Heat Pumps & Co-Generation Systems

JOSEPH CLOUTIER, OWNER, REGEN

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REGEN

REGEN is an energy company specializing in Turn-Key Energy Solutions, Combined Heat and Power (CHP), and Gas Heat Pumps (GHP) systems

The mission of REGEN is to provide affordable and sustainable energy solutions to organizations relying on fossil fuels as their main source of energy

REGEN provides consumer driven turn-key energy solutions with value added services from point of energy analysis, consultations and engineering through sale, financing, services, and fuel supply contracts

As a result, REGEN has developed strong strategic partnerships with industry leaders for natural gas, propane, biogas energy applications to provide the best energy alternatives to our customers

Realty Resources Management

Realty Resources Management has been providing professional real estate management services to a portfolio of affordable residential properties since 1976

Since then, we have grown to a portfolio of over 80 affordable housing projects, responsible for the managing services in Maine, New Hampshire, Massachusetts, New York, and Vermont, totaling over 2,000 units

We at Realty Resources Management are committed to assessing the energy needs of our portfolio, while providing energy alternatives that will improve the longevity of affordable housing stock

REALTY
RESOURCES MANAGEMENT

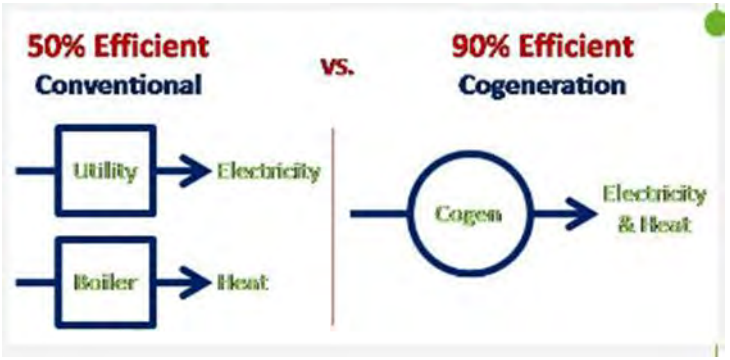
Combined Heat and Power (CHP)

CHP also known as cogeneration is the concurrent production of electricity or mechanical power and useful thermal energy (heating and/or cooling) from a single source of energy

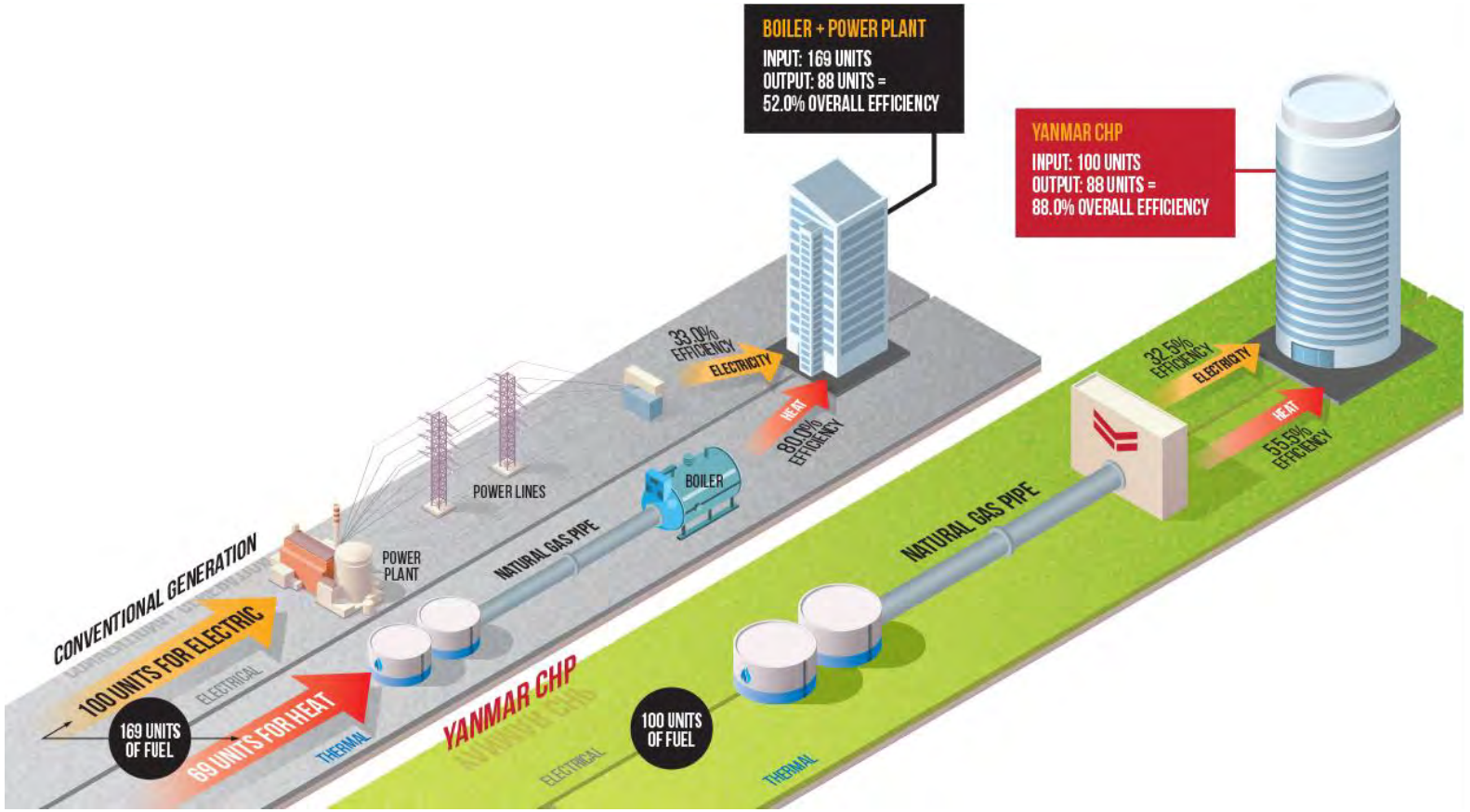
This system improves efficiency and reduces greenhouse gas emissions

The recovered heat is then used to offset fuel that is used to supply thermal energy (heat, water, chilling, process)

Therefore, it reduces your fuel consumption and costs through energy costs, environmental friendlies, and grid reliability



HEATING EFFICIEINCIES



Famous Dave's Restaurant CHP/Cogeneration Project

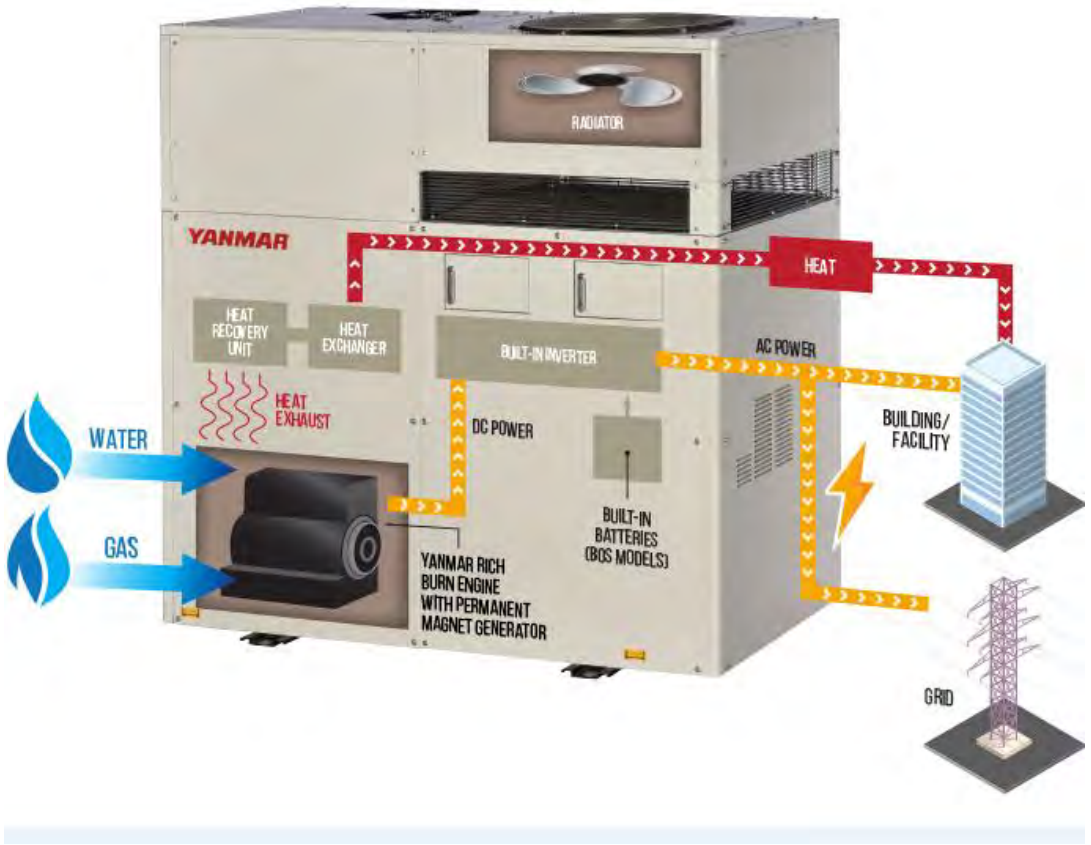
Famous Dave's Restaurant, Scarborough, Maine

Cogeneration system installed in May 2018

Reasons for install:

- Provides on-site energy production
- Uses less fuel to produce same energy
- Uses waste heat for thermal and cooling
- Lowering carbon emissions
- Deliver energy at low operating costs

Cogeneration System



Results

Time Period	Gas Cost Per Therm	Other Cost Per Therm	All in cost per Therm	Days in Month		Electricity Savings	Thermal Savings	Total	Add'l Gas Cost	Net (Savings) Cost (1)
						ACTUAL COSTS				
6/1 to 6/30/18	$ 0.46	$ 0.06	$ 0.52	30	June (2)	$ (3,752.78)	$ (266.33)	$ (4,019.11)	$ 1,297.71	$ (2,721.40)
7/1 to 7/31/18	$ 0.59	$ 0.07	$ 0.66	31	July	$ (3,831.92)	$ (313.92)	$ (4,145.84)	$ 1,665.59	$ (2,480.25)
8/1 to 8/31/18	$ 0.61	$ 0.07	$ 0.68	31	August	$ (3,832.04)	$ (328.84)	$ (4,160.88)	$ 1,744.10	$ (2,416.79)
9/1 to 9/30/18	$ 0.60	$ 0.07	$ 0.67	30	September	$ (3,783.37)	$ (367.74)	$ (4,151.11)	$ 1,677.74	$ (2,473.37)
10/1 to 10/31/18	$ 0.72	$ 0.08	$ 0.80	31	October	$ (3,996.14)	$ (720.44)	$ (4,716.58)	$ 2,103.36	$ (2,613.21)
11/1 to 11/30/18	1.105	$ 0.12	$ 1.22	30	November	$ (3,886.20)	$ (1,385.51)	$ (5,271.71)	$ 3,116.33	$ (2,155.38)
12/1 to 12/31/8	1.105	$ (0.08)	$ 1.02	31	December	$ (4,010.48)	$ (1,496.70)	$ (5,507.17)	$ 3,189.95	$ (2,317.22)
1/1 to 1/31/19	1.105	$ 0.13	$ 1.24	31	January	$ (4,159.47)	$ (1,441.11)	$ (5,600.58)	$ 3,227.90	$ (2,372.68)
2/1 to 2/28/19	1.105	$ (0.10)	$ 1.00	28	February	$ (3,758.46)	$ (1,140.62)	$ (4,899.09)	$ 2,364.21	$ (2,534.88)
3/1 to 3/31/19	1.105	0.07	$ 1.01	31	March	$ (4,156.61)	$ (1,120.48)	$ (5,277.09)	$ 2,626.12	$ (2,650.97)
4/1 to 4/30/19	0.46	0.03	0.49	30	April	$ (3,993.62)	$ (734.95)	$ (4,728.57)	$ 2,541.25	$ (2,187.32)
5/1 to 5/31/19	0.38	0.04	0.41	31	May	$ (4,092.32)	$ (651.89)	$ (4,744.21)	$ 2,621.43	$ (2,122.78)
					12 Month Totals	$ (47,253.41)	$ (9,968.53)	$ (57,221.95)	$ 28,175.69	$ (29,046.25)

Robur – Heat Pumps

Heat that is gained from an outside renewable energy source (air, ground, or water) is combined with the gas-operated absorption cycle of the heat pump, providing hot water at a very high heating efficiency. For cooling, the absorption cycle transfers heat from the indoor space to the outside energy source.

These units produce either chilled water for cooling or hot water for heating. In the cooling mode, heat from the indoor space is dissipated to the outdoors, and, in the heating mode, heat is gained from the outdoors. The water- or ground-source heat pump provides chilled and hot water simultaneously.

Benefits include using economical natural gas as the primary energy source; utilization of renewable energy sources; heating efficiencies exceeding 100 percent; hydronic cooling and heating flexibility; and, depending on the model, the ability to provide or supplement domestic hot water requirements.

The unit is single-packaged, installed outdoors on a pad or rooftop, and connected to a building via hydronics. It is well-sized for large homes, multi-unit residential and industrial-commercial-institutional (ICI) buildings.

The Robur Approach

The Robur modular and redundant configuration allows minimal energy usage to meet system demand for varying building loads.

- **Reduce electrical demands** by as much as 80% compared to VRF, DX heat pumps & chillers.
- **Single phase** power 208/230V.
- **No Compressors or Engines**.
- **Eliminate Electrical Infrastructure** upgrades and associated costs.
- **Reduces overall capital costs** of the project.
- **Low Operating Costs**.
- **Emergency cooling**: greatly reduced back-up generator requirements.
- **Avoid excessive Time of Day rates & Demand rates**.
- Available in **Natural Gas** or **LPG**.

Air Source Heat Pumps

Heating Only System
Provides 129% heating efficiency at Nominal Conditions
Ambient Operating Temperatures: 113 F to -20 F
Max Outlet Water Temp 140 F
Cost: $19,666 (including installation)
$6,555 per unit (based on 700 Sq. ft unit)

	Temp	BTU/h	Sq. ft	Apt. Units
Heating	-20	83,600	2,090	3

Based on 700 Sq. ft at coldest temperature

GAHP-A COP – HEATING MODE CAPACITY (BTU/h) Input 95,500 BTU/h				
EXTERNAL AMBIENT TEMPERATURE °F	**OUTLET HOT WATER TEMPERATURE °F**			
	86°F	**113°F**	**122°F**	**140°F**
	ΔΔT=18°F	ΔΔT=18°F	ΔΔT=18°F	ΔΔT=27°F
-20°F	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	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	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	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	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	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	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	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	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	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	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	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

Air Source Heat Pumps

Heating Only System
Provides 129% heating efficiency at Nominal Conditions
Ambient Operating Temperatures: 113 F to -20 F
Max Outlet Water Temp 140 F
Cost: $21,330 (including installation)
$7,110 per unit (based on 700 Sq. ft unit)

	Temp	BTU/h	Sq. ft	Apt Units
Heating	-20	80,900	2,022	3
Cooling	95	59,400	2,500	3.5

Based on 700 Sq. ft Unit at coldest and warmest temperatures

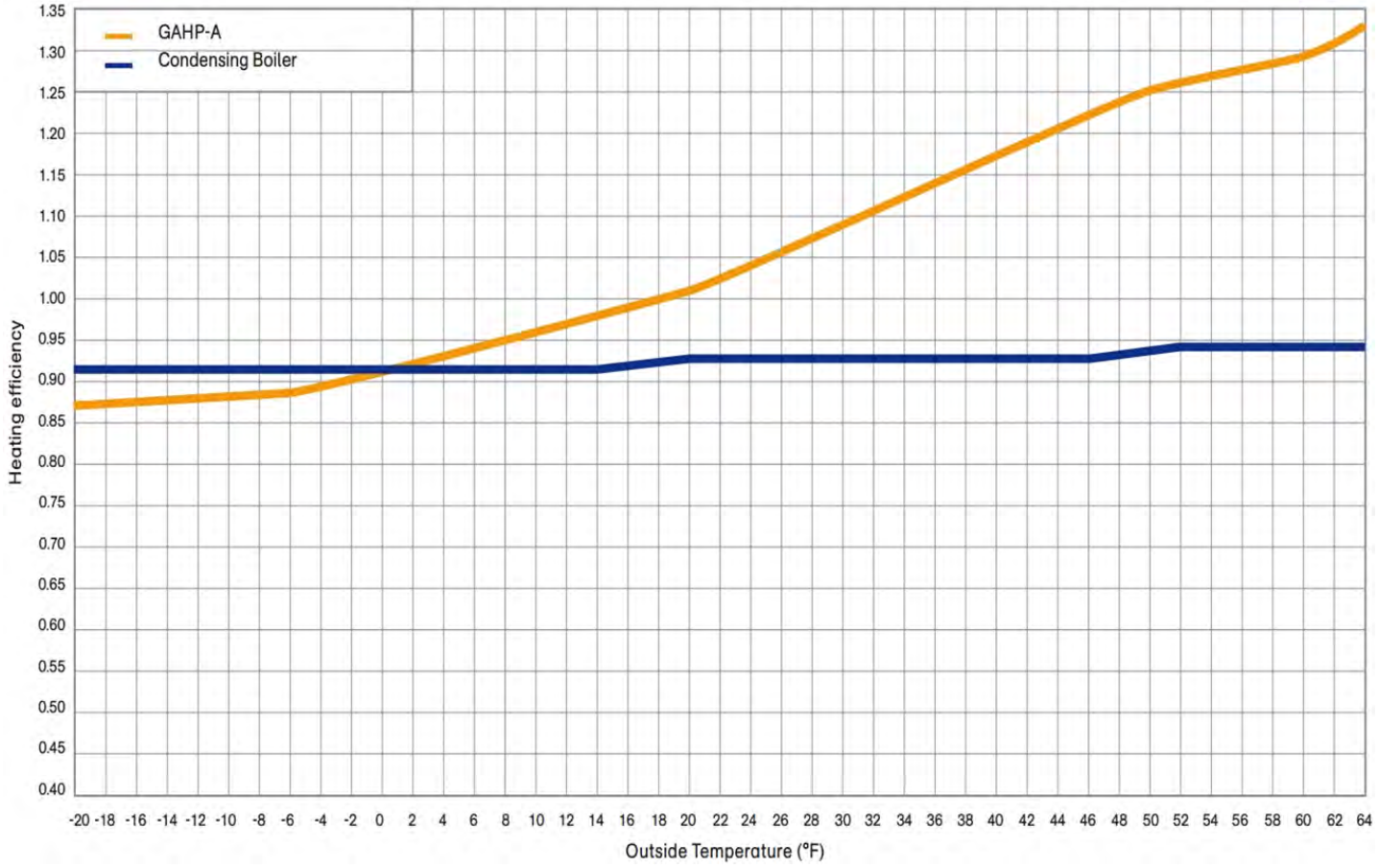
GAHP AR
Coefficient of Performance Chart

COP – HEATING MODE				
EXTERNAL AMBIENT TEMPERATURE °F	**OUTLET HOT WATER TEMPERATURE °F**			
	86°F	**113°F**	**122°F**	**140°F**
-20.0 °F	.95 COP 91,100 BTU/h	.87 COP 82,900 BTU/h	.87 COP 82,900 BTU/h	.85 COP 80,900 BTU/h
-13.0°F	.96 COP 92,100 BTU/h	.88 COP 83,900 BTU/h	.88 COP 83,900 BTU/h	.86 COP 81,900 BTU/h
-4.0°F	.98 COP 93,200 BTU/h	.89 COP 85,000 BTU/h	.89 COP 85,000 BTU/h	.87 COP 82,900 BTU/h
5.0 °F	1.02 COP 97,200 BTU/h	.94 COP 89,400 BTU/h	.92 COP 88,000 BTU/h	.90 COP 85,600 BTU/h
14.0 °F	1.10 COP 105,400 BTU/h	.99 COP 94,500 BTU/h	.96 COP 92,100 BTU/h	.94 COP 90,100 BTU/h
19.4 °F	1.17 COP 111,900 BTU/h	1.05 COP 100,300 BTU/h	1.01 COP 96,900 BTU/h	1.00 COP 95,500 BTU/h
35.6 °F	1.30 COP 123,900 BTU/h	1.24 COP 118,700 BTU/h	1.15 COP 109,900 BTU/h	1.07 COP 102,400 BTU/h
44.6 °F	1.35 COP 129,300 BTU/h	1.34 COP 128,000 BTU/h	**1.26 COP** **120,400 BTU/h**	1.18 COP 112,600 BTU/h
50.0 °F	1.38 COP 131,700 BTU/h	1.37 COP 131,000 BTU/h	1.30 COP 124,200 BTU/h	1.23 COP 117,700 BTU/h
59.0 °F	1.40 COP 134,100 BTU/h	1.40 COP 133,400 BTU/h	1.34 COP 128,300 BTU/h	1.28 COP 122,200 BTU/h
68.0 °F	1.41 COP 134,800 BTU/h	1.41 COP 134,400 BTU/h	1.35 COP 129,300 BTU/h	1.30 COP 123,900 BTU/h
77.0 °F	1.41 COP 134,800 BTU/h	1.41 COP 134,400 BTU/h	1.36 COP 129,700 BTU/h	1.32 COP 126,200 BTU/h

GAHP AR
Coefficient of Performance Chart

COP – COOLING MODE			
EXTERNAL AMBIENT TEMPERATURE °F	**OUTLET CHILLED WATER TEMPERATURE °F**		
	37.4°F	44.6°F	50.0°F
59.0 °F	.68 COP 64,800 BTU/h	.67 COP 63,800 BTU/h	.68 COP 64,800 BTU/h
68.0 °F	.66 COP 63,500 BTU/h	.66 COP 63,500 BTU/h	.67 COP 64,100 BTU/h
77.0 °F	.63 COP 61,100 BTU/h	.65 COP 62,400 BTU/h	.66 COP 63,300 BTU/h
86.0 °F	.57 COP 54,300 BTU/h	.64 COP 60,700 BTU/h	.65 COP 61,800 BTU/h
95.0 °F	.46 COP 44,000 BTU/h	**.60 COP** **57,700 BTU/h**	.62 COP 59,400 BTU/h
104.0 °F	--	.54 COP 51,200 BTU/h	.57 COP 54,600 BTU/h
113.0 °F	--	--	.48 COP 46,100 BTU/h

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

Gas Absorptions Chillers

These commercial grade chillers offer complete hydronic flexibility for comfort conditional and industrial process cooling applications.

Less electrical energy consumption – reduce up to 87% of the electrical energy consumption

Uses 0.75KW of electrical energy to produce 60,500 BTU/h of cooling output.

Cost: $18,192 per unit (including installation)

ACF60 ST
Coefficient of Performance Chart

COP – Cooling				
EXTERNAL AMBIENT TEMPERATURE °F	OUTLET CHILLED WATER TEMPERATURE °F			
	37.4°F	41°F	44.6°F	48.2°F
32 °F	.62 COP 59,307 BTU/h	.63 COP 59,912 BTU/h	.64 COP 61,123 BTU/h	.66 COP 62,323 BTU/h
41°F	.62 COP 59,307 BTU/h	.63 COP 59,912 BTU/h	.64 COP 61,123 BTU/h	.66 COP 62,323 BTU/h
50°F	.62 COP 59,307 BTU/h	.63 COP 59,912 BTU/h	.64 COP 61,123 BTU/h	.66 COP 62,323 BTU/h
59 °F	.62 COP 59,307 BTU/h	.63 COP 59,912 BTU/h	.64 COP 61,123 BTU/h	.66 COP 62,323 BTU/h
68 °F	.62 COP 59,307 BTU/h	.63 COP 59,912 BTU/h	.64 COP 61,123 BTU/h	.66 COP 62,323 BTU/h
77 °F	.62 COP 58,701 BTU/h	.63 COP 59,912 BTU/h	.64 COP 61,123 BTU/h	.66 COP 62,333 BTU/h
86 °F	.57 COP 54,465 BTU/h	.62 COP 59,307 BTU/h	.64 COP 61,123 BTU/h	.66 COP 62,333 BTU/h
95 °F	.43 COP 40,546 BTU/h	.55 COP 52,650 BTU/h	**.64 COP** **60,517 BTU/h**	.65 COP 61,727 BTU/h
104 °F	-------	-------	.56 COP 53,255 BTU/h	.59 COP 56,281 BTU/h
113 °F	-------	-------	.43 COP 40,546 BTU/h	.50 COP 47,203 BTU/h
120 °F	-------	-------	-------	.41 COP 39,336 BTU/h

Nominal value in bold type

Applications

Application (Continued)

The Truly Green Choice

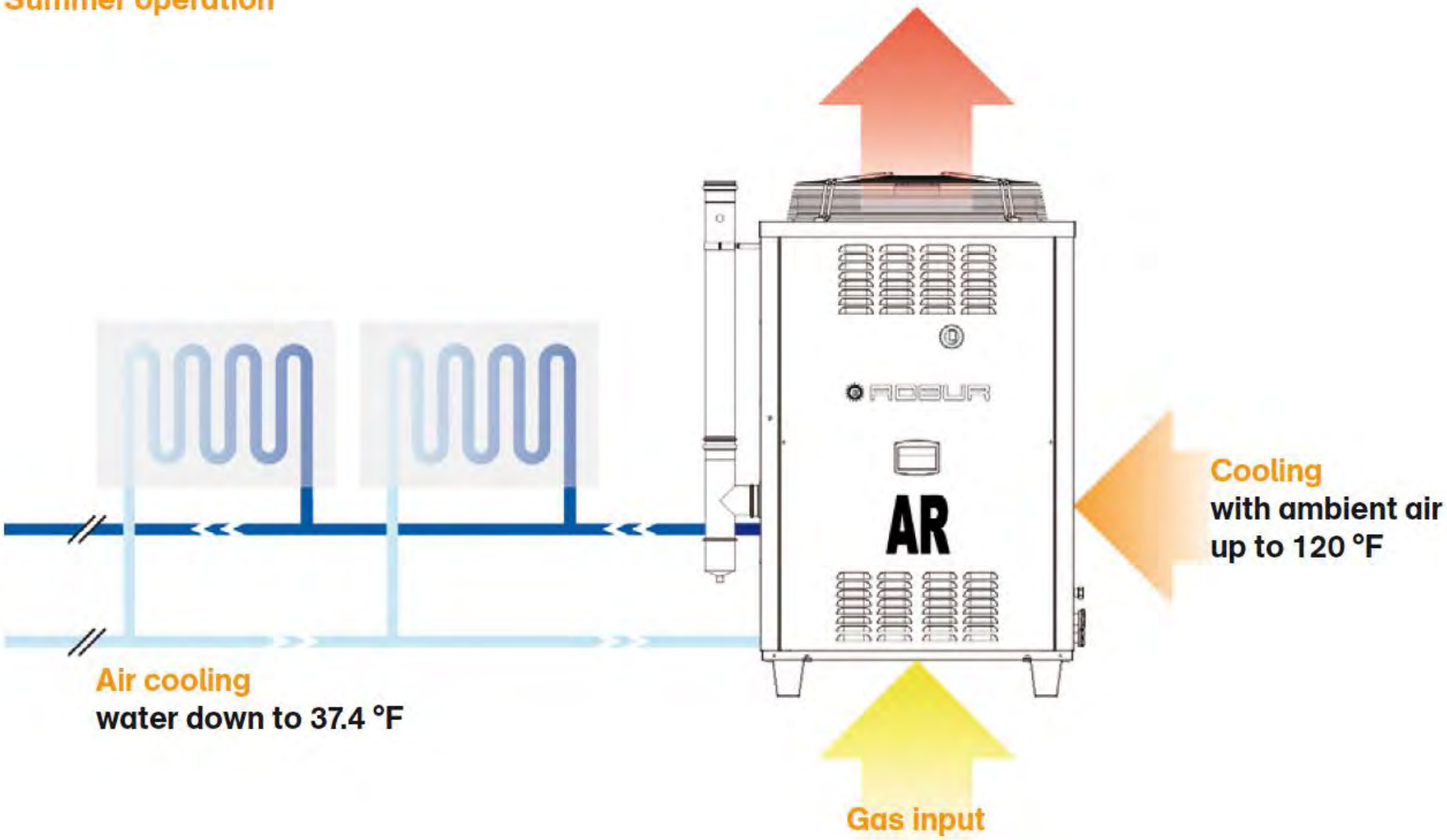
No CFC's, HFC's or HCFC's which deplete the Earths Ozone and contribute to Green House Gas Emissions

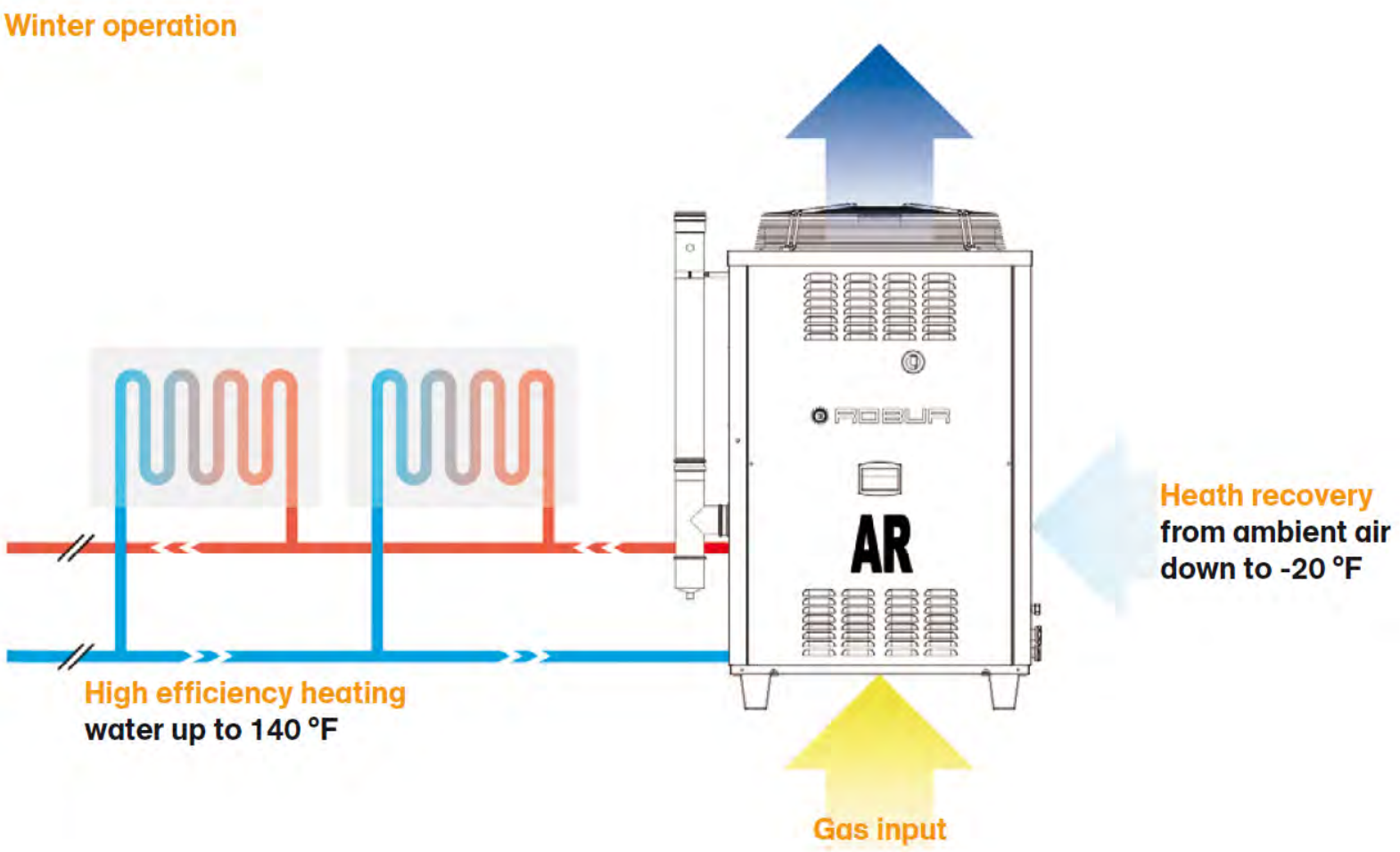
R-717 (Ammonia) Ozone Depletion Potential (ODP) = 0

R-717 (Ammonia) Global Warming Potential (GWP) = 0

No Refrigerant Phase-Out Date

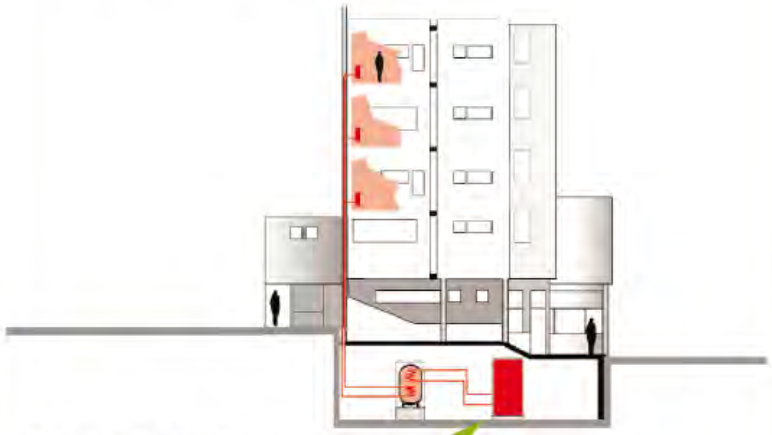
Summer operation



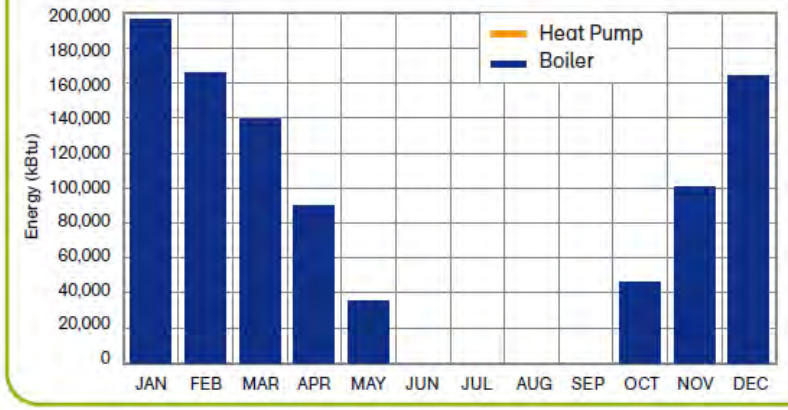

Winter operation
ROBUR
AR
Heath recovery
from ambient air
down to -20 °F
High efficiency heating
water up to 140 °F
Gas input

Boiler only

Seasonal System Efficiency: 86%
No outdoor reset curve

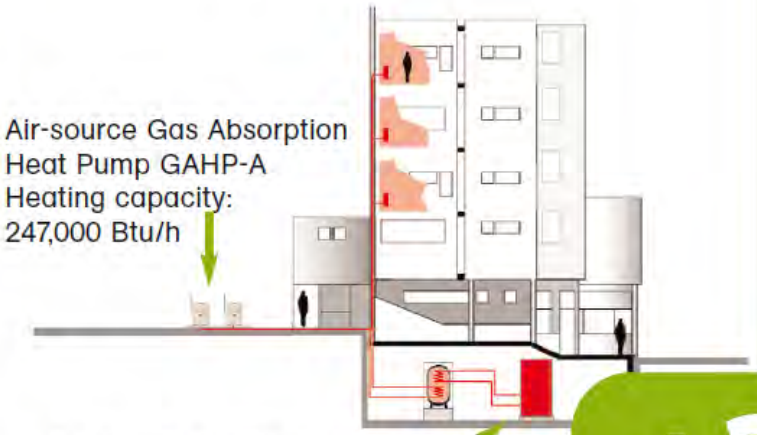


Existing Boiler Efficiency: 86%
Existing Boiler Capacity: 400,000 Btu/h



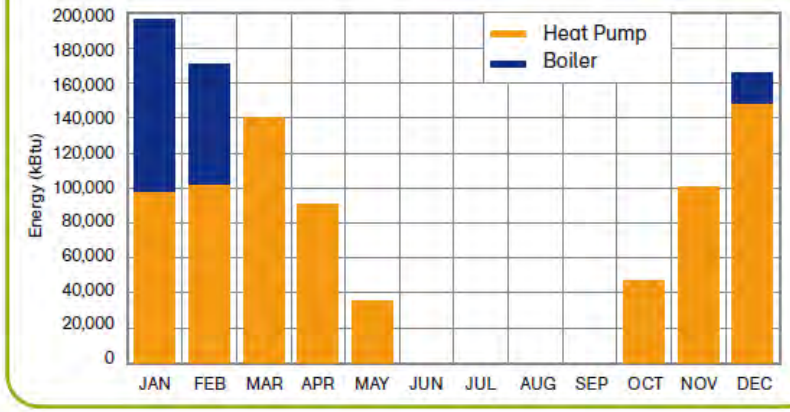
Boiler + Heat Pumps

Seasonal System Efficiency: 113%
Outdoor reset curve



Existing Boiler Efficiency: 86%
Existing Boiler Capacity: 400,000 Btu/h

+31%



Affordable Housing Opportunities

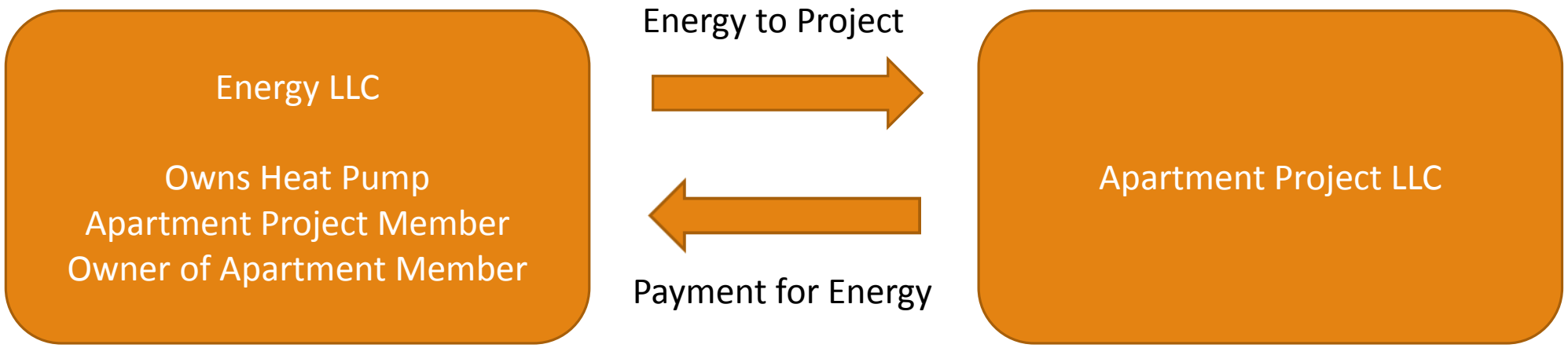
An affordable housing market of over 30,000 units – comprised of LIHTC, HUD, and Rural Development projects (does not include state, local, or private properties and units), needs integrated energy resources that will reduce their energy costs.

Energy alternatives will help reduce operations expenses which will improve the overall condition of affordable housing units

Roughly 70 percent of our affordable housing portfolio are on oil and propane. We feel this is a strong representation of the state, due to the region we cover. As such, the industry requires alternative heating solutions that run on oil or propane to provide the housing stock with additional energy efficient options.

The affordable housing industry needs to more energy efficient options that cut carbon emissions while reducing operating costs.

Incentives for Owners



Owner of Energy LLC can write off 100% of the cost of equipment in year one for Federal Income Tax Purposes

Contact Us

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