



# LEEP Case Study 1.2: Combination Space and Water Heating Systems

This case study is part of a series that explores how builders resolved issues through their participation in Natural Resources Canada's Local Energy Efficiency Partnerships (LEEP) process.

## The Builder

**Doug Tarry Homes** ([www.dougtarryhomes.com](http://www.dougtarryhomes.com)) is an ENERGY STAR® builder in St. Thomas, Ontario that typically builds 75 to 100 single detached homes annually.



Doug Tarry Homes single detached home

## The Challenge

Providing even air temperatures throughout homes that have low design heating loads.

## The Technology Choice

**Combination space and water heating systems** provide space and water heating with a single heat source. The heat source is typically a gas-fired on-demand water heater, tank-type water heater or boiler. Space heating is typically provided by a forced-air fan coil (air handler), though a system may also use hydronic baseboards or radiant floor heating.



Combination Space and Water Heating System installed by Doug Tarry Homes.

## The Result

Doug Tarry homes used the LEEP process to focus on the space heating needs of low energy homes and to make an energy efficient choice within the range of combination system options.

## The LEEP Process

LEEP is a builder driven technology assessment, selection and trial process developed and delivered by Natural Resources Canada's Innovation & Energy Technology Sector's LEEP team with technical support provided by CanmetENERGY's housing researchers. To learn more, email us at [LEEP@nrcan-rncan.gc.ca](mailto:LEEP@nrcan-rncan.gc.ca).

## See Pages 2 and 3 for

Questions and Answers with Doug Tarry Homes on their LEEP combination system case study.

## See Page 4 for

Questions and Answers with CanmetENERGY on high performance combination systems.

*This case study resulted from the expanded LEEP pilot that took place in four Ontario regions during 2011 and 2012.*

*Natural Resources Canada wishes to thank all funding partners, builder participants, industry associations and manufacturers who have helped develop LEEP for the benefit of the building industry.*

### In discussion with Doug Tarry of Doug Tarry Custom Homes Ltd.

Doug Tarry, owner of Doug Tarry Custom Homes Ltd., played a key role in the original LEEP project in London Ontario. He also participated in a second LEEP initiative, exploring single-source space and water heating among other technologies. Doug Tarry speaks about LEEP and about combination space and water heating systems (combo systems) below.



#### **Doug, you've been involved in a couple of LEEP initiatives. How would you compare them?**

Well, I found that the first time through is when you're gaining a knowledge base. In the first LEEP I was looking at how we could improve our building envelope in terms of insulation to get it where we think it should be for the next ten years. We talked about advanced framing. That was the big takeaway, because it coincided with us going to ENERGY STAR® as a standard. And by making that change we were able to bring ENERGY STAR® in and remain competitive with other builders. So it was a big, big change for us. In the second LEEP, we already had that knowledge to build on. And we focused on a number of technologies, including combo space and water heating systems.

#### **Why did you choose to focus on combo systems?**

We ran into a situation where we couldn't get our homes to balance from a heating standpoint. We were having tremendous amounts of stratification. So we ran some HOT2000 energy analysis on a house and found that the numbers said it should have had about a 9 kW (30,000 BTU) capacity system to handle the worst day of the year, and instead it had a 20 kW (68,000 BTU) output furnace. We ran 3 or 4 other homes and came to the same conclusion. And we found that there really wasn't anything on the market for highly efficient homes that need heating systems under 9 kW (30,000 BTU).

*“For a builder that wants to be a progressive builder, LEEP is a tremendous opportunity to learn what technology is out there, and to work with experts in the field and with other builders.”*

#### **So oversized heating equipment is an issue?**

Yes. I'm building bungalows now where I'm at around 7 kW (23,000 BTU) capacity on the worst day of the year, and I was putting in a 9 kW (30,000 BTU) furnace, because that's what is typically available now. So when it comes to heating the home the system is oversized.

#### **What is the issue?**

Well, you've got a thermostat, and a furnace that's going to blast a whole lot of hot air, and it's going to hit the temperature point on that thermostat and then shut off. And then about ten minutes later it's going to do the same thing again. But it's going to hit that point so quickly that it doesn't allow for the heated air to mix and even out the temperature in the home. So you have a basement that's colder than the main floor, outside walls that don't get as warm as the center of the home... the air is just not getting mixed well enough, and people are going to be uncomfortable and complain.

#### **So you explored combo air and water heating as a solution?**

Right. That's why I got involved with the combo idea. Because with a combo system I can bring my heating capacity more in line with what my heating loss is



### **And did LEEP help you find the combo technology you ended up going with?**

the overall process. It gave us an opportunity to start looking at ‘How can we do this? Are we ready to do this? What steps should we be taking?’ And from there we worked through developing a good combo system, and we started rolling it into our homes. We went with a condensing water heater and an air handler with an ECM motor. And it performs better and makes for a more comfortable home than the traditional high-output approach. It’s a really cool technology. I really like it.

### **Was the change in heating systems a problem for installers?**

Not really. We worked with our HVAC installer and explained that we needed an upgrade to our water heater in order to handle the new system— which we were going to be doing anyway because of new ENERGY STAR® for New Housing Program specifications. So for us that wasn’t really a hardship. The biggest thing is that we had to make them rethink the modeling.

### **Can you see combo systems becoming more common in new homes?**

I’d like to think so. But for that to happen it’s important that manufacturers recognize that there are issues with regard to sizing that are going to be of ever-increasing importance in our industry as homes get tighter and more energy efficient, and that we are going to need either smaller furnace sizes or alternatives using air handlers with water heating systems. It’s critical that manufacturers help us find solutions. And that means they need to do testing.

### **So, in sum then, through LEEP you’ve benefited from a better understanding of both advanced framing technology and combo heating?**

Well, we focused on many technologies through LEEP, but those are two of them.

We also looked at advanced windows, which included insulation super spacers that make a big difference to window performance, and low-solar gain glass, which I’ve been offering in different forms for quite a while, and high-efficiency glazing.

### **Based on your experience, what do you see as the biggest benefit of LEEP?**

What was really great about it was that we didn’t just have manufacturers talking to us. We were actually sitting down with industry experts and discussing the pros and cons of the technologies and processes.

So with LEEP I was able to drill down into the actual problem without a manufacturer trying to sell me a product, and I found that it was really helpful to be in a room with peers and with experts. Don’t get me wrong, we did eventually bring in manufacturers. But by then I could pick and choose among 3 or 4 of the solutions based on what worked best for my platform.

### **It sounds like the collaboration with other builders was a key to the success of LEEP.**

Yes, and the format itself is a key. If you were to just put a bunch of builders in a room and do an afternoon session and say here’s everything you should know about LEEP, it wouldn’t be the same. It’s when we’re in a room together and we use the LEEP process to work through the technologies together that we get a much clearer and deeper grasp of those technologies and a better idea of how they fit into the building process.

To learn how LEEP can help, ask your Home Building Association to contact:  
**LEEP@NRCan-RNCan.gc.ca**

## An Insight into Efficient Combination Systems from Natural Resources Canada's CanmetENERGY Housing Research Team.



### How do I find an efficient combo system?

Look for systems that have been tested and rated to the new combo performance standard (CSA P.9-11). Natural gas combos are tested under full and part load space heating conditions as well as in domestic hot water heating mode.

Look for efficient systems with:

- high Thermal Performance Factors (TPF) and
- low Annual Electric (AE) consumption ratings

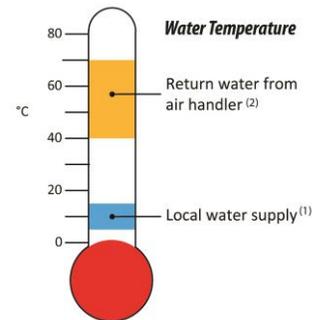
CSA P.9 also provides space and water heating capacity ratings.

### Does ENERGY STAR® for New Homes credit the use of high performance combos?

The Canadian ENERGY STAR® for New Homes initiative is using CSA P.9 ratings for combos to set equivalency with furnace and water-heater performance, and to set targets used to gain additional credits:

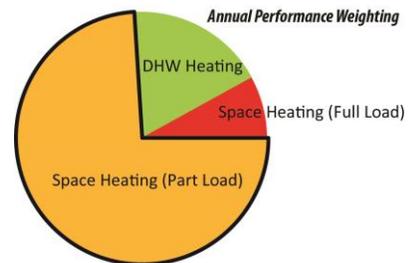
### Can water heating test results be used to estimate space heating performance?

Water heating tests do not include many of the factors that affect combo space heating efficiency. These include the air handler's air flow, coil size, pump capacity, controls approach, and the temperature of the water returning to the water heating device. It is much easier to be efficient and condense flue gases when heating cold mains water <sup>(1)</sup> for use at taps than is when heating warm water returning from an air handler <sup>(2)</sup> for use in space heating.



### How much does efficient space heating matter?

Space heating efficiency is the dominant factor in determining a combo system's overall efficiency. What's more, space heating is rarely required at its capacity (full load). When it comes to getting a high TPF, part-load space heating matters most.



### How are manufacturers adapting to CSA P.9?

Combos can be designed to perform very efficiently in part-load space heating conditions. To achieve a high CSA P.9 TPF, manufacturers may choose to lower the supply water temperature or pump speed at part load. This typically leads to lowering the fan speed in the air handler as would be done in a multi-staged furnace.

**Note:** Combination systems with CSA P.9 test results have become available since the Ontario LEEP pilot that the case study is based upon. Efficient systems start with high performance components such as condensing water heaters and boilers, and air handlers with ECM blower motors.