Building for a cooler planet

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The good news

33% of energy-related CO2 emissions are generated by energy use in buildings

29% of that could be cut by 2020 using existing technologies

The bad news

By 2020 energy use in US buildings is predicted to rise by 25%

While in China it is predicted to rise by as much as 50%

Danny Harvey likes his Toronto office, especially the 8-square-metre window that lets the sunlight flood in. But one day last week he did a quick back-of-the-envelope calculation. Winter temperatures in the Canadian city can drop to -20 °C, and Harvey estimated that keeping his office at 20 °C in such weather pours 2000 watts of heat through the window. That wastes more energy than boiling a kettle all day.

For Harvey, a climate change expert at the University of Toronto who has developed plans to radically reduce energy use in buildings, that is hard to bear. What he sees outside his window makes it even worse. All across town, the energy sins committed by the architects of his office are being repeated. Apartment blocks are springing up and big windows are in fashion. High-performance windows that could drastically reduce heat loss are available, yet builders are not using the best products. "Every single apartment is a future liability," says Harvey.

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It need not be that way. According to a newly published collection of studies by Harvey and others, the carbon dioxide generated by energy use in buildings - a third of the global total of man-made CO2 emissions - could be cut by almost 30 per cent in little more than a decade. The technology to achieve this already exists, in contrast with aviation or power generation, say, where reducing emissions may require significant innovation. What's more, future energy savings mean most of such spending would pay for itself in three to seven years.

So are the studies likely to boost the fight against climate change? Unfortunately not. The papers, which appear in a special issue of *Building Research & Information*, may map the route towards a much more sustainable future, but construction experts say that much of the world is taking a different path. In China, rapid urbanisation is fuelling a construction boom, and the country's developers are ignoring environmental building codes. Meanwhile, the world's other big greenhouse gas emitter, the US, is

building larger houses that are helping wipe out gains from improved efficiency standards. "The trends are in the opposite direction to what we need," says Danny Parker, a buildings researcher at the University of Central Florida in Cocoa.

To see what a different direction might look like, consider the homes built in recent years to Europe's "passive house" standard. By carefully sealing all joints, using high-quality insulation and positioning windows to make the most of sunlight, passive houses can be heated using around a tenth as much energy as the average dwelling. "I can usually heat the house using 10 candles," says Katrin Klingenberg, an architect who built and lives in a passive house in Urbana, Illinois, where winter temperatures regularly drop below -10 °C.

That translates into up to 65 per cent less emissions per house, depending on the energy source. And with 5000 passive houses built every year in Europe, and almost 4000 existing homes being renovated to the same standard each year, emissions savings from those new houses alone will knock 14 per cent off emissions due to the residential sector in 2020, according to a report published last year by a consortium of European building researchers.

The savings get even bigger when you include other measures such as replacing traditional incandescent light bulbs and old electric water heaters with more efficient alternatives. Solar water heaters can cut the energy needed to heat showers and wash clothes, and in sunny climates, solar electricity may also be cost-effective. Simply supplying a slow flow of air at floor level in commercial buildings, rather than the existing practice of pumping in large volumes of air, can cut the energy used for ventilation by up to 60 per cent. "We could have an enormous impact immediately," says Parker.

When Harvey and colleagues combined 80 national and regional surveys on the potential impact of such measures, they concluded that they could cut global CO2 emissions due to energy use in buildings by 29 per cent by 2020 (*Building Research & Information*, vol 35, p 379). That would increase by a further 4 to 7 per cent if agreements such as the Kyoto protocol pushed up the price of fossil fuels, forcing people to burn less to heat residential and commercial buildings. When the Intergovernmental Panel on Climate Change published the same figures in a report in May, it noted that the potential savings in this area were the biggest of all those it looked at, from agriculture to transport.

While Europe is steadily embracing energy-efficient housing, progress in the US has been much more patchy. Houses may have become better insulated and appliances such as washing machines more efficient, but appliances have also proliferated. The average house size has doubled since 1940, says Parker, and towns are springing up in the south of the country, where air conditioning comes as standard in many new homes. Klingenberg's house is a rarity; only one more has been built in the US since hers in 2003. So despite the potential for savings, the US Department of Energy predicts that energy consumption in residential and commercial buildings will grow at over 1 per cent annually from now until 2030.

China is starting from relatively low rates of energy use, but catching up quickly. In 2004, Chinese homes consumed around a sixth of the American average. Since then,

however, the country has added enough new buildings to house the occupants of New York City three times over. Nor is that a sudden surge: over the last 30 years, government policies aimed at shifting surplus rural labour into cities have more than doubled China's urban population to more than half a billion.

As the country becomes more wealthy, these new urban dwellers will be able to afford heating and air conditioning, so energy use will soar. Unpublished projections developed by Mark Levine, an energy-efficiency expert at Lawrence Berkeley National Laboratory in California, suggest that China's buildings will consume 50 per cent more energy overall by 2020, as more are built and incomes rise. Building researchers do not dispute China's right to develop in this way, but point out that China could be building energy-efficient houses as it expands, and yet is not.

Looked at purely in terms of costs and benefits, American and Chinese consumers ought to be adopting energy-efficiency measures, since many produce net savings in just a few years. Klingenberg says that her house cost just 10 per cent more than average and will pay for itself in seven years. However, building researchers point out that such market forces often fail because so many different parties are involved in constructing and running properties. It is not in a landlord's interest to invest in better insulation, for example, since tenants pay heating bills. Many consumers also doubt whether energy efficiency will translate into real savings.

"It is not currently in a landlord's interest to pay for better insulation, for example, since tenants pay the heating bills"

What can be done to reverse these trends? Since the market is failing to generate emissions cuts, experts in energy efficiency say governments should step in. When Diana Ürge-Vorsatz of the Central European University in Budapest, Hungary, and her colleagues rated 20 policies for reducing emissions, top marks for impact and cost-effectiveness went to targeted regulations, such as building codes *(Building Research & Information*, vol 35, p 458).

In the UK, for example, the government has committed to making all new houses carbon-neutral by 2016. The growth of passive houses in Germany, which is building more than 2000 every year, is in part due to tax breaks and low-interest loans offered by the government.

Such codes could be implemented in the US, but efforts have so far been confined to isolated state-level or voluntary schemes. "There has been no real push nationally to do something," says Parker. "We're still coming out of the fog of having a leadership that says climate change doesn't exist."

In China there are positive signs, but perhaps only superficially so. In March the government announced a single set of building codes that are similar to US standards, and says it wants developers in the largest cities to adhere to them by 2010. If implemented they would cut energy use in new buildings by up to 65 per cent.

However, there is no guarantee that developers will take notice, notes Timothy Hui of the Natural Resources Defense Council, a US environmental group that has an office in Beijing. Only 15 per cent of new homes conform to existing standards, he says,

although that number is up from 5 per cent just a few years ago. Hui adds that compliance depends on training many new inspectors.

The problem of educating people is common to the different housing challenges facing countries around the world. The technology for low-energy houses has existed since the 1970s, but architects and developers are not familiar with it. Even though Europe is taking a lead, governments there still struggle to persuade the many groups involved in house building, from town planners to local contractors, to factor emissions reductions into their plans.

"Everyone has to be heading in the right direction," says Robert Lowe, a buildings researcher at University College London. And right now, he adds, "nobody is doing that quick enough".

Read the full article at: http://environment.newscientist.com/channel/earth/mg19526143.800

Related Links

- *Building Research & Information* , volume 35, issue 4, 2007: www.informaworld.com/openurl?genre=journal&issn=0961-3218&volume=35&issue=4
- Wikipedia definition of "Passive House": http://en.wikipedia.org/wiki/Passive_house
- Intergovernmental Panel on Climate Chang Report: www.ipcc.ch/SPM040507.pdf
- Katrin Klingenberg's passive house: www.e-colab.org/ecolab/SmithHouse.html
- Natural Resources Defense Council website: www.nrdc.org/air/energy/china/greenbuildings.asp