further abrupt changes in the Arctic. This would aid the development and deployment of adaptive strategies, and could contribute to a more pre-emptive, precautionary policy approach. Unfortunately, time series on the dynamics of environmental and biological tipping elements other than sea ice are patchy at best[1]. A major collaborative effort to compile time series through data-rescue programmes and to maintain observation capacity of key tipping elements needs to be developed[5]. Arctic ozone-monitoring efforts represent an excellent example of such an international collaborative programme.

To reduce the risk of near-term abrupt changes in the Arctic, short-lived radiative forcing agents should be mitigated. The deposition of black carbon (soot) on Arctic snow and ice is making a large contribution to warming and ice melt[10]. Yet the technology to mitigate soot emissions from coal-burning power stations or biomass-burning stoves is uncomplicated and readily accessible. Methane and the tropospheric ozone produced from it are also significant contributors to Arctic warming. Encouragingly, around 40% of global anthropogenic methane emissions could be mitigated at zero cost or with net economic benefit (the stumbling block being that the benefits are shared by everyone, whereas the mitigation costs are borne by only a few). Of course in the long term, restricting cumulative emissions of carbon dioxide is essential for safeguarding slow tipping elements such as the Greenland ice sheet.

The perception of present danger is such that the Arctic Council is already discussing regional geoengineering options. Reduction in tropospheric sulphate aerosols has been a major contributor to recent Arctic warming; hence, it has been proposed to replace them with deliberately injected stratospheric aerosols. Modellers have begun simulating whether such deliberate sunlight reflection can prevent, for example, irreversible melting of the Greenland ice sheet[11]. Whether such methods can reduce the risk of further dangerous Arctic climate changes warrants research. But in the meantime, we should stop debating the existence of tipping points and start managing the reality of dangerous climate change in the Arctic. ❐

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COMMENTARY:

Higher standards for sustainable building materials

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Certification criteria for sustainable building materials need to be rationalized to avoid confusion in the marketplace.

The market for building construction in the United States is estimated to be worth nearly US$1 trillion per year[1], representing around 13% of the gross domestic product. Buildings account for approximately 42% of US energy consumption[2], 67% of electricity consumption[3] and 39% of carbon dioxide emissions[4]. Buildings and the building industry have an enormous potential impact on global climate change — improving the sustainability of building practices and materials can have an equally great effect on mitigating its severity.

The US Green Building Council, which develops and administers the Leadership in Energy and Environmental Design (LEED) rating system, has certified nearly 5,000 green buildings since 2000 (ref. 5). US state governments and federal agencies have adopted policies to make their construction and building projects environmentally sustainable. But despite such programmes, quantifying and evaluating the sustainability of building materials has proved difficult. There is little coherence in the measurement and assessment of sustainability attributes, resulting in competing, inconsistent and often imprecise eco-labels, standards and certifications. This discord has led to confusion among consumers and commercial purchasers alike, as well as inconsistent sustainability criteria in building certification programmes.

When manufacturers of electronic gadgets and electrical appliances develop standards, they benefit from a shared vocabulary that describes the basic features and functions of their products. In the realm of sustainability standards, however, there is no such common lexicon, and most variables measured suffer from a lack of consistent and rigorous definition. For example, renewable energy may be defined in many different ways: some certifications consider energy offsets, others exclude sources such as nuclear power, and so forth. Sustainability standards for materials also lack consistent and transparent means of measurement and testing.

The lack of common terminology and measurement techniques makes sustainability standards and certifications difficult to compare meaningfully. For example, in the area of commercial carpeting, the SMaRT certification[6] produced by the Institute for Market Transformation to Sustainability and NSF International's NSF-140 standard[7] both award points for reducing the percentage content of certain toxic substances. Other standards measure the reduction of harmful substances found on different lists, a few of which may be proprietary. Still others recognize only the complete phase-out of such substances rather than percentage reductions. Compounding this problem are the different weights that point-based rating systems subjectively allocate to different sustainability attributes. Thus, the Cradle to Cradle (C2C) system[8] allocates 54% of its points to toxicity-related characteristics and 10% to energy use, whereas SMaRT allocates only 20% to toxicity and 33% to energy use (Fig. 1).

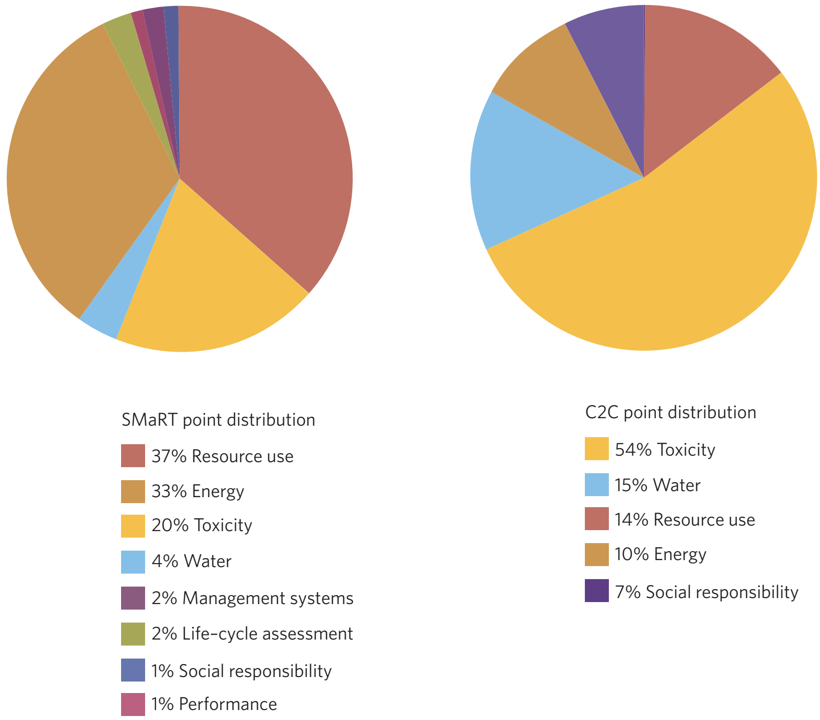

Figure 1 | C2C and SMaRT award different point values for the same sustainability attributes.

A number of certifications tend to assess attributes that are inherently subjective or unmeasurable, such as a manufacturer's adoption of policies relating to sourcing, recycling and labour practices. Other certifications assess measurable quantities, but on only a relative basis, for example, assessing a manufacturer's year-to-year reduction in carbon emissions without providing information on actual quantities.

Perhaps one of the most vexing aspects is the plethora of eco-labels for sustainable building products. These logos can represent compliance with the same standard(s), and sometimes with combinations of publicly accessible standards and proprietary criteria. Thus, at least three different eco-labels may signify compliance with the same NSF-140 carpeting standard: NSF International, the group that developed the standard, as well as Scientific Certification Systems and UL Environment. However, each of these organizations certifies compliance with the standard using its own unique eco-label. Thus, carpet products that comply with NSF-140 may bear one, two or three different logos. Such a proliferation of labels causes significant confusion.

Many sustainability certifications for materials are based on point systems, whereby a manufacturer receives a specified number of points for achieving different goals. The total number of points determines whether a product will be certified and, if so, at what level. For example, under the present draft UL Environment gypsum board certification[9], a manufacturer that ensures its waste is diverted from landfills is considered equivalent to a manufacturer that documents its water use. Such aggregated scores offer flexibility to manufacturers, but mask the underlying attributes or sustainability features of certified products. This loss of specificity is compounded when such point-based certifications are used as inputs to comprehensive building-rating systems such as LEED. Thus, LEED awards credit for the use of C2C- and SMaRT-certified products. But calculating the impact of a LEED-certified building on, for example, water use is nearly impossible on the basis of these nested, nonspecific certifications.

There is a lack of transparency both at the standards-development level and at the product level. Although an increasing number of sustainability standards are being developed in open organizations with procedural requirements of balance and transparency, a number of prevalent certifications remain proprietary. Likewise, measurement and testing methodologies used by certification organizations often remain undisclosed. At the product level, manufacturers may claim that a product meets a particular certification's top-tier (for example, 'platinum' or 'gold') requirements, but fail to disclose the underlying attributes supporting that certification. Some private organizations offer product-sustainability information through websites and publications. However, these resources are often proprietary and require payment for use, and the lack of consistency across standards and the sheer number of labels make searching tedious.

New framework

We offer the following set of recommendations for government, standards-setting organizations and industry. The first step towards rationalizing sustainability standards is the development of a common vocabulary or ontology for sustainability attributes, features and variables across numerous product categories. Thus, when a standard refers to water use, the meaning of the term should be understood by all market participants in the same way. That is, it should be clear whether water use is measured in terms of product composition or the manufacturing process, whether re-use of water is accounted for, and the degree to which water contamination is assessed, and so on. Such a common vocabulary would vastly improve comparability among standards, both intrasector and intersector. Similarly, standardized measurement methodologies and data reporting should be developed.

For the greatest public benefit, sustainability attributes and compliance should be consistent, transparent and easily understood. We propose the development of a standardized product sustainability label (PSL), akin to the US Food and Drug Administration's nutrition facts label or the Environmental Protection Agency's fuel economy label for passenger vehicles. The PSL would summarize, in an easily understood format, key measurement variables and sustainability attributes (for example, water use, carbon emissions, recycled content, indoor air contamination, and so on).

The PSL would allow the comparison of sustainability characteristics of different products across categories. Although PSLs could not replace the more detailed technical descriptions contained in environmental product declarations and other legally mandated documents, the information conveyed should be sufficient for most uses. Thus, if a designer or an architect wishes to specify a building that is carbon neutral, or that conserves water, or that reduces overall energy consumption, it will be possible to compare not only the imprecise tier placements of certified products in arbitrary point systems, but the actual values germane with those sustainability characteristics.

PSLs would not eliminate the need for selected sustainability certifications and eco-labels. Although the present explosion of such labels has led to confusion in the marketplace, a limited set of widely recognized certifications based on standardized measurements should drive manufacturer behaviour both through the pull of consumer demand and the push of governmental regulation. For example, designers and consumers interested in water conservation could seek out products bearing a water-minimizing certification, and manufacturers wishing to address this demand would be required to adapt their practices to achieve such a certification. Comprehensive building-level certifications such as LEED would continue to play a role in the sustainable building marketplace. However, such certifications would be improved by using more objective and uniform criteria in their own point systems than those available at present.

Public database

We also propose the creation of a public database or other centralized resource for data on the sustainability of materials. This resource should span all sectors and categories of building materials, and should display information using the common vocabulary and measurement data proposed above. Ideally, it would enable comparisons among products both in the same and different categories, on the basis of one or more commonly defined sustainability attribute.

Conclusion

Discord, imprecision and incompatibility among the sustainability standards and certifications of materials cause significant confusion in the marketplace and obscure the positive role that such products can play in mitigating climate change. Accordingly, we propose a framework that will improve comparability, precision, transparency and utility among sustainability standards and certifications for materials. Such improvements would benefit consumers, architects, designers, contractors, manufacturers and the environment. Given the significant impact of the building industry on the environment and human health, we urge government, industry and the standards-development community to take these important steps towards global environmental sustainability soon. ❒

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