



Notes from the Underground

March 1

Who in their right mind would live underground?

We used to live on an off-the-grid organic farm. Our farm crew grew up and is now in university so my wife and I decided to take the next step toward sustainability—a step even beyond off-grid living. We are now building an earth-sheltered home next to a fast-flowing rapid on a river north of Kingston. How is that more sustainable? That's what I hope to convey while suggesting ways you can become more sustainable, too.

Why all this fuss about sustainability? Because our climate requires too much energy to heat our homes in the winter and cool them in the summer.

According to *Canada vs. The OECD: An Environmental Comparison* by David R. Boyd at the University of Victoria, Canada ranks an embarrassing 27th out of 29 Organization for Economic Cooperation and Development (OECD) nations in terms of energy use per capita.

We consume double the OECD average energy per capita, and more than five times the world average. Between 1980 and 1997, our energy consumption grew by 20%, slightly higher than the average OECD increase of 18%.

Developing sources of energy requires energy, even if we use renewables. Someone has to build and transport solar panels and wind turbines, drill for oil and build hydroelectric, oil, gas, and nuclear power plants. It is clearly much cheaper to save a watt than make a watt. So, if we want to leave anything for our grandchildren, we are going to have to use less energy. That's what an earth-sheltered house allows us to do.

When you go about two metres deep, the earth is nearly the same temperature throughout the year. In Kingston, that's about 12-15° C, depending on the soil type, moisture, and other factors. So you only have to heat about 5°C in the winter and, in the summer, your air conditioning is free.

Since heating and air conditioning account for about half of the energy your house uses, living underground saves energy.

Then, when you add a Trombe wall, a solarium, or berm insulation (all topics we will cover in this blog) you can pretty much let nature take care of your heating and cooling needs. That saves even more energy.

The next question, of course, is “Can I do this without living like a mole?” and, luckily, the answer is “Yes”.

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Earth-sheltered houses have been around for decades, and many designs have more light and air circulation than conventional houses. And our house will not all be underground. The current design is a hybrid, mostly underground with a small, two-storey attachment so we can see the river from our office on the second floor.



(House view from the southwest. The river is outside the frame on the left)

Plus, we are building an atrium around a beautiful oak tree on the north side of the house so we will have soft, even north light and strong south sunshine.

To make this work, the first consideration is site. We don't usually think of this with our energy-guzzling home heating and cooling machines, but our grandparents did. Look at old farmhouses, they usually took advantage of nature's warmth from the sun in the winter and cooling from shade trees in the summer. We searched for a long time before we found a south-facing hill we could build into with trees in the right spot. In the winter, evergreens and the earth behind us will protect us from the north winds while the sun warms our south side. In the summer, the deciduous trees on the south will provide cooling shade.

The next crucial part of building an earth-sheltered house is to integrate it with the landscape. Our first attempt looked like a fortified bunker glowering from underneath green bushy eyebrows. Our second attempt looked like a shed pasted on the end of an elementary school. We think we are getting closer to what we want.

Because much of the house is underground, moisture can be a problem. The roof will be covered by insulation, a rubber membrane, a root barrier, and topsoil before we plant wildflowers or groundcover. The roof must be well sealed and the slab on grade must be well drained.

We will have only one small roof of cedar shingles, one face of barnboard siding, and no lawn.

We will reclaim and re-use as much as possible. Stonework will be from the building site; siding from local barns. The interior will be post and beam construction with beams from a 1920s Ottawa aircraft hanger. Reclaimed flooring will be used on both the floor and ceiling, and we have a stockpile of salvaged, 36-inch doors to provide generous openings for the time when we are playing hide-and-seek in our wheelchairs.

The primary heating system will be in-floor heating with solar hot water. A woodstove is backup and we might occasionally draw on a propane combination hot-water heater and boiler. This will be nearly carbon neutral because we will harvest firewood from our site and replant what we cut. The house will be designed so we can shut the water off in the kitchen, close off the above-ground part, and heat the rest with a 60-watt light bulb if we are away for extended periods in the winter.

An air exchanger will bring in outside air and a hot water line will heat the cold winter incoming air. Then, in the summer, a cold water line directly from the well will cool the summer incoming air and condense most of the moisture.

In the small two-story wing, a Trombe wall and a poured staircase will be just inside the south bank of windows. The winter sun will heat this mass and then, after thermal blinds are drawn in the evening, the heat will slowly radiate into the wing.

Our office will be on the second floor, looking up the river, and a dumb waiter will run up from the kitchen so we can have High Tea and Coffee in our second-floor sitting area without spilling on the way up the stairs. We can also holler at each other from the office to the kitchen through this lung-powered intercom.

Our electricity will be supplied from a renovated mill directly across the river that will be a showcase for low impact, run-of-river hydroelectric production as it powers three other nearby houses as well as ours.

Water is from a drilled well and the waste system will be a Waterloo Biofilter®, a patented trickle-filter type treatment system that sprays wastewater intermittently into a patented medium and drains by gravity. Organic biomass grows quickly within the medium after start-up, oxidizing organic material and nitrifying ammonia in the wastewater. Because the Biofilter medium is contained in a tank, it is effective under all soil or drainage conditions. This is a significant improvement on a conventional septic system and was developed here in Canada at the University of Waterloo.

The cost of our new home will be about the same as conventional residential buildings but it has taken quite a lot more thought and research. Ideas have been contributed by dozens of people as we tell them of our plans and listen to their suggestions.

This is a house that is well-suited to our Canadian climate and the weather extremes that our CO₂ emissions are already creating.

I've been working on sustainability for three decades now, and I'm studying even harder to keep ahead of my students at Queen's. Unfortunately, we have largely lost our opportunity to reduce the devastating effects of climate change. For that, we can thank our political leaders of the last eight years who first denied then dismissed the damage caused by fossil fuels. Most people have no idea how bad it is going to get in our lifetimes. That's why we are building an underground home in the woods on the bank of a river with an off-grid, renewable power supply. Stay tuned for updates on our progress.

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