Driving Sustainability Trends in the Electrical and Electronics Industry with Polymers

Support for a Greener E&E World

Electrical and electronics manufacturers want to reduce greenhouse gas emissions from their products and optimize waste management and recycling for them. This can be achieved, among other ways, by using more sustainable thermoplastics and quality-assured recyclates. A close cooperation between companies to establish material cycles and the recycling-friendly design of equipment are also important.

Product sustainability is also playing an increasingly important role in the electrical and electronics (E&E) industry. In a market study, Covestro analyzed which sustainability trends are prevalent in the European E&E industry. Among other things, the E&E industry is one of the largest customers for polycarbonate compounds and blends from the plastics manufacturer. The findings of the study will help to support the E&E industry with materials, technologies and services to achieve its sustainability goals.

In total, the study looks at 35 companies. 28 of them provide public information about their sustainability performance, for example in sustainability reports or by publishing key performance indicators (KPIs) online. Both listed corporations and smaller and medium-sized companies were examined. The companies cover much of the spectrum of the E&E world. They include manufacturers of energy and automation technology, electrical installation, household appliances and lamps, security technology, consumer electronics, communications technology and network devices, EV charging stations and also an international furnishing group. Among the companies are ABB, Bosch, EVBox, Ericsson, Hager, Ikea, Miele, Nokia, Philips, Schneider Electric, Siemens and Signify.

Accordingly, the following four sustainability topics are particularly signifi-

cant for the E&E sector in Europe, with the first two topics standing out:

- the reduction of greenhouse gas emissions,
- waste management and recycling,
- energy management,
- water management.

Reducing greenhouse gas emissions is a key sustainability goal for all companies. At 26 %, around a quarter of them want to produce in a climate-neutral way in the future. Three companies report that they have already achieved CO_2 neutrality in terms of direct emissions from production (Scope 1) and indirect emissions, for example from purchased electricity (Scope 2) – including, for example, Philips as a global manufacturer of healthcare technologies and household appliances. Measures companies are taking to reduce greenhouse gas emissions include using green electricity for production, saving energy with appropriate management systems, products that reduce CO_2 emissions at the customer's site, and reducing emissions in distribution by making products lighter and increasing the use of ships and trains for transportation.

Reducing waste and improving recycling is also a high priority for companies. This is to be achieved through a more sustainable design of products (design for sustainability) and the use of recyclates. Other measures include the avoidance of packaging and the establishment of take-back programs for products in the sense of a circular economy.

A Climate-Neutral Polycarbonate

Covestro sees opportunities to support its customers on these points, particularly in reducing greenhouse gas emissions, designing components to be recyclable, managing waste and establishing material cycles. For example, the company's climate-neutral polycarbonates (PC), the first of their kind in the world, provide an opportunity to reduce greenhouse gas emissions and at the same time enter into a circular economy. They originate from Covestro's Makrolon RE series and are currently being launched on the market. The compounds are to be used in particular for applications in which, in addition to a significantly reduced CO_2 footprint,

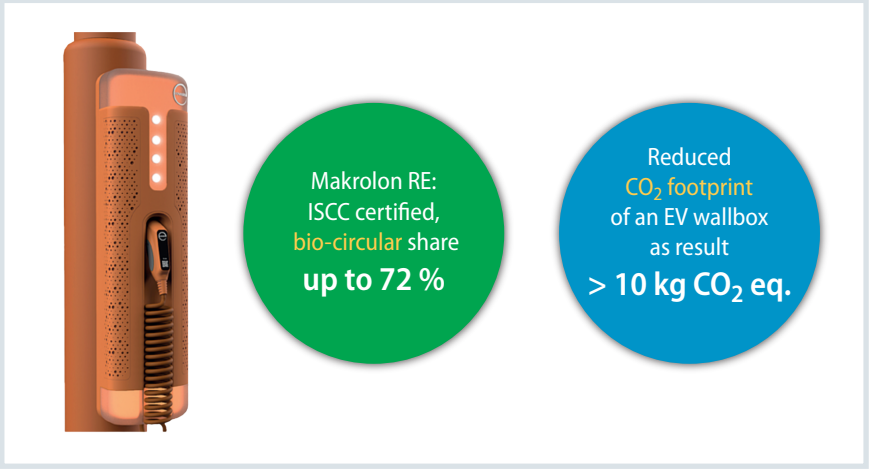

Fig. 1. Charging stations for electric vehicles can also be manufactured in a more climate-friendly way using RE polycarbonates. © Covestro

exceptional technical and optical characteristics are important.

RE products consist proportionately of raw materials derived from biowaste and residues and are partly produced with renewable electricity. The sustainable origin of the raw materials is certified according to ISCC Plus (International Sustainability and Carbon Certification). Mass balancing is associated with the certification. This chain-of-custody method (product chain method) allows fossil and alternative raw materials to be mixed in production but separated for accounting purposes. As a result, the proportions of sustainable material are allocated to the end products, even if multi-stage production processes were used. How sustainable a product is can thus be transparently and precisely demonstrated to the user.

Easy Deployment as a Drop-in Solution

The bio raw materials for the RE product range are chemically converted into raw materials for the chemical industry and assigned by means of mass balancing first to feedstocks for PC production and then to the PC itself. The starting materials, some of which are bio-based, are chemically and physically completely identical to the purely fossil-based raw materials previously used for PC. The RE products therefore have the same quality. They have physical, mechanical, thermal, optical, electrical, weather- »

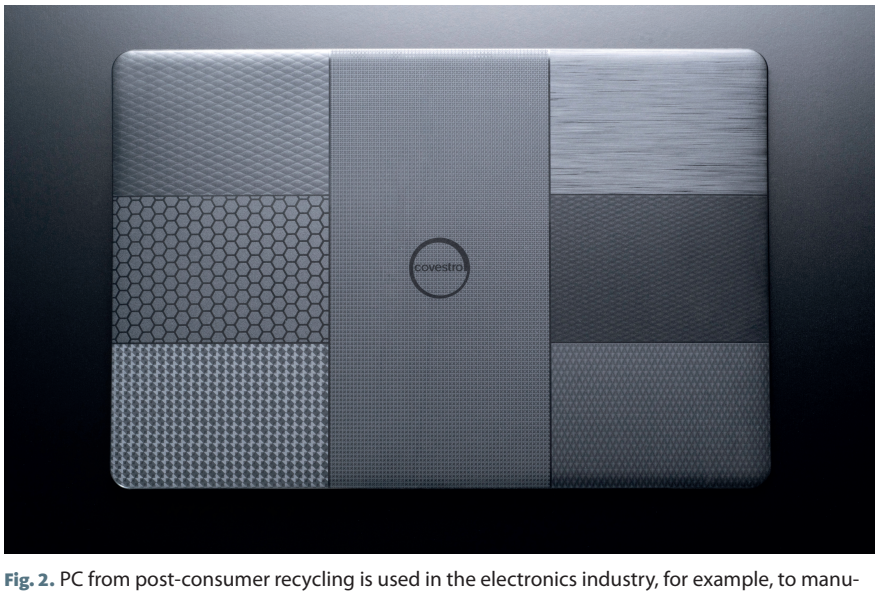

Fig. 2. PC from post-consumer recycling is used in the electronics industry, for example, to manufacture laptops. © Covestro

Fig. 3. The modular design simplifies the repair and recycling of the smartphone "Fairphone". © Fairphone

ing and processing properties that are identical to those of their purely fossil counterparts. They meet the same technical specifications and certifications. Since they are produced on the same equipment, the existing chemical infrastructure can be used for PC and its blends. A major advantage for processors is that they can quickly and easily use the RE products as so-called drop-ins in existing processes without incurring technical risks or additional costs for product conversion.

Fig. 4. The PC filament Polymaker PC-r for 3D printing is made from recycled plastic obtained from used water bottles from the Chinese water bottle manufacturer Nongfu Spring. © Covestro

In principle, the entire Makrolon range can be covered by the mass-balanced drop-in raw materials. RE ranges certified to ISCC Plus are also currently being introduced for the heat-resistant co-polycarbonates Apec and the blends Bayblend and Makroblend. All RE products are available in large quantities. The proportion of assigned, ISCC-certified bio-circular raw materials can be up to 72 % wt. %. A sustainability declaration confirms the proportion of bio-circular raw materials used in each delivery.

Among the first applications of the ISCC-certified PC in the future will be charging stations for electric cars. Covestro has entered into a cooperation with the Dutch EVBox Group for this purpose. The goal is a new standard for the charging infrastructure: Resources are also to be conserved in the manufacture of charging stations and more sustainable materials used to keep the stations' carbon footprint as low as possible. For example, calculations by Covestro showed that substituting 3.5 kg of fossil-based PC with a RE counterpart with a bio-circular material content of more than 70 % reduces the carbon footprint of a charging station by more than 10 kg of CO_2 equivalents (**Fig. 1**).

Around half of the companies in the study are currently pursuing projects or developing products in which recycled plastics are used. Some of them have also committed themselves to increasing the proportion of recyclates used over the next few years. Covestro has developed PCs and related blends for this purpose, with plastics and carbon fibers derived from post-consumer (PCR) and post-industrial recyclates (PIR). Together with partners, mechanical upcycling processes were developed for this purpose in order to be able to use, among other things, used water bottles, CDs, waste from PC plate production and old car headlights as a material base. The recycling processes are traceable and ensure high material quality.

Recyclates with Assured Quality

The recycled plastics are mixed with virgin materials. The proportion of recyclate can be up to 75 wt. %. The resulting compounds possess the typical strengths of PC. They are heat resistant up to about 144 °C (Vicat), have high light or good IR transmission, meet the UL 94 flame retardancy test of the U.S. testing institute Underwriters Laboratories with the best rating V-0 (at 0.75 mm specimen thickness) and hardly form any corrosive fumes in the event of fire. They are used, for example, in laptops, chargers for smartphones, televisions, copiers and printers. In this process, one and the same material can be used to create different surface structures through laser material processing of the injection mold, enabling different haptic perceptions and visual appearances and thus providing great scope for design. This is exemplified by a laptop cover made of Bayblend with 30 % PCR content (**Fig. 2**).

The Fairphone 4 from the Dutch company Fairphone is a current example of a product with recycled content that is easy to repair. The rear device cover, the center frame and the wireless charger of the smartphone, among others, are made of PC with a PCR content of 30 to 50 % (**Fig. 3**). A glass fiber-reinforced grade from the Makrolon PCR portfolio is suitable for the Fairphone 4's heavily stressed center frame. Compared to conventional, purely fossil-based materials, the use of PCR-PC reduces CO_2 emissions by up to 30 %. In addition, as with the Fairphone 3, completely recycled thermoplastic polyurethane (TPU) is used for the Fairphone 4's casing.

Fig. 5. The "Handbook for Circular Design" is aimed primarily at companies in the electrical, electronics and household appliance industries. It is intended to help them design products that are more circular and sustainable. © Covestro

Building Material Cycles Together

Around 40 % of the E&E companies analyzed in the study have set up take-back programs for products from their product range in order to promote economic activity in material cycles. Covestro specifically seeks cooperation with such companies, but also with other partners in the plastics value chain, in order to have access to recycled raw materials that are reliably available in sufficient quantities and of assured quality.

In China, for example, the company is working with the beverage distributor Nongfu Spring and the recycler Ausell. The three companies are working together to improve the recycling of large 5-gallon (19-liter) PC water bottles. Covestro's PC and blends with recycled content comply with industry-specific eco-labels such as the "Blue Angel" eco-label or the "EPEAT seal" (Electronic Product Environmental Assessment Tool). Among other things, the 3D printing materials manufacturer Polymaker uses these materials to produce PCR filaments for the industrial 3D printing of components for consumer electronics (**Fig. 4**). Compared to virgin material, the more sustainable filament has a significantly lower carbon footprint.

The vast majority of the companies examined now also focus on designing their E&E products to be recyclable. This is a prerequisite for the establishment of large closed material cycles. It is particularly important that the materials used are recyclable. In addition, products should be designed in such a way that, at the end of their use, the various components can be separated into material streams that are as pure as possible.

Designing Components for Recycling

For example, efforts are being made to greatly reduce the variety of materials. If possible, a mono-material solution is sought. To make it easier to disassemble assemblies, they should also have a modular design. This is not just about recovering plastics. In fact, components can be designed in this way so that other valuable materials such as precious metals or rare Earth elements can also be separated and collected more easily. A good example of such a recycling-friendly design is the aforementioned Fairphone.

To help its customers in "designing for sustainability" for their products, Covestro has teamed up with Renato Lab, a Taiwanese consulting firm specializing in circular economy and resource efficiency, to write the "Handbook for Circular Design" (**Fig. 5**). It serves as a guide for designers and developers to integrate the circularity model early in the design of new products and provides guidance on the selection of appropriate materials. ■

Info

Text

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Service

For more information on the market study on sustainability trends in the European E&E industry, please click on the following link:
https://solutions.covestro.com/en/highlights/articles/stories/2022/more-circular-materials-for-e-e-sector

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