

Form Follows Sustainability

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The situation is becoming more critical. Described by the media as "planetary emergency" [1] and dubbed by scientists as "Humankind abolishes itself" [2]. Nevertheless, not everyone wants to acknowledge the seriousness of the situation, be it out of childish defiance or ignorance, for lack of qualified information, for economic calculation or for a mixture of all of these.

What is meant is the fact that mankind has been working for a long time to rob itself of its own livelihood. Mankind is obviously an inert mass and only with difficulty able to set the necessary course sufficiently early if the consequences for the individual person can only be recognized in the abstract.

Many people are still watching relaxed as global warming, which has now been proven to be forced by humans, takes on dramatic forms, albeit only by a few tenths of a year so far. But the consequences are already noticeable: extreme weather events are piling up, permafrost, glaciers and mainland ice are melting, methane gas is being released, sea levels are rising, lakes are drying up, regional droughts, famines and water shortages are increasing. As if that wasn't enough, the strong increase in the world's population goes hand in hand with a growing but understandable claim to prosperity and quality of life. This leads to an increasing problem of waste disposal, the pollution of the oceans and a high densification of cities and traffic. This in turn has consequences for our health, be it the pollution by fine dust, eutrophication or the reduction of habitats, with the consequence of a dramatic decrease in the number of animal species. The cycle is picking up speed with an uncertain, presumably frightening outcome for the environment and humankind.

If we believe recognized scientists, which we should do, we have little time left to stop the chain reaction described above. If the deadline elapses, it will inevitably go downhill - "Humankind abolishes itself".

Now there are strategies for averting the chain reaction. The three main objectives are:

- drastic reduction in emissions, especially greenhouse gases. The Kyoto Protocol lists six greenhouse gases: carbon dioxide (CO₂), methane (CH₄), and laughing gas (N₂O), and the fluorinated greenhouse gases (F-gases): hydrogen-containing fluorocarbons (HFCs), perfluorinated hydrocarbons (HFCs), and sulphur hexafluoride (SF₆) From 2015, nitrogen trifluoride (NF₃) will also be included. In Germany, 88.2% of the greenhouse gas emissions come from carbon dioxide, 6.0% from methane, 4.2% from laughing gas and around 1.7% from F-gases (in 2016).

- quick switch to renewable energies. These essentially include bioenergy (biomass), geothermal energy, hydropower, marine energy, solar energy and wind energy. By far the most important source of energy is the sun.
- sustainable use of resources, i.e. Minimization of the need, recycling of substances and, after the end of a product's life, its environmentally friendly disposal.

All three goals also affect the construction sector. If one realizes that 42% of global CO₂ emissions are attributable to electricity consumption (including heating and cooling), 24% to transport, 19% to industry and 8% to the manufacture of buildings [3], that a lot can and must be achieved in the construction sector. Admittedly, it is difficult to clearly assign the emissions shares to the sectors, as there are inevitable intersections. What is certain is that the building industry has a meaning and responsibility with regard to emissions, the use of energy and the recycling of construction products and building materials.

The above main goals in the construction industry are in line with the general concept "The 6R's" (see e.g. [7]):

Rethink: what could be done differently?

Refuse: are there materials a designer should not use?

Reduce: can the use of materials be reduced?

Reuse: can the product be used again for another purpose?

Recycle: can materials be used that are easy to recycle when the product is finished with?

Repair: can the product be repaired instead of thrown away?

In 2007 Werner Sobek already clearly stated in his lecture "Building in the 21st Century: High-Tech and Ecology" [4] what the common goal of all involved must be, namely the "Triple Zero Concept" [4]:

- zero energy consumption / zero energy: Build buildings that do not require any energy for their operation in the annual sum
- zero emissions: Build buildings that do not emit harmful emissions
- zero residues / zero waste: Build buildings that are completely recyclable

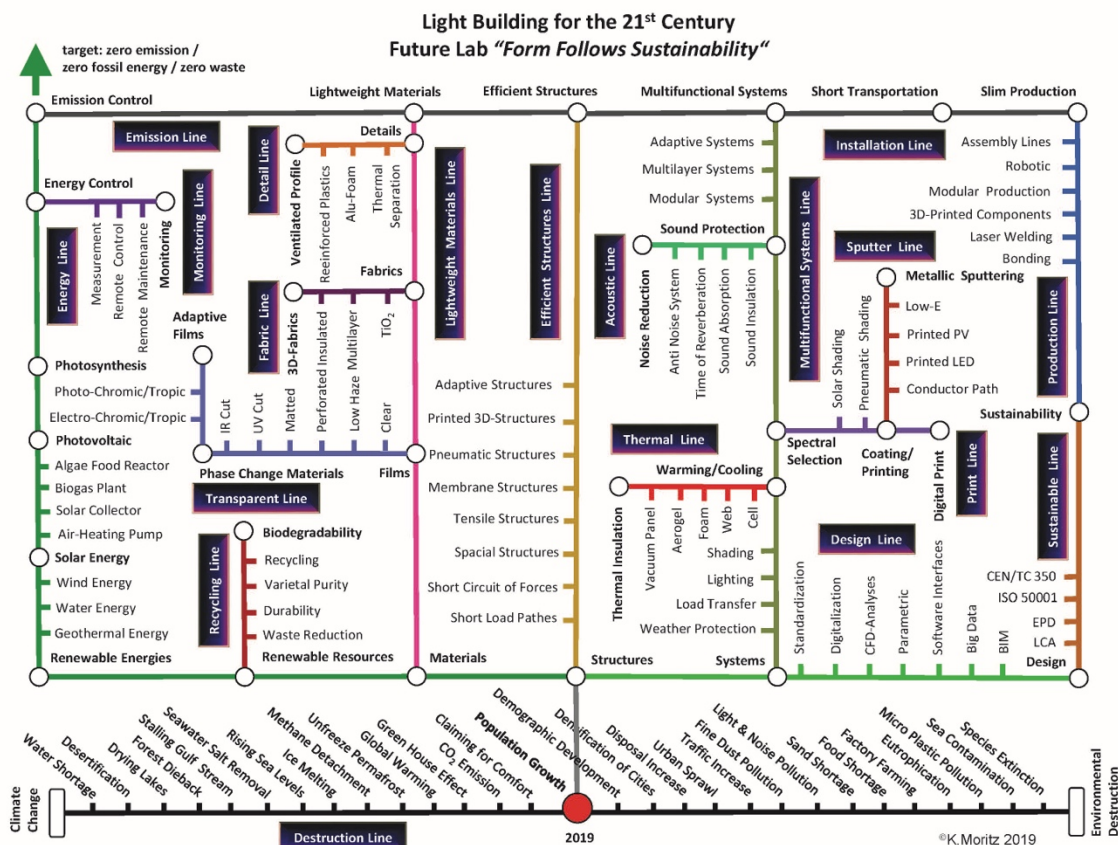
He also made the following hypothesis: "While many eco-houses and eco-cars have been so far a commercial flop because they were all characterized by a depressive renunciation of aesthetic, it will probably be the most important task, which product designers, architects and engineers in the near future will have to solve: make ecology breathtakingly attractive and exciting..." [4]

If one follows this hypothesis, the guideline for building in the 21st century could be: "Form follows Sustainability". We remember the famous words "Form follows Function" from 1896, which were attributed to Louis Sullivan [5]. Ideally, one should be able to draw conclusions about their function or purpose from the shape of objects, components or buildings. In the

future, the sustainability of objects, components or buildings should be derivable from their form (in a wider meaning, including shape, material...), or vice versa.

Since its beginning in the last century, membrane construction has followed the principle of "form follows forces", even if no one may have formulated it explicitly. The reason for this guiding principle was the fact that form and force are mutually dependent in typical single-layer, mechanically prestressed, membrane constructions. If you change the shape of the membrane, the force changes accordingly and vice versa. These types of membrane constructions will continue to exist, but their applications are limited due to physical limitations (e.g. thermal and acoustic insulation).

Future research and development fields for the construction industry can be derived from the demand and necessity of sustainability for an aesthetic architecture and environment. Considering the "Mega-Trend-Map" of the *Zukunftsinstitut* [6], the network plan *Light Building for the 21st Century - Future Lab "Form Follows Sustainability"* was developed that shows the interdisciplinary research and development requirements for lightweight and membrane construction for the following decades. The three pillars of lightweight construction, building with light materials, with efficient structures and with multifunctional systems, play a central role. With these three pillars, enormous mass savings and smart systems can drastically reduce emissions, make renewable energies usable and also significantly reduce material waste. Building on this network plan, the next steps would be to show the connections between the interdisciplinary research fields, to weight the technologies and finally to structure and evaluate their importance and urgency.



However, the diagram shows, even without such a prioritization, that there will certainly be energetically important technologies, which must, however, be critically assessed with regard to their sustainability. Examples include spectrally selective layers, e.g. metallic sputtering on fabrics and foils that do not emit infrared radiation (so-called low-e layers). Composite systems of this type must first be separated into their components before each individual material can be returned to the material cycle in pure form. Consequently, it will be the case that the development of such composite materials can only be successfully completed in the future if their separation and recyclability of the individual materials is developed at the same time or is already available.

The construction sector will change quickly. However, construction sector not only means the construction industry and design, but also the sciences and political bodies involved. Because one thing is certain: If sufficient and timely changes in the supply and demand side in the economy are no longer to be hoped for, there is a need for action by politicians. In this case, this action is required on a global level.

Anyone who describes climate change and the efforts to avert it, as a megatrend, and sees it only as a way to generate profits, does in no way understand the problem. If the consequences predicted by the scientists come true, there will be no supply and demand side as we know it today.

Sources

- [1] Planetarer Notstand / Planetary emergency, Marco Evers, Der Spiegel, edition 07.12.2019
- [2] Die Menschheit schafft sich ab / Humankind abolishes itself - The Earth in the grip of the Anthropocene, Harald Lesch, Klaus Kampfhäuser, 2019, ISBN: 9783831204243
- [3] Statistical survey of the proportions of global CO₂ emissions by sectors, 2019, <https://de.statista.com/statistik/suche/?q=Emissionen>
- [4] Building in the 21st century: high-tech and ecology, Werner Sobek, lecture, published by the Federal Ministry of the Interior, for construction and home, 2019, <https://www.nachhaltigesbauen.de/veranstaltungen/nationale-veranstaltungen/nachhaltiges-planen-bauen-und-betreiben-von-gebaeuden/bauen-im-21-jahrhundert-high-tech-und-oekologie.html>
- [5] Form Follows Function, Designlexikon, 2019, <http://www.designlexikon.net/Fachbegriffe/F/formfollowsfunkt.html>
- [6] Mega Trend Map, Future Institute, 2019, <https://onlineshop.zukunftsinstitut.de/shop/megatrend-dokumentation/>
- [7] 6R's explained, STEM Learning Ltd, 2019, <https://www.stem.org.uk/elibrary/resource/30113>