Beyond Energy Efficiency

Every building is a long-term contract with the environment. Here's the fine print.

Chris Magwood

PRETEND that you are about to build a modest home somewhere in Canada. You've made the appropriate arrangements with designers, building officials, contractors and suppliers. The only thing left to do before you start construction is order the 75,000-litre railway tanker full of gasoline that you'll burn to provide the energy required to build the house.

Okay, you won't actually need that 75,000-litre tanker on your construction site. But, shockingly, your construction project will consume the equivalent of its contents before you move into your new home. The harvesting, processing, transportation and

This oval straw bale house was designed by Ingrid Cryns of Soma Earth Architect and built in Erin, Ontario, by Harvest Homes. Find details about the home's energy savings, materials and a wealth of other resources at ***somaearth.com****.*

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insulation of all the building materials require energy inputs, and the term used to describe these inputs is "embodied energy." The Canada Mortgage and Housing Corporation estimates that for a standard house in Toronto with a 40-year life, the total embodied energy is 2352 gigajoules. Therein lies your tanker with enough gasoline to drive a car around the equator 20 times, or provide 16 years' worth of household electricity.

When we build our homes, we are entering into what author Dan Chiras calls "a long-term contract with the environment." That contract begins with the vast consumption of resources used to construct the building, and includes a continued commitment to consumption as demanded by the performance of the home and the behaviour of the occupants throughout the building's lifespan. It also includes the end of its life, when the embedded resources are disposed of or reused.

It is only when we reach an understanding of the four-clause contract described below that we will begin to reduce the size of that 75,000-litre tanker and move toward sustainable building.

Clause 1: Energy efficiency

Most Canadians understand that the amount of energy they consume at home has a direct effect on the environment. They also recognize the impact of rising energy costs on their personal budgets. As a result, energy efficiency is a growing priority for homeowners and builders. Over half a million Canadian households have participated in ecoENERGY, the federal government's energy efficiency home-upgrade program, and an increasing number of homeowners are seeking ratings from performance systems such as LEED, Passive House and EnergyStar. The number of Ontario homes enrolled in EnergyStar, for example, more than doubled to 10,000 between 2006 and 2007.

It's hard not to see this as a good thing and it's certainly not bad, but energy efficiency tends to eclipse the rest of the contract with the environment as we blindly pursue this one clause. In the name of energy efficiency, a homeowner might embody so much energy in his or her house by adding more insulation and extra windowpanes that it negates years of energy savings.

The pursuit of energy efficiency in homes, while highly desirable, is also the wildest variable in our contract with the environment because it is so dependent on occupant behaviour. Occupants in a very efficient house could easily consume more energy than a conscientious occupant in an inefficient house if they leave the plasma television turned on, crack open windows during the winter and ignore basic maintenance such as weather stripping.

Energy efficiency is important, but we need to recognize that it is only one of four considerations that lead to sustainable building.

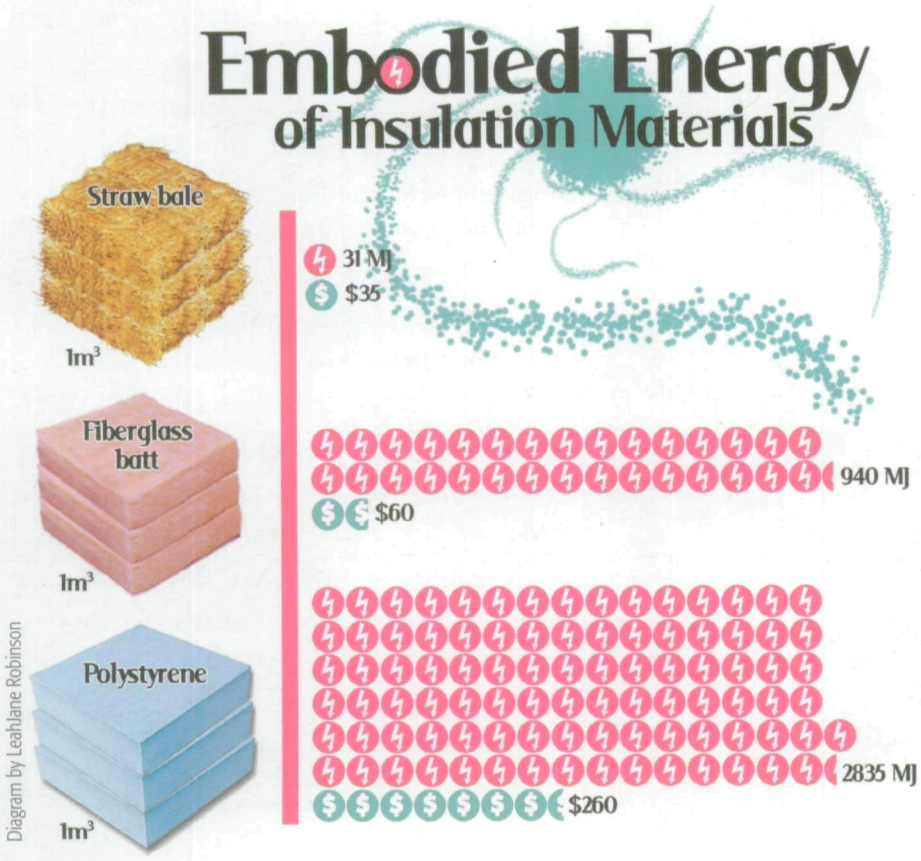

Diagram by LeahJane Robinson

POLYSTYRENE foam insulation uses 91 times the energy of straw bales, but costs only 7.5 times as much.

FIBREGLASS consumes 30 times the energy of straw, but costs only 1.7 times as much.

PEOPLE are more likely to use conventional materials because they are widely and easily available, they are recognized in building codes, and they have large marketing and advertising support. To change this, adequate consumer demand would be needed to encourage large corporations to invest in bringing these materials to market in the same manner as their more energy-intensive counterparts. Even then, there is less profit in less expensive materials.

Source: The Inventory of Carbon & Energy (ICE), University of Bath.

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Clause 2: Embodied energy

The railway tanker of gasoline is a vivid illustration of the energy embodied in our building materials. Yet this part of our contract is often completely overlooked even though, unlike energy efficiency, designers and builders can control the amount of energy that is embodied in a building. Whereas energy efficiency comes down to occupant behaviour, a building designed to have the lowest possible embodied energy will definitely have less of an environmental impact than its high-embodied-energy counterpart.

For her master's thesis, University of California, Berkeley student Ann V. Edminster set out to measure and compare the embodied energy between conventional buildings and those designed to be lighter on the environment. She found that the embodied energy for a low-impact straw-bale house was about one-twelfth that of a conventional frame house.

Remarkably, only the most efficient homes being built today can hope to achieve this kind of improvement. In practice, most energy efficient homes offer only a 10 to 30 per cent improvement. It is quite possible, however, to guarantee a tenfold improvement for buildings designed with low embodied energy.

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There can be cost benefits to using building materials with lower embodied energy. If energy costs were not so heavily subsidized, products made with high-energy inputs (such as polystyrene) would often cost more than those with lower inputs (such as straw). Even considering the economy-of-scale and existing subsidies for energy, many natural building materials already cost much less than their manufactured counterparts. Cost factors are not a major impediment to making buildings with radically lower embodied energy. (See "Embodied Energy of Insulation Materials," on the opposite page.)

Clause 3: Durability and Adaptability

Canadian homes that are 100 or more years old are generally considered to be energy hogs. The big energy user, however, is not the house; it's the home's occupants. These houses often have little insulation, but their earliest occupants did not aspire to keep them at 20°C year round. These people pumped water by hand, did not have as many, if any, electric lights and appliances, and sometimes closed off parts of the house in the winter to conserve fuel.

These often stately homes have adapted from low-energy usage to high-energy usage, and are now being retrofitted to reduce energy consumption. Because they have proven to be durable and adaptable, they have not been replaced. Furthermore, their durability and adaptability means that their embodied energy has not been lost and no new energy has been used to replace them.

It's worrisome that many of our new homes may not prove to be as durable or adaptable. We now rely on materials that have short life expectancies. In particular, structural materials that rely entirely on adhesives for their strength are prone to moisture failure. Furthermore, current building codes in Canada require that new homes have primary energy systems for ventilation and heating that run continuously as long as the home is occupied. Since passive or non-electrical systems are not allowed to be primary systems under these building codes, such homes may be more difficult to adapt to a low-energy future.

Admittedly, adding durability and adaptability can be costly in pure economic terms. Building products often increase in price as their durability improves. Think of pine versus cedar siding or vinyl versus wooden windows. Cost is a major reason why we tend to build with less durability than we should to meet this clause in the contract.

Clause 4: End of Life

Since no building lasts forever, it makes sense to consider the end of a building's life as part of our contract with the environment.

When homes built with durable, non-toxic materials are no longer habitable, these materials can be made into new structures. Visit a company such as Timeless Materials in Waterloo, Ontario, if you doubt the durability of doors, windows, flooring and other components of older buildings. Many of the composite materials used in modern homes, however, are not suitable for reuse or recycling and must be sent to the landfill. At this point, their embodied energy is converted into greenhouse gas and other noxious emissions.

Making (and Keeping) the Contract

If we are serious about our contract with the environment, our focus on energy efficiency must expand to include embodied energy, durability and adaptability, and what happens to the building at the end of its life.

The good news is that the knowledge and skills to make buildings that honour this contract are available now. Though they represent only a minuscule fraction of buildings, excellent examples that seriously consider all four aspects of this contract exist in Canada. To make them the norm rather than the exception, we need building designers and builders to be aware of the full extent of the contract and how they might go about honouring it. We also need public awareness so that the home-buying public asks for environmentally responsible homes. While both of these factors could be brought around rapidly if our governments were to adjust their building codes to require them, there is no need to wait. It is possible to sign on the dotted line now.

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