governments and carried forward to conclusion, adoption and entry into force through other multilateral processes. Even if not all of the countries possessing the weapons of concern join the treaty, they become progressively constrained by its provisions and legal status.

Humanitarian disarmament approaches do not undermine current arms control or present a 'nuclear weapons convention' as the only answer. By focussing on use rather than numbers, they aim to delegitimise and outlaw the weapons. International legal recognition that nuclear detonations would violate international law and be treated as a crime against humanity would greatly increase the political and legal pressure on nuclear armed states to take their weapons off deployment and undertake the necessary steps to dismantle and eliminate them.[12,13] Compared with the nuclear threats, policies and arsenals still around more than 20 years after the Berlin Wall was pulled down, reinvigorating nuclear disarmament and changing the status quo would be a major step forward.

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Sustainable building materials: how eco-friendly are they?

Insulation has little 'wow' factor compared to solar panels, but greater potential to reduce carbon emissions cheaply. However, it is crucial that we consider the energy required for their manufacture: natural, non-toxic materials consume the least energy and are safer for human health, argues Tom Woolley.

There is general acceptance of the need for buildings to be well-insulated but much less awareness of the wider environmental and social impact of mainstream insulation materials. New buildings must meet high energy-efficiency standards, and the UK government is also introducing the new – but somewhat flawed – Green Deal scheme to encourage greater retrofitting of existing buildings. While there is a strong case for increasing our use of renewable energy sources to help to reduce carbon emissions – although less so for micro-renewables on individual houses – improving the fabric of buildings is a far cheaper and more effective way.

The importance of establishing a thermally efficient building envelope, a concept known as 'fabric first', is accepted by many experts, but there is a surprising lack of expertise in how best to insulate buildings. For many, insulation is insulation: it does not matter what you use as long as the insulation supplier says it has a good thermal resistance. However, insulation materials perform differently and some are not appropriate for renovation. Furthermore, manufacturers' claims about thermal performance can be misleading; a product may not perform as well once it is installed.

Embodied energy of insulation materials

Insulation should be selected according to strong environmental criteria. The market is dominated by synthetic materials, many of which are made from petrochemicals and contain toxic chemicals that may harm the indoor environment. They also present a pollution hazard when disposed of in landfill. The energy required to manufacture, transport and install them – called the embodied energy – is largely ignored by energy efficiency advocates. Bodies like the AECB (now also known as the Sustainable Building Association), which used to promote use of ecological building materials, now support the use of synthetic materials and argue that the damage these materials do to the environment can be justified by the energy they save over the building's lifetime.[1]

However, there is growing evidence to the contrary, as recently demonstrated by work in Finland[2] which examined the total energy used in the early stages of building construction, called the 'carbon spike'. The carbon spike can outweigh the energy efficiency savings over the lifetime of a building. De Selincourt[3] argues that this problem is a "ticking time bomb", as carbon emissions during construction will enter the atmosphere sooner and cause warming earlier than emissions during operation. Work in the UK on the

carbon foot-printing of buildings[4] also shows that embodied energy is at least equivalent to operational energy. Embodied energy can be significantly reduced by using much more environmentally friendly materials.

It is now possible to select from a wide range of low impact, renewable materials that have a much lower embodied energy and do much less harm to the planet, based on timber, wood fibre, hemp, wool, straw, earth, lime, and recycled sources. Timber frame construction is still not established despite attempts by some public sector organisations to adopt a 'wood first' policy.[5] However, low impact, renewable materials also have many other advantages over synthetic materials. They can handle moisture and store heat more effectively, and are healthier to install and live with, and their manufacture and disposal are less polluting to the environment.

There is some prejudice against natural renewable materials over their durability, but building owners are increasingly choosing environmentally friendly products even when they are more expensive. As a result, even during the current recession, the production of ecological materials is growing. As the output of natural materials increases, their unit cost comes down, making them more competitive.

Other problems of synthetics

Many of the manufacturers of synthetic insulation products use 'greenwash' statements to convince architects and their clients to use petrochemical-based synthetic products. They claim their materials are healthy, good for the environment and perform better than natural materials. Many architects and the general public accept this without question.

However, claims about the recycled content of many man-made fibre insulations have been criticised by the UK Advertising Standards Authority.[6] Health risks from fibres, glues and flame-retardants remain a problem despite a 2003 report by conservation body WWF drawing attention to toxic chemicals found in the blood of young people.[7]

Foam insulation products are based on petrochemical 'polyols' and toxic additives such as isocynates. Most manufacturers have reduced the use of ozone depleting foaming chemicals but have substituted other greenhouse gas chemicals. Some insulation foams contain soya but are still 80% polyurethane. The Pharos Project, which campaigns for transparency in the building materials market, recently reported the death of a spray foam applicator in Massachusetts, USA.[8] Emissions of volatile organic compounds in buildings are not regulated in the UK, whereas in Germany there are strict emission levels and indoor air quality standards. These have affected the selection of flooring, glues for flooring, paints, boards and other finishes as well as general building and insulation materials.[9]

Eco-friendly options

A more environmentally responsible approach would be to use natural, non-toxic, renewable, bio-based materials that require little energy for their manufacture and lock carbon dioxide into the fabric of the building, known as carbon sequestration.

Ecological materials fall into three main categories:

1. Composites of biologically based materials mixed with binders such as hemp and lime, or earth and straw. These can be used with a timber frame to create solid walls, and even floors and roofs.
2. Manufactured composites such as wood fibreboards, flax, hemp, wool and other insulation combinations (known as 'quilts and batts'), usually using natural glues and resins present in the materials.
3. Low impact products made from genuine recycled materials such as 'foam glass'.

Other bio-based materials are available that not only outperform lightweight synthetic insulation materials, but also help control dampness in buildings and are breathable, helping to make buildings healthier. Some of these materials are being adopted by mainstream construction in the UK. For instance hempcrete – a mixture of hemp and lime – has been used to construct large food and wine warehouses, offices, and a superstore. There are also some social housing schemes that have been built with 300-400 mm solid hempcrete walls. The solid wall is breathable, fire proof, non-toxic and provides a good level of insulation.[10]

It is regrettable that mainstream advice on eco-building materials fails to give due attention to natural materials. For example, the BRE's widely used Green Guide[11] fails to give ecological materials a better rating than those made from petrochemicals, and even gives a high environmental rating for PVC windows! Alternative certification is now available through Natureplus,[12] a rigorous international environmental standard, which only approves materials that contain little or no petrochemicals and considers manufacturing, sourcing of materials, and ethical issues. In 2011, a wide range of UK companies formed the Alliance for Sustainable Building Products[13] to press for greater use of eco-friendly building materials.

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