Lessons

Building a net-zero house in Canada presents many challenges. We find out what the first generation of these homes can teach us.

By Don Proctor | Photography by Seeing256 Photography, Burke Stoller, and Habitat Studio & Workshop Ltd.

Learned

As more net-zero or near-net-zero energy homes go up across Canada, designers and builders are learning - sometimes through trial and error - what works and what doesn't to meet their objectives.

Sometimes what looks like a good idea in theory doesn't pan out in practice.

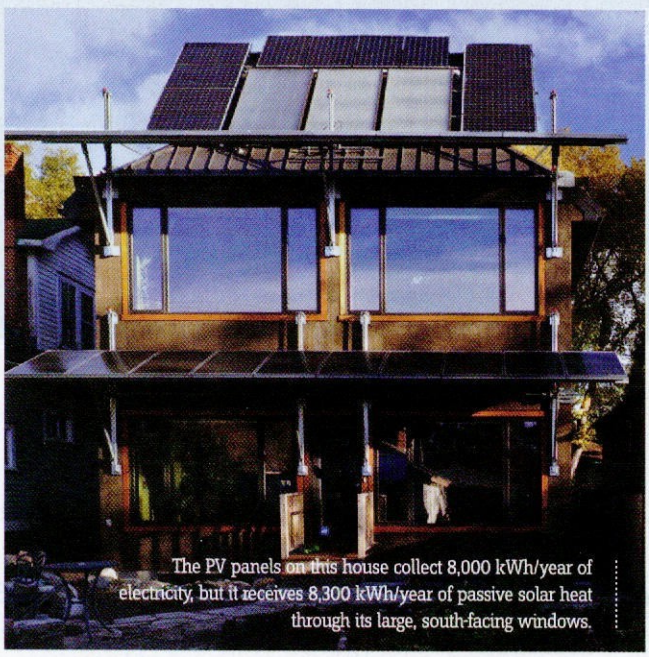
Peter Amerongen, president of Edmonton-based Habitat Studio & Workshop Ltd., knows that well. His company built Edmonton's Riverdale Net-Zero home in 2007, the first of its kind in the Alberta capital. Net-zero energy homes produce as much energy through such renewable sources as photovoltaic (PV) systems as they consume from energy utilities.

The builder, who is constructing his fifth net-zero house in Alberta's capital, says that the flat plate collectors of a solar thermal space heating system (a solar thermal system that stores heat energy in water or glycol, which he used in the Riverdale home), have proven impractical in some applications in Alberta's chilly winters. That is because it is difficult to store heat from solar thermal equipment collected in the summer and fall when it is most plentiful until winter when it is needed.

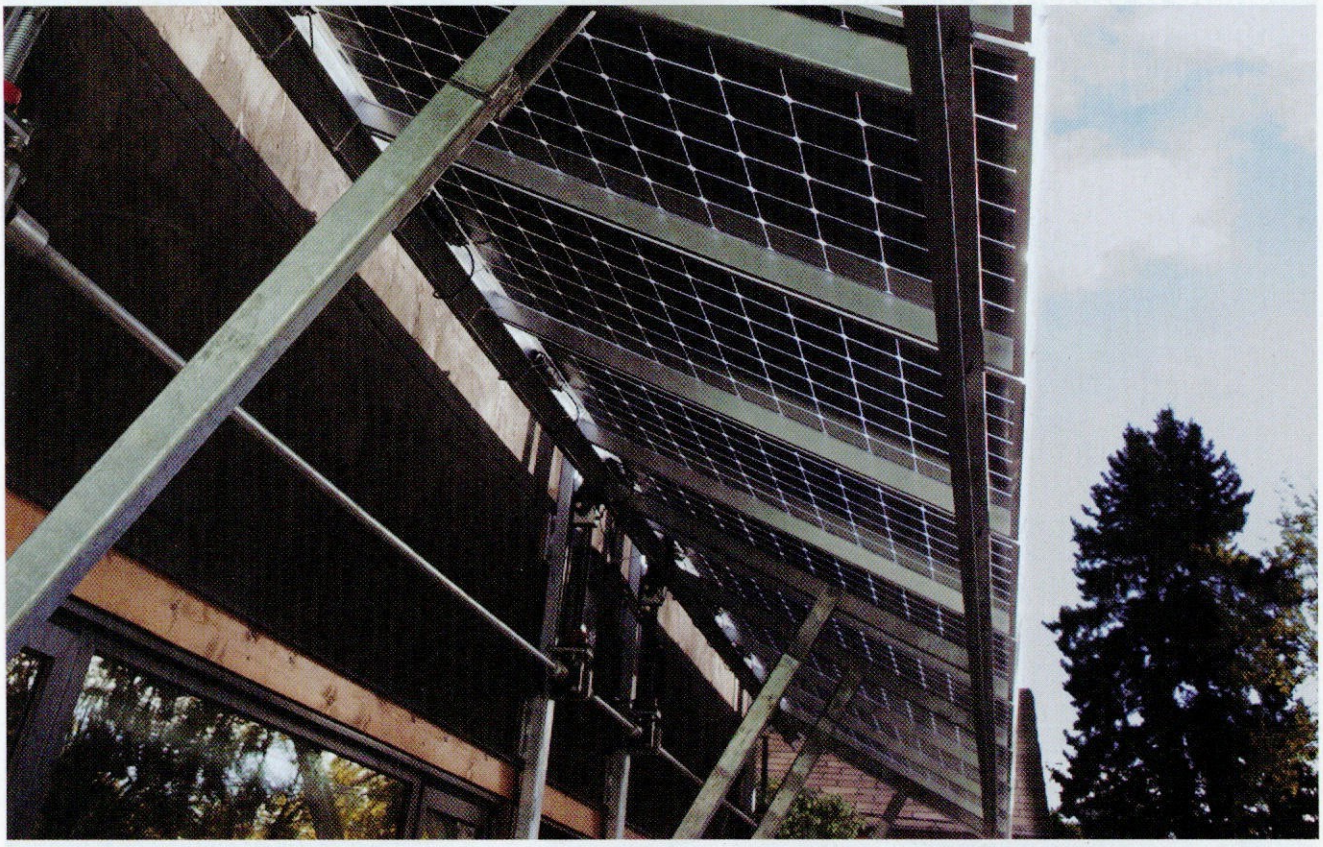
Amerongen says even though solar thermal is more energy efficient than PV systems, he has relied on PV electricity for subsequent houses because electricity generated in summer can be inexpensively stored in the grid until winter. PV is also favoured because the wiring required is easier and more economical than the plumbing required for solar thermal. The builder cut the incremental costs by 45 per cent in subsequent net-zero houses by eliminating the complicated solar thermal system.

In many circumstances solar thermal is a good idea for heating domestic water, he points out, but the exact mix between solar thermal and PV is determined on a project-by-project basis.

Surprisingly, Amerongen says the most cost effective renewable energy strategy is passive solar – utilizing the sun's heat simply by including large, south-facing windows in the design. Habitat Studio's second net-zero project collects 8,300 kWh/year of heat through its south-facing windows, while the $40,000 PV system collects only 8,000 kWh/year of electricity.



The PV panels on this house collect 8,000 kWh/year of electricity, but it receives 8,300 kWh/year of passive solar heat through its large, south-facing windows.



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But for passive solar to provide a high proportion of the annual space heating needs it is vital that the building have a well-insulated, airtight envelope. "People are missing a great opportunity when they don't take the building envelope seriously," he says, adding there's little point in installing renewables such as photovoltaics on a house without an energy-efficient envelope.

Amerongen's net-zero energy building envelopes are comprised of double stud walls filled with 16 inches of cellufibre insulation, a blown-in high-density recycled newspaper product. Air tightness is a critical factor in the design. To achieve blower door test ratings of about 0.5 air changes per hour (required to obtain an EnerGuide for House rating), the builder has developed a number of details in the envelope. "You can always add renewables later but it's very expensive to upgrade the envelope once it is built," he says.

Air leakage, as he points out, is the biggest factor of heat loss in most homes. "An average new house has an air leakage rate of about three changes per hour. Most older houses have much higher rates." Blower door tests subject a house to a negative pressure which is approximately equivalent to a 30 km/h wind. The air change rate is how many times the entire volume of air in the house leaks out and is replaced by cold outside air.

Various government programs and initiatives have helped the industry kick-start the growing sustainable home market. The Riverdale Net-Zero Project, for example, is one of a dozen projects across Canada that is part of CMHC's EQuilibrium Sustainable Demonstration Initiative.

A lesson learned from past mistakes is that sustainable houses should be based on an integrated design. "If you adjust any factor of the design, you look for the effect on other aspects of the house," explains Thomas Green, the EQ's project manager.

The EQ initiative is based on five principles of integrated design: health (such as indoor air quality); energy efficiency; resources conservation; low environmental impact; and affordability, which is based on the life cycle operational costs, rather than upfront purchase costs.

"What EQuilibrium is trying to show is that we have a lot of the knowledge, capacity, technology and wherewithal to deliver very sustainable housing right now," says Green. The CMHC supplied funding for design development, supported integrated design charettes and provided communications, marketing and technical support for teams making public demonstrations.

The Mill Creek Net Zero project was Habitat Studio's second net zero house. While the front of house may not look extraordinary (BELOW), the rear certainly does.

Net-zero energy homes might have been pricey in years gone by, but today's models are more in tune with market homes, typically costing only about 10 per cent more than conventional custom built models. The biggest additional cost is for renewables such as photovoltaics, says Amerongen. About 80 per cent of the energy efficiencies represent only about 20 per cent of the cost increase to build the house. Much of that is in the building envelope.

Amerongen says that in a cold climate like Edmonton, building envelope upgrades for a 1,800- to 2,000-square-foot house cost about $15,000. In Alberta, residents are eligible for grants of up to $10,000 for building a house with an EnerGuide Rating of 86. Few homeowners to date have chosen the upgrade because it is still a new arena waiting to be discovered.

While renewables such as PVs represent the big cost, in some provinces (Ontario, for example) electricity is now being sold at a good margin (80 cents/kWh for electricity they purchase for 7.5 cents) back to the utility company so owners can justify the expense. That's a good deal of profit. "They could be in a cash neutral situation once they amortize the cost of the system," says Green. Other provinces offer credit deals.

While much has been learned about how to build an affordable energy efficient house today, net-zero or nearly net-zero energy homes may not catch on in a big way as long as home owners pay a heavily subsidized price for energy. If energy prices soar, as they have in Europe, experts suggest the market could well take off.