

Efforts to Make Buildings Greener are not Working



Rules on “zero energy” buildings do not go far enough

Architecture students used to visit Brumunddal, a town of 10,000 people on the shore of Norway’s biggest lake, for all the wrong reasons. Its crime-ridden high street illustrated how not to design a town centre. In the 1990s a third of all racist attacks in Norway, a country of some 5m people, occurred there. But locals hope that architects will soon have a better excuse to visit. In March the world’s tallest wooden skyscraper, 85 metres high, will open on Brumunddal’s waterfront.

The Mjostarnet tower currently looks like a naked tree rising spectacularly above the town’s low-rise concrete housing. But it is not the pine cladding of the tower that makes it special. The surprise is that all of its supporting columns are made of glulam—wooden beams laminated together. These are lighter than steel of comparable strength and require just one-sixth as much energy to produce. Most of the wood came from sawmills and spruce forests within a 50km radius of the tower, says Rune Abrahamsen, chief executive of Moelven, the Norwegian firm that supplied it. In short, few greenhouse gases were emitted in creating and transporting materials for the tower.

“This is the future of construction,” beams Harald Liven, Moelven’s project manager for Mjostarnet. But is it? Many governments in the rich world want to reduce greenhouse-gas emissions from constructing and using buildings. With some wonderful exceptions, they are failing.

Turning up the thermostat

Ever since the Romans began to build with fired-clay bricks and concrete, construction has been a polluting industry. The International Energy Agency (iea), a research group, estimates that putting up and running buildings consumes 36% of the world's energy and produces some 40% of energy-related carbon emissions. Five-sixths of that energy is used to light, heat, cool and run appliances. Consider the energy that goes into producing construction materials and the share of emissions from buildings is even higher. More than 5bn tonnes of cement—the raw material for concrete and mortar—is produced each year, adding a further 6% of emissions. The steel industry, half of whose production goes into construction, accounts for another 8%.

In 2015 world leaders pledged to keep global temperatures from rising more than 2°C above pre-industrial levels. That would entail drastically cutting emissions associated with buildings. So far, progress has been slow. Some things, like domestic boilers and lighting, have become much more efficient. Others have not. Under the current regulatory framework, for example, emissions from the cement industry will rise 4% by 2050 if policymakers take no further action, according to a report published last April by the iea and the Cement Sustainability Initiative, an industry outfit.

The obvious way to make buildings greener is to impose a broad carbon tax, covering everything from household energy use to the emissions embodied in building materials. But any levy that visibly raises energy bills will be unpopular. In Britain the Labour Party jumped in the polls in 2013 when its leader, Ed Miliband, pledged to freeze household energy tariffs.

One problem is that the poor feel the hit from green taxes especially hard. They tend to live in the least efficient homes and struggle to afford better insulation, which would cushion them against rising prices. And many people will keep their homes toasty no matter what. The sensitivity of demand to price for domestic heating in Britain has been close to zero since the 1990s, according to research by Roger Fouquet of the London School of Economics.

Policymakers have tried offering subsidies and loans for rooftop solar panels and energy-efficiency improvements that are repayable with the savings from lower energy bills. America has a programme called *pace*; Britain has a Green Deal. Unfortunately, take-up has been much lower than expected, partly because the expected savings did not materialise. Claims in Britain that installing loft insulation can cut energy bills by 20% were contradicted by a government study that found that it reduced gas consumption by just 1.7% on average.

One reason is the rebound effect. Insulate buildings better, and people will wear fewer layers rather than turn the heat down. The way energy-efficiency schemes are structured does not help, argues Richard Twinn of the *uk* Green Building Council, a think-tank. The schemes only finance a single type of upgrade at a time, such as loft insulation. A whole-house retrofit, in contrast, could have added digital thermostats to ensure that greater efficiency was converted into lower bills rather than higher temperatures.

A flawed blueprint

Many rich-world governments are therefore trying a third tactic. They have created rules forcing developers to build new projects to “zero energy” or “zero carbon” standards. Through a combination of energy-efficiency measures, on-site renewable heat or power generation and buying offsets elsewhere, new buildings are supposed to cover all their energy requirements from renewable sources.

From January 1st 2019 all new public-sector buildings in *eu* countries must be built to “Nearly Zero-Energy” standards. Other types of building will follow in January 2021. Parts of America and Asia are

following. In Japan the government wants zero-energy buildings to become the standard from 2020. Last month the Canadian province of British Columbia passed a plan requiring that all new buildings from 2032 must be built to these standards. Governments in countries such as New Zealand are being lobbied to copy them.

The technology to build and retrofit buildings to cover their carbon footprint already exists. One such system is Energiesprong from the Netherlands, which clads entire apartment blocks and terraces in insulation and solar panels to the point where they can generate all the energy they need themselves. Some buildings can now produce more renewable electricity than they use, which helps to offset the emissions used in their construction. Norway is a pioneer. The Powerhouse in central Trondheim produces 49 kWh per square metre of floor space per year from solar panels and consumes just 21—an impressive achievement for a building just 350km from the Arctic Circle.

Regulations and standards are less efficient than taxes. But they are a politically palatable way of reducing emissions caused by the construction of buildings and their operation. They bury the costs of environmental action in house prices and office rents, where consumers cannot see them as readily as in monthly heating bills. And “industry is not going to do this on its own”, says Luc Luyten of Bain & Company, a consultancy. Construction is one of the world’s most fragmented industries, with fierce competition between small firms for contracts. With thin margins, developers and builders are unlikely to build greener than they are required to.

Still, Elrond Burrell, an architect based in New Zealand, questions whether the zero-energy standards are sensible. First, he points out, the impact on emissions will only be slight. The policy is focused on new buildings and does little to cut emissions created by older ones. In the developed world only about one in 100 buildings is replaced by a new one each year.



Mjostarnet’s rib

Second, the standards are not as exacting as they sound. They exclude items plugged into sockets, such as laptops and dishwashers. Astute architects can make buildings appear greener by replacing ceiling lights with free-standing lamps. And “zero carbon” buildings exclude the carbon emissions required to build them (which explains the “nearly” in the eu’s new standard). Sometimes these emissions are larger than for conventional buildings. Research at the University of Hong Kong has found that green walls covered in plants to turn carbon dioxide into oxygen required three to six times as much energy to build as a bare wall.

Third, as Mr Burrell notes, many “zero carbon” buildings are neither as efficient as they are supposed to be, nor do they generate as much renewable energy as expected. Britain’s Building Research Establishment, a research laboratory, was designed to be an exemplar of a zero-carbon building. It ended up consuming 90% more energy than planned. Wind turbines and solar panels on buildings produce far less power than larger ones in wind and solar farms. Installing wood-burning boilers in new buildings is especially daft because they discharge dangerous particles and gases into crowded parts of cities.

If zero-carbon standards were changed to include the emissions from building and demolishing structures, many of the perverse incentives in the building regulations would disappear. It would probably lead to more building with wood. Many mature forests do little to take extra carbon out of the atmosphere. Chopping some of them down, storing the carbon in wooden buildings, and planting new trees in their place could well increase forestry’s contribution towards actually removing carbon from the air. (Sawmills can be green, too: the electricity that powers Moelven’s sawmills comes from burning sawdust.) And because wood is so light compared with steel, brick or concrete, it lends itself to the mass production of buildings in factories. That should cut emissions from moving materials to building sites.

British Columbia is moving particularly quickly. A decade ago the spread of mountain pine beetles left 18m hectares of dead trees in the province. If those trees were left to rot or to burn in forest fires, Canada’s total carbon emissions would increase by 2% in 2000-20. So it passed a law in 2009 that required wood to be used in all new buildings erected with public money.

In the light of the Grenfell Tower fire in London that killed 72 people, Benjamin Sporton of the Global Cement and Concrete Association, a trade body, questions whether there will be much demand for wooden skyscrapers. But, as Mr Abrahamsen points out, wood does not melt in a fire. And once it has charred it does not continue burning, like a flamed-out log fire. Mjostarnet’s fire-exit staircase is clad in cross-laminated timber, a material widely regarded as safer than steel in a blaze.

A few other wooden skyscrapers are rising. Amsterdam and Vienna are already building wooden towers the height of Mjostarnet. More ambitious projects have been proposed, such as a 40-floor tower nicknamed “Treetop” in Stockholm and 300 metre-high towers in London and the Netherlands. Mjostarnet may be the world’s tallest wooden tower, “but we hope not to hold the record for long,” says Mr Liven. They do little more than demonstrate a possibility. But even that is useful.

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