

RenewaBoiler Installation Instructions



RenewaBoiler from 2040 Energy is an air-to-water heat pump designed for high-temperature hydronic heating systems, such as cast iron and baseboard radiators, in single-family and small multi-family homes.

This document describes the design and installation procedures for the product. Our goal is to make the installation process fast and easy for professionals, and approachable for DIY enthusiast homeowners.

We are always interested in your feedback! If you have suggestions to make the process simpler or these instructions clearer, please let us know.

Before Installation: System Design

Suitability

RenewaBoiler is designed to replace or supplement fossil-fuel boilers in homes with traditional cast-iron and baseboard radiators. It can also be used to power low-temperature radiant heat (e.g., in floors or ceilings), and can also supply forced-air heat via a hydronic air handler.

However, there are certain scenarios for which RenewaBoiler is not a good fit:

- **Steam heating systems** – RenewaBoiler cannot generate steam, and thus cannot replace or supplement a steam boiler.
- **Very-high temperature hydronic systems** – The vast majority of hydronic radiant systems in the US and Canada can meet their designed heating load with a 160-175°F supply temperature. However, some homes require water temps of 180°F or higher. RenewaBoiler will not achieve these temperatures.
- **Gravity hot-water heating systems** – RenewaBoiler will not work efficiently without pumped water flow in the system. Gravity systems will need to be retrofitted to pumped hydronic to work with RenewaBoiler.
- **Placement issues** – RenewaBoiler must be placed outdoors near the home, and insulated water piping must be run from the heat pump to the existing boiler location in the home. This may be impractical in some cases (e.g. a row house with a sloped roof and no backyard).

Backup Heat

Each model of RenewaBoiler provides its nominal capacity down to temperatures below -10°F. This means that often, no backup heating system will be required.

However, backup heat is still recommended in the following situations:

- Remote locations where extended power outages are likely to occur.
 - Of course, a backup boiler without electricity is also useless. Make sure that the backup boiler and all its accessories (e.g. pumps) are operable with a generator or backup battery.
- When an electric utility offers significant discounts for an interruptible-service (“dual-fuel”) plan.
- Locations where ambient temperatures may fall below -15°F.
 - We recommend using 10- or 25-year record low temperatures to determine this. Note that ASHRAE design temperatures (even the 99.6% value) are not sufficient! 0.4% of a year means an average of 35 hours per year – and eventually there will be a once-in-a-decade extended cold snap with several consecutive days well below design temperature.

A RenewaBoiler customer with a cold house is a disaster for our business and for yours. Please avoid this situation!

Power Level

RenewaBoiler is available in three different power levels:

- **Medium** – 31,000 BTU/hr
- **Large** – 51,000 BTU/hr
- **Extra Large** – 96,000 BTU/hr

Simply match the RenewaBoiler power level to the heating design load of the home. These heating capacities are based on the heat pump performance at the most demanding conditions, so no temperature-based derating is required.

RenewaBoiler implements outdoor reset automatically, adjusting heating output and water temperature downward in warmer conditions.

If a backup heat source is present, you can round down to a smaller product size – otherwise, you should round up. (Though if the heating load is just slightly over a size threshold, a plug-in space heater can add an extra 4,000 BTU/hr of heat for those very coldest days.)

Heating design load can be estimated with either a Manual J calculation or from fuel usage history. Online tools at www.2040energy.com can help with this.

Physical

Dimensions

RenewaBoiler dimensions are 39" H x 69" W x 24" D.

It comes pre-mounted on two 24" support rails, spaced 40" apart center-to-center. These run in the depth direction and stick out 3" from the back side of the heat pump. (The front of the heat pump is curved, so the rails do not increase the dimensional size in the front.)

Full dimensional diagrams will be available upon product release.

Placement

Use the following guidelines when physically placing RenewaBoiler:

- **Outdoors**, in an area with free airflow. (Like any air-source heat pump, RenewaBoiler depends on free airflow to maintain performance. Airflow leaving the heat pump is chilled, so if this air is "recycled" back into the heat pump then it will not operate properly.)
- **At least 2' away from the house** or any other obstructions to the rear of the unit, for airflow and serviceability.
- **Secured to a solid base on flat ground**, sloped slightly away from the building. We recommend hard plastic pads such as the Diversitech E Lite series, though concrete will also work. Place the included vibration absorbers between the mounting rails and the base to reduce noise.
- **Near the indoor mechanical room** to minimize the piping required.
- **Away from bedroom windows**, especially on the ground floor, to minimize noise problems. (2040 Energy puts in huge effort to keep the noise level down, but no homeowner wants their sleep disrupted by their heat pump!)
- **Protected from snow drifting.**

Risers / Stands

In many cases, RenewaBoiler does not need a stand or risers. Its fan coil is elevated 8" above the ground, and the included support rails and vibration absorbers lift the heat pump an additional 1-2" to allow for water drainage.

However, if installed in an area prone to deep snow, a heat pump stand is recommended.

Electrical

Electrical installation of RenewaBoiler is comparable to that of other heat pumps and air conditioners:

- A dedicated 220-240V circuit is required, with two line-voltage conductors and a ground conductor. (No neutral conductor is required.)
- A service disconnect must be installed in a location readily accessible from the heat pump.
- All conductors, terminals, and breakers in the circuit must satisfy the unit's MCA (minimum circuit ampacity) and MOP (maximum over-current protection) rating.

Remove the back service panel to access terminal lugs for L1, L2, and ground connections. A knockout for power connections is located on the back of the unit.

MCA / MOP Ratings

For a given size of RenewaBoiler, the MCA and MOP ratings are always equal. They are as follows:

- **Medium** - 40A
- **Large** - 70A
- **Extra Large** - 100A

Electrical installations must follow the National Electrical Code and all local codes.

Refrigerant

RenewaBoiler comes pre-charged from the factory with R744 (CO₂) refrigerant. R744 is the most efficient refrigerant for high-temperature heating, and has an extremely low GWP (global warming potential).

Installation requires no handling or servicing of the refrigerant. The system design is a “monobloc”, meaning no refrigerant ever leaves the outdoor unit. Instead, heat is transferred via water (mixed with glycol).

IMPORTANT WARNINGS

R744 operates at extremely high pressures, up to 1,950 psig on the high side and 1,700 psig on the low side. Do not attempt to service the refrigeration system without R744-specific training and equipment.

RenewaBoiler may vent refrigerant through one or more pressure relief valves in the case of an unexpectedly high pressure. If this occurs, shut off power to the unit and contact 2040 Energy support.

Do not store or install RenewaBoiler in an unventilated area, as it can create an asphyxiation hazard. R744 is non-toxic and non-flammable, but if a large portion of the refrigerant were to leak or vent in an enclosed area, it could result in a hazardously high concentration of carbon dioxide.

Hydronic

RenewaBoiler is designed as a “monobloc” heat pump rather than a split system. This means that heat is transferred from the heat pump to the home via water (mixed with propylene glycol) rather than with refrigerant.

Connections

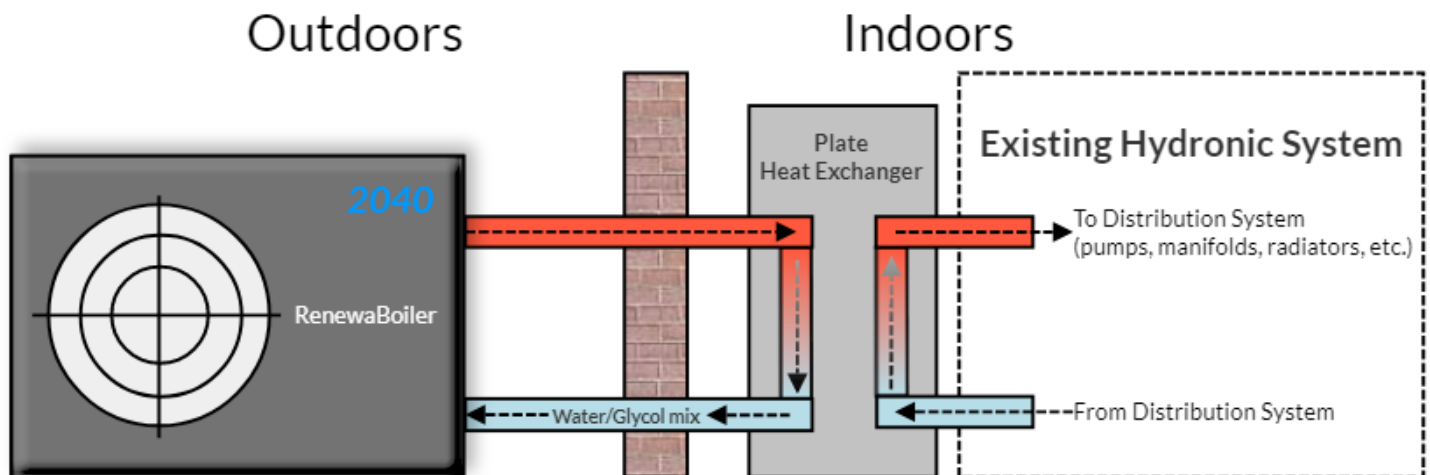
RenewaBoiler connects to the hydronic piping via universal flange connections, like a circulator pump. Use isolator flanges (or ball valves) to facilitate easier replacement for maintenance and upgrades.

These flange connections and the outdoor piping should be insulated to minimize heat loss. We recommend using pre-insulated PEX to save time and ensure complete insulation coverage.

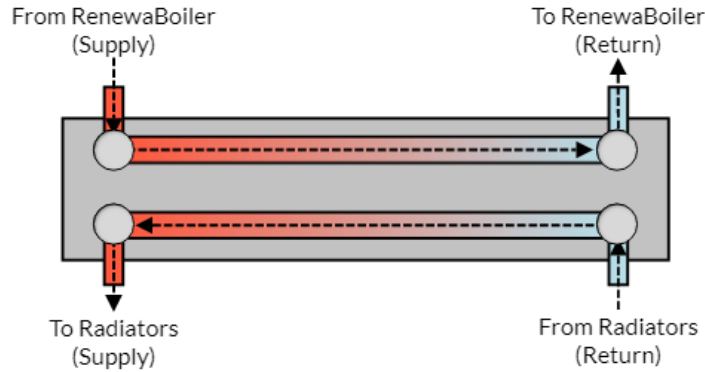
If there are ferrous elements connected to the piping, make sure to use oxygen-barrier PEX (or copper). The hydronic components of RenewaBoiler itself are stainless steel, copper, and bronze, so it can be used in an open-loop system.

Indirect Heating for Pure Water Systems

For a typical hydronic system that runs with pure water, RenewaBoiler must supply the heat **indirectly** – running on its own dedicated hydronic loop with glycol mix, connected to the main hydronic system via a plate heat exchanger. In this scenario, the heat exchanger acts as the heat source in the main hydronic system.



2040 Energy supplies a specially designed heat exchanger that minimizes the temperature loss between the glycol loop and the hydronic system. It is crucial that this is connected in a counterflow configuration – with the RenewaBoiler and hydronic supply connections both on one end and the return connections both on the other end.



The RenewaBoiler loop with glycol requires all the standard hydronic components: circulator pump, expansion tank, air separator, wye strainer, fill valve, and relief valve. If autofill is desired, it should come from a glycol feeder rather than a make-up water valve.

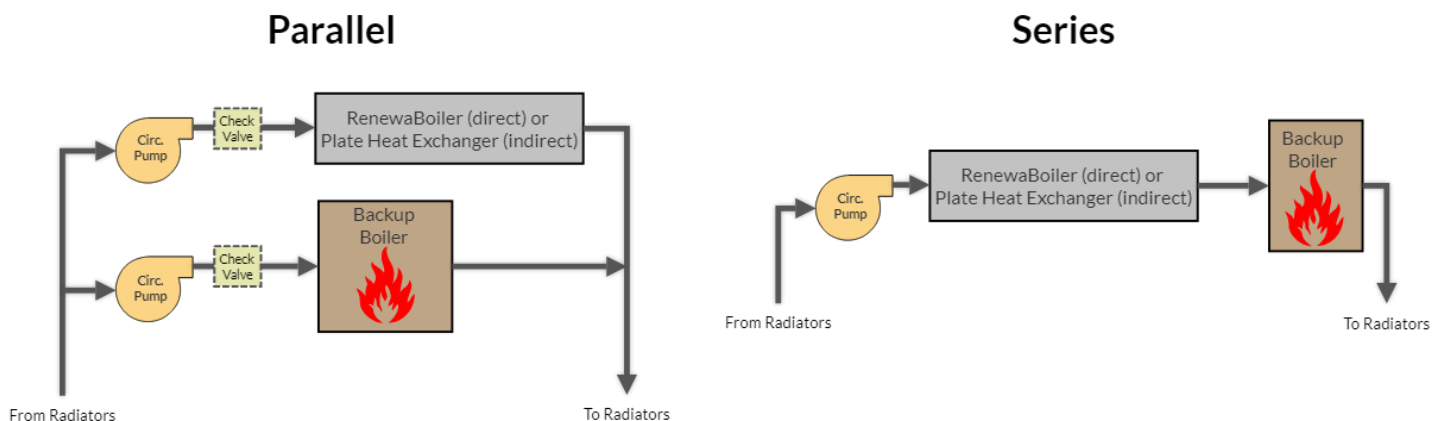
Direct Heating for Glycol Systems

If a hydronic system is already using glycol, then RenewaBoiler can be connected directly to the system (without the plate heat exchanger and separate hydronic loop).

We do not recommend converting an existing pure-water hydronic system to glycol to achieve this, as glycol is much more prone to leakage than pure water. There are many plumbing joints in the wild that are watertight but not glycol-tight!

Piping to Backup Heat

When a backup boiler is used, RenewaBoiler (or the plate heat exchanger, if using the indirect heating approach) can be piped either in parallel or in series with the backup boiler, as shown below.



The parallel approach allows each heat source to control its own circulator pump. This can simplify control wiring and allows for optimization of the RenewaBoiler flow rate (see the next section) without interfering with the existing boiler. It also adds redundancy in case one of the circulator pumps fails.

The series approach avoids the cost of an additional circulator pump.

Flow Rate

Unlike most air-to-water heat pumps, RenewaBoiler's performance generally improves with **lower** flow rates and a larger delta-T (temperature difference between supply and return water). However, too large of a delta-T can create comfort issues as radiators closest to the return line will not be as hot.

For most cases, we recommend targeting a flow rate that creates a 25°F delta-T at design load. However, if a home requires the maximum RenewaBoiler output temperature of 175°F then a 35°F delta-T is required.

Note that when using the indirect heating approach, the delta-T on the RenewaBoiler side of the heat exchanger should match the delta-T on the hydronic system side. Since pure water carries more heat per gallon than a glycol mix, the flow rate on the hydronic system must be around 10% lower.

For example, we recommend the following flow rates for a Large (51,000 BTU/hr) RenewaBoiler:

- RenewaBoiler (glycol) side: $51,000 \div 450 \div 25 = 4.5$ gal/min
- Hydronic (pure water) side: $51,000 \div 500 \div 25 = 4.1$ gal/min

The simplest way to achieve this is to use circulator pumps with a delta-T operating mode, and set each side to the same delta-T.

Buffer Tank

RenewaBoiler uses a frequency inverter that enables it to match the heating load of the home across a wide range of temperatures. However, on very mild heating days, even the lowest operating speed will generate far more heat than is required to heat the home.

To protect the compressor from short-cycling, RenewaBoiler will always run for at least 10 minutes every time the thermostat calls for heat – even if the call for heat is turned off. (This feature can be disabled in the heat pump settings by checking the box for “Allow Short Cycling”.) If the radiant system has a low thermal mass, this 10-minute heat cycle may over-warm the house.

A buffer tank can eliminate this problem. Use the following guidelines to determine if one is required:

- For a multi-zone system, a buffer tank is always recommended.
- Multiply the total hydronic system water volume by 1,000. If the result is significantly less than the RenewaBoiler nominal capacity (in BTU/hr), then a buffer tank is recommended.
- If you do not know the total water volume:
 - A system with cast-iron radiators or in-floor heat likely does not need a buffer tank.
 - A system with oversized supply pipes leftover from a steam or gravity system retrofit likely does not need a buffer tank.
 - Otherwise, a buffer tank is recommended.

Controls

RenewaBoiler offers the following low-voltage (24VAC) control connections.

24VAC		T-Stat			Aux		HP Flow		System Flow		DHW	
R	C	R	W1	W2	R	W	R	W	R	W	R	W

- **24VAC** is simply the terminals of an included 24VAC transformer. If you are using a backup boiler, you do not need to use these connections. Otherwise, jumper the **R** terminal to **T-Stat R** and connect **C** to the common wire from the thermostat (if the thermostat has a C connection).
- **T-Stat** is for connections to the thermostat in a single-zone system. **R** should be jumpered to either **Aux R** (if using a backup boiler) or **24VAC R**. **W2** is optional.
- **Aux** is for TT connections to a backup boiler. If using a backup boiler, jumper the **R** terminal to **T-Stat R**. Otherwise you do not need to use these connections.
 - Internally, the **W** terminal is a normally closed relay to **T-Stat W1** that is held open when the heat pump is operational and able to meet the heating load. If the heat pump is not able to meet the heating load, or if it loses power, the relay is closed such that the boiler TT is connected to the thermostat R/W.
- **HP Flow** is a normally open relay for controlling the pump on the RenewaBoiler piping. This can be connected to a zone relay to activate the pump to flow water to the heat pump.
- **System Flow** is a normally open relay for controlling the pump in the main hydronic system, when using the indirect heating approach. This can be connected to a zone relay to activate the pump to flow water on the hydronic system side of the heat exchanger. (If using the direct heating approach, you do not need to use these connections.)
- **DHW** is for activating water heating mode. In this mode, outdoor reset is disabled and the heat pump targets a high temperature and power output. If using an indirect water heater, connect these wires to the heating zone for the tank.

To make the connections, remove the back control access panel to access the terminal blocks. Two knockouts for control cables are located on the back of the unit. Make sure to use a cord grip rated for wet locations to prevent water from entering the heat pump. Also, make sure to use a cable rated for outdoor locations (we recommend direct burial wire, typically used for automatic sprinkler irrigation systems).

Commissioning

Linking to your 2040 Energy Account

RenewaBoiler is continuously tracking its performance and detecting potential problems. To gain access to this data, you must have a 2040 Energy account and the device must be linked to it.

If the device is correctly linked to your account, you will get a notification when it powers up in the field for the first time. This notification will contain a web link to the device info page, where you can check the status of the system and view troubleshooting data.

If this does not happen, contact 2040 Energy support and we will resolve the situation as quickly as we can.

RenewaBoiler does not require online connectivity to operate. This connectivity is simply for tracking performance, energy usage, and maintenance issues.

Testing

Once you have linked the RenewaBoiler to your 2040 Energy account, test the functionality of the heat pump by running the following test procedures:

- Test the heating by turning the thermostat up by 5°. Continue this test for at least ten minutes and ensure the heat pump is continuously supplying heat. Turn the thermostat back down and ensure the heat pump stops.
- If a backup boiler is being used, test it by shutting off power to the heat pump and again turning up the thermostat. Ensure that the backup boiler is now supplying heat. Continue this test for at least five minutes. Turn the thermostat back down and ensure the boiler stops. Turn the power back on to the heat pump.
- If an indirect water heater is being used, run a hot water faucet or shower for several minutes to stimulate hot water demand. Ensure that the heat pump supplies heat to the indirect water heater.

Troubleshooting w/ Direct Connection

The online RenewaBoiler status page updates once every minute. To troubleshoot more quickly with a real-time view of system status, pressures, temperatures, and more, you can connect a laptop directly to the RenewaBoiler as follows:

- Remove the back control access panel.
- Connect an ethernet cable from your laptop to the RenewaBoiler ethernet jack.
- Visit http://rb2040_XXXXXX.local, substituting the device serial number for the XXXXXX