Building a Solution

Nick Enge

What if we could maintain all of the energy-intense comforts of home at just a fraction of the cost, even as energy prices continue to rise rapidly?

Buildings are a crucial component of any sustainability plan because their operation is responsible for a full 40 percent of all energy use and greenhouse gas emissions in the United States. Residential buildings account for half of that, and are simultaneously the easiest and largest opportunity for you to make a difference with regard to climate change.

According to European experts working on the "passivhaus," or "passive house," building standard, homes can now be designed to provide identical services while using 90 percent less heating and cooling energy than the average home, and significantly less additional energy for hot water, lighting and electronics.

The single largest user of energy in homes is heating, accounting for one-third of residential energy use. In order to reduce heating energy demand, passivhauses are super-insulated and sealed, to the point of being nearly airtight, preventing heat loss through the walls. The passivhaus can then be heated by a combination of internal gains, heat generated by residents and appliances and solar gain through windows. When internal and solar gains are not enough, a small active heating system may be added, but at nothing near the size, cost, and inefficiency of modern furnaces.

Of course, an airtight seal could prove unhealthy for residents, who on average spend 90 percent of their lives inside buildings, which contain significantly higher levels of pollutants and containments than outdoor air. To solve this indoor air quality problem, a passivhaus employs a heat recovery ventilator to provide fresh air without wasting heat. Heat recovery ventilators use a heat exchanger to transfer heat between the incoming and outgoing airstreams, preventing up to 95 percent of the heat loss compared to ventilation systems without heat recovery. The heat recovery ventilator also provides a central location for the home's heating element, which in passivhauses is effectively a hairdryer.

Overhangs may be designed to shade windows from the high summer sun, when solar gains can be a burden to cooling, while allowing the lower winter sun to stream in through southern, sun-facing windows when heating is most needed. Thermal mass, in

the form of tile floors or masonry, are used to soak up extra heat during the day and reradiate it at night, minimizing fluctuations in temperature.

Insulation, airtightness, overhangs and thermal mass, along with passive cooling techniques like opening windows at night, can also all but eliminate cooling demand in most climates. Any additional cooling needs are met by a cooling element in the passivhaus's heat recovery ventilators.

Energy requirements for water heating can also be easily reduced. By replacing traditional tank heaters with new tankless water heaters, heat losses can be greatly diminished without any loss in amenity. In locations with good sun, solar water heaters can provide a significant portion of your hot water renewably.

Taking advantage of natural daylight can significantly cut lighting energy use as well. There is no reason that homes cannot be designed to function with minimal artificial lighting from dawn until dusk. Natural light has been repeatedly shown not only to save energy, but also to increase residential happiness and productivity.

Finally, energy efficient appliances can significantly reduce electricity demand. While hot water, lighting and electronics may not yet be able to achieve the same 90 percent reduction in passivhaus heating and cooling energy use, the savings made available by these other systems are still significant.

But won't such an efficient home be prohibitively expensive? Actually, a recent study of more than two hundred certified passivhauses in Europe found that these well-designed homes cost at most 10 percent more than the average to construct. Given the significant savings in monthly energy bills, an intelligently built and financed passivhaus can make you money in the first year. In places with adequate sun, like California, homes can be made even more sustainable by applying these savings toward the added cost of solar photovoltaic panels to power their remaining energy needs, making these homes completely carbon neutral.

Passivhauses are not just a concept for the future. In Europe, there are at least 6,000 passivhauses; the United States lags behind in ambition and number, but we're starting to catch up. There remains no technological barrier to their adoption, only a lack of awareness among both residents and architects. If you build your own home in the future, make it a passivhaus, and show your kids and your neighbors that you've made a lasting difference in the world.

To learn more about energy-efficient buildings, take CEE176A: Energy Efficient Buildings with Gil Masters. Nick can be reached at nick@positivesustainability.org.

Citation: Enge, Nick. (2008, May 29). "Building a Solution." *The Stanford Daily.* http://www.positivesustainability.org/daily/ps7passivhaus.php.