A Circular economy from an HVAC perspective

OLAF OOSTING
Olaf Oosting is managing director at Valstar Simonis, an MEP/ Building Services consulting company. As an expert and initiator of circular solutions and installations, Oosting likes to share his knowledge and regularly gives lectures on topics as circularity. Besides his work at Valstar Simonis, he is Board Member at TVVL and also part of the Organising Committee and Scientific Committee for the CLIMA2022 congress.
o.oosting@valstar-simonis.nl

The circular economy is everywhere. The strive for less waste and having the possibility of using instead of buying things is becoming more visible. The European Commission developed and announced several policies in the last decade to promote circularity. In this article I present my opinion about the short-term focus and possibilities of the Circular Economy for the HVAC industry and relate them to the Circle Economy Action Plan and future Ecodesign guidelines.

Keywords: Materials, Circular economy, As a Service, Design for Disassembly, Product Passports, Circular Economy Action Plan, Ecodesign

Circular Economy: Where it started for me

I was inspired by the possibilities of a Circular Economy in 2015 due to an advertisement[**1**] by a multifunctional supplier which described a circular office. In addition to various, more or less circular products, the advertisement also mentioned a solar panel, a windmill and an ATES (Aquifer Thermal Energy Storage) as part of this office. The lack of a supplier for these products prompted me to investigate what the circular economy could mean for the building services industry. This led to the creation of the TVVL Community Circular Installations. Together we formulated three strategies to achieve circularity in our business:

- A circular design - how can an (installation) design be as flexible and adaptive as possible? A Design for Disassembly (DfD) of the various installation components must be guaranteed in order to keep the potential interchangeability as great as possible in the near future.
- A circular product - where the (installation) design must facilitate circularity, a product must be implemented that consists of fewer or different virgin materials. Both the origin and the future of materials are important here.
- A circular business model - in order to actually guarantee material flows and improve the quality or lifespan of products, a change of ownership is necessary. The manufacturer of a product is pre-eminently the best party to design, build and maintain a product in such a way that it can be optimally utilized in use as well as in reuse.

As perhaps can be inferred from the above strategies, my focus is on (virgin) materials and products and not directly on the CO_2 emissions associated with this. For me, this is a conscious choice. The circular economy is also described by Nederland Circulair[**2**] as: a circular economy is an economic system in which value is preserved or created by reusing products and raw materials and minimizing the destruction of raw materials.

Energy vs virgin materials from a construction perspective

In the Circle Economy Action Plan (CEAP)[**3**], Circular Building is mentioned as one of the themes.

The built environment requires about 50% of the required raw materials. The emissions related to construction in 2019 were about 10% of the total amount. (25% of the share of the built environment). What is also striking is that 10%[**4**] of the emissions are caused by 5% of the energy demand. Assuming that emissions are entirely caused by energy consumption, it can be concluded that the construction industry also does this inefficiently compared to other sectors. This applies to construction as a chain.

In the construction of an office, between 75% (small office) and 90% (large office) of the mass comes from the concrete, according to the EIB in collaboration with Metabolic and SGS Search[**5**]. Cement is an important raw material and is responsible for about 6% of global CO_2 emissions. This is a significant share, and it explains the attention paid to circular ideas in relation to limiting CO_2 emissions and the resulting climate change. For example, the CEAP indicates that up to 80% can be saved on these construction-related emissions as a result of better material efficiency. And rightly so, because this will save 4 to 5% of total emissions in absolute terms in the example of cement. In the short term, quick steps can be achieved with this. However, a concrete shell has a lifespan of 75 years. In the medium term, more structural thinking will have to be done and the focus will shift to the other components. Installations are an important part of this. As we have seen, the share of installations in the building, in kilograms, is very limited. When we take into account the amount of metals in the building, this is largely due to the HVAC industry. Moreover, after 15 years, installations have a high demand for replacement or renovation. On balance, this means five installations against one concrete shell, which puts the proportions in a different perspective. This is confirmed in the aforementioned study by the EIB. Installations only amount to 1% of the mass, but count for 9% in the ECI for new construction, based on figures from 2014. Here too, the energy demand during the use phase counts significantly. but if we do not take into account the energy consumers, the ECI per ton of product is greatest for, for example, water, electricity and heat distribution. With increasing sustainability requirements, this share will have increased: over the years we have started installing more and more solar panels. This perspective on installations is in my opinion still insufficiently reflected in legislation and regulations like CEAP.

Energy vs materials for HVAC manufacturers: Product Passports

Where for me personally the scarcity of materials is at the top of the list when it comes to circularity, I understood from some suppliers of energy-consuming HVAC products that material efficiency is lower on the list of priorities. From the perspective of these suppliers, energy efficiency is much more important, also from the circularity principle. The reason for this stems from the energy consumption in the use phase of, in particular, the air handling units and heating and cooling generators. Binnenklimaat Nederland (BN, former VLA) mapped the environmental performance of air handling units[**6**] in 2016 on the basis of a LCA.

Global share of buildings and construction final energy and emissions, 2019

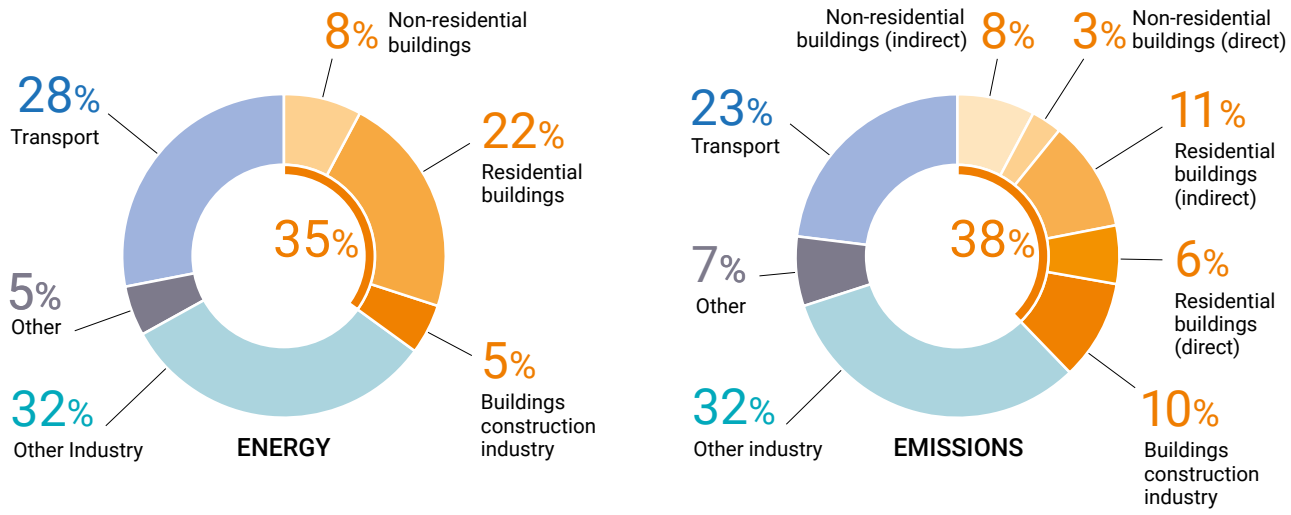

Figure 1. Global share energy and emissions of buildings and construction (source: 2020 Global status for buildings and constructions)

BN has had it calculated that the application of a rotary heat exchanger costs 5.5 tons of CO_2 as a result of the extra materials and 19 tons of CO_2 in extra electricity demand, but in the use phase the amount of CO_2 saved for 25 years compared to a variant without heat recovery, leads to 475 tons of CO_2 savings. A simple choice, but that does not directly contribute to the circularity of the product.

The fact that BN has determined the impact of the extra materials is a good step forward. Our HVAC industry is lagging behind with regard to circularity and circular products compared to construction as an industry. The supply chain is many times longer and, moreover, a large part of our products consists of other products supplied by third parties, or semi-finished products. As a result, many manufacturers have insufficient insight into the Bill of Materials of their product. This makes the origin of raw materials unclear, but it also provides insufficient insight into the future of materials in the products and their potential value, but also into possible risks in business operations. Product Passports are not an end goal, but a very useful tool in creating insights in the material flows and environmental impacts of HVAC products.

Focus on Design for Disassembly (DfD)

From a circularity perspective, it is important with examples such as BN to look at the materials and choice of materials. After a publication by the Netherlands Environmental Assessment Agency, the Dutch newspaper het Financiele Dagblad[**7**] describes

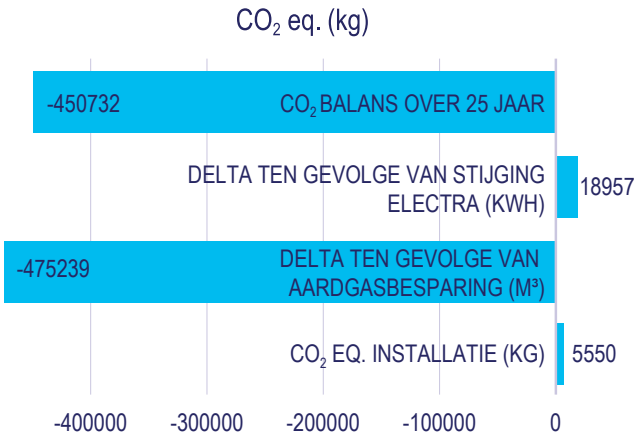

Figure 2. CO_2 balance over 25 years for air handlers with a rotory heat exchanger compared with an air handler without a heat exchanger (source: BN, Duurzamere luchtbehandeling in gebouwen, 2016).

that problems are already arising due to a lack of raw materials to make the energy transition happen. And the demand will rise in the future. Recycling is of course an opportunity to reuse the raw materials. But recycling tends to use a lot of energy and cannot continue indefinitely. The implementations of the DfD philosophy in products can be a key here. Critics think that DfD is a way of advancing the possibilities to the future. Design for Disassembly means that not eventually less virgin materials are used in buildings. This is a valid argument compared to a detachable concrete hull. Simply dismantling and reusing a skeleton in 75 years will not contribute to solving the climate problem. But here too, a different perspective applies due to the relatively short lead time for Buildings Services or components. With the relatively short lead time, it pays for HVAC manufacturers to focus more on the DfD in the design (the simple disassembly of a product) and on the product itself (for the replaceability of parts).

DfD in the design also offers the possibility to replace products that are currently not yet circular for a circular variant at a later stage. You increase the circular potential of an installation or building: it also offers the possibility to build in existing or already used products when a circular variant is available, without losing energy or materials.

Renewed Ecodesign guidelines

The Ecodesign Directive, published in 2009, was supposed to steer the energy demand of energy-related products. Ecodesign thus ties in with the first part of my argument, the focus was mainly on climate change. At the end of January this year, amendments[**8**] were adopted by the European Parliament to ensure that the Ecodesign Directive is amended so that products

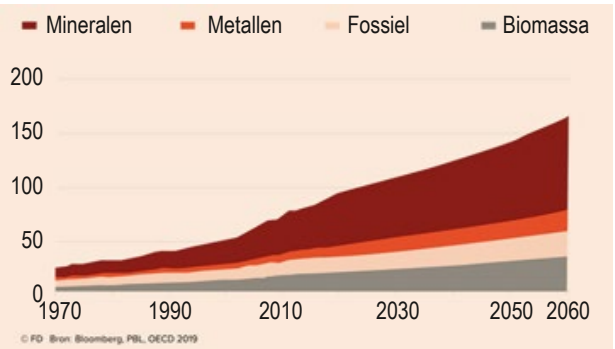

Figure 3. Demand of materials in the past and in the future, (source: het Financiele Dagblad based on Bloomberg, PBL ans OECD).

placed on the EU market perform well, are durable, are not toxic, can be upgraded and recycled, contain recycled content, are resource - and energy-efficient, are reusable, and can be easily repaired. Not only does this mean that a bill of materials must be drawn up to map the structure, the environmental impact and the toxicity of a product, but also the product passport is mentioned as a next step. The origin and degree of recyclability of products and materials come into play here. These are good steps towards a circular product. And with the latter two, reusable and the right to repair, DfD also emerges indirectly. A product must be easy to dismantle, so that it can actually be repaired, without causing damage to other parts and without requiring a lot of valuable time from installers to prevent such an operation becoming too expensive and replacement for a new product is cheaper economically. The right to repair also directly endorses the need to think further about the way in which we design our products and how we can repair them during the use phase: the amendments also describe the right to the availability of spare parts.

Circular opportunities

In the above, the circular product and design were discussed in particular. The Amendments, as adopted and thus also part of regulations in the future, offer not only a great deal of effort to map out product specifications and environmental impact, but also opportunities for new and circular business models. A business model is not the immediate goal, but it helps to achieve a circular economy in which no virgin materials are used. When the right to repair means an obligation for the suppliers, this offers a good incentive to no longer sell the product, but to offer it, for example, in an As a Service model or with a buy-back guarantee. This shifts the value thinking about a product and offers a different light on the possible residual value at the end of life. Mitsubishi has been offering this for its elevators for several years and Halton has recently introduced this model for commercial kitchens. I expect that the insight into the structure and materialization of a product, in combination with future material scarcity, will lead to a new way of designing products, in which the origin of materials and the way in which DfD is guaranteed, will lead to a fully circular economy. An economy in which Ecodesign requirements are not only a burden to HVAC suppliers, but also offer sufficient opportunities to show how decisive we are in delivering comfort in buildings in a material and energy-efficient way. ■

Endnotes:

[1] See https://www.werktrends.nl/app/uploads/2015/06/NRC_ricoh-hr-def-poster_opt.pdf;.

[2] Nederland Circulair is a program of the Versnellingshuis, a partnership between MVO Nederland, the Ministry of Infrastructure and Water Management (IenW), VNO-NCW, MKB Nederland, Nederland Circulair! and RVO.nl

[3] Circle Economy Action Plan, European Commission (march 2020) https://op.europa.eu/en/publication-detail/-/publication/45cc30f6-cd57-11ea-adf7-01aa75ed71a1/language-en/format-PDF/source-170854112

[4] 2020 GLOBAL STATUS REPORT FOR BUILDINGS AND CONSTRUCTION, United Nations Environment Programme (2020) https://globalabc.org/sites/default/files/inline-files/2020%20Buildings%20GSR_FULL%20REPORT.pdf

[5] Materiaalstromen, milieu-impact en energieverbruik in de woning- en utiliteitsbouw, EIB, Metabolic and SGS Search (january 2020) https://circulairebouweconomie.nl/wp-content/uploads/2020/02/Rapport-Materiaalstromen-in-de-woning-en-utiliteitsbouw-klein.pdf

[6] Duurzamere luchtbehandeling in gebouwen, Vereniging Luchttechnische Apparaten (currently Binnenklimaat Nederland, 2016 https://www.binnenklimaattechniek.nl/wp-content/uploads/2016/09/Digitaal-Print_Folder_Milieuprestatie_A5_VLA.pdf

[7] Without raw materials there's no energy transition, FD, 21 January 2021 https://fd.nl/weekend/1370909/zonder-grondstoffen-geen-energietransitie-en-de-problemen-beginnen-nu-al-lje1caAqhYeF

[8] Amendments New Circular Economy Action Plan – Committee on the Environment, Public Health and Food safety, 22 January 2021 https://www.europarl.europa.eu/meetdocs/2014_2019/plmrep/COMMITTEES/ENVI/DV/2021/01-25/1222761EN.pdf