

Sustainable and Green Electronics: Carbon Neutrality

In the past months, many large tech companies have announced new or revised goals for reaching CO₂ neutrality. Increasingly, these activities filter up through the supply chain and now reach electronic packaging as well. The technical committee Sustainability and Green Electronics is aiming to gather experiences from within the electronics packaging community and to provide guidance to those, for whom this is a new topic.

Goal setting examples

Most prominently, Apple announced in July of 2020 to achieve climate neutrality in 2030 including the whole supply chain and the whole life cycle of Apple products. Other companies such as Google, Microsoft, Amazon or Bosch have existing or new commitments – some already claiming carbon neutrality before 2020, some aiming at the end of 2020. So – is the Apple announcement ahead of the competition or behind?

Company	Goal	Scope
Apple	100% carbon neutral by 2030	scope 3, including supply chain and lifecycle of all products
google	carbon neutral since 2007; but "carbon free" in 2030	scope 2; 2030 goal includes local carbon-free energy around-the-clock
Microsoft	carbon neutral since 2012; carbon negative by 2030	scope 2
Amazon	net zero carbon by 2040	scope 2
Bosch	carbon neutral by 2020	scope 2

Let's shortly go through the basics of what "carbon neutrality of a whole company" can mean, before zooming in on some packaging related aspects.

Differing scope of goals

In environmental assessments, such as now specifically quantifying carbon emissions, the scope or the boundary of the system included in the analysis is essential to make sense of the assessment results. Scientifically, emissions of a company are categorized in three scopes: scope 1 for emissions occurring at the company premises, scope 2 for inclusion of emissions from the provision of all energy carriers, and scope 3 for inclusion of all other emissions caused indirectly by the company and its products.

So, if you have a coal fired furnace on site, the emissions are counted in scope 1. If you buy electricity, which is generated elsewhere by burning fossil fuel, the emissions count towards scope 2. If you buy a component, and a lot of energy was used to manufacture the component, then the emissions from that energy generation are allocated to scope 3. In all cases, not only CO₂ emissions need to be accounted for, but also all CO₂-equivalent emissions, such as methane or SF₆.

But for analyzing carbon reductions of larger companies, and formulating reduction and neutrality goals, the situation is much more complex than simply subdividing into the three scopes. Claims and goals need to be analyzed, how far they cover all sites and operations in all countries, how subsidiaries and potentially mergers and acquisitions are factored in, and then within scope 3, which indirect emissions are included. Scope 3 should include the carbon footprint of all entities entering or leaving the company boundary, so in addition to embedded carbon in materials and components bought (upstream supply chain), all waste streams and the life cycle of the products need to be accounted.

Ambition levels regarding timing and offsetting

Once the scope is transparently defined, ambitions of the companies obviously differ regarding the timing until carbon neutrality should be achieved. Alternatively, only partial neutrality goals can be formulated (i.e. 50% reduction by a specified year) or even net negative emission totals.

The ambition of the timing can only be understood, if the scope and in particular the scope 3 details are transparent, including coverage of the whole supply chain, the product use, and end of life. A company can be considered to be a frontrunner with full inclusion of scope 3 and full transparency on the above topics. Most companies are reporting and setting goals for scope 2 emissions.

So can companies be scope 2 neutral already and not only buy 100% green energy but also reduce all local emissions (scope 1) to zero? Certainly not to zero! For some remaining on site emissions and also for some sites, which cannot obtain green energy, carbon offsetting needs to be factored in.

Carbon offsetting means buying certificates that someone else is reducing emissions, or potentially removing CO₂ from the atmosphere. Offsetting, or RECs for renewable energy certificates for the energy part, is not generally bad from the environmental perspective, but is often compared to greenwashing, i.e. fabricating positive environmental claims that do not factually bring improvements for the environment. Offsetting needs to be quantifiable, independently verified and needs to be in addition to ongoing developments. Under those conditions, which many certification schemes follow, a certain percentage of offsetting is currently included in most scope 2 carbon neutrality claims.

Relevance for and of electronics packaging

If companies who either manufacture or employ massive amounts of electronics hardware aim for carbon neutrality, then the carbon footprint of the hardware needs to be much better understood in order to be drastically reduced. First order impact drivers for CO₂ equivalent emissions are usually connected to energy consumption in the product use – this would be the case for data centre servers, for example. But depending on the product type, the impact of semiconductor components can be a dominant factor, even surpassing use phase energy. This is the case for most mobile applications.

Following this, the importance of the packaging supply chain section - between the semiconductor fab and the finished product - is highest for semiconductor heavy mobile products. Even though direct emissions from packaging are comparatively low and the packages and printed circuit boards contribute only a minor part of the product composition, the total CO₂ footprint contribution from packaging can be as high as the whole end of life treatment of the final product.

So, now that the large players are following their carbon reduction goals, they are increasingly moving to scope 3 emissions and therefore ask their suppliers for carbon footprint data and for

joining carbon neutrality timelines. Semiconductor manufacturing and energy efficiency improvements are certainly the biggest targets still – but to come closer to carbon neutrality packaging needs to be addressed as well.

Are you prepared for this? Has this already happened in your company?

I would like to invite you to join the technical committee Sustainability and Green Electronics to exchange information on this virulent topic. We need to raise the awareness, prepare the packaging community and share best practices at the relevant technical conferences. Of course, other environmental topics such as green materials or circular economy are also part of the scope – not all environmental aspects are covered by looking at carbon emissions only. Contact nils.nissen@izm.fraunhofer.de to become a part of this discussion.