

# Commercial Boiler Systems and Controls

Condensing  
Non-condensing  
Hybrid Systems  
Steel Medium Mass  
Copper Instantaneous  
Electric



**Riverside**<sup>®</sup>  
HYDRONICS

# An introduction to hybrid boiler systems

## What is a hybrid boiler system?

A hybrid boiler system combines condensing and non-condensing boilers into one system and operates the different types of boilers at different times depending upon loop temperature. An outdoor temperature reset system that occasionally reduces return loop temperature below 130°F is required for the hybrid system to function most efficiently.

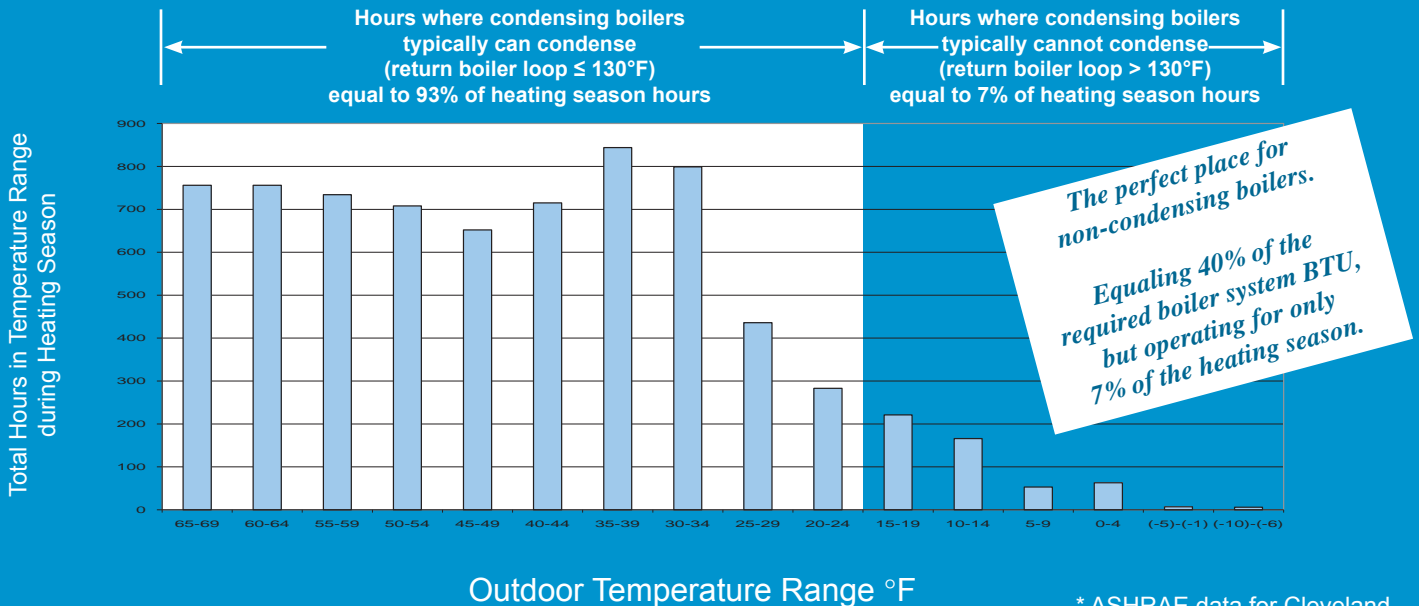
## Why use a hybrid boiler system?

A hybrid boiler system can significantly reduce the initial investment in the boiler system with only a slight increase in annual operating cost because non-condensing boilers are less expensive to purchase per Btu input when compared to condensing boilers.

## How does a hybrid system work?

Condensing boilers can save money because they're able to capture energy that is normally lost up the stack in a traditional non-condensing boiler. However, a condensing boiler is only condensing when the entering water temperature is less than 130°F. When entering water temperature is higher than 130°F, a condensing boiler becomes a non-condensing boiler. During the coldest times of the heating season, an outdoor reset system typically adjusts loop temperature upward to the point where water temperature is too high for condensing boilers to condense. Operating a condensing boiler under these circumstances results in only a slight increase in efficiency when compared to a non-condensing boiler. Also, the number of actual hours during the heating season with very low outside temperatures (and the highest loop temperatures) is a small fraction of the total heating season hours. Because the additional operating cost is small relative to the large difference in purchase price between condensing and non-condensing boilers, operating a non-condensing boiler when loop temperatures are elevated makes good financial sense.

Typical Heating Season Outdoor Temperatures\* and Boiler Loop Temperatures

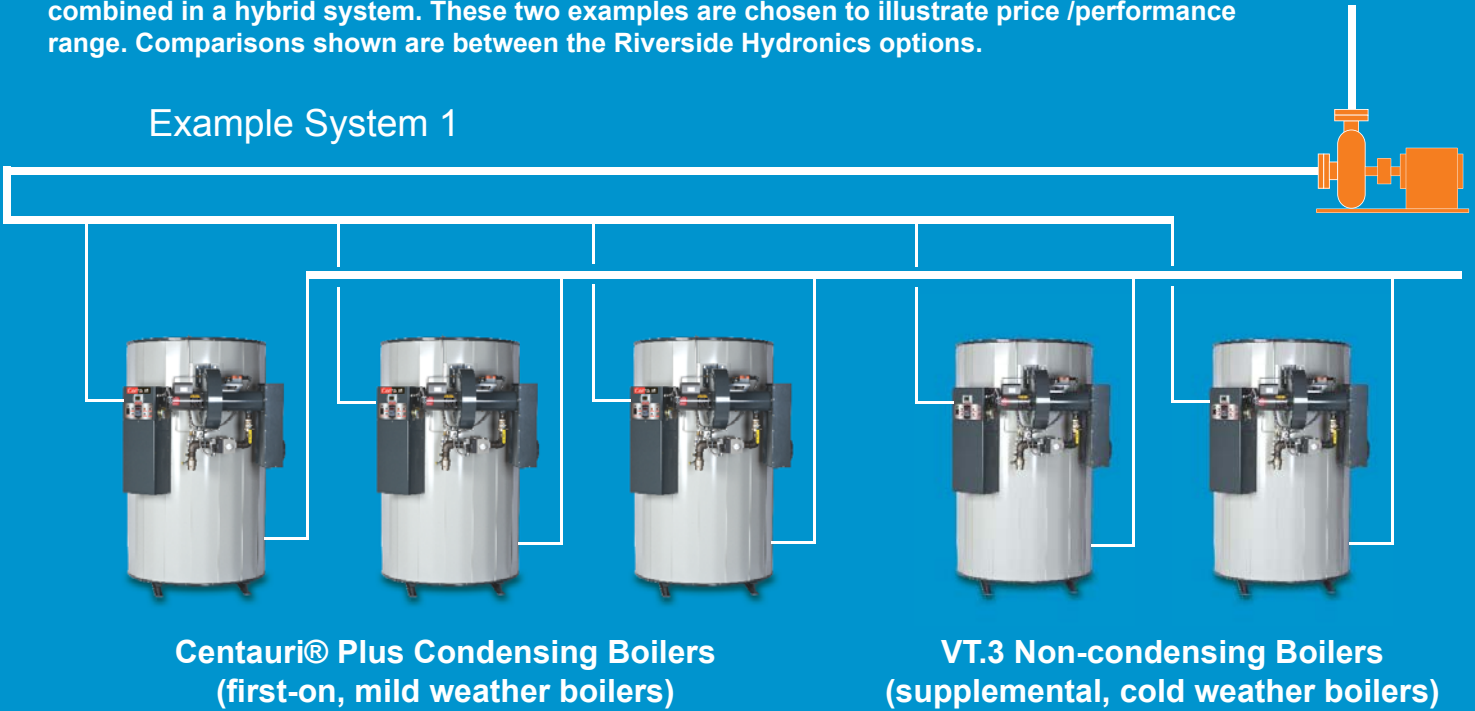


\* ASHRAE data for Cleveland

# Comparison of selected hybrid boiler systems

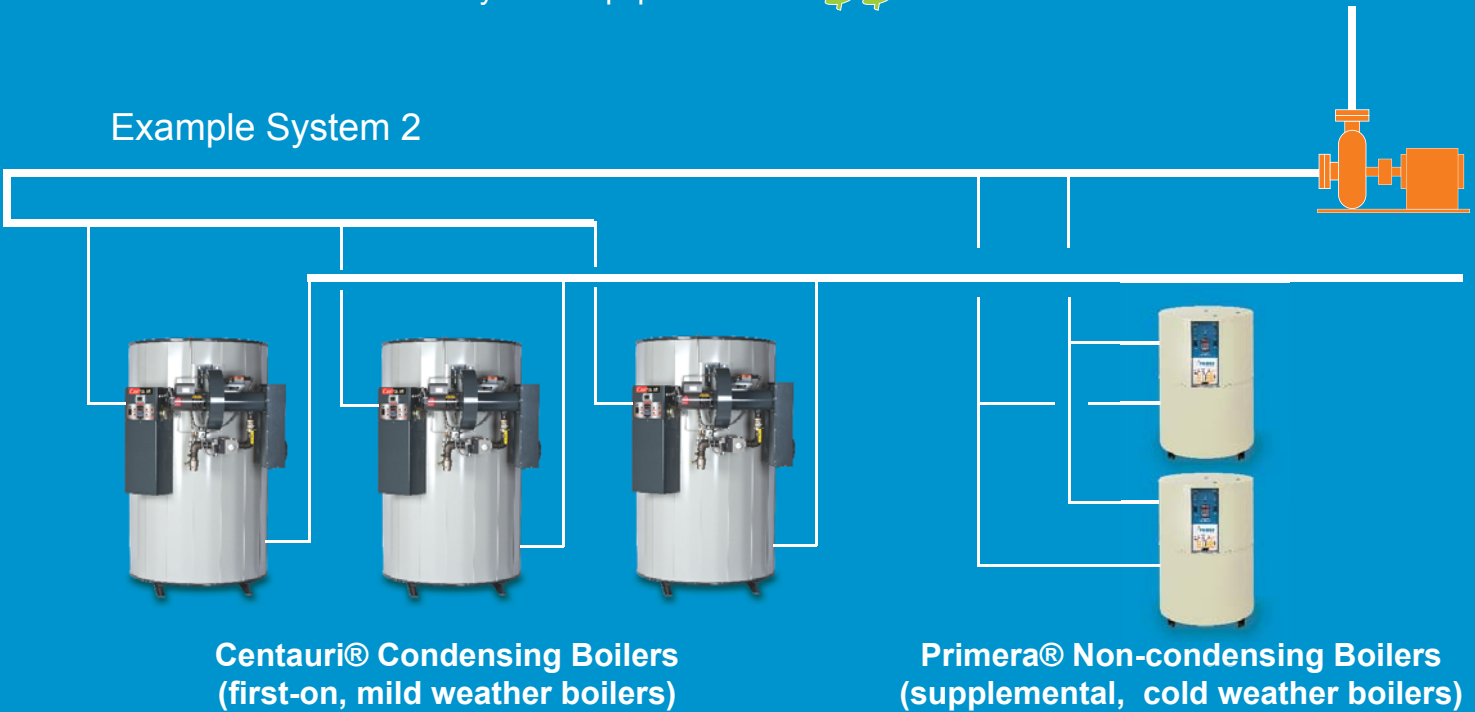
Any combination of Riverside Hydronics condensing and non-condensing boilers can be combined in a hybrid system. These two examples are chosen to illustrate price /performance range. Comparisons shown are between the Riverside Hydronics options.

## Example System 1



Annual Operating Efficiency: ★★★★★  
System Installation Cost: \$  
System Equipment Cost: \$\$

## Example System 2



Annual Operating Efficiency: ★★★★★  
System Installation Cost: \$\$  
System Equipment Cost: \$

## Condensing Boilers - medium mass



Centauri Plus features a supplemental economizer to boost efficiency to 99%.

### Centauri® Plus

Efficiency Range:	Up to 99% thermal efficiency
Inputs:	399,000 to 2,200,000 Btu (9 models)
Turndown:	Full modulation provided by VFD on blower and a proportionate gas valve ▪ Capable of 20-to-1 turndown
Burner:	Low NOx, pre-mix surface fired burner
Fuels:	Natural gas, LP or combination Nat/LP
Description:	Three-pass, steel fire tube design with supplemental economizer ▪ Condensing areas protected by PVDF acid-inert fluoropolymer *

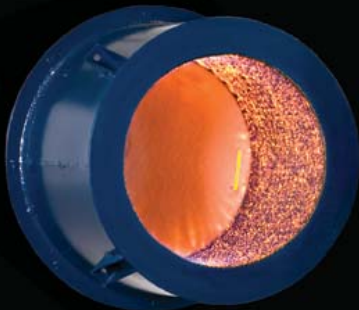
\* Polyvinylidene fluoride (PVDF) is a material that has been used for several decades in aggressive and acidic applications. It is the material of choice in piping that carries highly concentrated sulfuric and hydrochloric acids. Superior to stainless steel in acid environments.



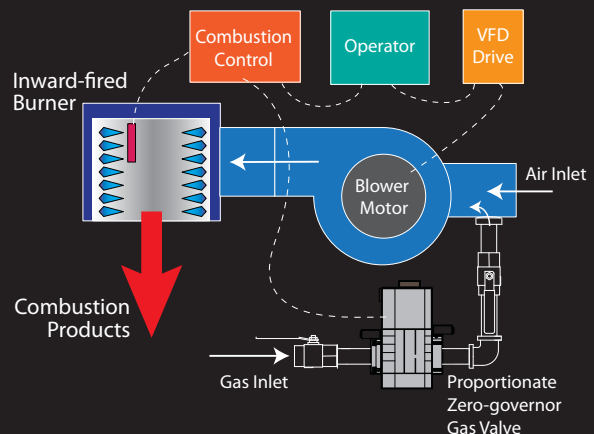
### Centauri®

Efficiency Range:	Up to 94% thermal efficiency
Inputs:	399,000 to 2,200,000 Btu (9 models)
Turndown:	Full modulation provided by VFD on blower and a proportionate gas valve ▪ Capable of 10-to-1 turndown
Burner:	Low NOx, premix surface burner
Fuels:	Natural gas, LP or combination Nat/LP
Description:	Three-pass, steel fire tube design ▪ Condensing areas protected by PVDF acid-inert fluoropolymer.

Inward fired burner technology, standard on 1.5 to 2.0 MMBH Centauri, Centauri Plus and VT.3 boilers



- Capable of turndown ratios of 20:1
- NOx levels as low as 7 ppm at low fire
- Dual-fuel capable, natural and LP gas
- Patents applied for worldwide



The Centauri burner features fully electronic modulation through a VFD blower motor control. Optimum combustion efficiency is maintained by a proportionating gas valve, a system that adjusts to changes in air density and vent pressure.

## Non-Condensing Boilers - medium mass



VT.3

Efficiency Range:	84% thermal efficiency
Inputs:	399,000 to 2,200,000 Btu (9 models)
Turndown:	Full modulation provided by VFD on blower and a proportionate gas valve ▪ Capable of 4-to-1 turndown
Burner:	Low NOx inward fired burner
Fuels:	Natural gas, LP or combination Nat/LP
Description:	Three-pass, steel fire tube design



EMX - Gas, Oil or Combination Gas/Oil

Efficiency Range:	82 to 84% thermal efficiency
Inputs:	399,000 to 1,400,000 Btu (7 models)
Turndown:	On-off operation with gas ▪ Staged firing available with oil
Burner:	High-efficiency, fan-assisted burners
Fuels:	Natural gas, LP, #2 oil or combination gas and oil
Description:	Single-pass, steel fire tube design

### What is a medium-mass boiler and what are the advantages?

A medium-mass boiler is a boiler that contains a moderate amount of water that acts as a thermal stabilizer or built-in buffer tank. This provides the following advantages:

Flow rate is not a critical requirement for proper boiler operation and, as a result, there are no limitations on VFD systems used on building pumps. With instantaneous (low mass boilers) the minimum boiler flow rate can dictate the minimum building flow rate, which can reduce the energy savings from the VFD system.

Boiler piping can be primary only; using the building circulator to directly flow water through the boilers. This is in contrast to the more complicated primary-secondary piping used for instantaneous boilers, where additional piping, valves, fittings and circulating pumps are required. Due to the criticality of flow rate, the sizing of all of these components also becomes critical in the proper operation of the boilers.

## OnTrac® Boiler Management System

OnTrac is a touch-screen interface, multiple boiler control that contains programming specific to the operation of hybrid boiler systems. The control is able to divide condensing and non-condensing boiler into sets; lead-lagging condensing boilers and leaving non-condensing boilers de-energized until all condensing boilers are on line. The control will then energize and lead-lag through the non-condensing boilers as necessary to supplement the heat output. This approach maximizes the seasonal efficiency of hybrid boiler systems.

Performance summary:

- Controls up to 20 boilers in standard mode, or up to 12 condensing boilers and 8 non-condensing boilers in hybrid system mode
- Color touchscreen interface
- 485 serial communication to individual boilers equipped with TempTrac control, allowing boilers to operate autonomously if the OnTrac control is off line
- Connect boilers with 2-wire, daisy chain
- Communication to Building Energy Management System using ModBus TCP/IP for full access to all registers. 4-20mA connection also available for simple remote temperature reset and shut down
- Customizable outdoor reset, nighttime setback, and firing sequence (parallel or sequential rotation)
- Alarm notification (optional)
- Local recording of operating history (remote optional)

BacNet serial and Ethernet protocols and LonWorks communication protocol are also available.



OnTrac model CS-8  
with 8-inch color screen

## TempTrac® Local Electronic Boiler Operating Control

Every Riverside Hydronics boiler is available with the TempTrac electronic operating control. It features LED readouts of both return and supply water temperatures and LED icons for burner and alarm status. User programmable including set points and differentials to initiate and terminate firing stages and establish modulation bands. TempTrac can also be programmed for a nighttime setback of loop temperature that is customizable by day of the week and hour. Accuracy is to within 1°F.

Unique among individual boiler controls, the TempTrac can monitor outdoor temperature and can be programmed to perform a reset of boiler loop temperature based on outdoor temperature.

Communication through serial connection and ModBus RTU protocol is available for monitoring by building energy management systems.



## PRIMERA® Finned Copper Boilers and Water Heaters

Efficiency Range:	84% thermal efficiency as a boiler 85% thermal efficiency as a water heater
Inputs:	399,000 to 2,000,000 Btu (7 models)
Turndown:	Full modulation with 3-to-1 turndown on 540 to 2000 MBH 400 MBH staged fired at 2-to-1 turndown
Burner:	Low NOx premix surface burner, proportionating gas valve
Fuels:	Natural gas or LP
Description:	Two or four pass copper tube boiler with integral tube baffles



PRIMERA offers:

- High boiler output with a low initial equipment cost
- Extremely small footprint with 2 million Btu input in a 30-inch diameter appliance
- Braze-welded tube and header joint that eliminates o-ring connections found in other designs
- Single panel access to all controls and gas train components
- Gas valve that adjusts to different vent pressures and air temperatures; optimizing efficiency
- Low gas pressure operation
- Category III sidewall venting capability
- Factory assembled piping manifolds are available

## Riverside Hydronics Storage Tanks

For connection to PRIMERA water heaters when providing high volumes of domestic water

- Storage from 225 to 3000 gallons
- Vertical or horizontal configuration
- Choice of either polymer or cement lining
- Five-year non-prorated warranty
- All non-ferrous tank connections
- ASHRAE 90.1 compliant at > R12.5 insulation
- ASME stamped for maximum allowable operating pressure of 125 or 150 psi
- Custom fitting locations and sizes available for installation flexibility



## Electric Water Boilers

- 18kW to 684kW input
- Incoloy heating elements, individually flange mounted in 18kW bundles
- Proportional sequencing



## Clean Steam Generators

- 1300 to 8000 lbs/hr of 15 psi delivered steam with 75 psi source steam
- 1900 to 12,000 lbs/hr of 15 psi delivered steam with 380°F source water
- Passivated stainless steel construction



## Warranty and Service Policies

### 10-year Non-prorated Pressure Vessel Warranty

The pressure vessel on all Riverside Hydronics boilers is covered for 10 years against failure due to manufacturing or material defect, thermal shock or condensate corrosion. Parts are covered for one year.

### Service Advantage Plan

For the first year, Riverside Hydronics will cover the freight and labor for any warranty covered repair or replacement. This is standard coverage on most boilers.

### Extended Service Advantage Plan

For 10 years, Riverside Hydronics will cover the freight and labor for any warranty covered repair or replacement. This is optional on all boilers.

See printed warranty and service policies for full details. Some exceptions and limitations apply. See individual submittals for warranty and service policy coverage.

