUILDING USE IN HVAC SYSTEMS. ONE ABSORBER CAN TAKE MULTIPLE HEAT STREAMS.**

# Broad USA Manufactures, Monitors, Services & Provides Training on Absorbers



# Why Modern Absorbers are good for CHP projects

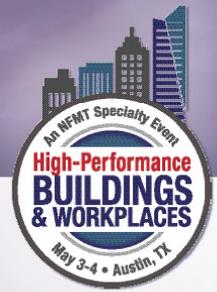


- Many Building designs have traditional heat loads that make CHP effective.
- Cooling loads can be viewed as “heat loads” with the utilization of thermal chillers
- No Chemical Refrigerants equals
- 1 LEED point directly!
- H2O is a “Natural Refrigerant”
- <http://www.r718.com/>



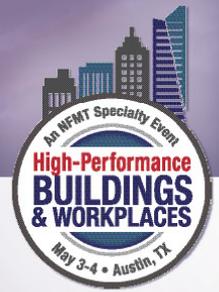
Stable  
Nontoxic  
Low cost  
Readily available  
Environmentally friendly  
No EPA phase out date!

# ANY TYPE OF HEAT INPUT works in a Modern Absorber



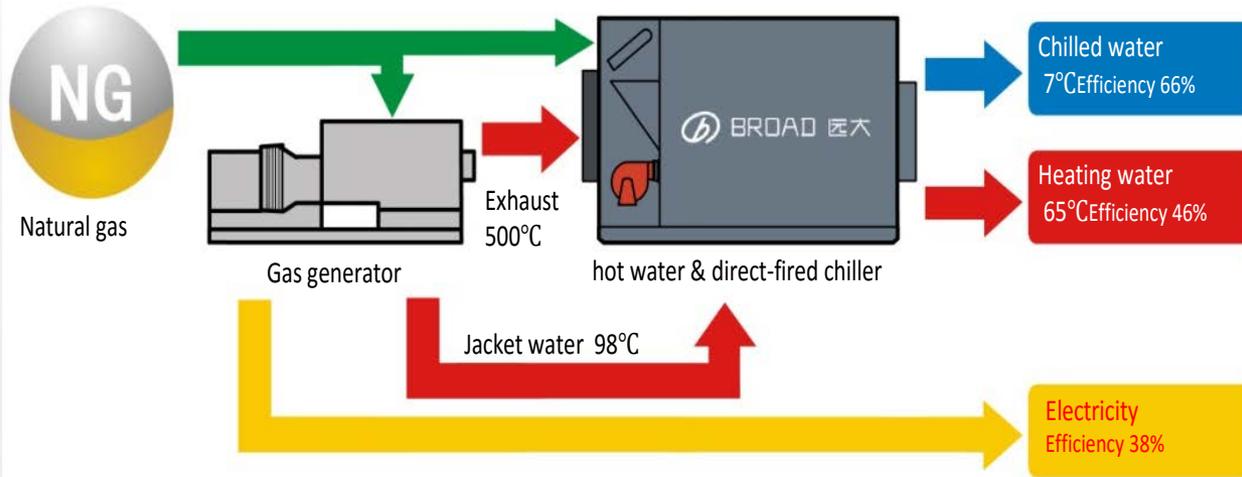
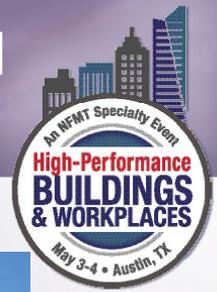
- PRIME MOVERS applied in CHP generate usable waste heat in various forms. All of which can be used to drive the cycle of Modern Absorber
- Some Fuel cells = Hot Air = 750 F
- Turbines (Large & Micro) = Hot Combustion Air
- Reciprocating Engines = “Tail pipe exhaust” & “Jacket Water” – keeps engine from overheating
- Using waste heat in cooling operation often aids in the cost of effect design of CHP.

# Two Case studies from the Retail Sector that use CHP

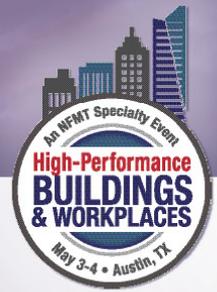


- BIG BOX Retail
- Showcase New Construction (50,000 sqft) and very typical design where chp is less the 50% of peak KW draw.
- Existing Building Upgrade (no store shut down required ) Store remains in operation as they cut the cord on electric grid power for normal operation and only use Natural Gas.
- Both case stores can run without the electric grid “resiliency”
- Lowers cost of operating store
- Reduced Carbon Footprint
- Reduces operating cost of low temperature refrigeration system.

# Typical arrangement Reciprocating Engine & “Pre Packaged CCHP” aka factory built CCHP

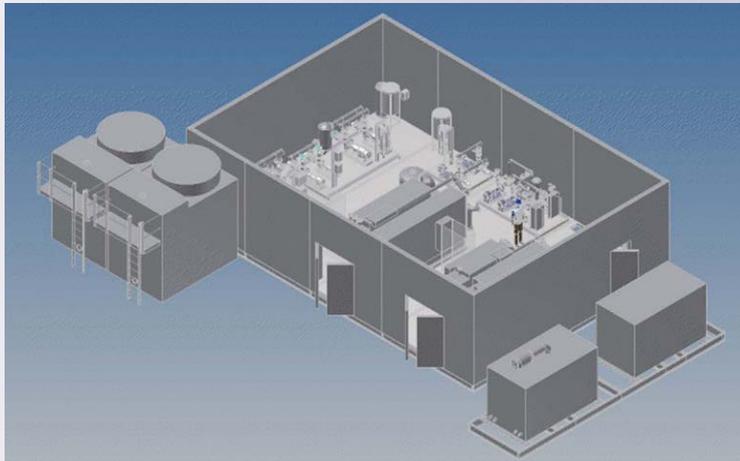


# MULTI-ENERGY Absorption in New Construction



Simplifies Operation & Increases Design Flexibility and Energy Efficiency  
Customer has done numerous outreach and education programs.

<https://www.youtube.com/watch?v=yaBhyjuZXyo>



## FROM SUPERFUND TO LEED PLATINUM



### WHAT IS LEED?

AN ACRONYM FOR LEADERSHIP IN ENERGY AND ENVIRONMENTAL DESIGN, LEED WAS DEVELOPED BY THE U.S. GREEN BUILDING COUNCIL TO PROVIDE BUILDING OWNERS AND OPERATORS WITH A CONCISE FRAMEWORK FOR IDENTIFYING AND IMPLEMENTING PRACTICAL AND MEASURABLE GREEN BUILDING DESIGN, CONSTRUCTION, OPERATIONS AND MAINTENANCE SOLUTIONS. FOR MORE INFORMATION VISIT USGBC.ORG.

RESTORED  
LANDSCAPE

RECYCLED  
WATER

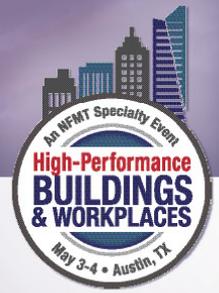
REALLY CLEAN  
REFRIGERATION

REUSED  
MATERIALS

RECLAIMED  
WOOD



Multi Energy Absorption applied in CHP can provide many benefits to project.



- Smaller Mechanical Equipment Room
- Lowers cost to recover heat (Less electrical AC Units)
- Simple sequence of operation & flexibility
- Increases Up-time via higher reliability with less moving parts i.e. points of failure
- Maximizes loading of chiller (10 to 100%)
- Decouples the design of CHP and HVAC
- LEED points “indirectly” by enabling CHP in building that might be difficult to do without thermal chillers ( i.e. heat sink in summer )

# CHP & Absorption Cooling in Renovation Project 1970 to 2016 upgrade with Sub Cooling Low Temp Refrigeration



# HIGH-PERFORMANCE BUILDINGS & WORKPLACES

MAY 3 - 4, 2016 | AUSTIN, TX

## Scoring LEED® Points with CHP

Presented by  
Charles Goff

Sr. Energy and Climate Consultant, ERG



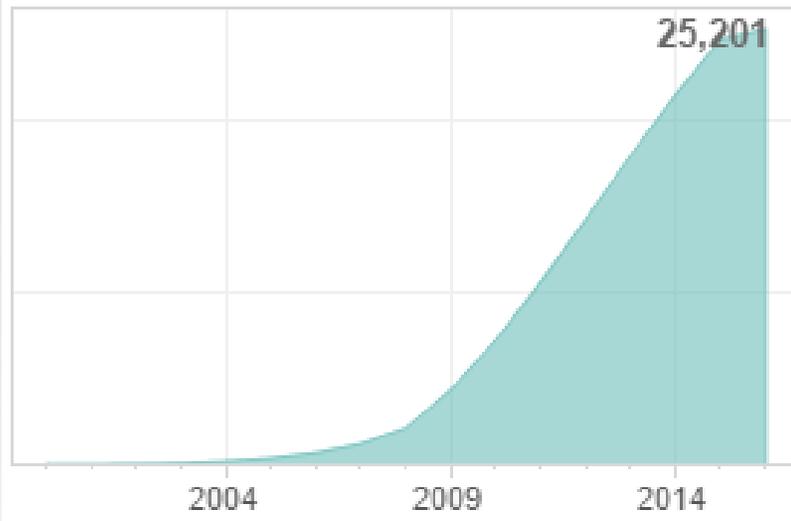
[nfmt.com/highperformance](http://nfmt.com/highperformance)

# Growth of LEED®



- LEED® green building program launched in 2000
- In the U.S. (as of March 2016):
  - More than 25,000 LEED®-certified commercial projects (3.2 billion GSF)
    - Annual certifications have grown from 40 in 2003 to more than 3,200 in 2015
  - More than 31,000 additional LEED®-registered commercial projects (4.9 billion GSF)

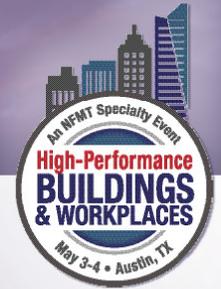
## Cumulative LEED® Certifications



## LEED® Projects by Building Type

Office/Mixed-Use: 36%  
Education: 14%  
Retail: 14%  
Public Assembly: 6%  
Residential: 5%  
Health Care: 4%  
Industrial Manufacturing: 3%  
Laboratory: 3%  
Military: 3%  
Public Order/Safety: 3%

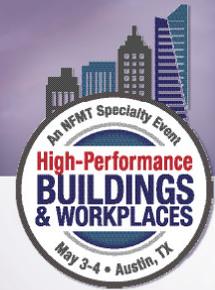
# LEED® v4 Certification Levels



Level	Points
Certified	40-49
Silver	50-59
Gold	60-79
Platinum	80-110

56 credits worth a potential 110 points

# Importance of Energy & Atmosphere: Optimize Energy Performance Credit



LEED® Version	Total # of Pts. Available	Total # of Pts. Needed to Earn LEED® Certified™*	Total # of Optimize Energy Performance Pts. Available
LEED® v2009	110	40	19
LEED® v4	110	40	18 (16 for Schools; 20 for Healthcare)

\*LEED® Certified™ is the lowest level that can be achieved under LEED®. LEED Silver® is earned with 50 points; LEED Gold® is earned with 60 points; LEED Platinum® is earned with 80 points.

➔ **Achieving all of the available Optimize Energy Performance credits would represent 47.5 percent (LEED® v2009) and 45 percent (LEED® v4) of the points needed to earn certification at the “LEED® Certified™” level.**

# CHP's Demonstrated Point Impact



Building	# of Apts.	CHP Type/Size	Pts. w/out CHP	Pts. w/CHP
1	620	130 kW MT	2	8
2	340	65 kW MT	2	10
3	500	200 kW MT	2	7
4	100	65 kW MT	1	7
5	185	65 kW MT	3	9
6	250	65 kW MT	1	7
7	230	200 kW MT	0*	9
8	40	75 kW Recip	0*	4

\* Would not meet Prerequisite w/out CHP

# CHP Plant “315 on A” – Boston, MA



- 225,000 square feet apartment building
- Aegen ThermoPower 75kW
- Provides domestic hot water heating (100%) and (80%) building heat
- Provides 28% of building’s electrical load
- LEED® Gold
- System earned 8 OEI points; CHP responsible for 4 of them

# Whole Foods Market – Brooklyn, NY



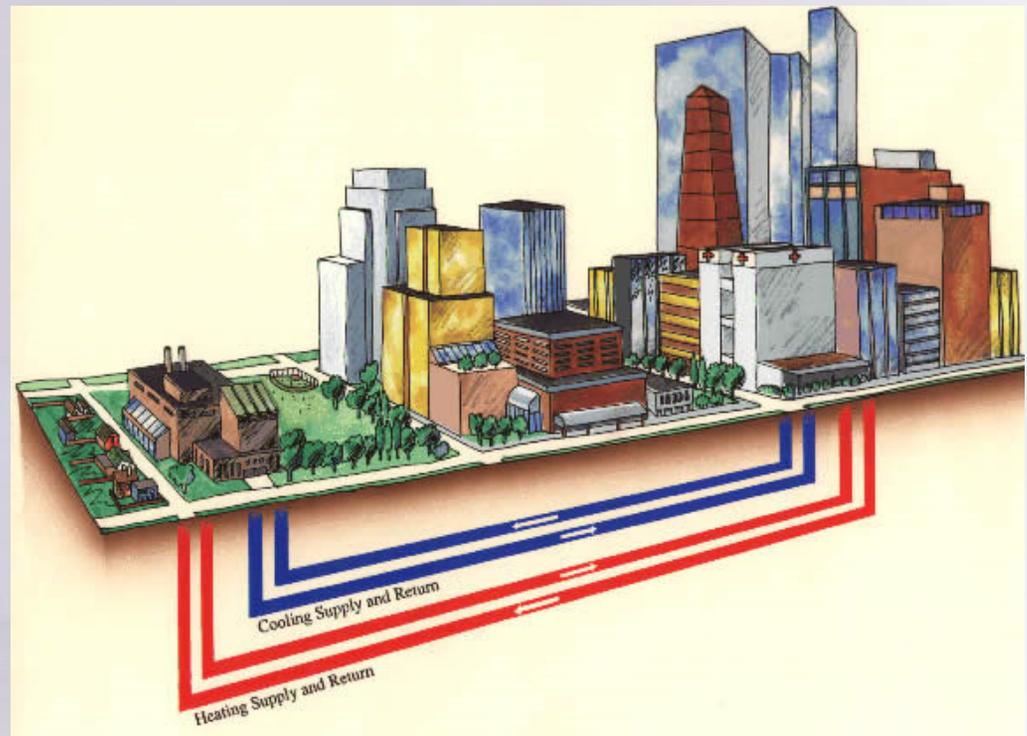
- 56,000 square feet
- Seeking LEED® Platinum
- Plans to achieve all 19 Optimize Energy Performance points
- CHP system
  - 157 kW plant with additional 250 kW backup generator
  - Offers the store black start and islanding capability (meaning it can continue to operate in the event of a grid outage).
- 100 and 168 ton Broad absorption chillers
  - No (synthetic) man made chemical refrigerants
  - CO2 direct expansion (transcritical) refrigeration system
  - Sub cooling provided by CHP for added efficiency
- 320 kw solar PV canopy array w/ rain water catchment for irrigation
- NYSERDA incentive participant



# CHP and District Energy



- Methodology in place to reward buildings connected to DES using efficient CHP.
  - Assigns portion of CHP input fuel to connected building based on proportion of thermal energy supplied to building.
- Projects shown to achieve as many as 9 additional points than would otherwise be achieved by not connecting to DES.



# CHPP LEED® Resources



- **Treatment of CHP in LEED® for Building Design and Construction: New Construction and Major Renovations**
  - Introduces CHP and its benefits to architects and engineers
  - Summarizes how CHP is treated under LEED® BD+C: New Construction
  - Available at: <https://www.epa.gov/chp/documents-and-tools>
- **LEED® CHP Calculator**
  - Estimates the energy cost savings and “Optimize Energy Performance” points a building meeting the requirements of ASHRAE 90.1 can achieve with CHP
  - Intended to be used at very early stages of building design so that CHP is given consideration as an energy option
  - Available at: <https://www.epa.gov/chp/documents-and-tools>
- **Treatment of District Energy CHP Outputs in LEED® for Building Design and Construction: New Construction and Major Renovations**
  - Summarizes how a building connected to a district energy system with CHP earns LEED® points
  - Coming soon...

# Key Takeaways



- LEED® rating system is big influencer of new construction
- CHP can have a dramatic LEED® point impact, whether is in stand-alone building or integrated into a district energy system
- CHP has lots of other benefits for buildings (e.g., cost, emissions, reliability)
- Think of CHP for your next project
- We're here to help!

# Contact Us



## Gary McNeil

U.S. Environmental Protection Agency

CHP Partnership

202-343-9173

[mcneil.gary@epa.gov](mailto:mcneil.gary@epa.gov)

## Charlie Goff

Eastern Research Group, Inc.

773-697-7702

[charlie.goff@erg.com](mailto:charlie.goff@erg.com)



[www.epa.gov/chp](http://www.epa.gov/chp)