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Fall
Heating
Issue

Low energy homes

New construction technologies
drive HVAC system changes

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SEPTEMBER 2017

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Cover: State-of-the-art construction techniques create homes that go together like Lego blocks. What does this mean for the HVAC industry? Please see our article on page 12. (Bruce Nagy photo)

Fall Heating



HRAI meets in Quebec City Industry challenges front and centre

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In Minden, Ont., a low-energy home goes together like a big Lego structure.

Ultra-low energy homes

New construction technologies driving significant changes in HVAC systems

By Bruce Nagy

“A rose by any other name would smell as sweet,” wrote William Shakespeare. And the net-zero and passive house homebuilding camps are like the two families in Romeo and Juliet, who cared a lot about their different names, despite the fact that they were similar.

A net-zero home generates as much clean energy as it uses on an annual basis (generated via heat pump, solar equipment, geothermal systems). A passive house usually

does too, but its definition really only deals with minimizing heat loads.

The German Passivhaus Institut requires a tight building of less than 0.6 air changes per hour at 50 pascals, using 10 watts or less of heat energy per square foot, 15 kilowatt/hours per square foot of annual heating demand and no thermal bridges. The Canadian and U.S. passive house groups have slightly modified these requirements.

Reducing costs

One loudly articulated knock against passive



Passive House designer Rob Blakeney, left, and Buildsmart production manager John Grahovac at the Minden job site.



In this St. Thomas, Ont. hybrid application, a small gas furnace and heat pump function seamlessly together

house is that its construction cost is high. It saves tens of thousands (and more) in energy costs over its lifetime, but we still focus on the extra up front 10 percent initial investment. To appease homebuyers, passive house builders in

“The final leap to net-zero using solar remains **problematic in Canada**. The initial cost is high and financing support is lacking.”

North America have struggled to contain first costs. One solution is the modular wall panel.

Wall panels consist of 2x4 and 2x6 insulated, sheathed, air-sealed, frames covered with rigid EPS foam. They are joined together

with Prosoco R-Guard fluid applied sealant. Doorframes or energy-efficient triple-pane windows from Klearwall are pre-installed in the factory.

“The panels snap together on site like Lego,” says designer Rob Blakeney of Local Impact Design in Guelph, Ont. He is using them on four projects, including a 2,400 square foot home in Minden, Ont.

The averaged annual heating load is just 16,644 Btu/h. “We’ll heat this house with an ERV (Energy Recovery Ventilator) and a downstream two-kilowatt coil.” In a similar home in Huron County, he’s using a conditioning ERV plus a 180-foot earth tunnel.

An earth tunnel is like a geothermal system, but it draws heating and cooling energy from the air inside an 8-inch underground pipe, rather than from smaller tubes containing glycol or refrigerant.

Please see ‘Minimal’ on page 15

Minimal heating load

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Blakeney has worked on over 200 solar photovoltaic (PV) projects over the past five years. “In a passive house with ultra-low heating and cooling loads, getting to net-zero...requires less than a six-kilowatt solar PV array.”

Passive homes in B.C.

Mike Banner of Prime Habitat Design Build in Kelowna, B.C. has switched exclusively to working on passive and net-zero homes. However, passive house is almost overkill, but his client loved the idea of triple-pane windows with walls, floors and ceilings at R56, R72 and R98 respectively.

“We only need 2,800 watts for heating and cooling using a 9,000 Btu/h Mitsubishi mini-split to condition a 2,400 square foot house.” There are 300-watt electric heaters in the bedrooms and a Zehnder Paul Novus 300 HRV provides fresh, filtered cool air from outside in winter and from an un-insulated crawl space in summer. Annual utility costs have been cut from \$4500 to about \$350, he added.

Alex Maurer of Marken Design and Consulting in Surrey, B.C. built a passive house in which the heating system remained off for more than 18 months. The owners report typical monthly hydro bills of under \$60.

The 4,000 square foot family duplex is home to six people. The mechanical system consists of two Ultimate Air 200 heat recovery ventilators (HRVs) with heating based on electrical resistance from the post-HRV air, distributed by small ducts. The building also collects rainwater for toilet flushing and uses a solar thermal system for heating domestic hot water.

Trying different things

Carter Scott designs and builds net-zero detached houses and small condos in

Massachusetts. Early on he built one house at a time, trying different things and testing each envelope and HVAC system for energy efficiency.

He ended up with thick walls like a passive house, but settled for about 1.0 air change per hour at 50 pascals. He tried high-efficiency gas-fired water heaters, small air handlers, 14-SEER air conditioners, and geothermal systems. They were all oversized and too expensive.

He now uses mini-split systems with one indoor unit for every 800-1000 square feet, or usually, one per floor. Construction costs are at \$102.43 per square foot. “It’s about \$1.43 to go from 70 on the Home Energy Rating System (HERS) scale to 40.” To move from 40 to zero he added solar PV, which in Massachusetts gets homeowners generous incentives on top of a U.S. federal tax credit. He uses ERVs, or in small units exhaust-only continuously running Panasonic bathroom fans at 30 CFM.

Production builders

Construction Voyer in Laval, Quebec was one of five production builders across Canada that participated in the Canadian Home Builders Association net-zero pilot last year. Company



Getting the air to the right place is critical in low energy HVAC design.

principal Jean-François Voyer says the experience taught them that while costs are dropping, Voyer’s net-zero homes still cost 12 to 15 percent more than a conventional home, or about eight percent more after government incentives and sponsorships.

Like the other builders we spoke to who participated, Voyer finds that homebuyers are enthusiastic about more efficient homes, but the final leap to net-zero using solar remains problematic in Canada. The initial cost is high and financing support is lacking.

Please see ‘Hybrid’ on page 16



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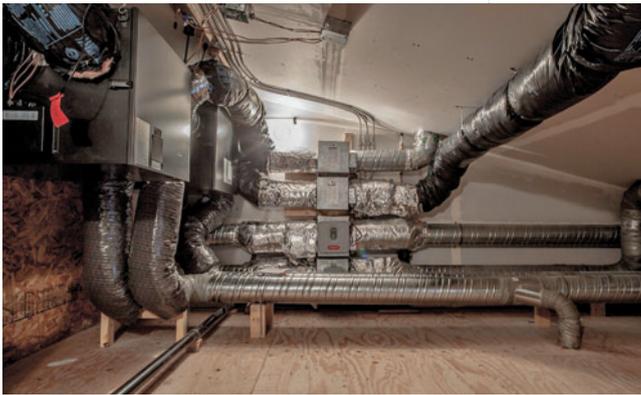
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Hybrid systems make sense

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However, at least three of the five builders are now offering homeowners solar-ready homes. An impediment to rooftop solar in Quebec is the abundance of inexpensive hydropower. Voyer now builds tight homes and heats them with mini-splits, with electric baseboard backup.



This Surrey, B.C. home uses HRVs and electric for heating.

Hybrid systems

Meanwhile in Ontario, solar is quiet and gas is inexpensive. Doug Tarry of Doug Tarry Homes in St. Thomas has worked with manufacturers to develop a hybrid system combining a quiet, efficient, fully modulating Alize heat pump at 21-25 SEER and a Dettson Chinook modulating gas furnace at 12,000-30,000 Btu/h.

The home switches seamlessly between the two systems, using a special thermostat that Doug describes as ‘set-it and forget-it.’

“We want homeowners to avoid having large temperature swings because this leads to humidity issues. So no smart phone, no rocket science and no spaceship in the basement,” he laughs. They are also installing sealed six and eight-inch main ducts with 2.5” flex ducts that have tested at under 10 percent leakage. “We don’t need to move much air...We place it accurately.”

Reid Heritage Homes in Guelph, Ont. has progressed from a handful of net-zero offerings to a new community of 18 net-zero-ready homes and more planned for the future. They are pre-wired for solar, and again, they come with a hybrid heat system of mini-splits plus gas furnaces, with controls that switch between the two, depending on outdoor temperature.



Also in Surrey, a solar DHW system minimizes energy use.

Code driven

Government projects and building codes are driving building technologies towards net-zero. NRCAN data shows that Canadian homes used 220 gigajoules for heat in 1970 compared with today’s net-zero or passive house at 25 gigajoules or less.

There are now 300-400 net-zero buildings in North America and about 1,500 passive houses. These may seem like small numbers, but growth is dramatic and most of these have been built in the last few years. If they continue to catch on, HVAC systems will change dramatically.

So whether you call an ultra-low energy building a passive house, net-zero building, Romeo, Juliet, or just a rose; lets hope the future, for HVAC contractors, smells as sweet. +



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