Construction materials, methods and design: Paradigm changes to come

A number of weather and climate records were broken summer 2018 in a lot of European countries. This may have happened by chance, or as a consequence of global warming, or perhaps a combination – we can't really know. However, the case, this and other extreme weather-events will add to the pressure for stricter regulations on the use of fossil fuels.

The impact on the construction & materials sectors could be very considerable in the next decade.

Now, construction has been regulated already, with increasingly stricter regulation of insulation and operational energy usage (mainly heating and cooling).

Yes – but as a consequence, the life-cycle pattern of energy consumption of buildings has changed greatly. Buildings are much more complex, using more complex materials etc. In a few decades, we have gone from perhaps 80% of life-cycle energy spent on operations and only 20% on materials, transport, etc., to a situation close to a 50-50 split for new buildings, and (on present trends) an even lower share for operations in the future. i)

And the total energy usage of buildings (materials production, transport, construction, operations, decommissioning and re-usage of materials) remains a huge share of society's total energy usage.

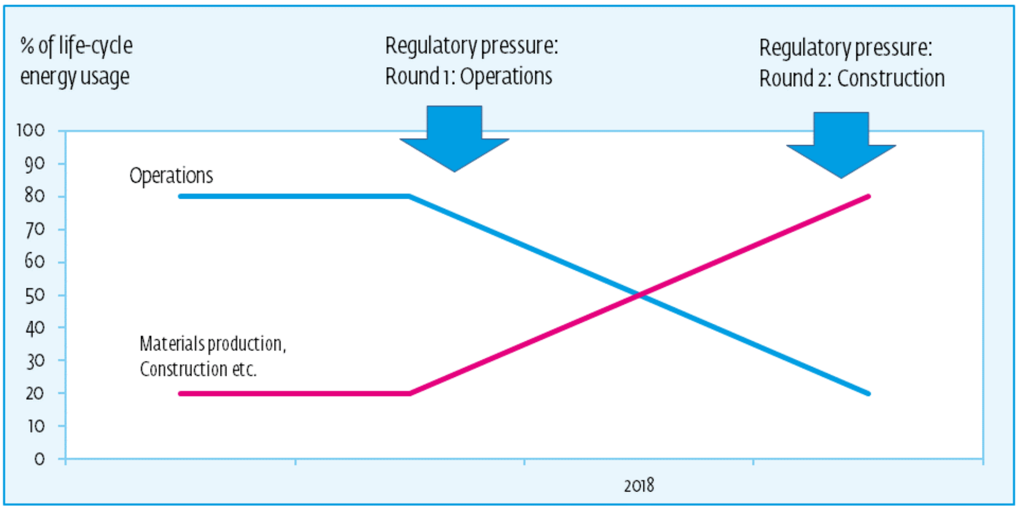
Since energy-related policies will remain in focus the next decades, we must expect much stricter regulation of not only current consumption, but of 'the rest of the life cycle' too – not least since the low-hanging fruit has already been picked in relation to current consumption (in new buildings – old buildings are a different story).

Note that materials production is in principle already impacted by the cost of carbon credits. But in reality, these have been so cheap as to have no impact. During the last year, however, the price of carbon credits has trebled, and the prize of carbon credits should rise steeply in the next years. ii)

For a number of reasons, we expect politicians to regulate the field directly too during the next decade. This could represent a paradigm change in relation to both materials production and the construction sector as such.

The 'CO2-lightness' of materials and processes will become much more important. This will give higher focus on materials-efficient design, with emission targets being met by the usage of lighter, stronger materials and a higher degree of precision in the construction phase.

Expected change of focus in regulatory pressure:
From operations focus to increasing focus on life-cycle energy usage, incl. materials construction, construction phase, re-usability etc.



Obviously, a 'Design for disassembly' approach could become useful too. Design for disassembly makes it a lot easier to dis-assemble a building and either reprocess materials or, even better, re-use its components directly. (This is coming. In a recent study of the circular economy in Denmark, 20% of construction companies expected more than 50% of their materials to be re-used materials by 2023 and a further 10% expect 25-50%. iii)

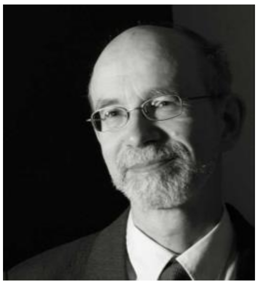
Another significant factor in relation to life-cycle energy usage of a building is the length of the life cycle. The smaller share of current consumption (operations) and the higher share of one-shot energy use 'embedded' in the construction as such (the investment) means that the useful life span of the building (the number of years in which the building is put to productive use) becomes relatively much more important than before. With a longer useful life, "CO2 investment" per year is smaller and we obtain a lower total carbon cost per year of the buildings useful life, which is an obvious goal for present-day construction. iv)

It is obviously hard to forecast the possible uses of a building 50 or 100 years down the line; thus, it may seem hopeless to design for a very long life-cycle. However, for one thing it is possible to describe a number of alternate scenarios for technology, life styles and the development of a region, thus giving at least some idea about what could become relevant within the life cycle of the building – and include that in the design. For another, it may be possible to design more "generalised flexibility" into a building. This is not necessarily easy, nor will it come about without extra cost, but it may still be extremely worthwhile in the longer run. It may be very considerably cheaper (in both money and CO2 terms) to add more flexibility at the design & construction stage if this makes for a longer life cycle with less reconstruction needed.

Could we imagine a certification of flexibility in the use of buildings? 'This building is certified to be flexible between uses as housing, offices, community centre, kindergarten, …' – or at least, that it is flexible as use for different types of residential uses, e.g. as small flats, large flats, communal living, …. Since the possibilities for long-term social change seem overwhelming, it is hard to specify exactly what would be needed e.g. 80 years from now, and hence hard to certify such a flexibility. But we could at least certify for design standards which permit certain, well described, types of flexibility, at a low cost. Could we imagine that a building with such certification would command a premium price? Yes, it would cost a bit more, but it costs money to fireproof a building too, and we would be very foolish not to do that. Could we 'future-proof' buildings too (or at least reduce the risks related to societal change) – accepting that this would incur an extra cost, but be worth the investment?

Whatever the details (e.g. whether or not a useful certification of flexibility is developed), the logic of reducing the carbon cost per useful year of service should drive a focus on higher flexibility in the design of buildings, probably supported by the consideration of alternate scenarios for diverse uses down the line, related to a spectrum of alternate societal scenarios.

Hence, the drivers described above may foster at least two paradigm shifts in construction in the decade ahead.



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[i] Note that these figures are "guesstimates": We can't know what the life-cycle energy usage will be until the end of the buildings life-cycle – and the figures will depend on local building traditions, climate, and a lot of other factors.

[ii] 5-fold to 2020 has been forecast by Berenberg Bank. Source: Forbes.com 2018-09-03

[iii] Construction companies with 15+ employees in Denmark where surveyed in Jan-Feb 2018. When asked about how large a re-use of materials in 4-5 years time (approximately Fall 2022), 20% expect more than 50% re-use of raw materials, and a further 10% expect having a re-use factor of 25-50% ("Don't know" was 20%, the rest between 0 and 25%). Source: "Cirkulær økonomi sætter dagsorden i fremtidens byggeri", Teknologisk Institut, Copenhagen, 2018 (Only in Danish, sorry)

[iv] Note that carbon cost should obviously be seen in relation to the services provided by the building, e.g. size, how many people live comfortably there, etc. Also note that even if a building is a net producer of energy over the life cycle e.g. by having a façade of very efficient solar panels, the logic remains the same, as the surplus simply gets larger with a longer useful life.