In a current remodeling project, the clients need to replace their gas boiler. Does it make sense to upgrade to a condensing boiler?

A Foster Lyons, an engineer and building-science consultant, responds: Because condensing boilers are 10% to 12% more efficient than equivalent non-condensing models, you'd think this question would be easy to answer—just figure out fuel costs and the cost of the equipment and run the numbers, right? But it's not quite that simple, because of the differences between the two types of boilers.

With a traditional (non-condensing) boiler, the exhaust gases are very hot, typically around 400°F. Those hot exhaust gases are immediately sent up a chimney and take a lot of thermal energy with them, which limits the energy efficiency of traditional boilers.

A condensing boiler, on the other hand, has components in the flue system that transfer some of that thermal energy from the hot exhaust to the water that is being heated. In the process of transferring that energy, the exhaust gases cool enough to cause condensation of the water vapor from those gases, hence the name "condensing boiler."

The exhaust from a condensing boiler is typically around 100°F—much cooler than the exhaust from a traditional boiler. In short, compared with traditional boilers, condensing boilers take a greater percentage of the energy inherent in the fuel and transfer that energy to the water being used for heat.

However, this increase in appliance efficiency adds a variety of complications. First, the controls for condensing boilers are more complex. Water returning to the boiler (after heating the house) is used to pull the thermal energy out of the hot gases in a heat exchanger. The temperature of that return water can't be too high; otherwise, the exchange of heat doesn't happen properly. Maintaining an optimum return temperature requires more controls than on a traditional boiler.

Second, the liquid condensate that is generated in the exhaust heat exchanger needs to be drained off somewhere, which usually requires a reservoir and a pump of some sort **(1)**. Third, the condensate liquid has a pH in the range of 3 to 5 (not as acidic as lemon juice, but more acidic than milk and about the same as tomato juice). That means the exhaust heat exchanger—and anything else the condensate liquid may touch—needs to be chemically resistant to acid. Stainless steel or aluminum-silicon alloys are the materials of choice. Also, because of this high acidity, the exhaust cannot exit through the same masonry chimney that is being used for the existing boiler without an acid-resistant liner.

Fourth, because the exhaust from a condensing boiler is relatively cool, it's not particularly buoyant. It doesn't go up a chimney very easily, like the 400°F exhaust from a traditional boiler does. So the exhaust needs to be pushed out with an exhaust fan. These added components boost the cost of condensing boilers compared with that of non-condensing boilers with the same output.

In addition to the fuel-efficiency benefit, the exhaust flue for a condensing boiler doesn't need to be masonry or metal. It can be made from ABS, PVC, or CPVC pipe with a high-temperature rating **(2)**. Because these less expensive materials can be used, gases from a boiler are commonly exhausted through a sidewall or rim joist rather than through a chimney, which can make a condensing boiler a good option for new construction. In your replacement scenario, the clients need to weigh the potential long-term fuel savings against the immediate added cost of upgrading to a condensing boiler.

1

2

Condensate from a condensing boiler drains into a reservoir and is then pumped safely to the outdoors **(1)**. With relatively low exhaust temps, the flue can be a plastic pipe with a high-temperature rating (gray) **(2)**. This jurisdiction requires rated pipe for just the first 5 feet from the boiler.

Photos by Roe Osborn

Q Can screws be used instead of nails for attaching wall sheathing to framing?

A Nick Robertson, product application specialist for Huber Engineered Woods, responds: There is a common misconception in the building industry that screws always outperform nails when attaching wood to wood. It's true that screws have a highly effective withdrawal resistance, which makes them excellent fasteners for tasks such as avoiding squeaks in flooring assemblies, resisting uplift forces that occur in roofs, and holding deck ledgers tight to a building. However, there are certain applications where nails are superior for fastening.

By design, nails are less brittle than screws, which leads to an increase in shear strength for nails. In other words, if two pieces of wood (or wood and metal) are fastened together and those materials are forced in opposite directions, the forces acting on the fastener are likely to cause the shank of a screw to break. A nail subject to the same forces is much more likely to bend without breaking, which in turn keeps the two pieces of wood joined together.

Let's take this simple concept and apply it to a braced wall application. Braced walls are areas of framed wall that contain no door or window openings (although some engineered braced-wall designs do allow for openings). These walls must have let-in bracing, diagonal board sheathing, or some sort of code-approved sheet material to stiffen the structure against racking. In a typical braced wall, the framing is primarily secured by a structural sheathing panel, such as OSB or plywood. The most important force at play for this wall is a shear force from the wall moving back and forth laterally due to wind or seismic activity.

The sheathing panels brace the framing to stop the wall from toppling over, and increasing the number of fasteners increases the wall's shear resistance. Now imagine if some of those edge fasteners start to fail. For every fastener that fails, the shear resistance of the entire wall decreases; in the worst-case scenario, the entire wall might end up failing, ultimately causing failure of the entire structure.

Because of this concept, many building-standards groups specify that only nails and staples are to be used for wood structural panel attachments in wall applications: ANSI National Design Specification, NDS Chapter 12: Dowel-Type Fasteners; AWC Special Design Provisions for Wind and Seismic, Chapter 4: Lateral Force-Resisting Systems; and the 2018 International Building Code, Section 2304.10: Connectors and fasteners.