



# INVICTUS<sup>TM</sup>

Hydronic Heating and Cooling Systems  
with Gas Absorption Heat Pumps



The heat transfer innovators.

# INVICTUS

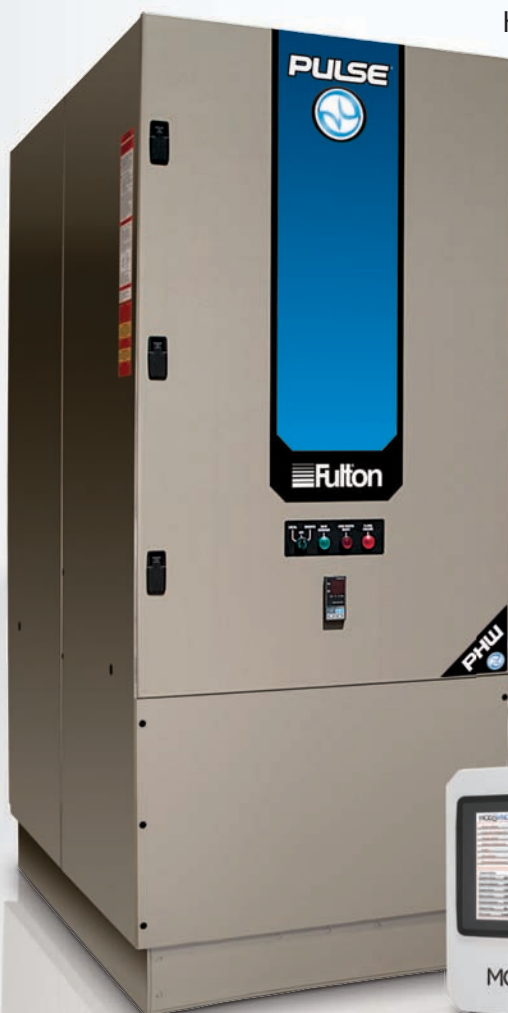
## HYDRONIC HEATING & COOLING SYSTEMS

### FEATURES

- Thermal Efficiency up to **149%**
- Gas Absorption Heat Pumps
- Renewable Energy
- Air, Water and Ground Source Applications
- Custom Systems Heat up to 240°F, Cool down to 37°F

### CUSTOMIZED CAPABILITIES

- **PROVIDE PRACTICAL SOLUTIONS** for HIGH PERFORMING GREEN BUILDINGS.
- Integrate gas absorption heat pumps into new and existing hydronic boiler systems to **SUBSTANTIALLY INCREASE EFFICIENCY** and **REDUCE OPERATING COSTS**.
- Increase heating efficiencies by up to **50%** over condensing boilers alone.
- Gas absorption heat pumps can be integrated with boilers, chillers and other technologies to meet requirements of a variety of commercial heating and cooling systems.
- Custom control packages facilitate communication between all relevant equipment.



# GAS ABSORPTION HEAT PUMPS

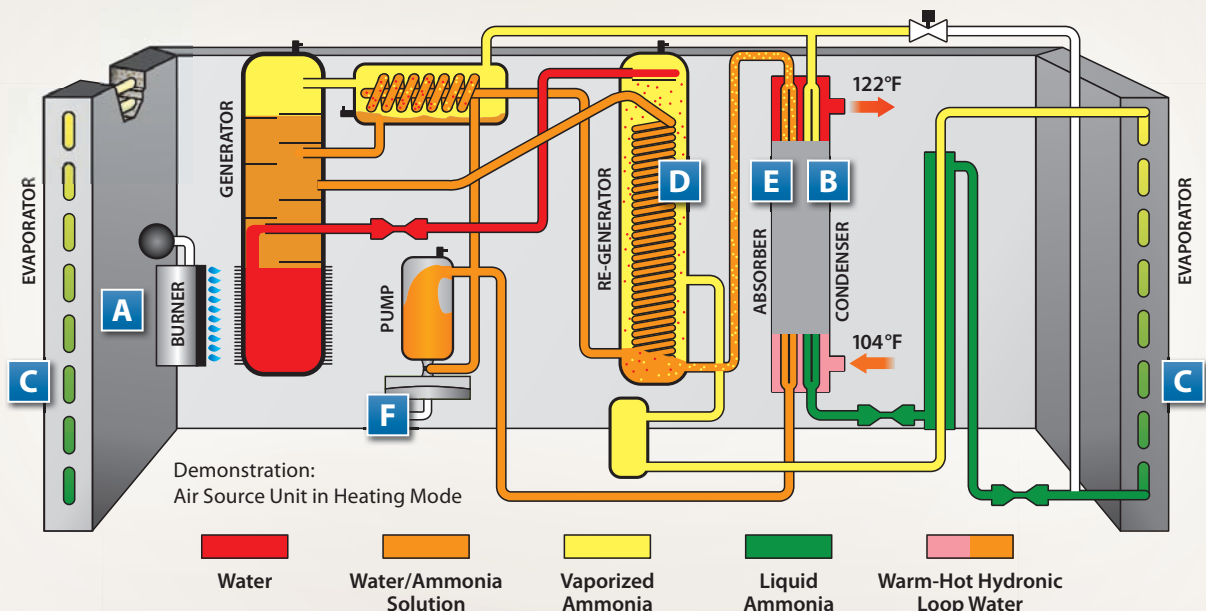
Gas Absorption Heat Pumps combine gas fired combustion with a refrigerant interacting with the environment. The heat pumps are hydronic, thus are used for heating or cooling water.

## TRADITIONAL GAS FIRED COMBUSTION

- Natural Gas Fired Combustion
- 95,500 BTU/Hr Input per heat pump
- Up to 142,600 BTU/Hr Output for heating
- Up to 5.5 Tons for cooling

## AMMONIA ABSORPTION PROCESS

- Water-ammonia solution (R-717)
- Ammonia is a natural and green refrigerant, with ZERO Ozone Depletion Value and ZERO Global Warming Potential Value



**A** Natural gas or propane fired combustion heats up the refrigerant solution contained in a chamber (generator). The heat from combustion separates the ammonia and water in the solution.

**B** Heat is transferred to the hydronic loop as a result of indirect contact with hot vaporized ammonia. The ammonia changes phase from a vapor to a liquid as this happens (condenses).

**C** As the liquid ammonia travels through the finned coil (evaporator), indirect contact with the outside air causes the ammonia to vaporize.

**D** Water is introduced to vaporized ammonia, resulting in a natural heat-producing exothermic reaction inside a chamber (re-generator). This is where we obtain free and renewable energy as a result of interacting with the environment.

**E** Heat is transferred to the hydronic loop as a result of indirect contact hot water-ammonia solution created in the re-generator.

**F** A small pump moves the solution back to the generator so the cycle can continue.

# AIR SOURCE MODELS

## APPLICATIONS:

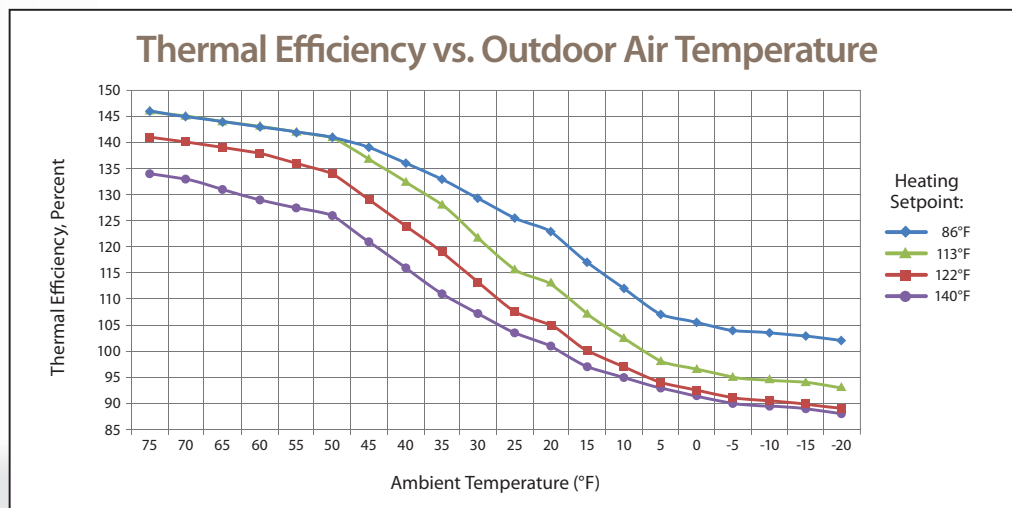
The air source models of the gas absorption heat pump can be used for hydronic heating and cooling applications. The IVS-095-A model is for heating only, and the IVS-095-AR is heating/cooling reversible.



Graphic: Air source models are installed outdoors.

## PERFORMANCE:

### Hydronic Heating Efficiencies: (IVS-095-A Model)



### Hydronic Cooling Capacities: (IVS-095-AR Model)

Outdoor Temp. (°F)	Output (BTU/Hr, Tons) 37.4°F Setpoint		Output (BTU/Hr, Tons) 44.6°F Setpoint		Output (BTU/Hr, Tons) 50.0°F Setpoint	
59	64,800	5.40	63,800	5.32	64,800	5.4
66	63,500	5.29	63,500	5.29	64,100	5.34
77	60,100	5.01	62,400	5.20	63,300	5.28
86	54,300	4.53	60,700	5.06	61,800	5.15
95	44,000	3.67	57,700	4.81	59,400	4.95
104	.....	.....	51,200	4.27	54,600	4.55
113	.....	.....	.....	.....	46,100	3.84

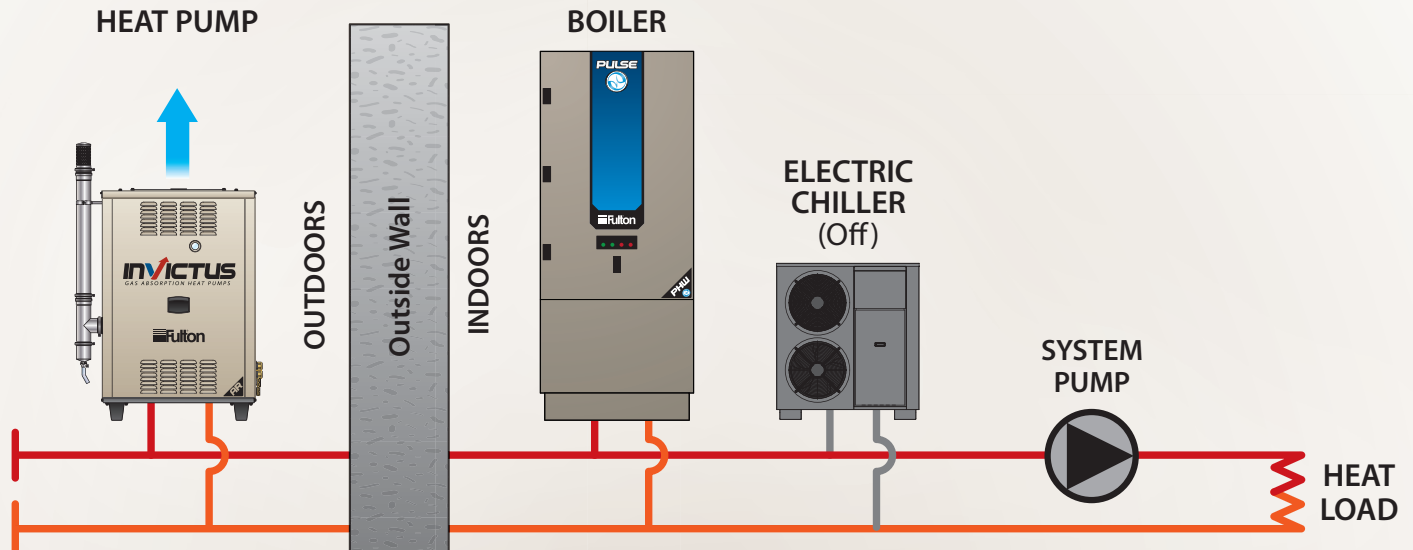


## OVERVIEW

The air source heat pumps either heat or cool water, and always interact with the outside air, integrating renewable energy.

## HEATING MODE

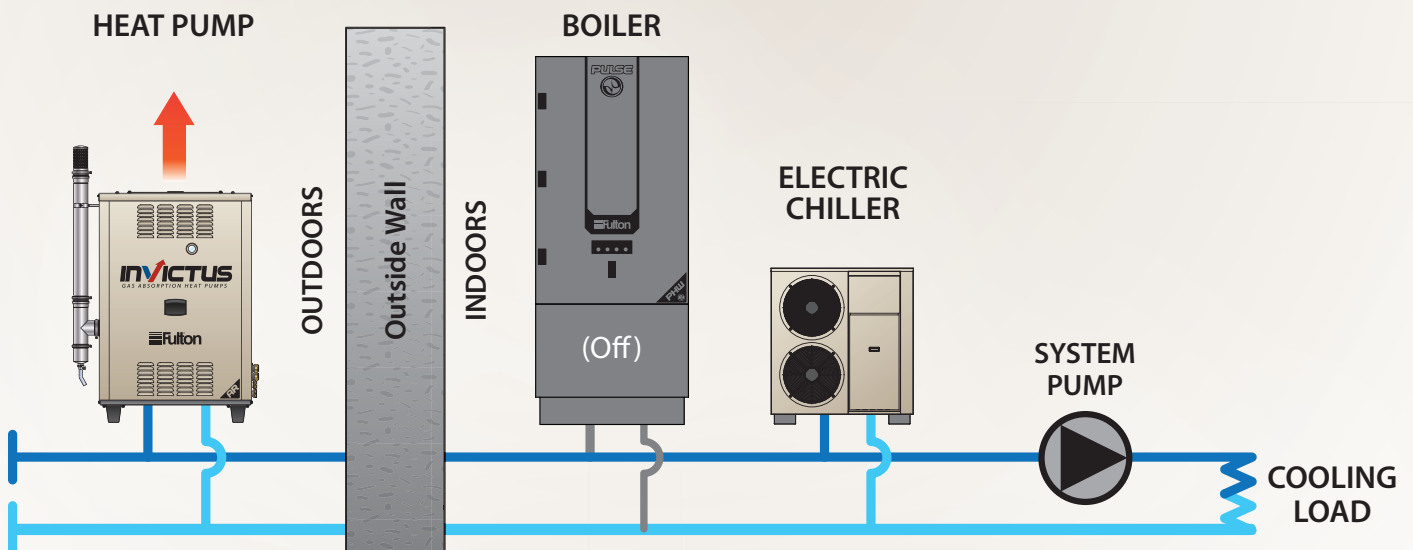
- Increase the efficiency of condensing boiler systems by **up to 50%**.



- The A or AR heat pumps can heat water up to 140°F. Systems should be designed to operate the heat pumps as much as possible as they are the most efficient component of the heating system.
- The boilers operate when water temperatures greater than 140°F are required (up to 240°F), or when the energy required to heat the building go beyond the available capacity of the heat pumps.

## COOLING MODE

- Satisfy small cooling loads without separate equipment dedicated to cooling.
- Hydronic cooling reduces air duct and fan sizes in a building.



- The AR heat pumps can cool water down to 37°F. Peak electrical demands can be offset with gas fired equipment.
- The electric chillers can be used to satisfy the base cooling loads.
- Smaller chillers can be purchased when the heat pumps are available to contribute to capacity requirements.

# WATER/GROUND SOURCE MODELS

## APPLICATIONS:

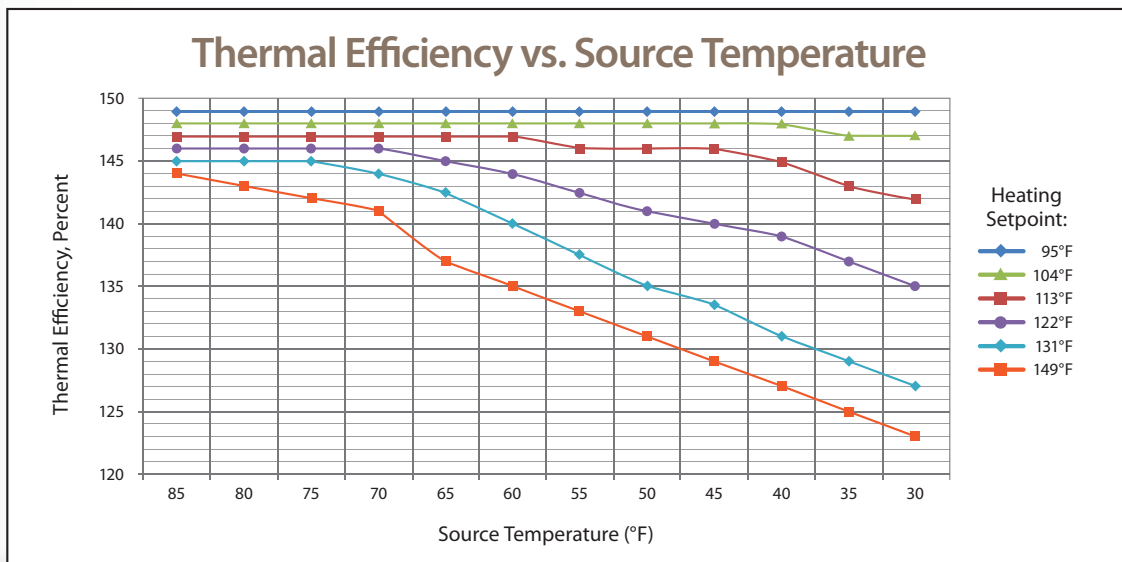
The water/ground source heat pump can be used for hydronic heating and cooling applications. The IVS-095-W model is for water source applications and the IVS-095-WLB is for ground source applications.

Graphic: Ground source models are installed indoors.



## PERFORMANCE:

### Hydronic Heating Efficiencies: (IVS-095-W Model)



### Hydronic Cooling Capacities: (IVS-095-W Model)

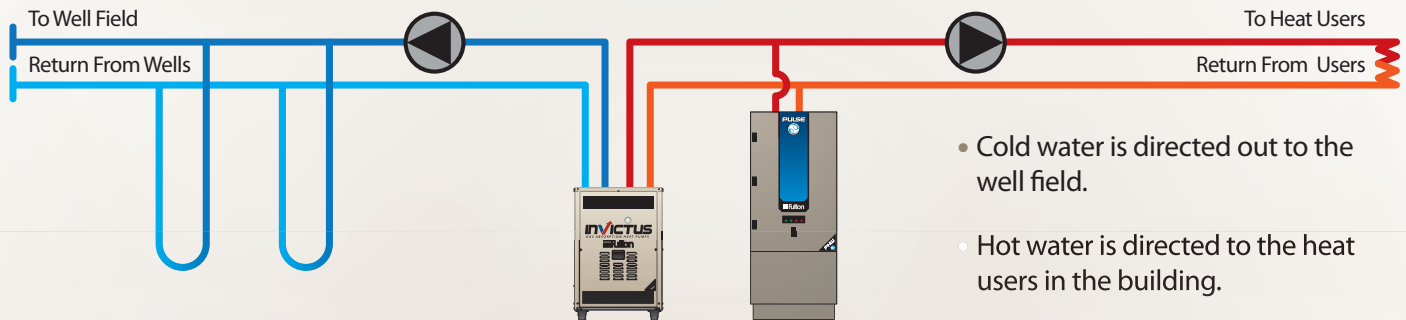
Chilled Water Inlet Temp. (°F)	Hot Water Circuit Temperature									
	95°F Circuit Setpoint		104°F Circuit Setpoint		113°F Circuit Setpoint		122°F Circuit Setpoint		140°F Circuit Setpoint	
	BTU/Hr	Tons	BTU/Hr	Tons	BTU/Hr	Tons	BTU/Hr	Tons	BTU/Hr	Tons
32	55,900	4.66	53,900	4.49	50,500	4.21	46,100	3.48	37,600	3.13
41	57,400	4.78	56,000	4.67	53,500	4.46	49,800	4.15	43,100	3.59
50	58,200	4.85	57,300	4.78	55,800	4.65	53,300	4.44	48,000	4.00
59	58,400	4.87	58,000	4.83	57,100	4.76	55,600	4.63	52,000	4.33
68	58,400	4.87	58,100	4.84	57,500	4.79	56,600	4.72	54,800	4.57
77	59,400	4.87	58,100	4.84	57,500	4.79	56,700	4.73	56,000	4.67

# OVERVIEW

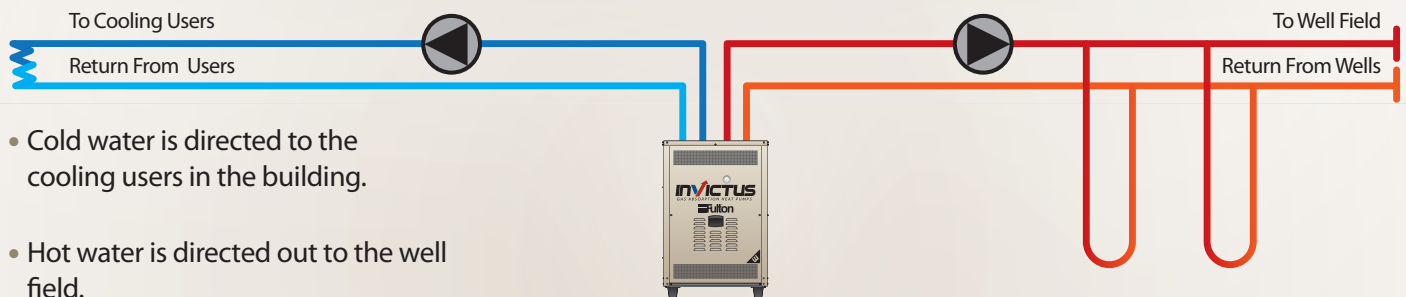
Commercial heating and cooling systems can be designed so the water/ground source heat pumps work with boilers, chillers or other technologies to manage load requirements.

- The W and WLB units simultaneously heat and cool water.

## HEATING MODE

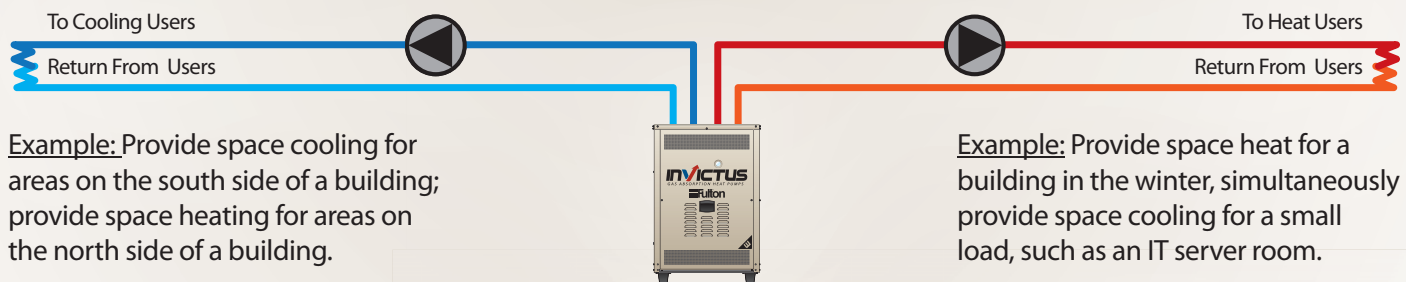


## COOLING MODE



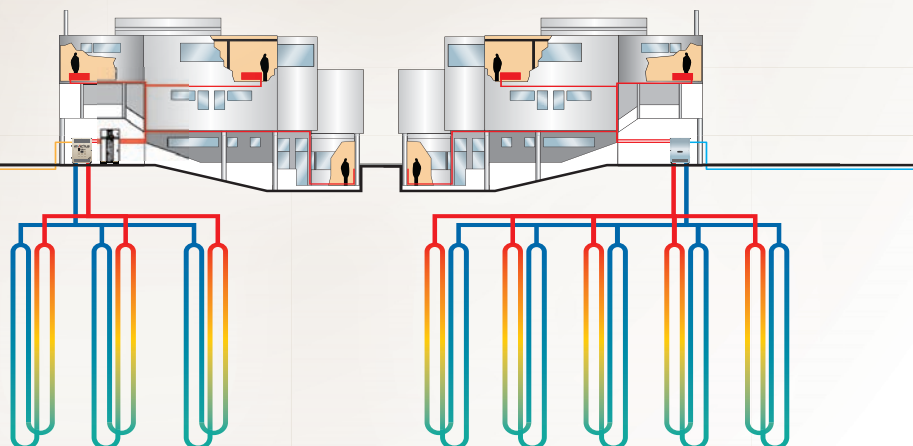
## HEATING/COOLING SIMULTANEOUSLY

- Instead of using the well field, it is possible to use both the hot and cold water for simultaneous applications.

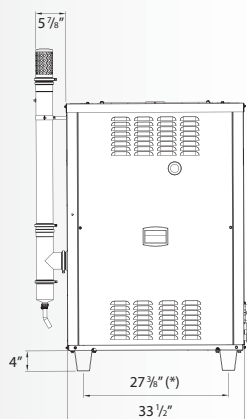


## WELL FIELD REQUIREMENTS

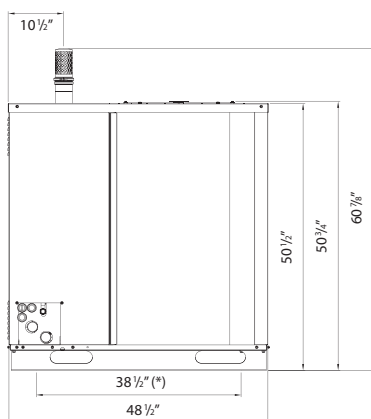
Gas absorption heat pumps require approximately **40% reduced size well field** compared to an electric heat pump system of similar capacity. This provides substantial savings in the up front capital investment associated with this infrastructure.



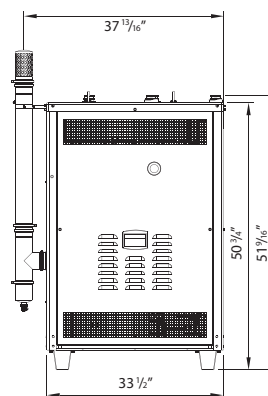
# SPECIFICATIONS AND DIMENSIONS



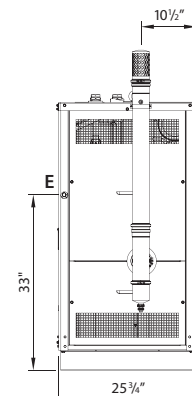
**A and AR Model  
Front View**



**A and AR Model  
Right Side View**



**W and WLB Model  
Front View**



**W and WLB Model  
Left Side View**

ENERGY SOURCE		AIR SOURCE		WATER / GROUND SOURCE	
MODEL		IVS-095-A	IVS-095-AR	IVS-095-W	IVS-095-WLB
Dimensions:					
Width	IN	33.5	33.5	33.5	33.5
Length	IN	48.5	48.5	25.75	25.75
Height	IN	50.75	50.75	50.75	50.75
Specifications:					
Application		Heating Only	Heat / Cool Reversible	Heat / Cool Simultaneous	Heat / Cool Simultaneous
Environmental Component		Outdoor Air	Outdoor Air	Water (Lake / Pond)	Ground
Input	BTU/Hr	95,500	95,500	95,500	95,500
Max Output Heat	BTU/Hr	139,200	134,800	142,600	133,800
Max Efficiency	%	146	141	149	140
Max Output Cool	BTU/Hr (Tons)	N/A	64,800 (5.4)	59,400 (4.9)	58,400 (4.9)
Max Hot Water Temp	°F	140	140	149	140
Min Cold Water Temp	°F	37	37	37	37
Max Ambient Op. Temp	°F	113	113	113	113
Min Ambient Op. Temp	°F	-20	-20	10	10
Electrical Rating	V/Ph/Hz	208-230/1/60	208-230/1/60	208-230/1/60	208-230/1/60
Electrical Consumption	kW	0.75	0.75	0.4	0.4

**Fulton®** The heat transfer innovators.

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