

CHOOSING DUAL FUEL CONDENSING BOILERS

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Dual-fuel capability is increasingly important not just because of local utility outages and equipment failures, but because of the possible disruption of regional gas supplies as well as uncertainties of gas availability during natural disasters, including extreme weather events.

Fundamental to the discussion of this capability when it comes to choosing boilers are two main use cases:

- ▼ **Critical Installations:** For heating processes that, per code or owner requirement, mandate the redundancy necessary to maintaining the safety of occupants and daily operations in many types of buildings, such as healthcare facilities, schools, federal buildings, and military operations.
- ▼ **Fuel Curtailment Programs:** For heating processes under the control of utility companies who manage primary fuel disruptions by either voluntary or mandatory reductions of customer usage.

Voluntary curtailment occurs when the customer signs up for a reduced utility rate (also called interruptible utility service) in exchange for agreeing to have the utility company reduce their use of primary fuel when its demand is high and/or its reliability is threatened.

Mandatory fuel curtailment ordinarily occurs after all available reductions have been achieved through voluntary curtailments. It is usually done as a last resort, and on a hierarchy or rotating basis, such as when gas suppliers tell industry to switch to a backup fuel to help offset residential demand.

As energy prices fluctuate and fuel costs rise, customers may, of course, decide to operate equipment based on whichever fuel is most economical for them—a flexibility granted only by dual-fuel equipment.

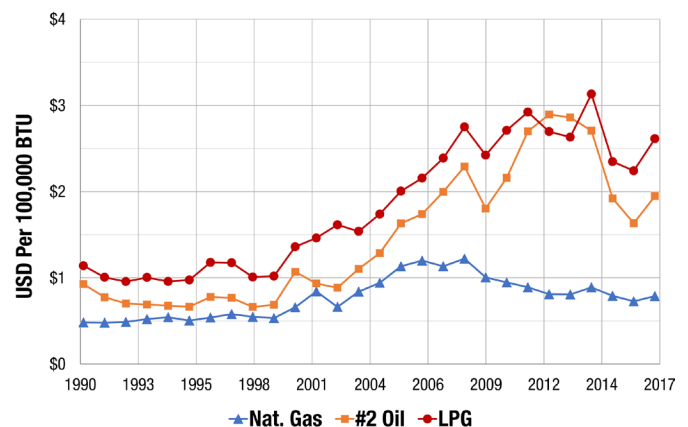
SELECTING APPLICATION APPROPRIATE FUELS

Multiple combinations of fuel are available for redundancy, including natural gas with #2 fuel oil, natural gas with propane, and propane with #2 fuel oil. But more owners and engineers are choosing to standardize on natural gas as primary with #2 grade fuel oil as backup.

No. 2 fuel oil is a top choice for the secondary fuel because it can be safely stored indoors, unlike liquefied petroleum gas (propane), which requires large tanks that must be installed outdoors. Propane storage tanks also have minimum clearance requirements to surrounding buildings, a requirement that is not always possible to comply with in metro areas. In addition, many climate zones will require the installation of costly propane vaporization systems to maintain suitable supply gas pressures on the highest-demand heating days.

In contrast to propane, No. 2 fuel oil has no such requirements, and in many cases is already available in buildings from prior installations or in facilities with backup electrical generators. So the same fuel oil used to power the generators can be piped right to the boilers, significantly reducing installed costs.

Fuel oil also has an advantage over propane when it comes to cost. Even though a gallon of heating oil currently costs about 13% more than a gallon of propane, #2 fuel oil has 48% more BTUs per gallon than propane, and Vantage boilers have on average 1% greater thermal efficiency on fuel oil than propane. Therefore, the operational cost of #2 fuel oil will be approximately 26% lower, as shown in Figure 1.



▲ **FIGURE 1: Energy Prices per 100,000 BTU/hr.**
Source: U.S. Energy Information Administration

Also, in regard to the type of fuel oil chosen, #2 grade fuel oil is considered the cleanest burning and thus the preferred choice over heavier petroleum-based liquid fuels such as #4 and #6, which have been phased out in most locales due to installation costs as well as emissions concerns.

DUAL FUEL GAS/OIL FEATURES AND BENEFITS

As an ever-increasing number of consulting engineers and building owners turn to ultra-high efficiency condensing boilers for their heating needs, it's important to be able to adapt this newer technology while still preserving critical fuel-redundancy requirements.

For many years, this was simply not possible unless a hybrid boiler plant was selected. For example, a hybrid plant may consist of a bank of modular gas-fired condensing boilers in combination with one or more fuel-oil fired, cast iron or scotch-type firetube boilers.

For obvious reasons, this type of installation results in much higher costs and complexity due to greater total plant burner capacity, conflicting stack types, separate water temperature and flow requirements, different maintenance and service, and added sequence-of-operation programming for the controls contractor.

In 2004, however, Fulton revolutionized the boiler industry with the introduction of the Vantage, *the first ever dual-fuel gas and oil condensing boiler sold in North America.*

With the Vantage, engineers could now dramatically reduce the physical size and complexity of their heating plant designs. And for the first time ever, owners could realize unprecedented energy savings with AHRI-certified thermal efficiencies as high as 98.1% while simultaneously preserving critical fuel-oil redundancy.

TRUE CONDENSING ON NO. 2 FUEL OIL

Consider also that Fulton's Vantage boiler is capable of operating in condensing mode not just on natural gas, but on #2 fuel oil as well.

Fulton's Vantage is optimized for ultra-high efficiency condensing operation on gas, while incorporating the capability of operating in a condensing mode when firing on #2 fuel oil, provided the fuel oil has a guaranteed sulfur content of <15 ppm. This fuel type is known as ultra-low sulfur (ULS) #2 fuel oil, or S15. It is the cleanest burning heating fuel oil available.

When operating on standard #2 fuel oils such as regular S5000 or low sulfur S500, the boiler must be operated in non-condensing mode to protect the heat exchanger and the building's sewer system from corrosive effects of sulfuric acid.

IMPORTANCE OF FUEL SWITCHOVER AND OPERATION SIMPLICITY

In the event of a fuel disruption, fuel switchover speed can be critical. Changeover capability should therefore be automated, if possible, so that swapping fuels is as simple as flipping a switch. This ability is a hallmark of Vantage, along with these other important operational features:

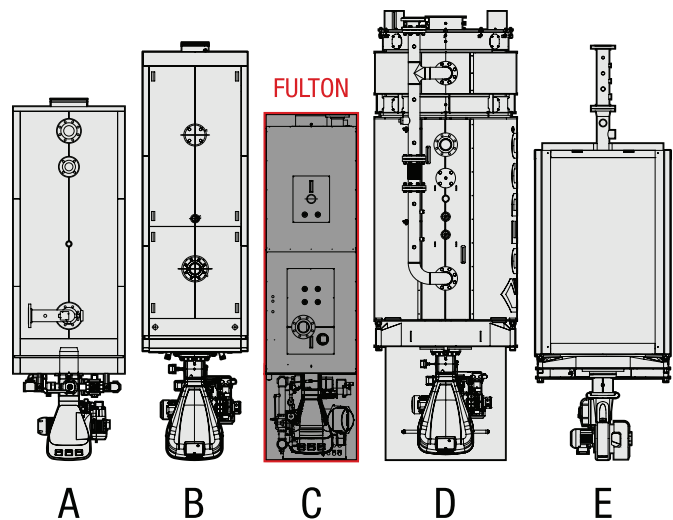
- ▼ Full BTU/HR input capacity on both fuels (no de-rate)
- ▼ No gas pilot required on oil (has direct spark oil ignition)
- ▼ No compressed air requirement for fuel atomization
- ▼ Minimal inspections or "cleanouts" required

VANTAGE VERSUS OTHER MANUFACTURERS

In the years since Vantage was introduced, other manufacturers have also released dual-fuel condensing boilers, but it's important to carefully consider the distinguishing installation and operation characteristics between each type.

Be aware of gas/oil condensing boilers on the market today which utilize an outsourced European heat exchanger engine optimized for use with natural gas or propane only. The manufacturer will fit the imported heat exchanger with a gas/oil burner, which will of course function, but with extremely strict oil run-time limitations ranging from 8 to 120 hours that preclude continuous operation.

Upon reaching this run-time limit, the heat exchanger must be opened, dissected and cleaned with power-washing equipment before resuming fuel-oil operation or switching back to gas-fired mode. For customers who don't expect to utilize their secondary fuel source for more than a few hours per year, this may be perfectly acceptable; for all others, it is clearly not.



▲ **FIGURE 2: 3,000,000 BTU/hr Dual-Fuel Condensing Boilers**

Another consideration is physical footprint size, which is to say the Fulton Vantage is generally, by far, the most compact in its class (see C in Figure 2). Additionally, Vantage gas/oil boilers are approved for 1-inch (25mm) side clearance, while competitors often have minimum side clearances of 24 inches (610mm) or greater. The net result is a more compact boiler with an even more compact installation, and therefore greater flexibility for both new installs and retrofits.

Materials of construction are also of critical importance inside the unforgiving environment of a fuel-oil fired condensing boiler. Material type and tube thickness directly contribute to safety margins relative to long-term durability in mitigating the effects of corrosion and fatigue.

That's why it's important to know that nearly every manufacturer of gas/oil condensing boilers use stainless steels from the 316 (austenitic) family in their designs, while Fulton's Vantage is instead built with LDX2101, a duplex alloy grade of stainless steel.

Compared to 316L, duplex has a 23% reduction in thermal expansion with 19% greater strength. Therefore, not only does 316L experience greater stresses of operation, but it also has less strength to deal with these higher stresses. Simply put, all other conditions being equal, duplex stainless steel will significantly outlast 316L in condensing boiler applications.

Lastly, the Vantage is fully factory assembled and fully factory tested including hydrostatic, hipot, fire test, safeties, and communication. Not all dual-fuel boilers are packaged in this manner, instead relying on the installation contractor to assemble boiler parts kits in the field.

For all of these reasons, Fulton continues to command a market-leading position, with the closest competitor in a distant second. Fulton has, by far, the most experience, install base and service network for dual-fuel boilers relative to any other manufacturer.

Thousands of customers rely on Fulton Vantage boilers for reduced cost of operation, unmatched combustion precision, and a robust pressure vessel design that is exceptionally tolerant of unexpected hydronic system conditions.