Commercial Gas Heat Pump Webinar presented with Robur

Janet Sebahar
Nicor Gas Energy Efficiency Program
Trade Ally Manager

Nicor Gas | Energy Efficiency Program

Safety moment – Call before you dig

I'm planning to dig. How does 811 work?

1. Call 811 or go to Call811.com a few days before digging to request that buried utilities in your yard be marked.
2. Wait a few days for all utilities to respond to your request.
3. Confirm that all utilities have responded.
4. Respect the utility marks or flags.
5. Dig carefully around buried utilities.

811®

Call811.com

KNOW THE COLOR CODE

WHITE :	Proposed Excavation
PINK :	Temporary Survey Markings
RED :	Electric Power Lines, Cables, Conduit and Lighting Cables
YELLOW :	Gas, Oil, Steam, Petroleum or Gaseous Materials
ORANGE :	Communication, Alarm or Signal Lines, Cables or Conduit
BLUE:	Potable Water
PURPLE :	Reclaimed Water, Irrigation and Slurry Lines
GREEN:	Sewer and Drain Lines

811®

Know what's **below.**
Call before you dig.

Background

- Nicor Gas helps customers save energy and money
  - Energy Efficiency Program offerings
  - Commercial GHP's Incentive
    - $4/therm thru custom program

- Several manufacturers of commercial GHP's

- Nicor Gas is not promoting specific brand, but promoting this energy efficient technology

- Working with several organizations to help accelerate adoption
  - Non-profits
  - Engineering firms
  - Manufacturers
  - Other utilities

Benefits

- Gas Heat Pumps are:
  - Highly energy efficient- Up to 140% AFUE
  - Space heating and cooling and water heating
  - No combustion in the building
  - No Global Warming or Ozone Depletion Potential
  - And more…

- Robur Company
  - Started in 1950's
  - Commercial GHP's introduced in
    - Europe in 2004
    - North America in 2006
  - Over 100,000 GHP installations worldwide

Presenter

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BOILERSOURCE
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Cell: 847.770.0788

BOILERSOURCE

Going Beyond the Boilerplate

www.boilersource.com

ROBUR®

caring for the environment

Nicor Gas

Speaker:

Tony Ranallo
Principal
BOILERSOURCE

GAS-FIRED
ABSORPTION HEAT PUMPS & CHILLERS

www.roburcorp.com

Why are we here today?

- **Identify the Issues**
- Review the Technologies
- Meet the Manufacturer & Products
- Target Markets and Applications
- Making it Easy

Some Basic Definitions

- **Efficiency** - Efficiency is a percentage that measures the ratio of an appliance's energy output to its energy input. It's used to evaluate the device's performance, and to help determine fuel costs.

- **AFUE** - Stands for Annual Fuel Utilization Efficiency, and it's a metric that measures how efficiently a furnace or boiler converts fuel into heat for a home. It's calculated by comparing the amount of heat a furnace or boiler delivers during a heating season to the amount of fuel it uses to generate that heat. The result is expressed as a percentage, with a higher percentage indicating greater efficiency. For example, a furnace or boiler with an AFUE of 90% means that 90% of the energy used to run it is returned to the home as heat

- **COP** - The **Coefficient Of Performance** or COP of a heat pump, refrigerator or air conditioning system is a ratio of useful heating or cooling provided to work (energy) required. Higher COPs equate to higher efficiency, lower energy (power) consumption and thus lower operating costs. A COP of 1 = 100% and COP of 2 = 200%

- **SEER** - Stands for **Seasonal Energy Efficiency Ratio** or "Rating." This is the ratio of the cooling output of an air conditioner or heat pump over a typical cooling season, divided by the energy it uses in Watt-Hours. SEER2 is an updated version of this calculation that uses the new M1 blower testing procedure. SEER2 represents the new standard.

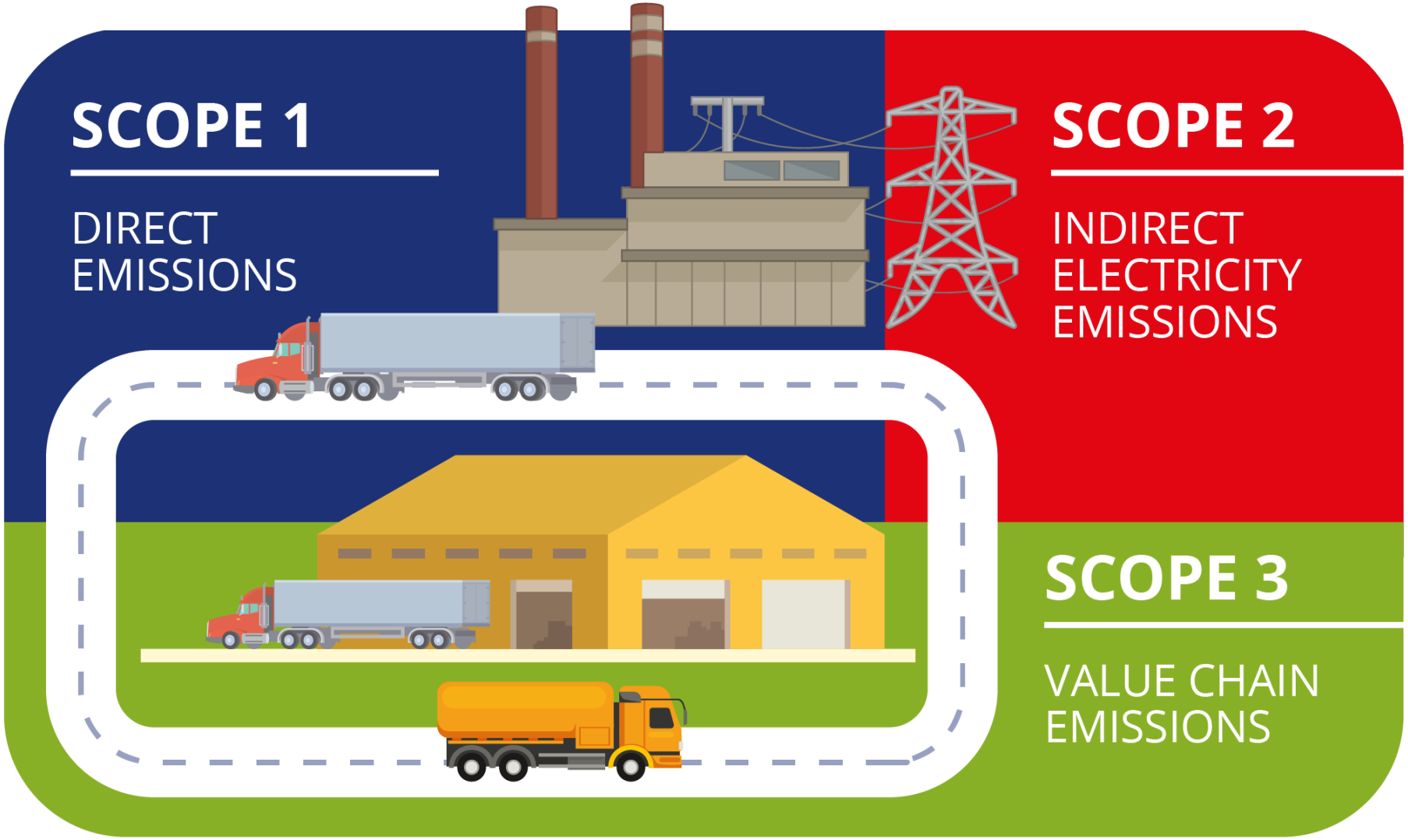
- **Degree Day** - A "degree day" is a unit of measure for recording how hot or how cold it has been over a 24-hour period. The number of degree days applied to any particular day of the week is determined by calculating the mean temperature for the day and then comparing the mean temperature to a base value of 65 degrees F.

- **Design-Day** - A period of time with maximum conditions that a HVAC system was designed to accommodate and maintain the desired indoor temperature and humidity.

- **Heat Pump** - Extracts heat from a source, such as the surrounding air, geothermal energy stored in the ground, or nearby sources of water or waste heat from a factory. It then amplifies and transfers the heat to where it is needed.

- **Condensing Boiler** - In short, it is a boiler designed to increase fuel efficiency and reduce wasted energy by reclaiming some of the energy that goes up the chimney. Water vapor is condensed, and the latent heat is recovered.

- **Tandem / Hybrid** – Tandem or Hybrid is the blending of two different technologies to increase performance and/or efficiency.



THE PATH TO DECARBONIZATION

THE 3 SCOPES OF CARBON EMISSIONS

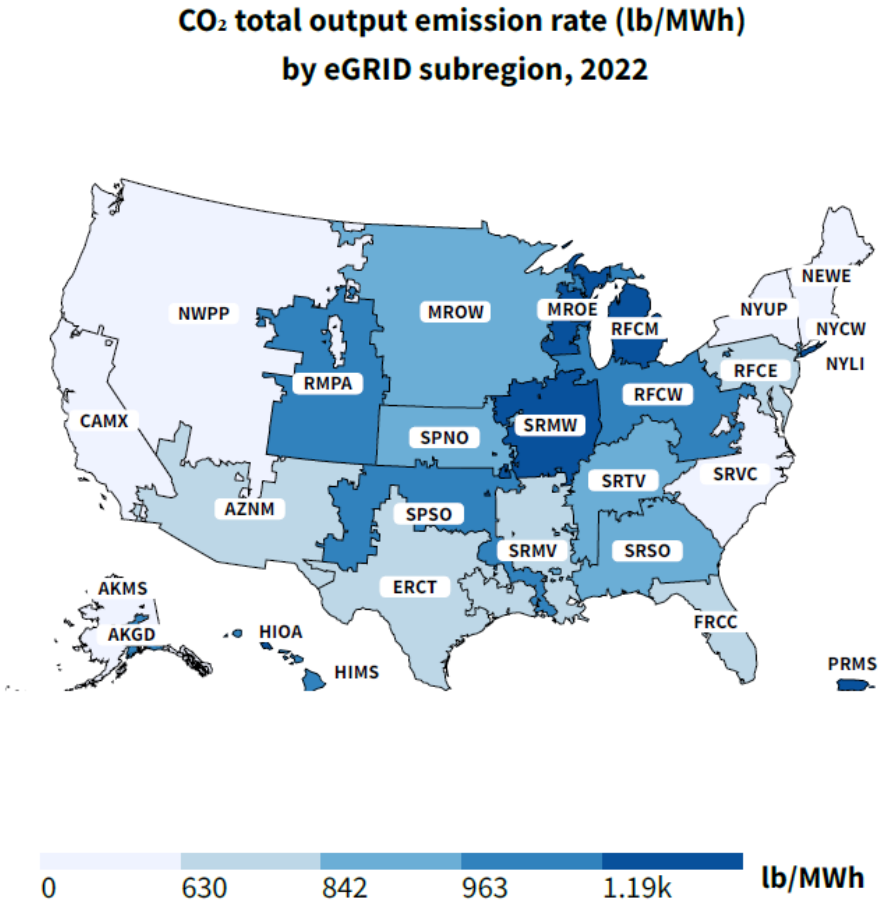
Scope 1 – Direct emissions from facilities and vehicles owned or controlled by a company, such as natural gas used to produce goods and fuel for company vehicles

Scope 2 – Indirect emissions resulting from the production of electricity, steam and heat purchased **from a utility or energy services company**

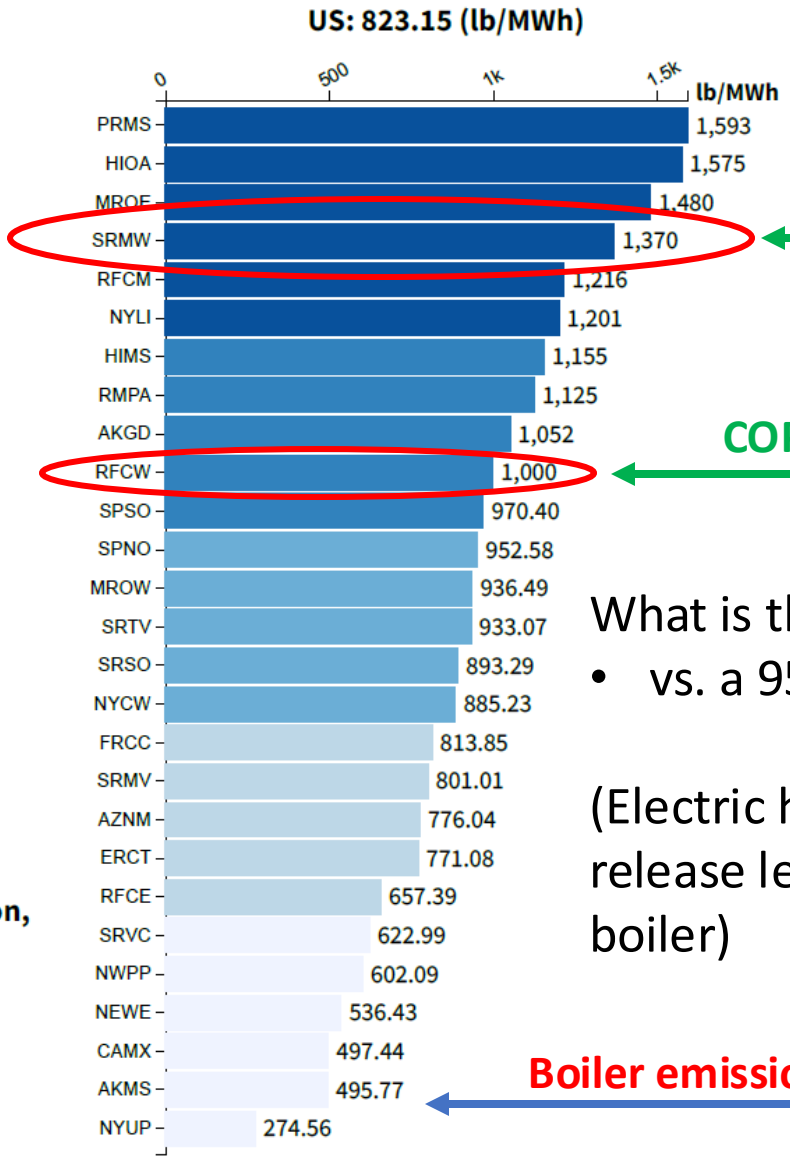
Scope 3 – Value Chain Emissions are all other indirect emissions associated with a company's activities, including business travel, purchased goods and how products are used by customers

Carbon Emissions Based on Grid Makeup

Electric heat pump versus 95% efficient boiler



https://www.epa.gov/egrid/data-explorer



COP = 3.26

COP = 2.38

What is the "Breakeven COP"…

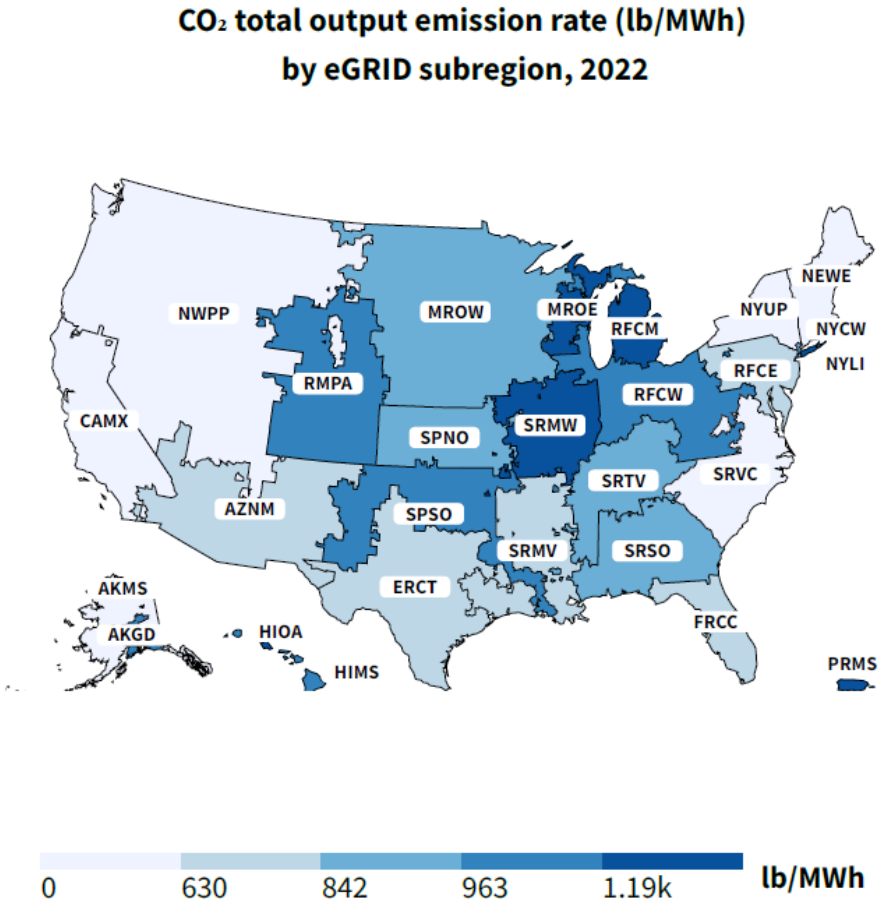
- vs. a 95% efficient boiler

(Electric heat pump minimum COP to release less GHG than a 95% efficient boiler)

Boiler emissions: 421 lbs. CO_2/MWh

Carbon Emissions Based on Grid Makeup

Electric heat pump versus Gas Absorption Heat Pump



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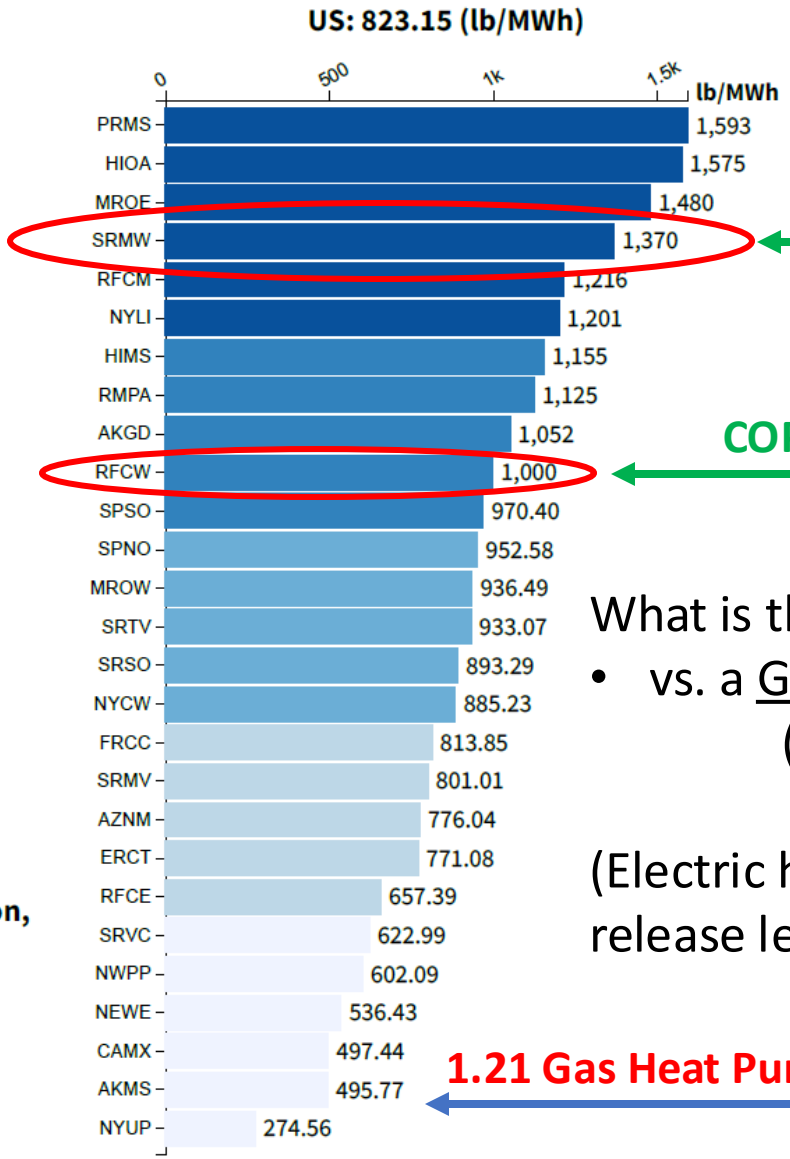


COP = 4.11

COP = 3.00

What is the "Breakeven COP"…

- vs. a Gas-absorption heat pump (COP = 1.21)

(Electric heat pump minimum COP to release less GHG than a GAHP)

1.21 Gas Heat Pump Emissions: 333 lbs. CO_2/MWh

Comparing Fuel Costs

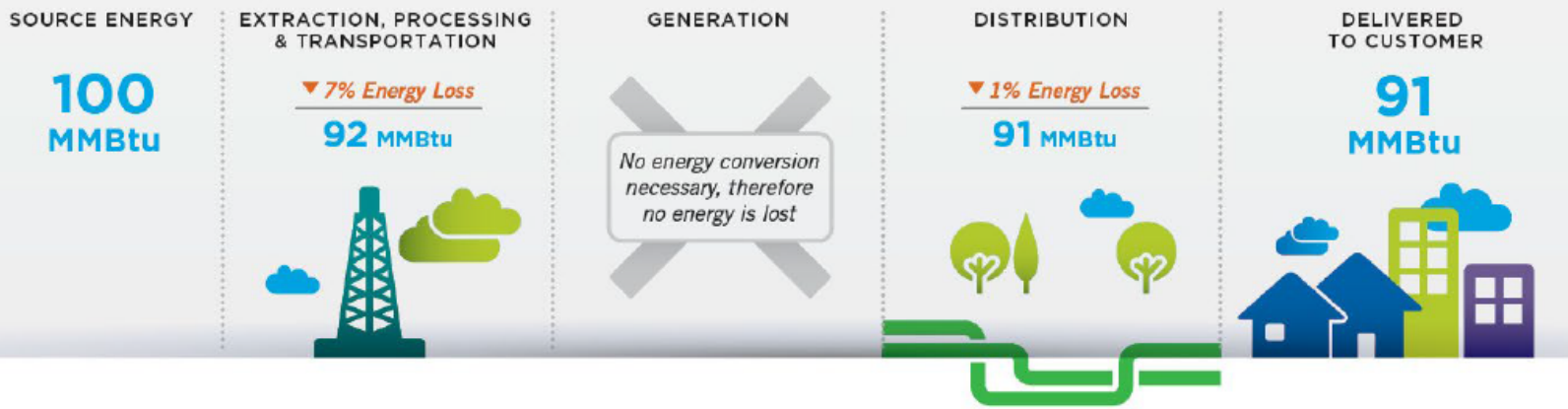
- $Minimum\ Average\ COP = \frac{\%\ Efficiency\ of\ Gas\ Unit * Cost\ of\ Electricity\left[\frac{\$}{kWh}\right] * 29.3\ [\frac{kWh}{Therm}]}{100 * Cost\ of\ Gas\ [\frac{\$}{Therm}]}$
- Here in Chicago:
  - Cost of Gas = $1.00/Therm
  - Cost of Electricity = $0.16/kWh
- What is the "Breakeven COP for an Electric Heat Pump" for costs?

Fuel Burning Nat Gas Efficiency	**82%**	**95%**	**120%**
Minimum Average COP for Electric HP	**3.84**	**4.45**	**5.63**

https://www.bls.gov/regions/midwest/news-release/averageenergyprices_chicago.htm

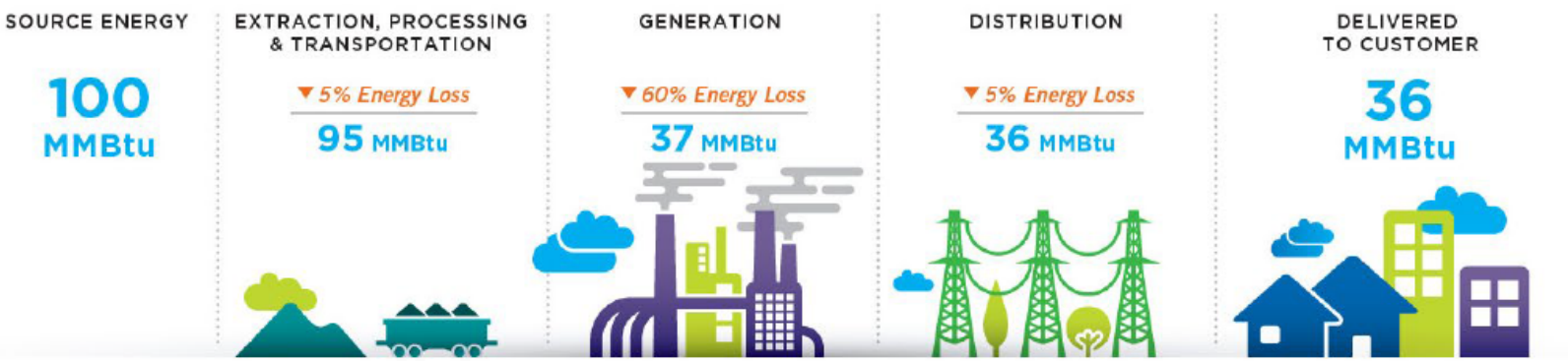
The natural gas delivery system is 91% efficient from production to customer.

Direct Use of Natural Gas



Converting to Electricity

Converting natural gas into electricity only maintains 36% of usable energy on the journey from production to customer.



https://playbook.aga.org/reliable

North American Gas Heat Pump Collaborative

TECHNOLOGY FOR A CLEANER FUTURE

APGA Research Foundation, representing:

- 150 Municipal Gas Utilities

Southern Company Gas, representing:

- Atlanta Gas Light
- Chattanooga Gas
- Nicor Gas
- Virginia Natural Gas

Northwest Energy Efficiency Alliance (NEEA), representing:

- Avista
- Cascade Natural Gas
- Energy Trust of Oregon
- Puget Sound Energy

- CenterPoint Energy
- Enbridge Gas
- FortisBC
- Intermountain Gas
- National Fuel
- New Jersey Natural Gas
- NW Natural
- Peoples Gas/North Shore Gas
- SoCalGas
- South Jersey Gas
- Spire

How Gas Heat Pumps Support Decarbonization

Sustainable

Gas heat pumps are extremely energy-efficient, offering fuel efficiency above 100%.

Affordable

Gas heat pumps are a win for consumers, significantly lowering energy bills.

Feasible

Gas heat pumps offer plug-and-play installation at relatively low cost.

Reliable

Gas heat pumps perform well in all climates, so consumers experience the same level of comfort.

North American
Gas Heat Pump Collaborative
TECHNOLOGY FOR A CLEANER FUTURE

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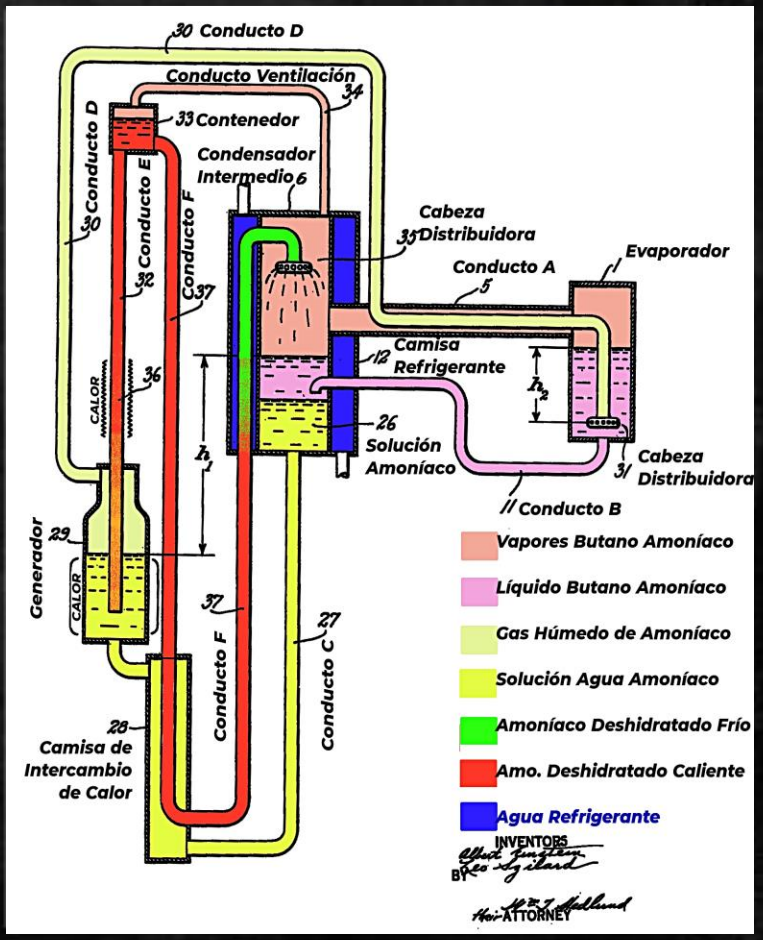
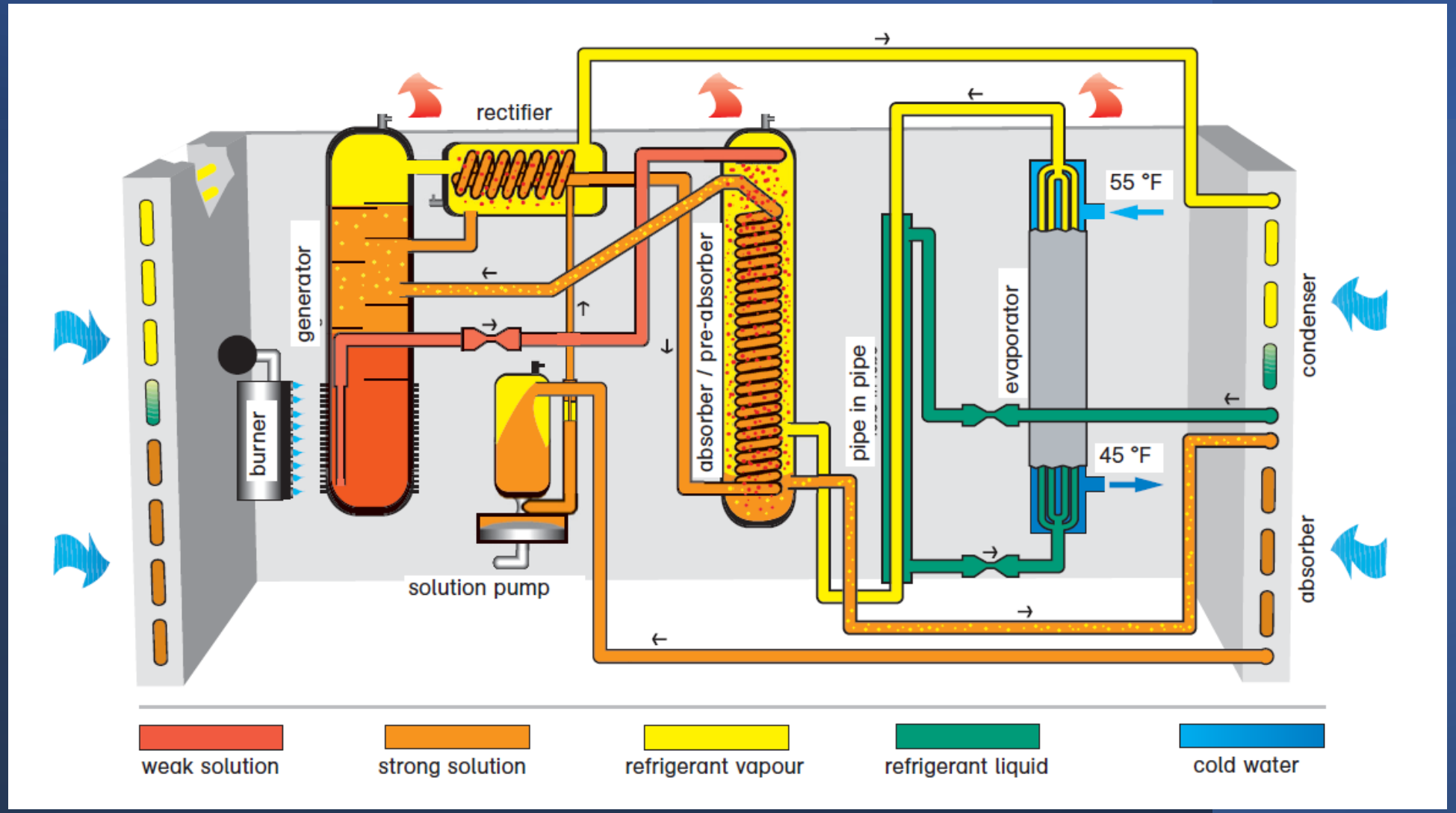
Einstein refrigerator

- The Einstein–Szilard or Einstein refrigerator is an absorption refrigerator which has no moving parts, operates at constant pressure, and requires only a heat source to operate. It was jointly invented in 1926 by Albert Einstein and his former student Leó Szilárd.
- The machine is a single pressure absorption refrigerator, similar in design to a gas absorption refrigerator. The refrigeration cycle uses ammonia pressure equalizing fluid, butane refrigerant, and water absorbing fluid, has no moving parts, and does not require electricity to operate, needing only a heat source, e.g. a small gas burner or electric heating element or even solar energy.
- On the cold side of a conventional refrigerator, a refrigerant evaporates at a temperature dependent pressure, $P_{ref}(T_{low})$. *Evaporation absorbs heat from whatever is being cooled, and the vapor flows to a compressor. In an* equivalent Einstein refrigerator, the refrigerant liquid evaporates at what is now a *partial pressure* $P_{ref}(T_{low})$ mixing with a flow of ammonia vapor to form a gas with a total pressure near the system pressure: $P_{ref} + P_{amn} = P_{sys}$. *The mixture flows, not to a pump, but to an ammonia absorber.*



Absorption Cycle of Operation
Description



The Truly Green Choice
Natural Refrigerant

- No CFC's, HFC's or HCFC's which deplete the Earth's Ozone and contribute to Green House Gas Emissions
- R-717 (Ammonia) Ozone Depletion Potential = 0
- R-717 (Ammonia) Global Warming Potential = 0
- No Refrigerant Phase-Out Date
- A single unit contains 15 – 17 lbs of ammonia
  - EPA allows up to 100 lbs to be discharged without concern
  - Sealed refrigerant system does not require maintenance

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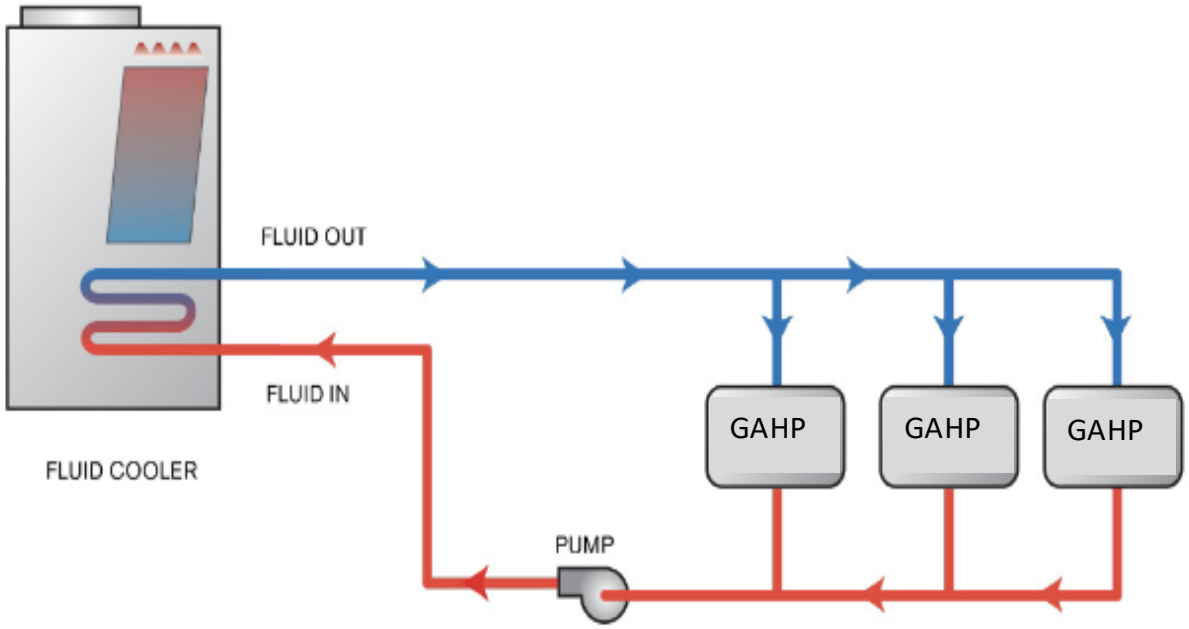
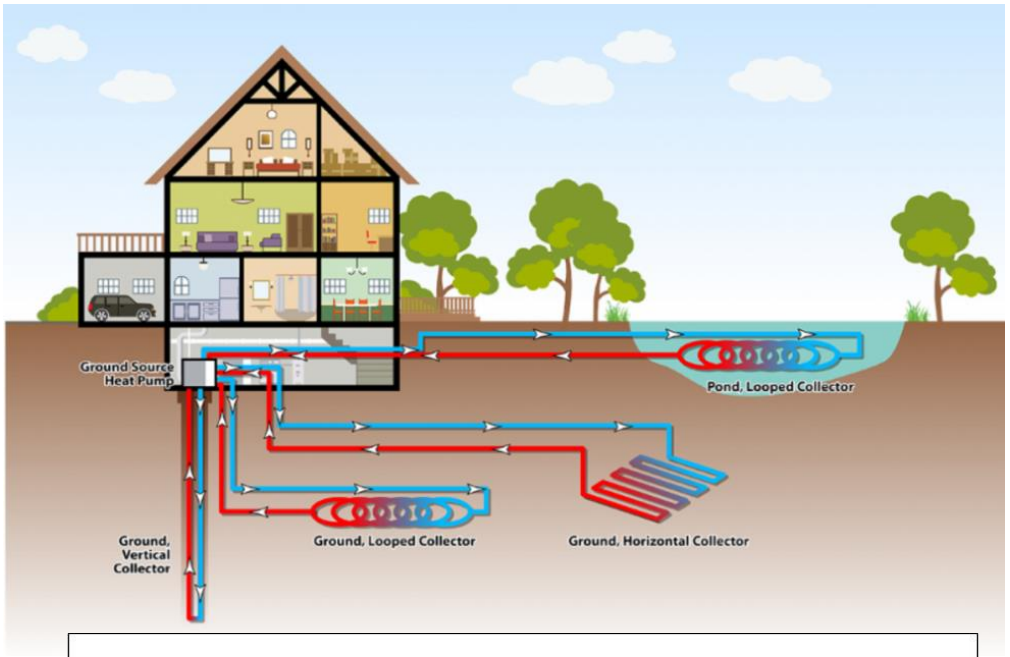
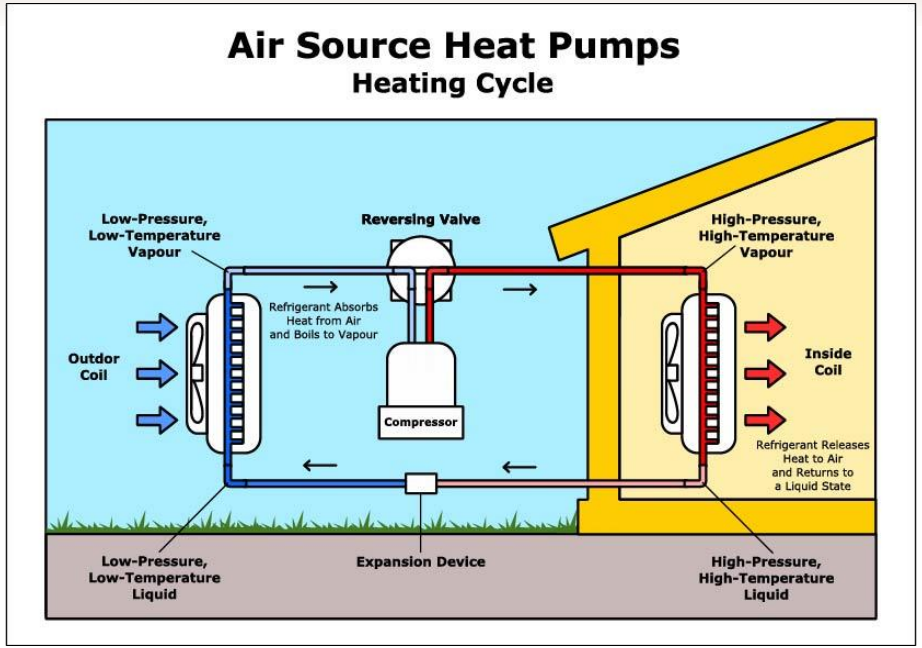
FLUID COOLER AS AIR SOURCE FOR A WATER SOURCE GAS ABSORPTION HEAT PUMP



GROUND SOURCE FOR A WATER SOURCE GAS ABSORPTION HEAT PUMP





GAS HEAT PUMPS AND RENEWABLE ENERGIES

GAHP units put together all the advantages of the two most common heating technologies

CONDENSING BOILER
ADVANTAGES
- Natural gas fired
- DHW supply
- Only 1/10 of electricity consumption in comparison to electrical heat pumps

ELECTRIC HEAT PUMP
ADVANTAGES
- Use of renewable energies
- Cooling supply
- No need of mechanical room

CONDENSING BOILER MINUS
- No renewable energy
- Efficiency lower than 100%
- Need for a boiler room

ELECTRIC HEAT PUMP MINUS
- High electricity consumption
- Use of fluids harmful for the environment
- Low efficiency at low outdoor temperatures

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2022 CONNECTED HEATING & COOLING EQUIPMENT

ROBUR CORPERATION

GAHP A Gas Absorption Heat Pump

JUDGE'S REMARKS:

"The GAHP A Gas Heat Pump is an innovative design and one of the first of its kind. The judges appreciate the highly efficient gas heat pump technology and see this product as an important decarbonization bridge solution."

2022 WINNER INTEGRATED HOME COMPETITION

Why are we here today?

- Identify the Issues
- Review the Technologies
- **Meet the Manufacturer & Products**
- Target Markets and Applications
- Making it Easy

Born in the US
from a big idea -
to make history

Welcome to Robur Corporation

- Turning talent and passion into useful objects for people and their communities since 1956.

- ROBUR Corporation was founded in 1991 and is the sister company to Robur, a leading manufacturer of Advanced Heating and Cooling Technologies in Italy since 1956.

- This led ROBUR to create GAHPs (Gas Absorption Heat Pumps) using natural gas and renewable energy, based on the studies of some of the brightest minds of the last century: Albert Einstein and Leo Szilard.

- They were made and developed in Evansville, Indiana, USA.

- In 2021 Robur celebrated their 30th year in business.

Gas-Fired Absorption Heat Pumps & Chillers

- Highest Gas Heating Efficiency Available –
  Exceeding 100% (COP greater than 1.0)

- Modular and Redundant Design –
  No System Downtime

- Up to 80% reduction in electrical requirements –
  Single Phase Operation

- Natural Refrigerant -
  Global Warming Potential = 0
  Ozone Depletion Potential = 0

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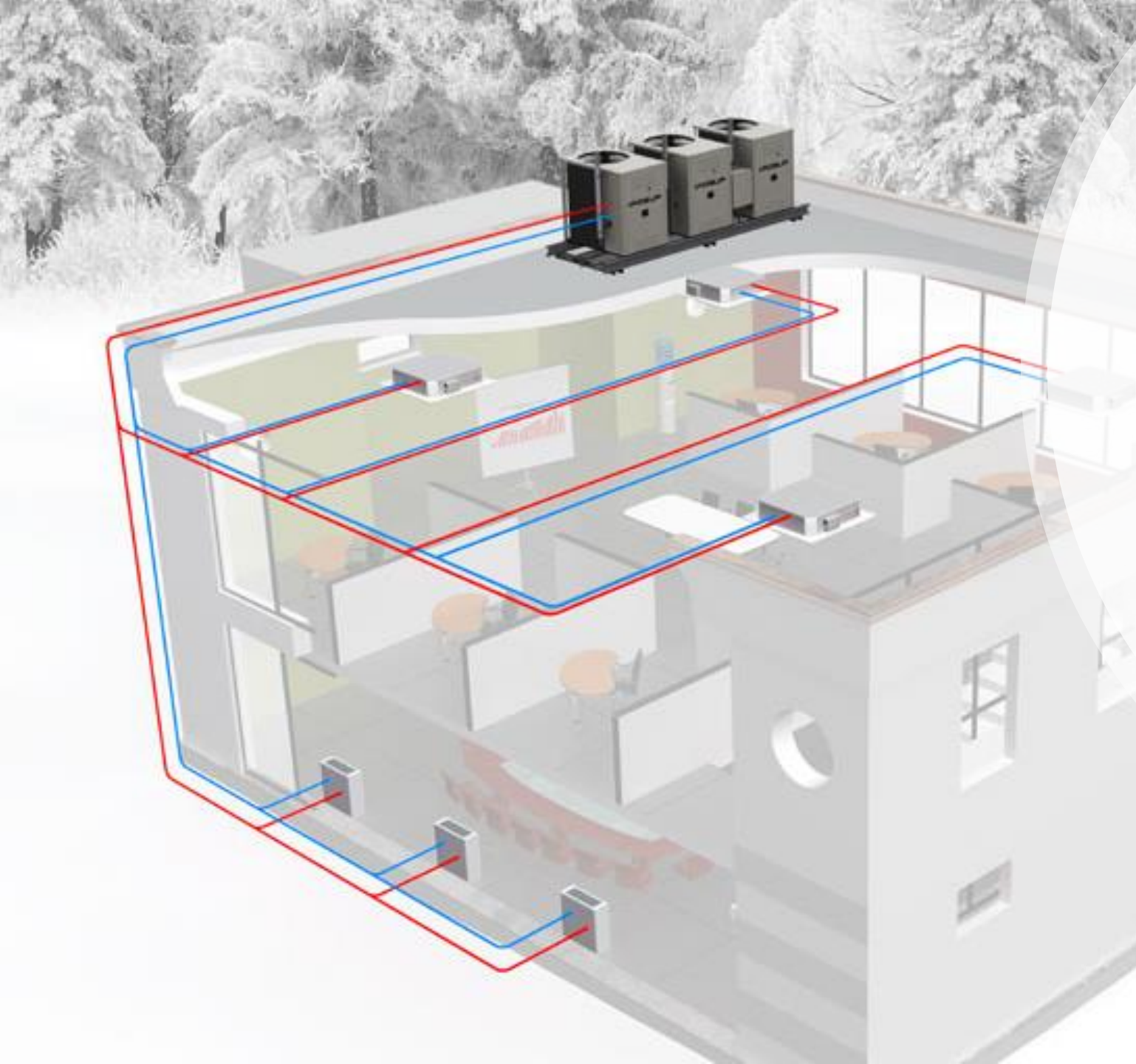

Robur manufactures air and water sourced chilled and hot water production systems using natural or propane gas as the main energy source.

Each module provides 5T cooling and/or 120,000 Btu heating.

Individual modules can be connected together to match building capacities.

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Proven Technology

Currently Gas Heat Pumps are viewed as an emerging technology.

Full production and commercialized units with all the necessary approvals have been available to North America since **2006**.

Many efficiency mandates set for the future can actually be achieved today.

Over 100,000 Robur water-ammonia absorption Chillers and Heat Pumps installations world-wide.

All equipment is in Stock in the U.S. – Evansville, IN

HEAT PUMPS

GAHP A Air-Source Heat Pump (Heating Only)

GAHP AR Air-Source Reversible Heat Pump (Heating, Cooling and Supplemental DHW)

GAHP W LB Water Source Heat Pump Geothermal Applications (Heating, Cooling and Supplemental DHW)

GAHP W Water Source Heat Pump (Simultaneous Heating, Cooling and DHW production)

CHILLERS

ACF ST for residential/commercial/industrial cooling systems with chilled water down to 37.4 °F.

ACF TK for heavy duty use, for process systems and applications with chilled water down to 37.4 °F, for operation down to 10.4°F ambient temperature.

ACF HT for very hot climates, for residential/commercial/industrial cooling systems with chilled water down to 41 °F, with outside air up to 131 °F.

ACF LB for cooling systems with chilled water down to 14 °F, for operation down to 10.4°F ambient

ACF HR for residential/commercial/industrial cooling systems with chilled water down to 37.4 °F., plus free recovered hot water up to 176 °F (e.g. supplemental DHW production).

Individual Modules can be field installed to meet system capacity

Also Available as a Factory Assembled Modular Link


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CHILLERS

ACF60 Absorption Chiller Series

ACF60 ST - STANDARD

5 Tons

Ambient Operating Temps: 120°F/49°C to 32°F/0°C

Min. Outlet Water Temp 37.4°F/3°C

ACF 60 TK - LOW AMBIENT

5 Tons

Ambient Operating Temps:120°F/49°C to 10.4°F/-12°C

Min. Outlet Water Temp 37.4°F/3°C

ACF60 HT - HIGH AMBIENT

5 Tons

Ambient Operating Temperatures:

131°F/55°C to 32°F/0°C

Min. Outlet Water Temp 41°F/5°C

ACF60 LB
Low Brine Chiller

Used for Dehumidification and Medium Temperature Refrigeration

Capacity: 4 Tons

Ambient Operating Temps: 120°F/49°C to 10.4°F/-12°C

Outlet Water Temps Down to 14°F/-10°C

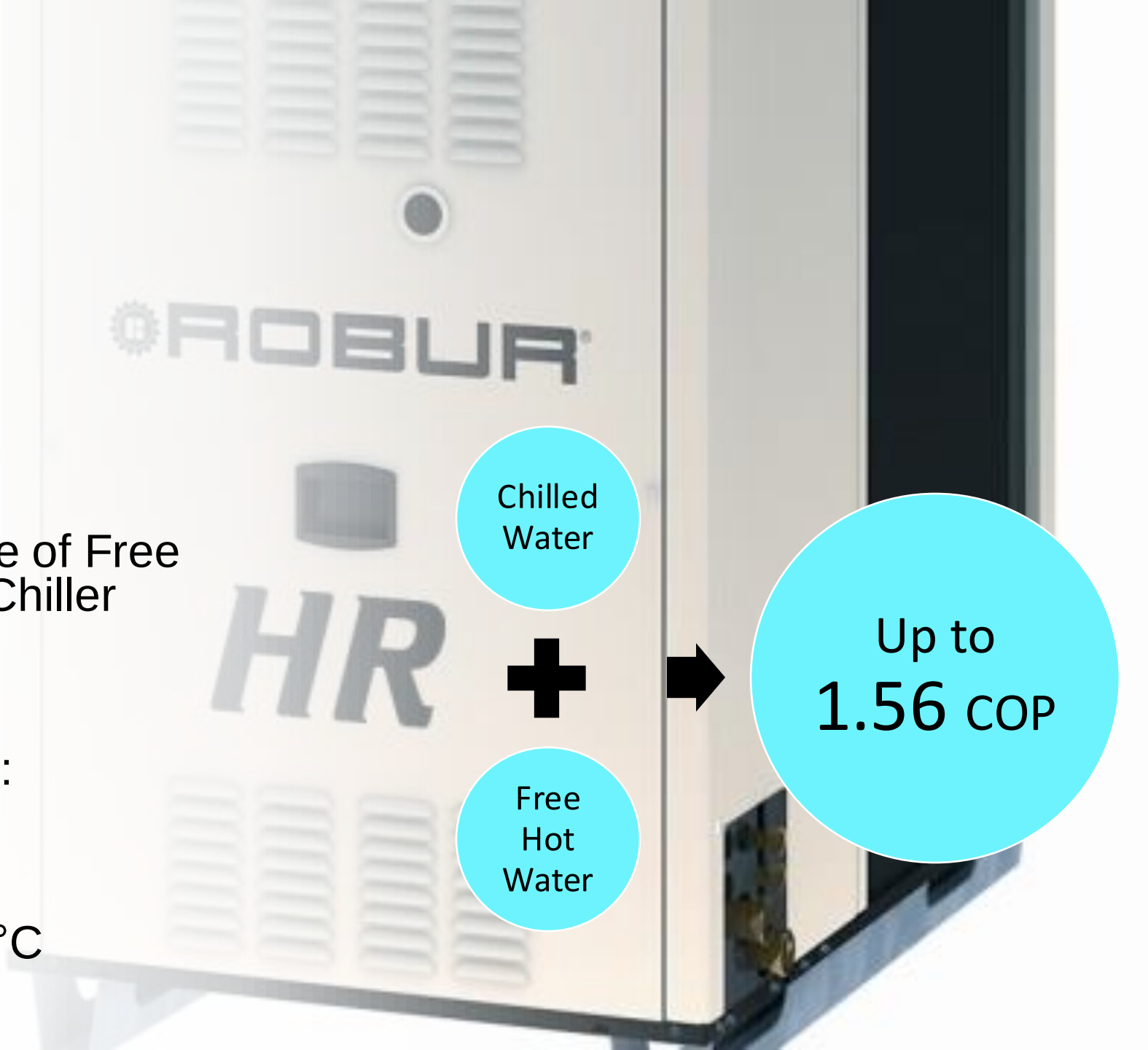
ACF60HR
Heat Recovery Chiller

5 Tons w/ Heat Recovery

Any Application Requiring the Use of Free Supplemental Hot Water During Chiller Operation

Ambient Operating Temperatures:
120°F/49°C to 32°F/0°C

Min. Outlet Water Temp 37.4°F/3°C

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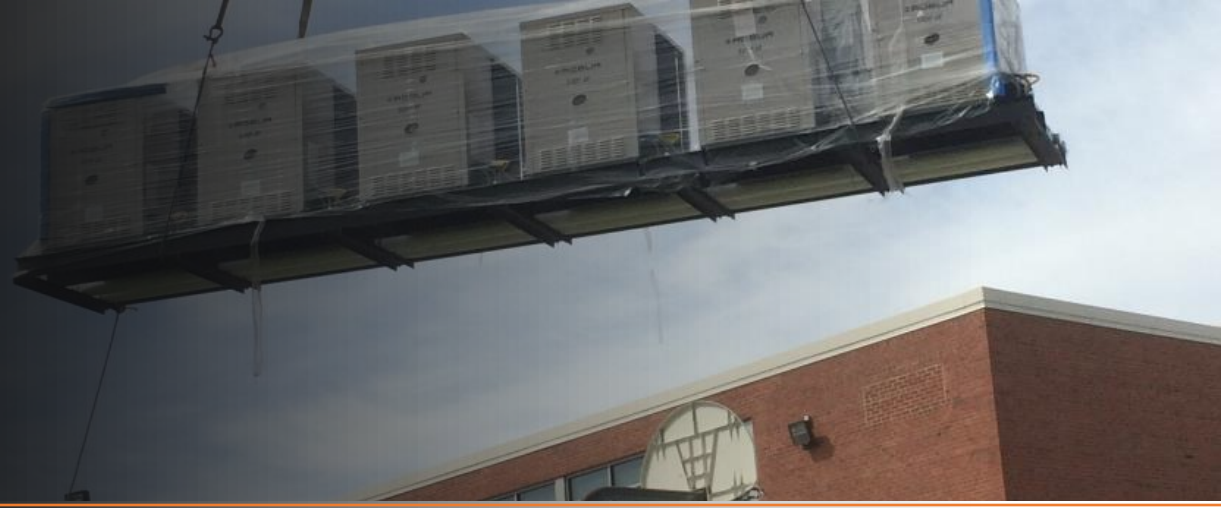
MODULAR LINKS

Factory Built Modular Links



- Provided with single point water, gas, and electrical connections
- Mix and Match Module types to provide a complete system
- Manifold multiple links for even larger capacities
- Up to 6 Modules per “Link”
- Customizable/ built to order

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RT120 102 W x 49 D x 54 H

RT180 153 W x 49 D x 54 H

RT240 204 W x 49 D x 54 H

RT300 255 W x 49 D x 54 H

RT360 306 W x 49 D x 54 H

150T Cooling
3.6 mBTU Heating
27 kW

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30T Cooling
720,000 BTU Heating
5.4 kW

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Department of Sanitation

New York City

(90) ACF TK

450T- Comfort Cooling

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Apartment Complex
Michigan

(18) GAHP AR – Reversible Heat Pumps

(4) ACF60 HR – Heat Recovery Chillers

2.2 MMBH- Comfort Heating

110T – Comfort Cooling

348 MBH – Free Heat Recovery

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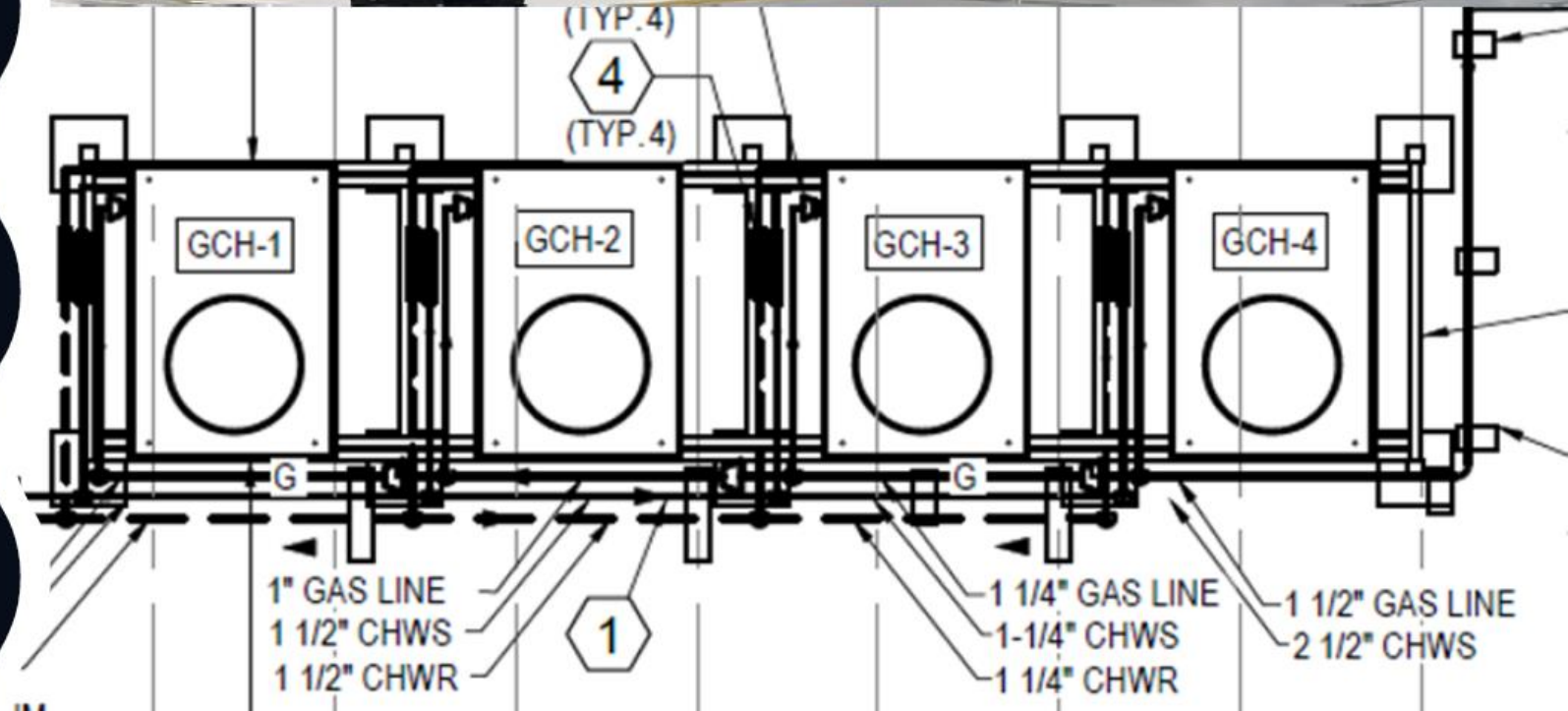
911 Call Center
Server Rooms

Indiana, PA

20 T

(4) ACF TK



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BICO LTD.

Ice Cream Manufacturing

Bridgetown Barbados

(6) ACF60 HR & (3) ACF60 LB

Comfort Cooling with Heat Recovery & Refrigeration

ACCESSORIES & CONTROLS

Control Options

Robur DDC Control

RB200
Controls 3rd party boilers or chillers

Roburberry Cloud Capability

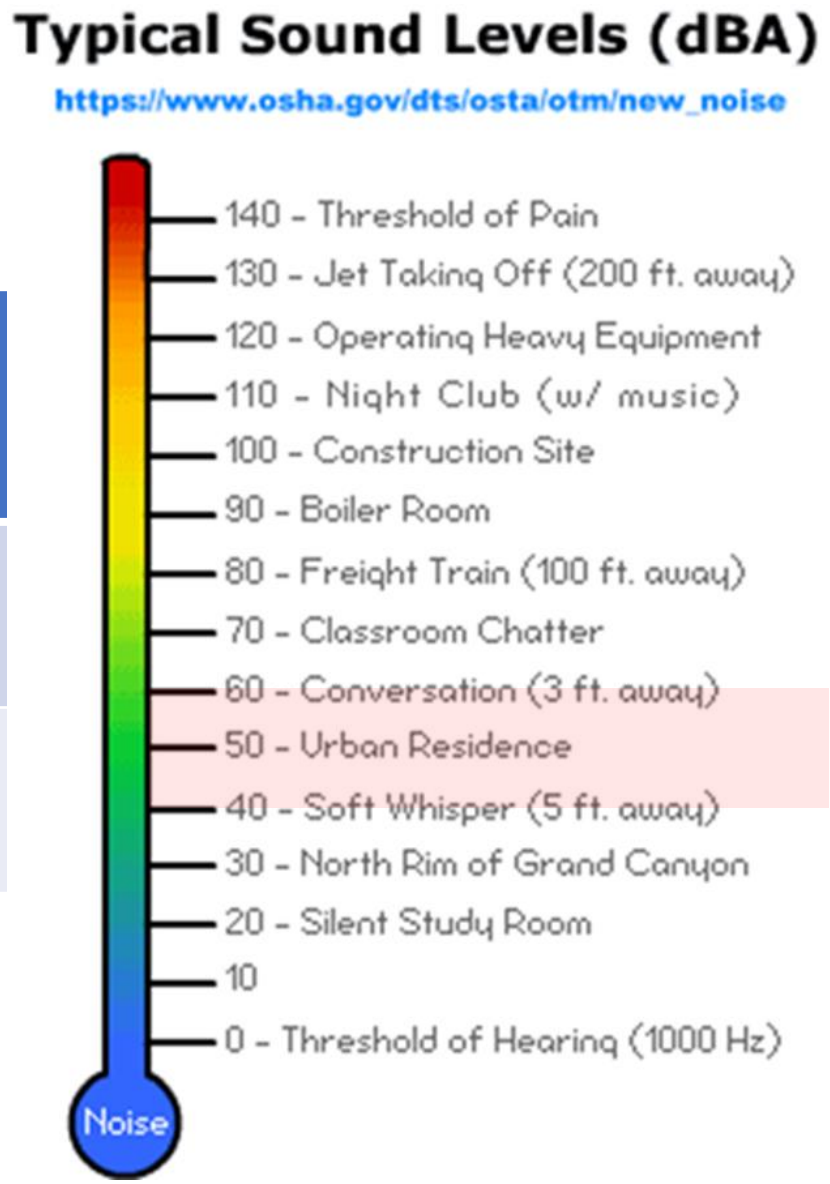
Robur Smartool Android App

Google Play

FAQ - Aspects to Consider

- Natural or LP Gas
- Low pressure Gas – Min. 5” W.C & Max 14” W.C.
- Power supply is only 208-230 single phase – no 3 phase
- Closed Hydronic loop – No potable water – Use HX
- Nominal flow rate of each unit is approx. 12 GPM – Check module spec
- System Flow rate will increase by multiple of each unit flow rate when combined in common hydronic loop. Pressure drop will not.
- Unit ΔT is approx. 9-10°F for cooling units and 18-20°F for heating units at nominal flow rate.
- Unit ΔT will increase with lower than nominal flow rate and decrease with higher.
- Water flow required at time of unit enabling and through cycle down period of 10 minutes – Use Robur N.O. contacts for pump control.

TECHNICAL DATA		GAHP & ACF60
Sound Pressure Level 1 2	dB(A) Max dB(A) Min	56 46
With Addition of Sound Attenuation	dB(A) Max dB(A) Min	53 44



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Drastic Reduction in Electrical Power Consumption

Advantages of Robur System

- Reduces buildings' HVAC systems' electrical demand by 80% compared to electric cooling & heat pumps
- Single Phase Power reducing electrical infrastructure and associated costs
- No additional building upgrades required
- Eliminate or reduce electric demand charges
- Smaller generator requirements for applications requiring off grid power or emergency cooling

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Modularity / Redundancy

Wide range of Systems available

Redundancy with modular design

Multiple Links available

Application Flexibility

Only use units required to meet building loads

Staging capability adapts to changing load conditions

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Reliability / Durability

- Long Life
- No compressors or engines
- Low mechanical wear and tear
- Less moving parts
- Low maintenance requirements
- Completely sealed, environmentally safe refrigerant circuit or loop
  - no need to periodically recharge refrigerant

Maintenance

Annually

- Check the alarms log of the DDC for recorded warnings/ errors - address as necessary
- Inspect & clean air source coil
- Measure fan clearance – 1.25 inches from top of unit
- Visually inspect hydraulic pump belt for wear
- Check flue gas passage – clean as necessary
- Confirm gas input pressure to gas valve and outlet pressure to burner

Every 12,000 Hours of Operation (Approx every 3 years)

Visually inspect: Burner, Ignitor, Flame Sensor, & Generator for deterioration and cleanliness – Clean and change as necessary

Every 25,000 Hours of Operation (Approx every 6 years)

Replace Hydraulic pump belt, ignitor, & flame sensor as preventative measure if they have not yet been replaced

It is not recommended to access the sealed refrigerant circuit under any conditions other than for needed sealed system diagnoses. Contact the Robur Technical Support or your local Robur representative for any additional information or recommendations.

Why are we here today?

- Identify the Issues
- Review the Technologies
- Meet the Manufacturer & Products
- **Target Markets and Applications**
- Making it Easy

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Don’t reinvent the wheel

Robur GAHP’s…

- Installs like outdoor boiler
- Typical Hydronic System
- Multiple Zones
- Outdoor Installations
  - Does not need to be in the mechanical room
- Heat Emitter Flexibility
- Component Flexibility

TARGET APPLICATIONS

- Limited Electrical Capacity
- Multi-Family
- Assisted Living
- Student Housing / Dormitories
- Senior Living
- Healthcare Facilities
- Education
- Hospitality
- Restaurants
- Retail
- Data Center
- Mission Critical
- Satellite Buildings
- Grow Rooms
- Commercial Properties
- Office Buildings
- Churches
- Historical Buildings
- Custom Residential

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Target DHW Applications

Multi-Family - Low to Mid Rise

- ✓Apartments
- ✓Condominiums
- ✓Mixed-Use
- ✓Senior Housing
- ✓Student Housing
- ✓Affordable & Subsidized Housing

Hospitality

- ✓Restaurants
- ✓Hotels

Groceries

GAHP A

Coefficient of Performance Chart

COP – HEATING MODE CAPACITY (BTU/h)

Nominal value in bold type

EXTERNAL AMBIENT TEMPERATURE	OUTLET HOT WATER TEMPERATURE °F / °C			
	86°F / 30°C	113°F / 45°C	122°F / 50°C	140°F / 60°C
-20°F / -29°C	1.02 COP 97,600 BTU/h	.93 COP 88,700 BTU/h	.89 COP 85,000 BTU/h	.88 COP 83,600 BTU/h
-13°F / -25°C	1.03 COP 98,600 BTU/h	.94 COP 89,700 BTU/h	.90 COP 86,000 BTU/h	.89 COP 84,600 BTU/h
-4°F / -20°C	1.04 COP 99,600 BTU/h	.95 COP 90,800 BTU/h	.91 COP 87,000 BTU/h	.90 COP 85,600 BTU/h
5°F / -15°C	1.07 COP 102,000 BTU/h	.98 COP 93,500 BTU/h	.94 COP 90,100 BTU/h	.93 COP 88,400 BTU/h
14°F / -10°C	1.21 COP 111,600 BTU/h	1.07 COP 102,400 BTU/h	1.00 COP 95,900 BTU/h	.97 COP 92,800 BTU/h
19.4°F / -7°C	1.23 COP 117,000 BTU/h	1.13 COP 108,200 BTU/h	1.05 COP 100,000 BTU/h	1.01 COP 96,200 BTU/h
35.6°F / 2°C	1.33 COP 126,900 BTU/h	1.28 COP 122,200 BTU/h	1.19 COP 114,000 BTU/h	1.11 COP 105,800 BTU/h
44.6°F / 7°C	1.39 COP 132,400 BTU/h	1.37 COP 130,700 BTU/h	**1.29 COP** **123,500 BTU/h**	1.21 COP 115,300 BTU/h
50°F / 10°C	1.41 COP 134,800 BTU/h	1.41 COP 134,400 BTU/h	1.34 COP 128,000 BTU/h	1.26 COP 120,100 BTU/h
59°F / 15°C	1.43 COP 136,500 BTU/h	1.43 COP 136,500 BTU/h	1.38 COP 132,000 BTU/h	1.29 COP 123,500 BTU/h
66°F / 20°C	1.45 COP 138,200 BTU/h	1.45 COP 138,200 BTU/h	1.40 COP 133,800 BTU/h	1.33 COP 127,300 BTU/h
77°F / 25°C	1.46 COP 139,200 BTU/h	1.46 COP 139,200 BTU/h	1.41 COP 134,800 BTU/h	1.34 COP 128,000 BTU/h

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IDEAL SITES FOR GAS HEAT PUMPS

- Look for lower water temperature applications like:
  - Domestic Hot Water Preheating
  - Radiant In-floor Building Comfort Heating
  - Air Systems using Hot Water and/or Chilled Water
    - If hot water requirement is above 140°F may need supplemental heating from a boiler
  - Snow Melting
  - Pool Heating
  - Any other heating application that requires 140°F or lower
- Look for sites that have limited electrical power
- Look for centralized gas meter (Master Meter)
- Look for centralized building comfort heating or domestic water heating
- Good location and adequate space for the equipment:
  - Air Source: Outdoor location (ground level or roof top)
  - Water Source: Indoor but must be vented
    - Use a fluid cooler for air source or geothermal
- Tandem or Hybrid systems are the key
- Remember, with outdoor reset lower temps are needed during the shoulder months

POOR SITES FOR GAS HEAT PUMPS

- High water temperatures above 140°F requirements without outdoor reset, are not the best option.
- Not applicable to DIRECT steam systems, only water
  - Look for Domestic Hot Water Preheating or other loads
- Don’t forget about derating at lower ambient temperatures (see COP vs Outdoor Air Temp Chart)
- Be aware of the venting requirements of the units and do not locate near operable windows. Follow NFGC venting guidelines
- Avoid buildings with individual unit gas meters
- Avoid buildings with individual unit heating or domestic water heating systems

Some Good Reference Literature

Gas Absorption Heat Pumps
Best Practices Guide

Version 1 | May 16, 2023

Developed by:
CLEAResult®

Developed for:
FORTIS BC™

[Gas Absorption Heat Pumps Best Practices Guide - CLEAResult for Fortis BC.pdf]

Gas Fired Absorption Heat Pumps

Main advantages

[Gas fired Absorption Heat Pumps - Main Advantages.pdf]

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INSTALLATION GUIDELINES & CHECKLIST

A review of this information is essential before starting the installation of Robur Air to Water Heating and/or cooling unit. Failure to follow these guidelines could result in an improper application and poor performance of the system.

The following is a condensed version of key elements that are included in the unit's manual. Always follow the procedures outlined in the *INSTALLATION* ▪ *START-UP* ▪ *ADJUSTMENT* ▪ *MAINTENANCE* manual.

SAFETY – Read all safety information prior to starting the installation.

[Installation, use and maintenance manual.pdf]

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Absorption Cycle of Operation

Introduction

[https://www.robur.com/en-us/media/inside-the-thermodynamic-cycle]

Tandem / Hybrid System Configuration

Robur Heat Pumps + Boiler

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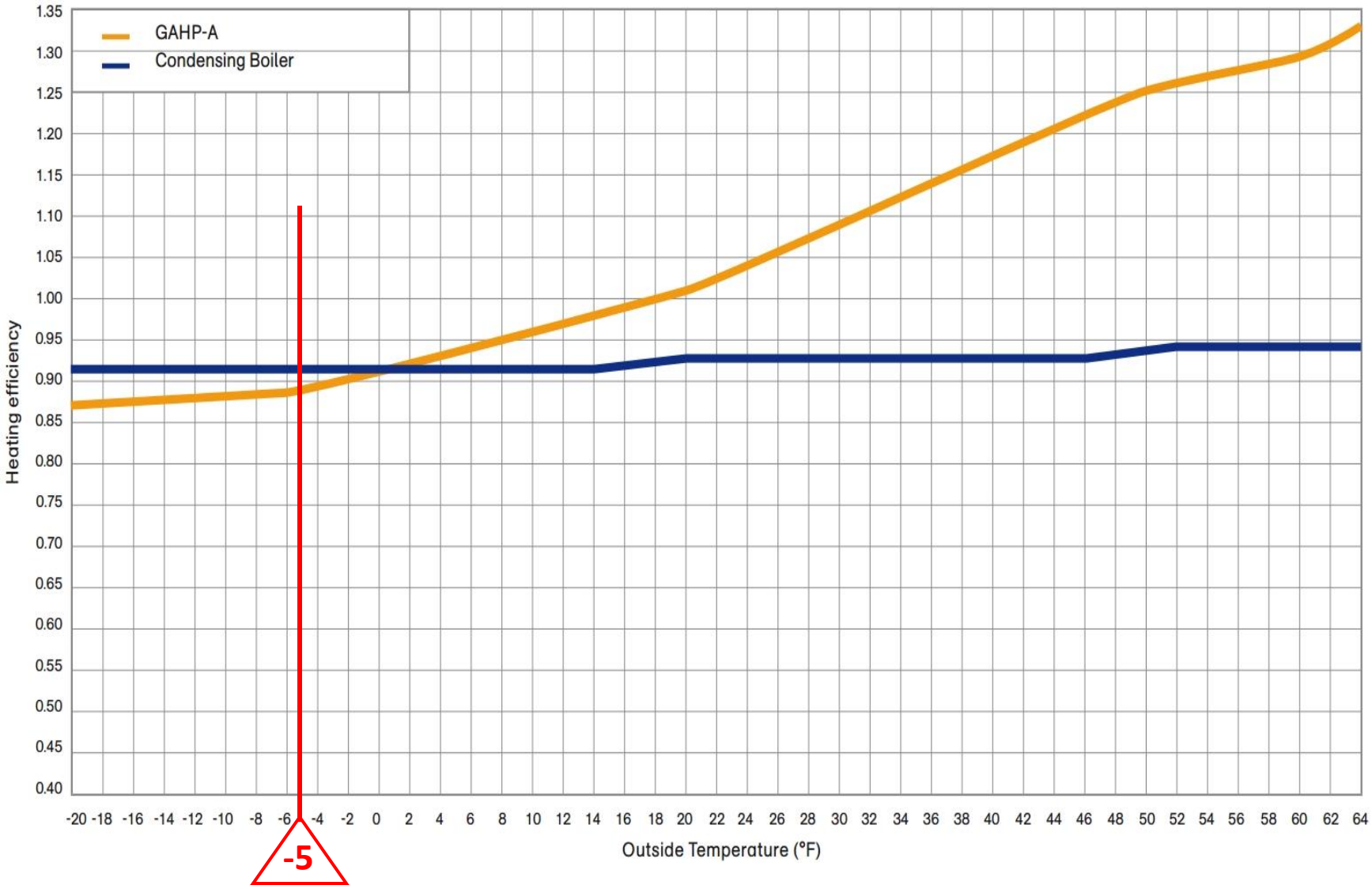
ROBUR HEAT PUMP vs. CONDENSING BOILER



CONDENSING BOILER ADVANTAGES

- Environmentally friendly using natural gas
- DHW supply
- Only 1/10 of electricity consumption in comparison to electrical heat pumps
- ideal integration into existing or new installations
- High Reliability
- Easy Maintenance
- No use of Harmful Refrigerants

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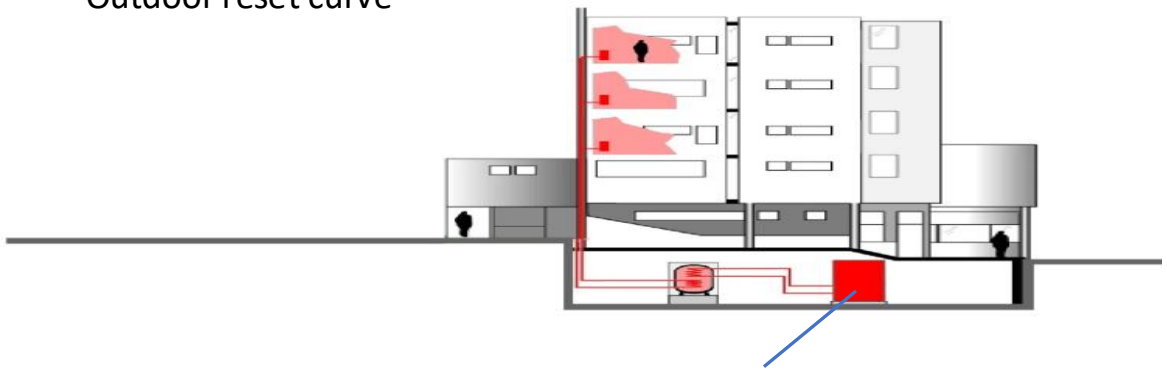
Boston, MA - Design Temperature: 7°F - Building Load: 400,000 Btu/h - Design water temperature: 167°F

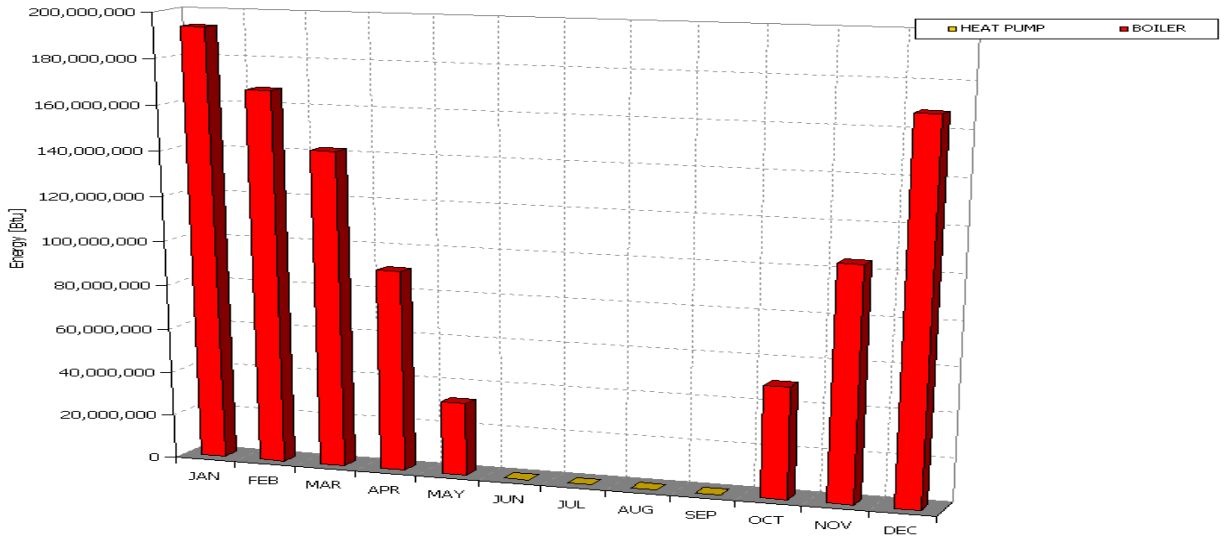
93% Boiler only application

Seasonal System Efficiency: 93%

Outdoor reset curve



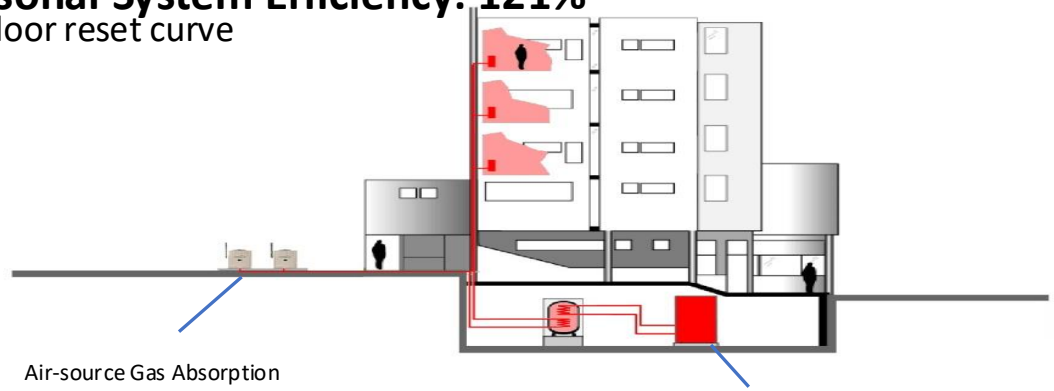
Existing Boiler Efficiency: 93%
Existing Boiler capacity: 400,000 Btu/h



Retrofit application – 93% Boiler + Heat Pumps

Seasonal System Efficiency: 121%

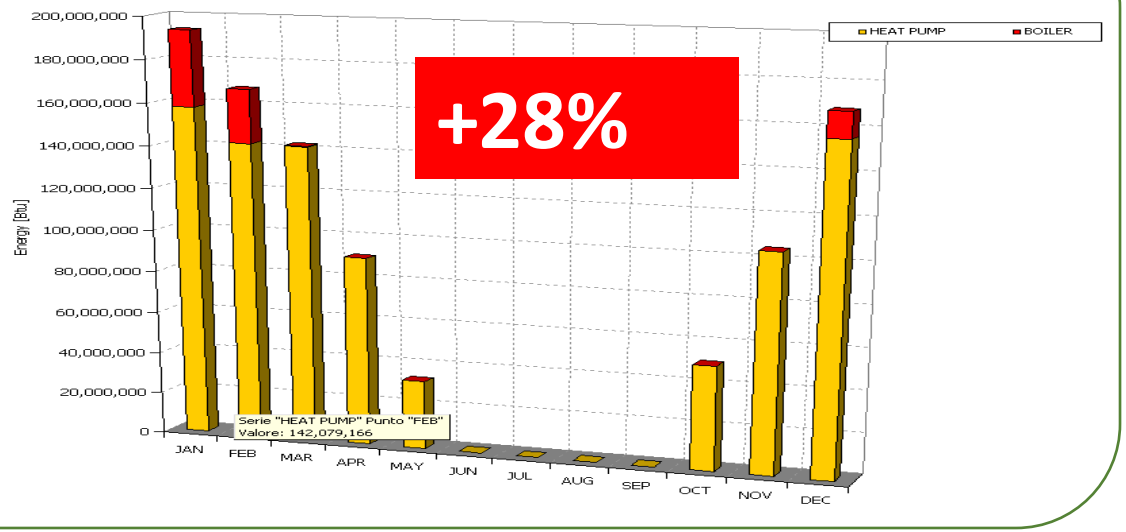
Outdoor reset curve



Air-source Gas Absorption
Heat Pump GAHP-A
Heating capacity: 247,000 Btu/h

Existing Boiler Efficiency: 93%
Existing Boiler capacity: 400,000 Btu/h

Heating energy produced by Heat Pumps: 92%



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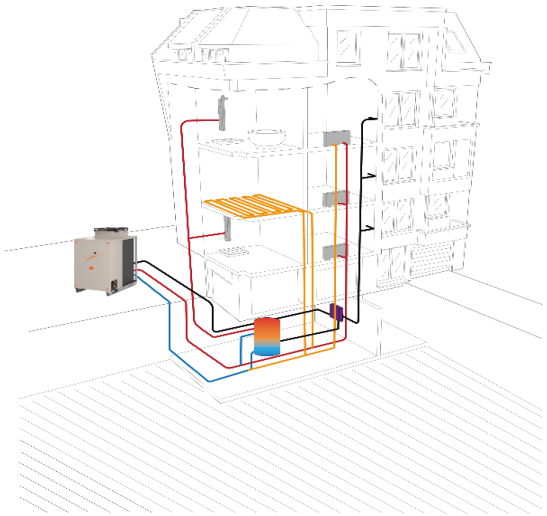
Integrated Plant Efficiencies

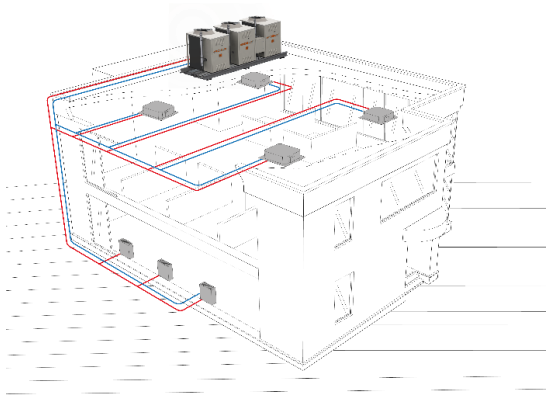
- Comfort Heating Application
- Building Load: 400,000 BTU/h
- 2 GAHP A units + 96% Boiler- 250,000 BTU

	PLANT EFFICIENCY	DESIGN TEMP	HP @ DESIGN T-%	ENERGY DELIVERED BY HP-%
Chicago	**1.17**	**-5**	**43**	**93**
Cleveland	1.21	2	27	95
Denver	1.17	-4	44	94
Detroit	1.16	3	45	90
Indianapolis	1.21	-2	44	95
Minneapolis	1.10	-15	43	88
New York City	1.23	13	48	93
Philadelphia	1.22	11	47	93
Portland	1.24	21	51	94
Seattle	1.24	23	52	94
St. Louis	1.23	2	45	96
Toronto	1.11	4	45	93
Vancouver	1.24	19	50	93

Heating / DHW

Heating





GAHP A

- Heating Only System
- Provides *129%* Heating Efficiency at Nominal Conditions
- Ambient Operating Temperatures : 113°F/45°C to -20°F/-29°C
- Max Outlet Water Temp 140°F/60°C

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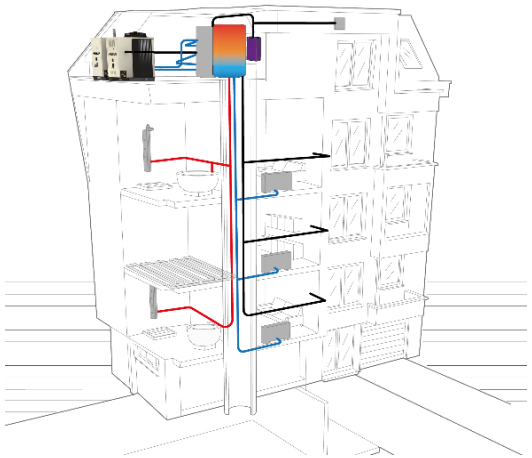
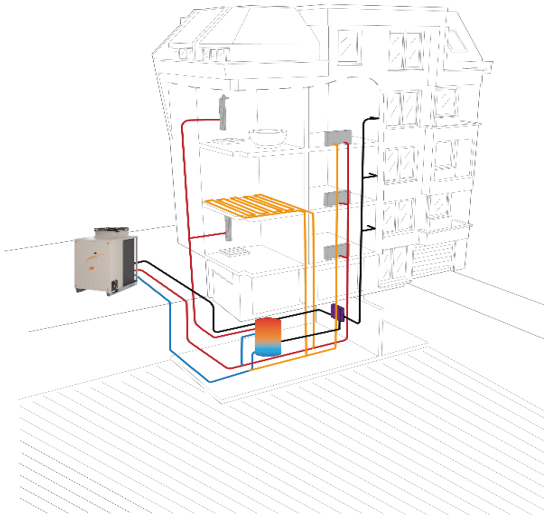
Cooling

Heating





GAHP AR

- Reversible Cooling & Heating System
- Provides *126%* Heating Efficiency at Nominal Conditions
- Ambient Operating Temperatures : 120°F/49°C to -20°F/-29°C
- Max Outlet Water Temp 140°F/60°C
- Min Outlet Water Temp 37.4°F/3°C

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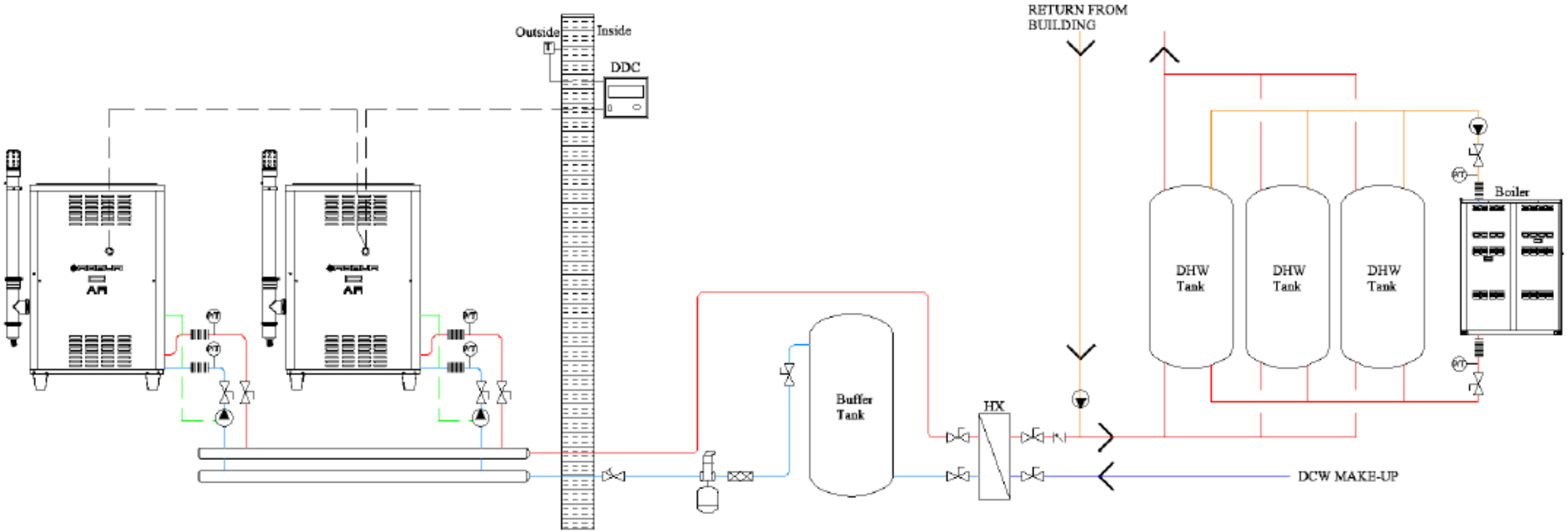
Tandem / Hybrid System Configuration

Robur Heat Pumps + Boiler



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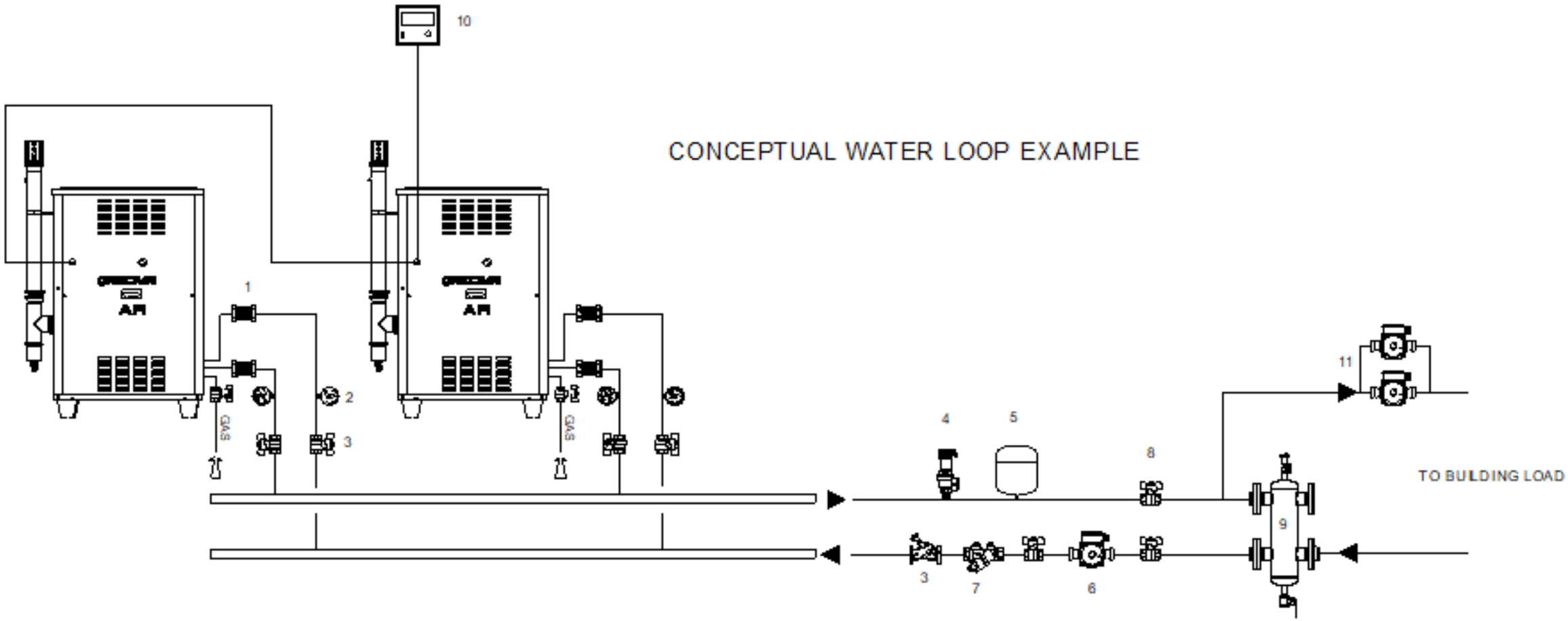
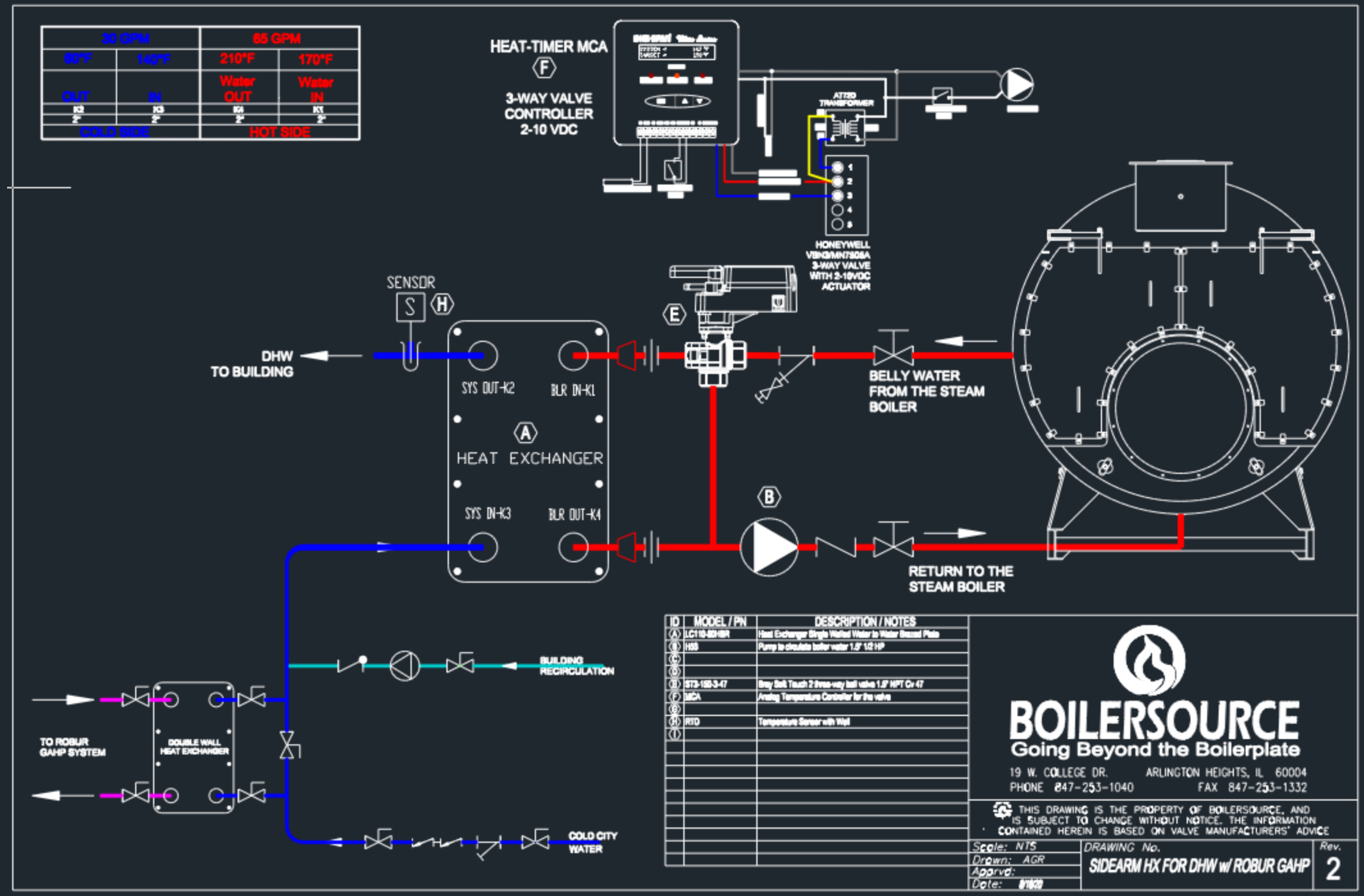
CONCEPTUAL WATER LOOP EXAMPLE



1. ANTIMBRATION JOINTS
2. PRESSURE GUAGE
3. FLOW REGULATOR
4. SAFTEY RELIEF VALVE
5. EXPANSION TANK
6. CIRCULATOR PUMP
7. WATER STRAINER/ FILTER
8. ISOLATION VALVE
9. BUFFER / HYDRONIC SEPERATOR
10. DDC CONTROLLER
11. SYSTEM CIRCULATOR PUMP(S)



ID	MODEL / PN	DESCRIPTION / NOTES
A	LC110-80H-IR	Heat Exchanger Single Walled Water to Water Brazed Plate
B	HSS	Pump to circulate boiler water 1.5" 1/2 HP
C		
D		
E	373-150-3-47	Bray Ball Touch 2 three-way ball valve 1.5" NPT Cv 47
F	MCA	Analog Temperature Controller for 3 way valve
G		
H	RTD	Temperature Sensor with Well
I		

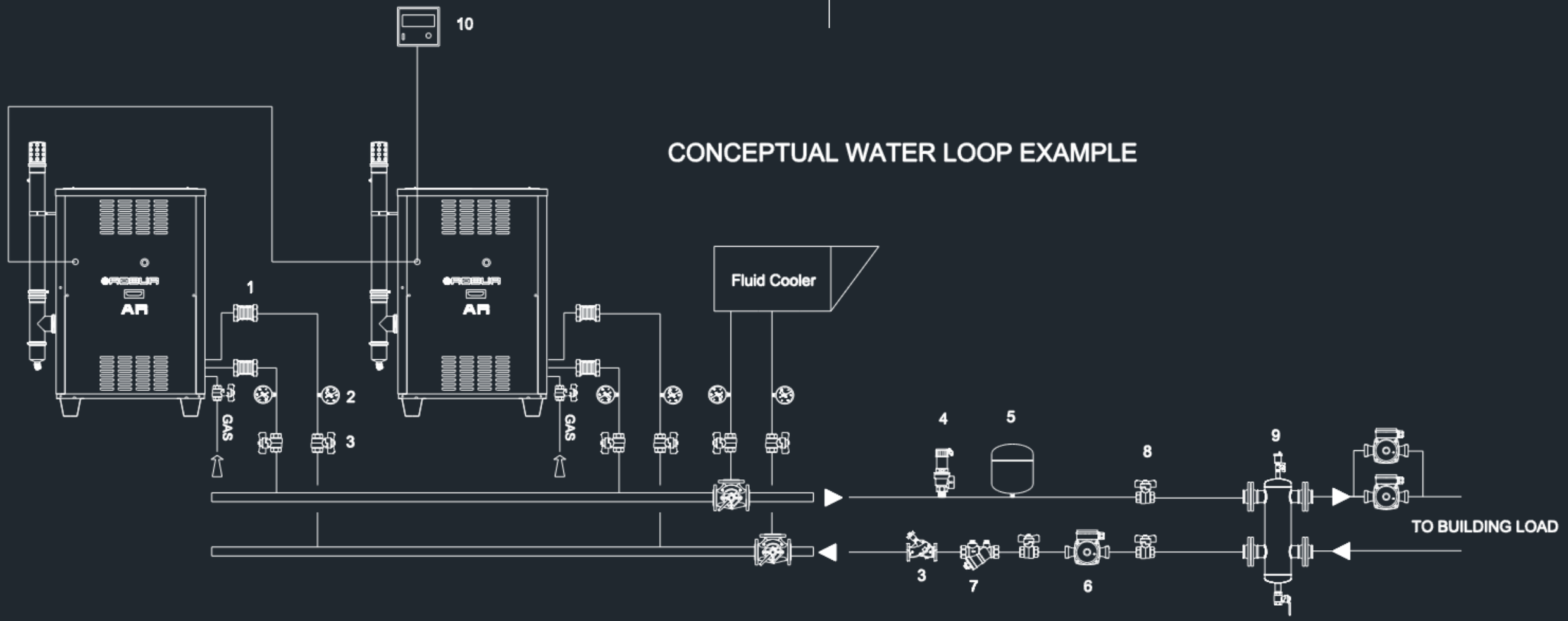
BOILERSOURCE
Going Beyond the Boilerplate
19 W. COLLEGE DR. ARLINGTON HEIGHTS, IL 60004
PHONE 847-253-1040 FAX 847-253-1332

Scale: NTS
Drawn: AGR
Apprvd:
Date: 8/18/20

DRAWING No.
SIDEARM HX FOR DHW w/ ROBUR GAHP

Rev. 2

CONCEPTUAL WATER LOOP EXAMPLE



1. ANTIVIBRATION JOINTS
2. PRESSURE GUAGE
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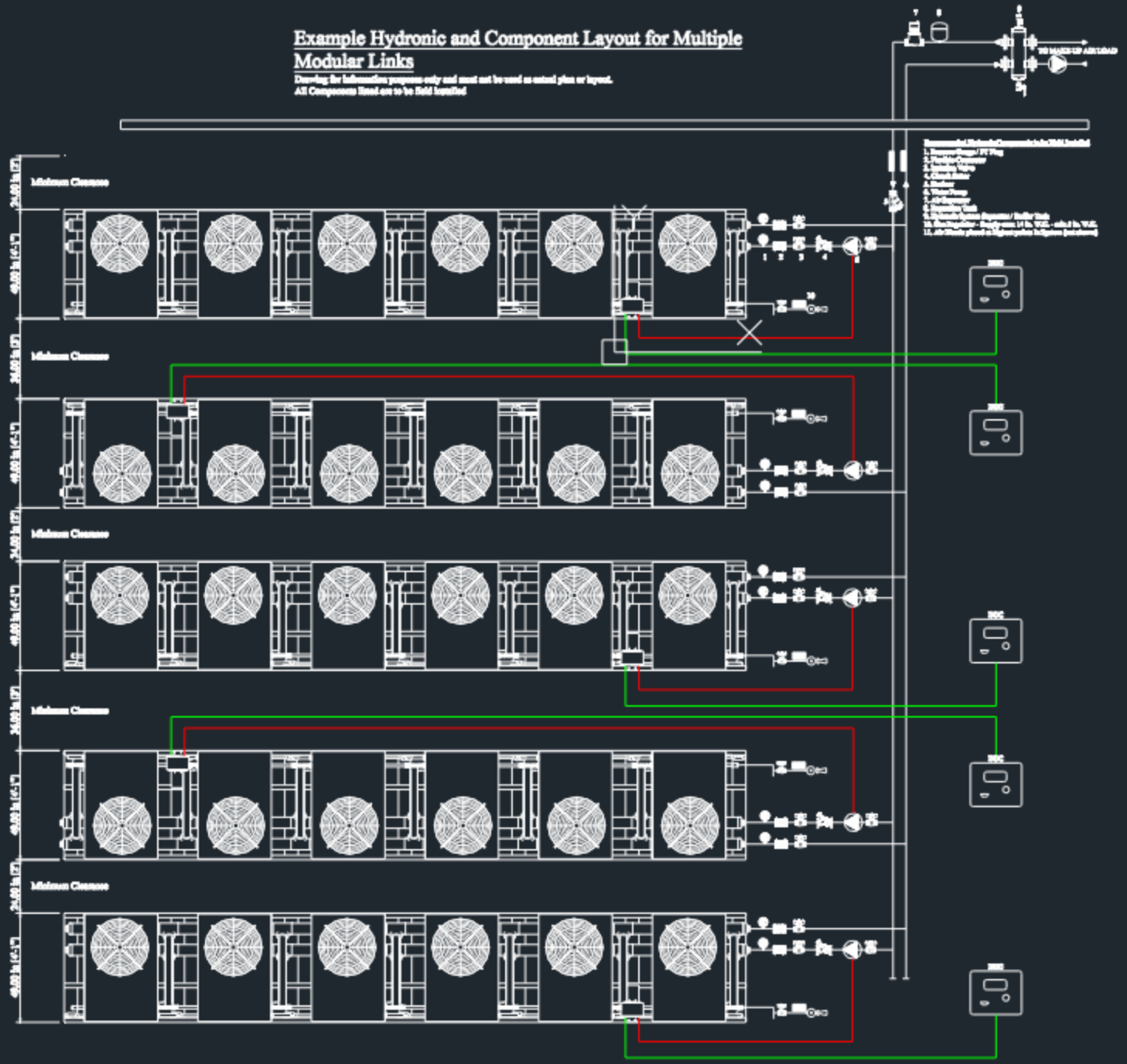
4. SAFTEY RELIEF VALVE
5. EXPANSION TANK
6. CIRCULATOR PUMP
7. WATER STRAINER/ FILTER
8. ISOLATION VALVE
9. BUFFER / HYDRONIC SEPERATOR
10. DDC CONTROLLER

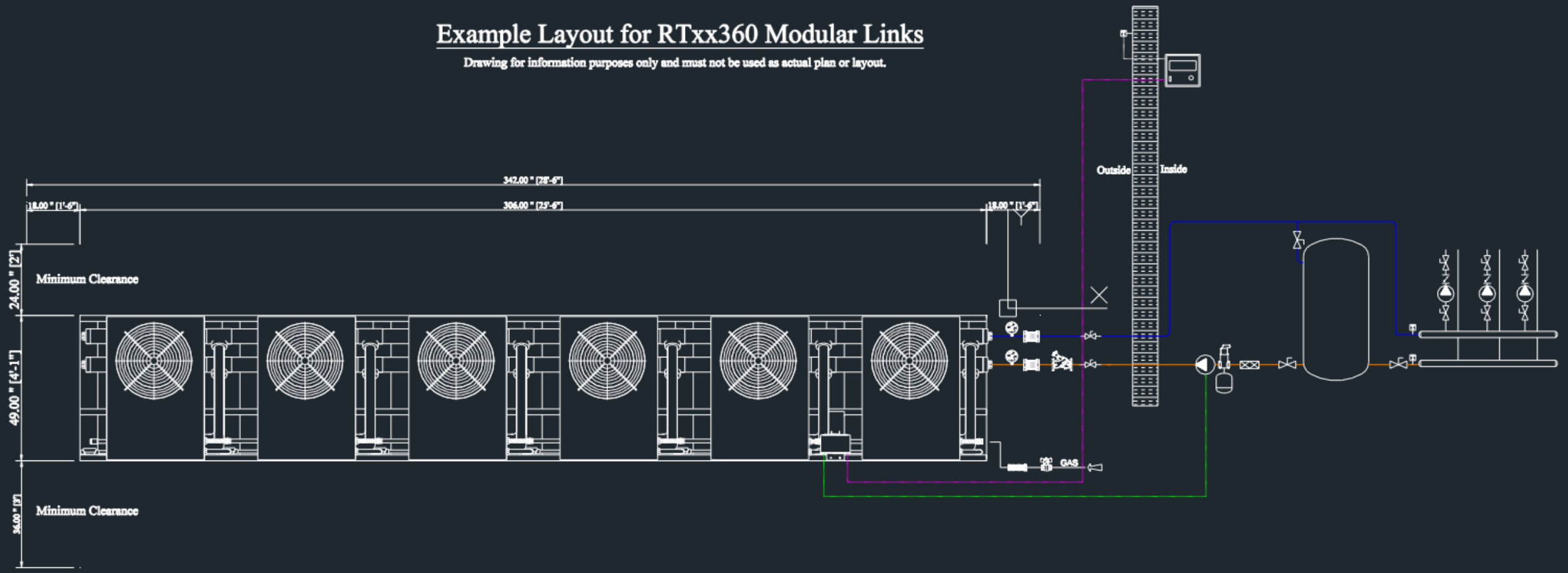
Example Hydronic and Component Layout for Multiple Modular Links

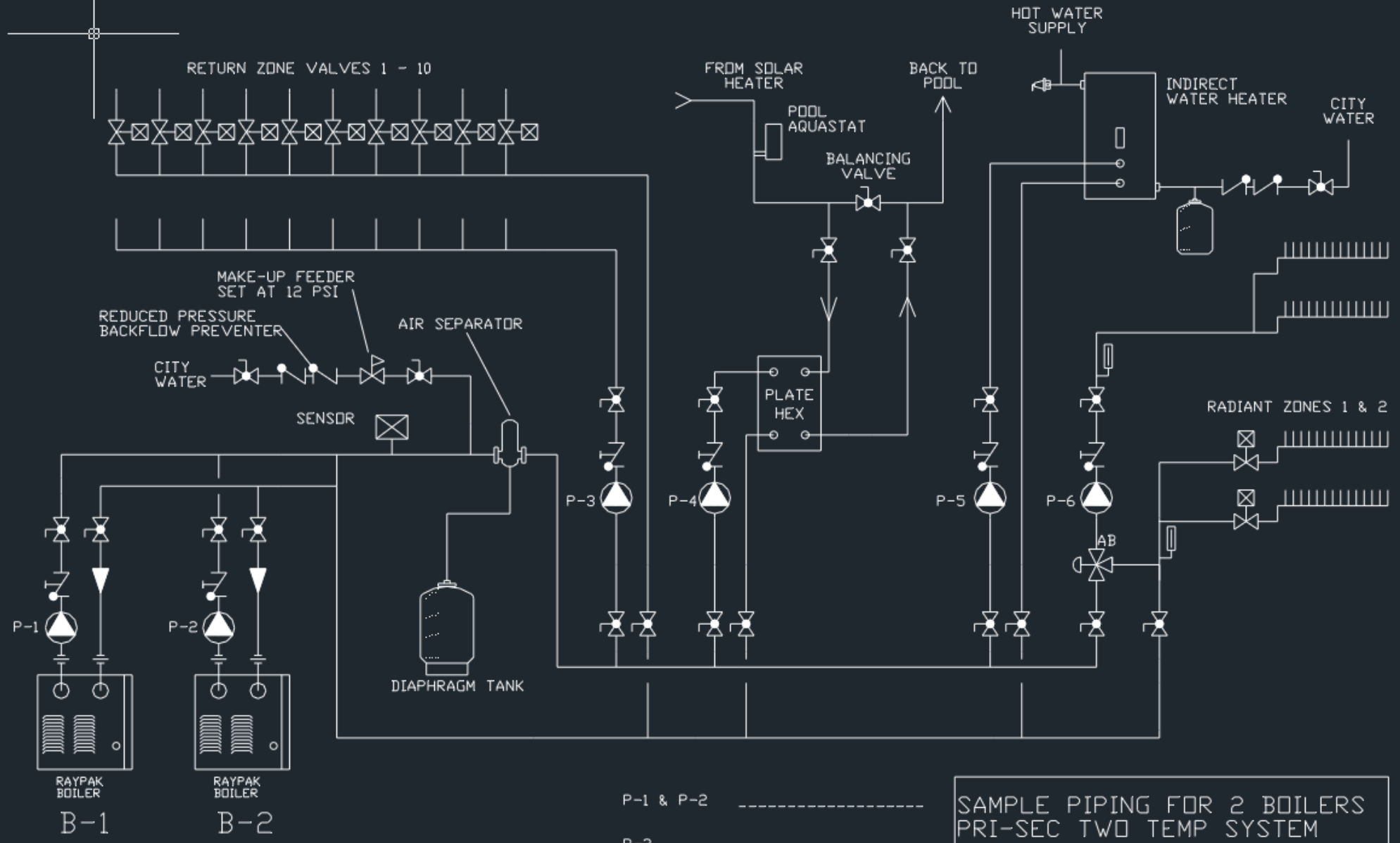
Drawing for information purposes only and must not be used as actual plan or layout.
All Components listed are to be field installed



Example Layout for RTxx360 Modular Links

Drawing for information purposes only and must not be used as actual plan or layout.





NOTES:

1. BOILERS TO BE RAYPAK MODEL H3-263 TWO STAGE FIRING.
2. PROVIDE UNIONS AS NECESSARY FOR SERVICING.
3. PROVIDE BOILER SEQUENCING CONTROL SYSTEM.

P-1 & P-2 _____

P-3 _____

P-4 _____

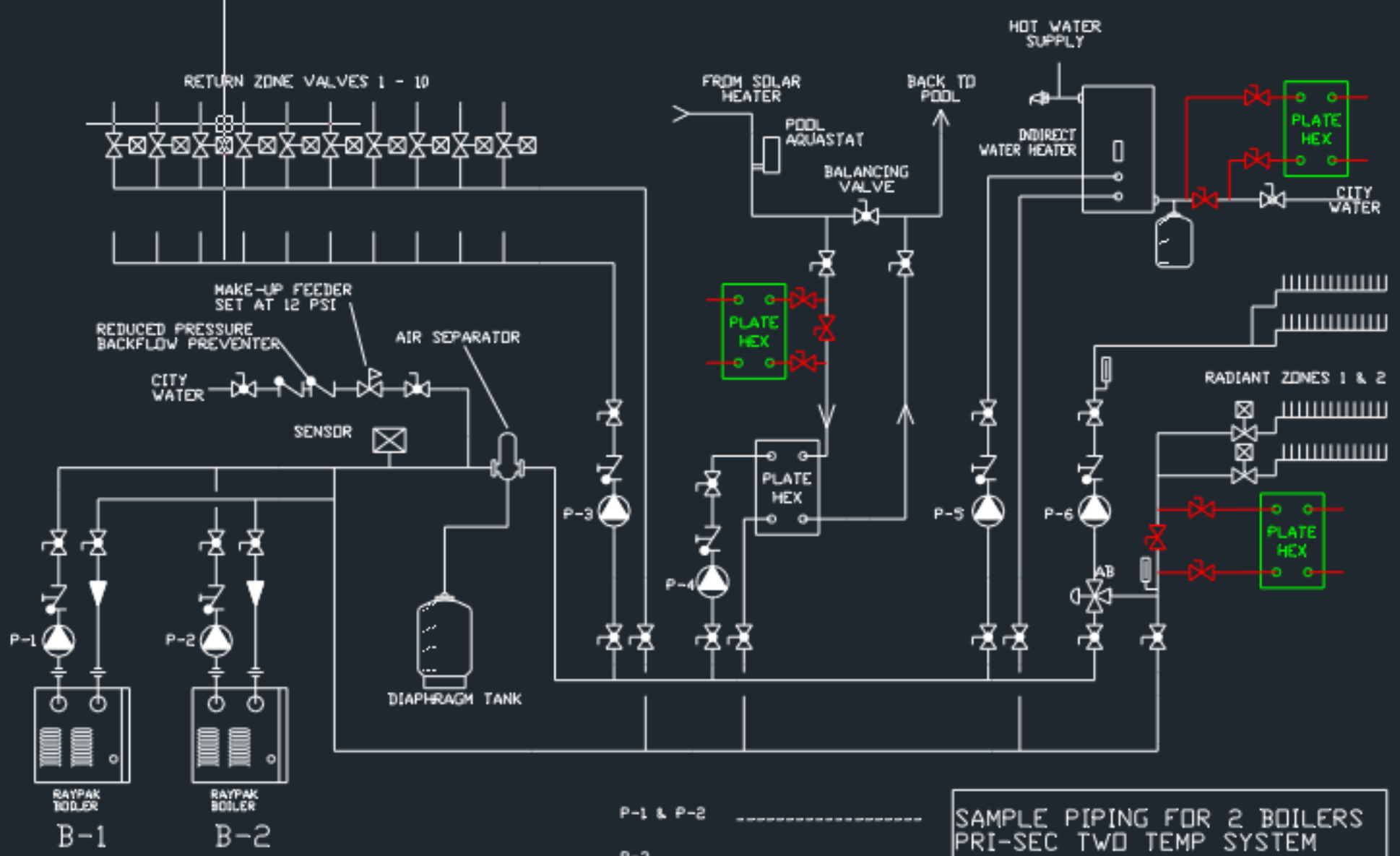
P-5 _____

P-6 _____

SAMPLE PIPING FOR 2 BOILERS PRI-SEC TWO TEMP SYSTEM

BOILERSOURCE
Going Beyond the Boilerplate

DATE:	BY:	DWG NO:
9-13-94	AGR	



NOTES:

1. BOILERS TO BE RAYPAK MODEL #3-263 TWO STAGE FIRING.
2. PROVIDE UNIONS AS NECESSARY FOR SERVICING.
3. PROVIDE BOILER SEQUENCING CONTROL SYSTEM.

P-1 & P-2 ----------

P-3 ----------

P-4 ----------

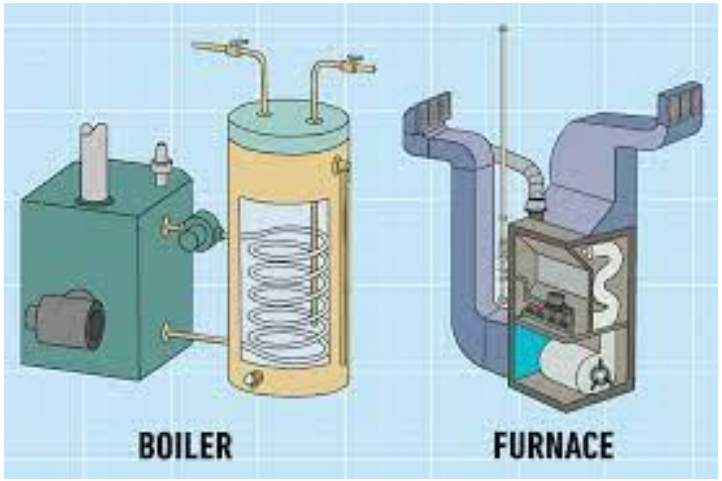
P-5 ----------

P-6 ----------

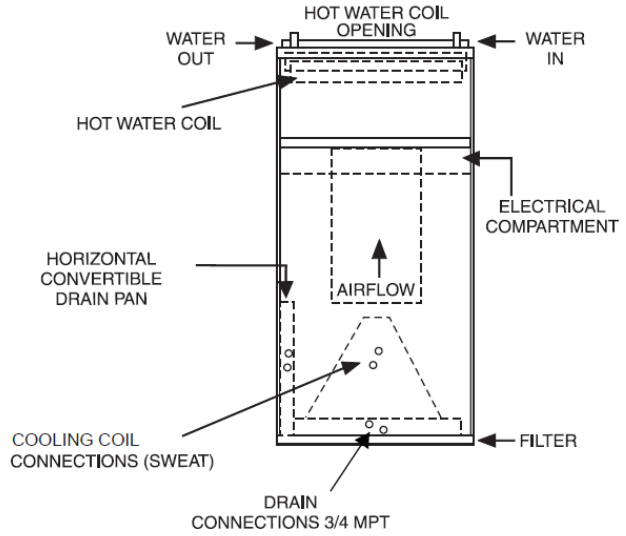
SAMPLE PIPING FOR 2 BOILERS PRI-SEC TWO TEMP SYSTEM

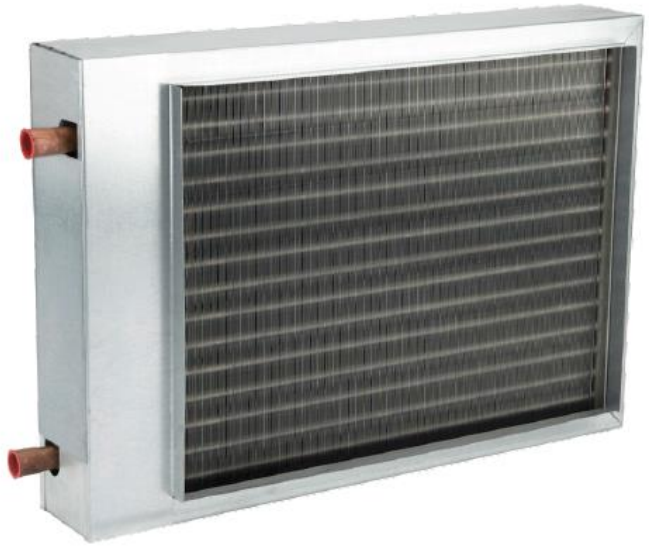
BOILERSOURCE
Going Beyond the Boilerplate

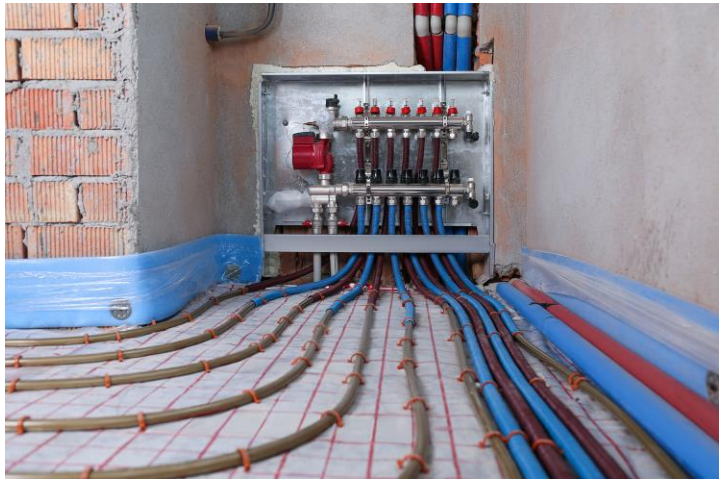
DATE	BY	DWG NO
9-13-94	AGR	


BOILER
FURNACE


MuhTherm

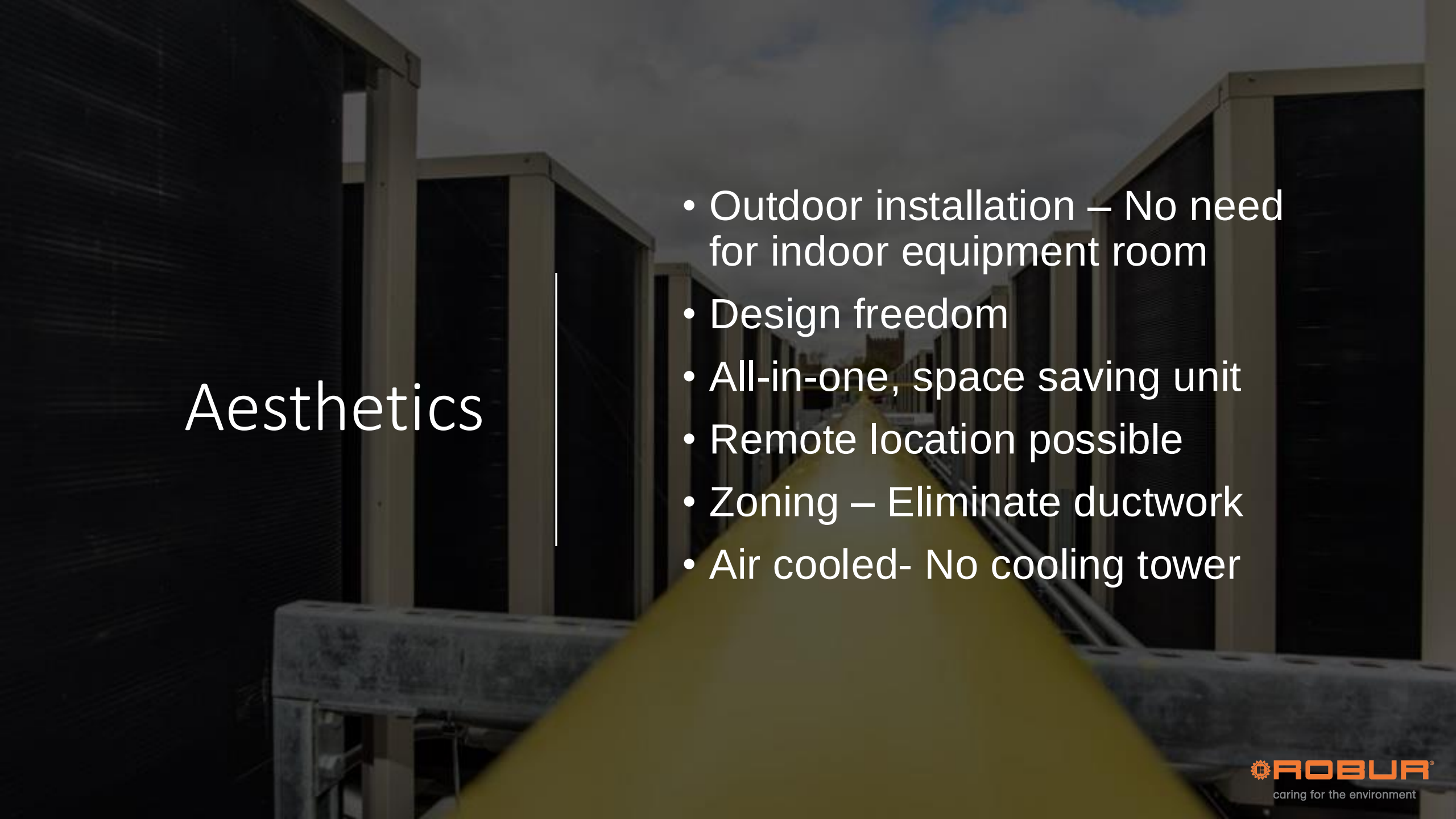

HOT WATER COIL
OPENING
WATER
OUT
WATER
IN
HOT WATER COIL
ELECTRICAL
COMPARTMENT
HORIZONTAL
CONVERTIBLE
DRAIN PAN
AIRFLOW
COOLING COIL
CONNECTIONS (SWEAT)
FILTER
DRAIN
CONNECTIONS 3/4 MPT





Advantages of Tandem / Hybrid Integration

- Boost plant efficiencies above 100% while remaining economically viable
- Existing lower efficient system can be used at peak conditions or back up
- Reduce capital cost of entire system replacement
- Reduction of carbon footprint, emissions and gas input
- Avoid fuel switching
- Reduced operating costs
- Avoid building infrastructure upgrades
- Grid Relief



Aesthetics

- Outdoor installation – No need for indoor equipment room
- Design freedom
- All-in-one, space saving unit
- Remote location possible
- Zoning – Eliminate ductwork
- Air cooled- No cooling tower

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Gas-Fired Absorption Heat Pumps & Chillers

- Highest Gas Heating Efficiency Available – up to 134%
- Modular and Redundant Design – No System Downtime
- Up to 80% reduction in electrical requirements – Single Phase Operation
- Natural Refrigerant -
  Global Warming Potential = 0
  Ozone Depletion Potential = 0
  No phase out date
- Ultra-Low Noise Level (*Max 57 dB Min 48 dB)*
- Wide Range of Ambient Operating Conditions
- Water Temperatures from 14°F/-10°C to 140°F/60°C

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caring for the environment

Why are we here today?

- Identify the Issues
- Review the Technologies
- Meet the Manufacturer & Products
- Target Markets and Applications
- **Making it Easy**

Gas Heat Pumps

- Mature Product in the US market- commercial Gas Heat Pump (GHP's)
- Benefits of GHP's include:
  - High fuel efficiency (up to 140% AFUE)
  - Reduces Green House Gas (GHG) emissions
  - Natural refrigerant with Zero Global Warming Potential (GWP) and Zero Ozone Depletion Potential (ODP). No phase out date.
  - No combustion inside the building
  - Only water/food grade propylene glycol mix is used to transfer heat
  - Comfortable space heating even when outdoor temperatures are as low as -5° F with no backup required
  - Space heating and water heating and cooling options
  - No chimney, duct work, or electrical panel upgrades needed in most cases
  - Rebates
    - New Gas space and water heating measure- option when need to replace a boiler
    - Innovation measure so have higher incentives for now
    - MFES for Income Eligible Customers – Fully incentivized rebate available per installation
    - Commercial and Multi-Family GHP's Incentive - $4/therm saved thru custom program
  - Tax Incentives
  - Special Financing options

H.R.5376 - Inflation Reduction Act of 2022 *Residential Applications*

Sec. 13301

Heat pump and heat pump water heaters; biomass stoves and boilers.--Notwithstanding paragraphs (1) and (2), the credit allowed under this section by reason of subsection a)(2) with respect to any taxpayer for any taxable year shall not, in the aggregate, exceed **$2,000** with respect to amounts paid or incurred for property described in clauses (i) and (ii) of subsection(d)(2)(A) and in subsection (d)(2)(B)

A) Any of the following which meet or exceed the highest efficiency tier (not including any advanced tier) established by the Consortium for Energy Efficiency which is in effect as of the beginning of the calendar year in which the property is placed in service:

(i) An electric or natural gas heat pump water heater.

(ii) An electric or **natural gas heat pump.**

(iii) A central air conditioner.

(iv) A natural gas, propane, or oil water heater.

(v) A natural gas, propane, or oil furnace or hot water boiler.

RenewEnergy
PARTNERS

Save Money and the Earth

Improve your buildings today – without Capital Investment or borrowing – by funding upgrades with future savings.

RENEWEP.COM

Renew Energy PARTNERS

Fund your building upgrades with future savings.

We work with building owners and management to make it financially rewarding and effortless to implement energy efficiency upgrades and clean energy in commercial and industrial buildings now.

How it works:

1. Renew Energy Partners provides the up-front funding to purchase, install, and maintain the new systems – all as part of a Master Service Agreement (MSA).
2. Each month after installation, for the duration of the agreement, a portion of the measured savings goes to Renew Energy Partners as a service fee, and a portion goes straight to your bottom line.
3. At the end of the agreement, you take ownership of the new systems, and 100% of the savings go to your bottom line.

How much can you save?

95%

Increased operating efficiency with condensing boilers

75%

Reduced energy use with efficient lighting

85%

Improvement in energy efficiency with on-site CHP power/ heat generation system

RENEW's Master Service Agreement

Our Master Service Agreement is a funding solution that enables owners to decarbonize their buildings today, without making an investment.

- The MSA may include an Energy Services Agreement (ESA), which covers energy-efficiency retrofits like lighting, HVAC, or smart energy controls, and/or a Power Purchase Agreement (PPA), which covers on-site clean power, including solar + storage or combined heat and power (CHP).
- Just like a utility expense, an MSA has the opportunity to be given off-balance sheet treatment, and is 100% tax deductible.
- An MSA takes the financial and project implementation burden off of the building owner, and building owners pay a monthly amount that is less than the total saved, so from day one there are savings applied to the bottom line.

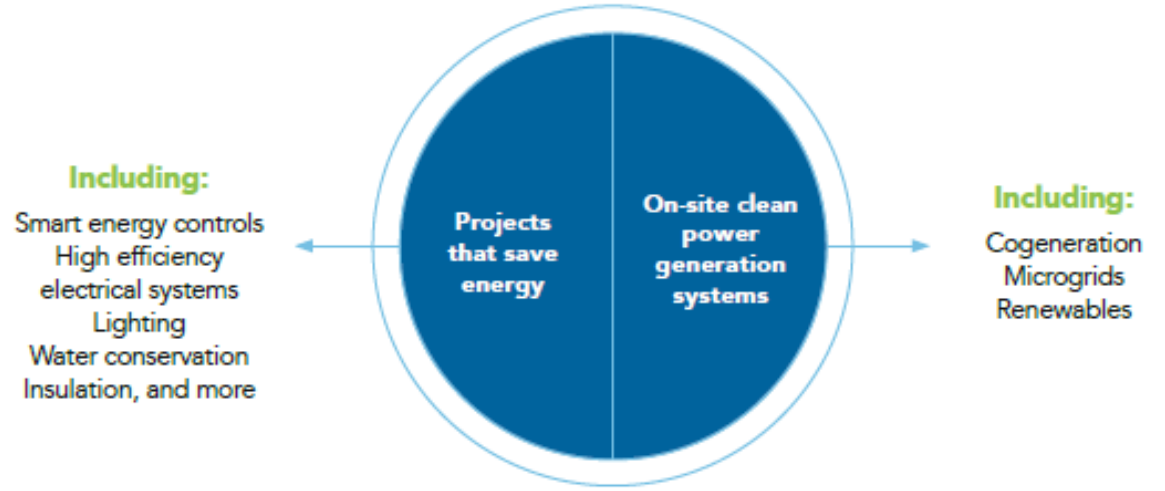
Renew Energy Partners manages the entire process.

Why upgrade now?

With **30% – 50%** in annual energy savings, when upgrades are delayed, both money and energy are wasted.	Why waste money and energy when you don't have to?

Project Examples

Renew Energy Partners will fund and execute any project that reduces carbon, and we are always looking forward to the next proven technologies to conserve energy or produce clean energy. We work with a network of trusted expert solution providers to install and maintain the new systems – RENEW provides the oversight throughout the life of the agreement.

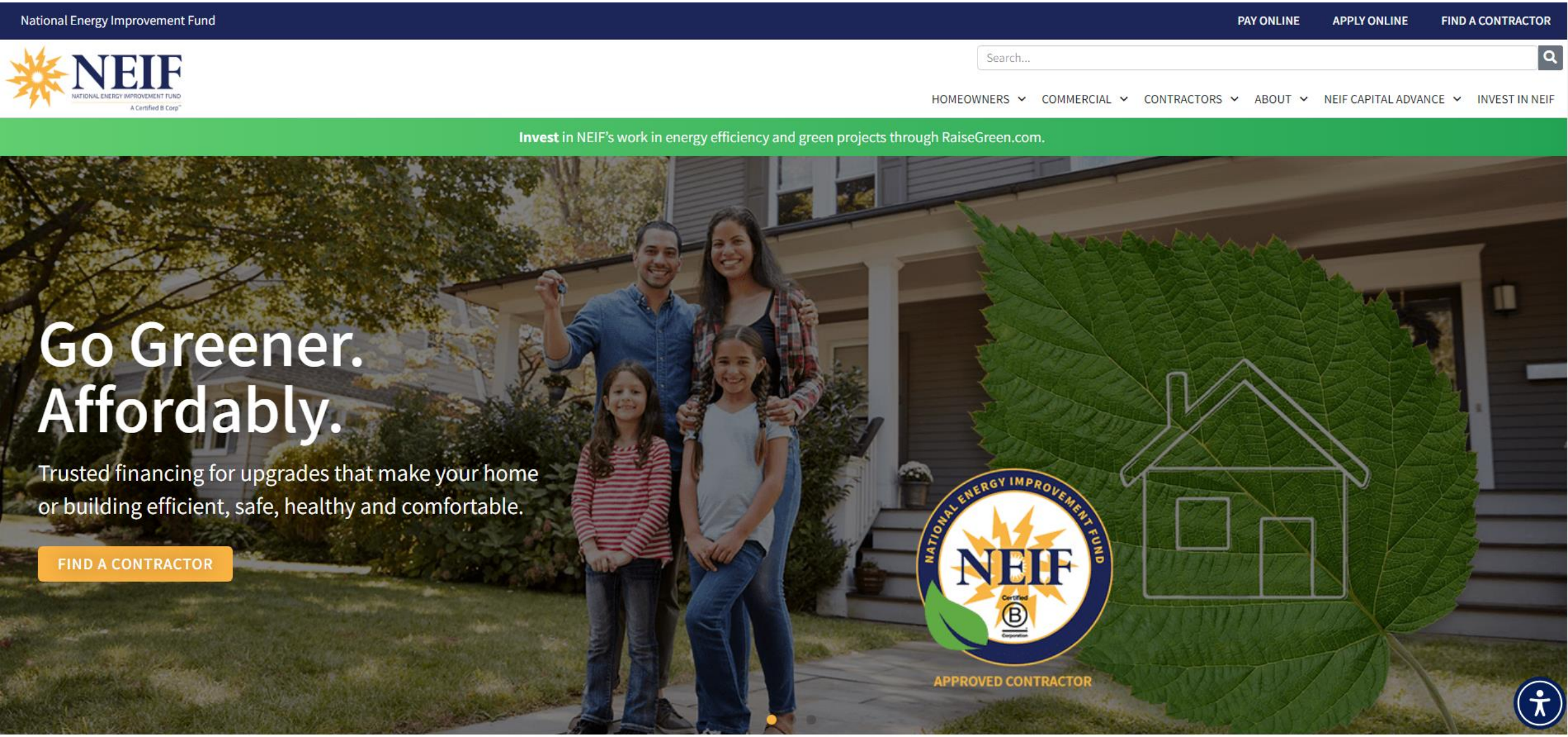


RenewEnergy PARTNERS

RENEWEP.COM

One Lincoln Street, 24th Floor, Boston, MA
888.938.6256 | info@renewep.com

https://www.neifund.org/



Innovative Solutions for Financing Energy Efficiency Projects

Financing for Energy & Resilience Home Improvements

NEIF helps homeowners improve comfort, resilience, health and efficiency with simple, trusted and transparent financing. We focus on guaranteed fixed-rate monthly payment plans with no lien on your home, no closing fees and no cost to contractors. Learn how simple and affordable it is to upgrade your home's heating, cooling, windows, roofing, insulation, air quality and more.

HOMES

Financing for Business Energy Improvements

NEIF's multi-channel funding and easy online process provides optimal financing for commercial, non-profit, industrial and municipal energy improvements. Learn how our affordable financing options for heating, air conditioning, refrigeration, lighting and air quality systems and renewable energy project can improve the efficiency and health of commercial buildings.

COMMERCIAL

Grow and Differentiate your Business

Contractors aligned with NEIF set themselves apart in the market because of their association with the nation's leader in energy efficiency financing. You can improve your bottom line with our no buydown charge programs and improve cash flow with our rapid payment and Rebate Bridge advance funding programs. Learn how NEIF can help HVAC, lighting, roofing and remodeling and energy contractors.

CONTRACTORS

Become a NEIF Partner, Increase your Program Uptake

NEIF works closely with manufacturers, distributors, governments, utilities and trade associations to help build, train and support contractor networks and integrate financing to increase energy improvement affordability and program's uptake. Learn how you can grow your programs and better serve your customers, members and stakeholders through a sponsor partnership with NEIF.

PARTNERS

NEIF
NATIONAL ENERGY IMPROVEMENT FUND
A Certified B Corp™

CONTACT US
Phone: (484) 838-5460
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loanservicing@neifund.org
contractors@neifund.org

What Makes Us Special

- Field and internal support teams
  - System evaluation, Design, Troubleshooting, Training, Startup, etc
- Bridge between our system manufacturers and the industries we serve
  - Experience and responsiveness during the design phase and installation
  - We will work with MFES assessors and Trade Ally Contractors to make the process easy
- Work with manufacturers to ensure their products continuously improve
- WBE/DBE

BOILERSOURCE
Going Beyond the Boilerplate

What Makes Us Special

BOILERSOURCE

Going Beyond the Boilerplate

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BOILERSOURCE

Going Beyond the Boilerplate

We are a nationally certified Women-owned Business Enterprise (WBE)

Going Strong for Over 50 Years!

Certified WBENC Women's Business Enterprise

INNOVATION · UNDERSTANDING · COMMITMENT · TLC360°

Let us tell you about our TLC360° promise!

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Thank you for your attention - QUESTIONS?

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