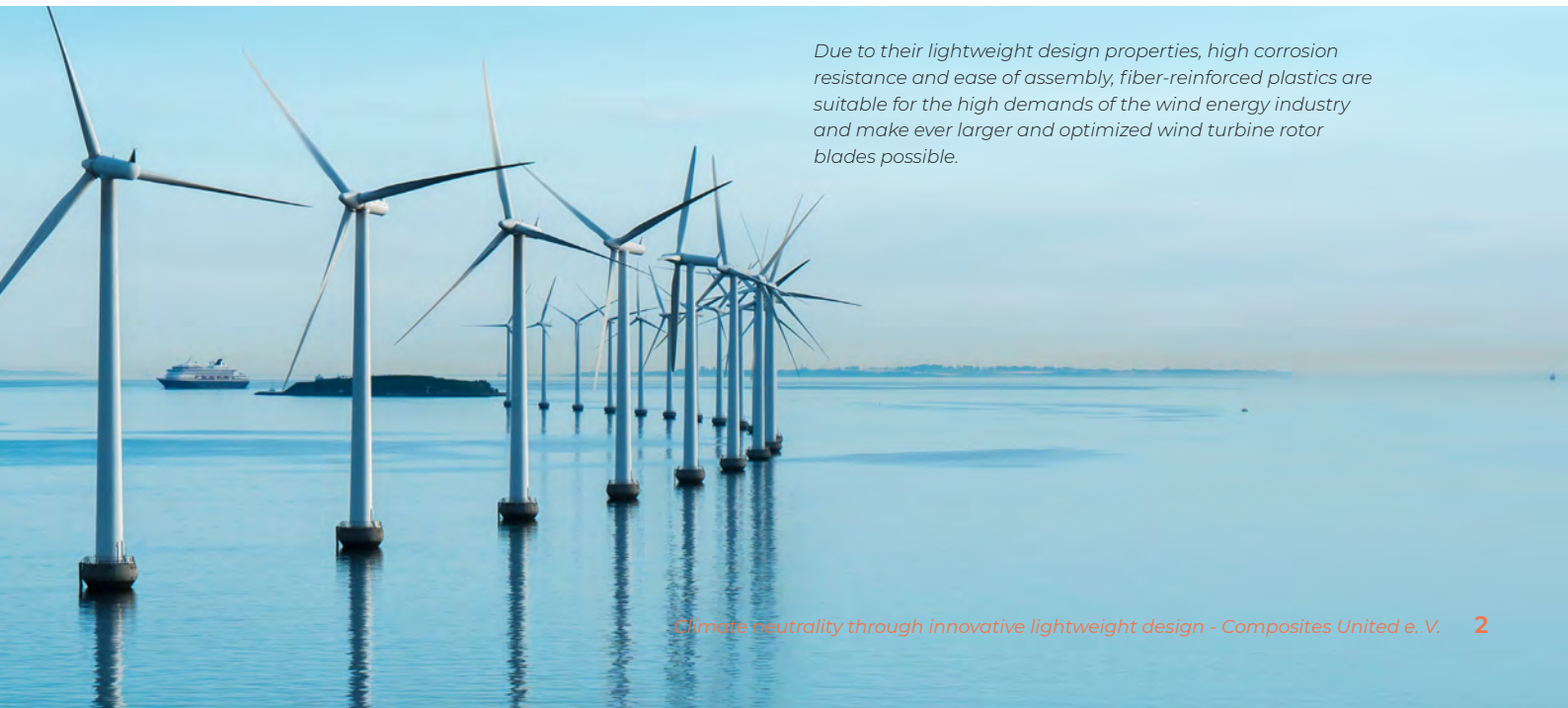
COMPOSITES UNITED

CLIMATE NEUTRALITY THROUGH INNOVATIVE LIGHTWEIGHT DESIGN

CLIMATE NEUTRALITY THROUGH INNOVATIVE LIGHTWEIGHT DESIGN

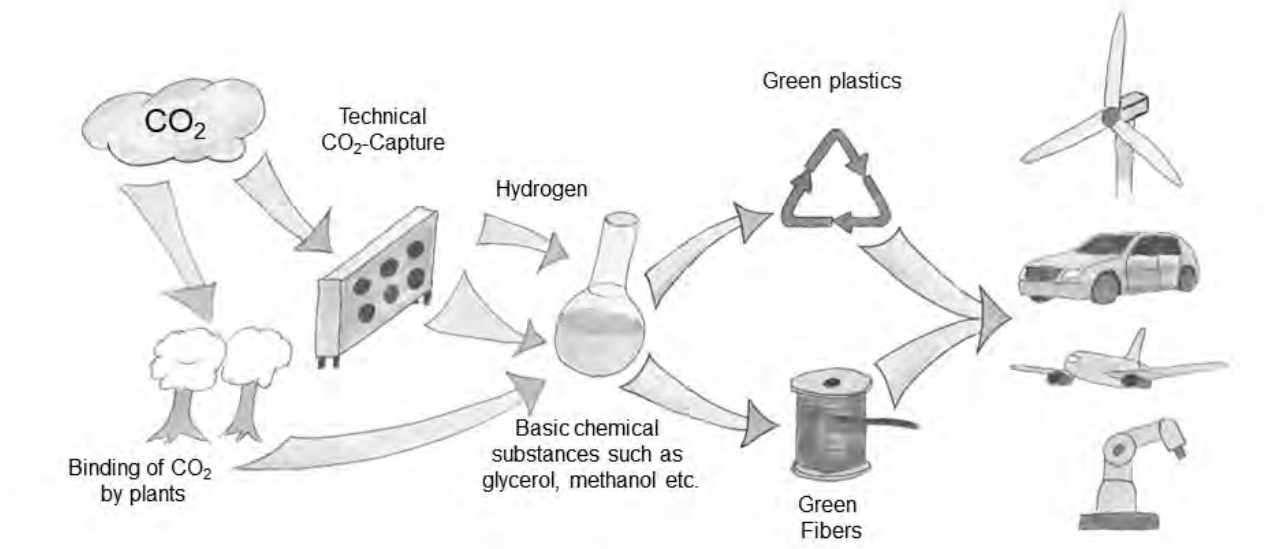
Resource consumption and the use of energy sources must be reduced for a sustainable society without lowering the standard of living in the process. Lightweight design will play an important role here, especially for the mobility sector. The relevant knowledge and the necessary technologies, including for recycling, are largely available and need to be industrialized. In the long term, the switch to renewable raw materials with natural fibers and biobased plastics offers the opportunity for sustainable production of complex lightweight materials. For European and German industry, this not only offers the opportunity to contribute to limiting climate change, but also to gain competitive advantages worldwide.

With the Paris Climate Agreement, there is a global consensus to minimize the consequences of climate change. With the Green Deal, the EU has launched an important program to this end, and after the 2020 presidential election, the USA will again be available as a partner. The framework conditions are thus in place for concrete steps to be taken towards implementation and the necessary (further) development of technologies. The large (import) demand for energy in the form of fossil raw materials poses challenges for Europe in particular. That's why we need new, intelligent solutions in Europe to conserve resources and drastically reduce CO_2 emissions without endangering our prosperity and standard of living.



Due to their lightweight design properties, high corrosion resistance and ease of assembly, fiber-reinforced plastics are suitable for the high demands of the wind energy industry and make ever larger and optimized wind turbine rotor blades possible.

Carbon fiber reinforced plastics (CFRP) as a CO2 sink



Lightweight design through the production of green fibers based on biomass or CO_2 from the air

Using lightweight design to save energy and raw materials

Fossil fuels are primarily used today, in addition to electricity generation, for heat generation and acceleration of masses both in industry and in the private sector. The larger the mass, the more energy is required. Therefore, one of the most effective measures to save energy and thus raw materials is to use lightweight design in moving systems and thus reduce the masses. Lightweight design can be achieved by using lighter materials or lighter constructions. The greatest potential here is offered by fiber-reinforced plastics (FRP). This is why they are already used intensively in aviation or high-performance sports. But even the blades of modern wind turbines could not be built without FRP. Lightweight design, and thus also FRP, will therefore be an important building block for the energy transition and for a reduction in the consumption of resources.

Polymers and carbon fibers as CO_2 sinks

Polymers and carbon fibers (the fibers with the highest lightweight potential) not only make it possible to avoid CO_2, but even to extract it from the environment and bind it in the long term. As a result, FRPs make a double contribution to CO_2 reduction. This is achieved when the polymers and fibers are obtained from renewable raw materials such as algae, rapeseed or other agricultural plants. But it is also possible to capture CO_2 directly from the air and process it into fibers and polymers with the help of hydrogen. These processes are currently being developed and are at the beginning of industrial implementation. The task now is to industrialize them on a large scale in a climate-neutral manner.

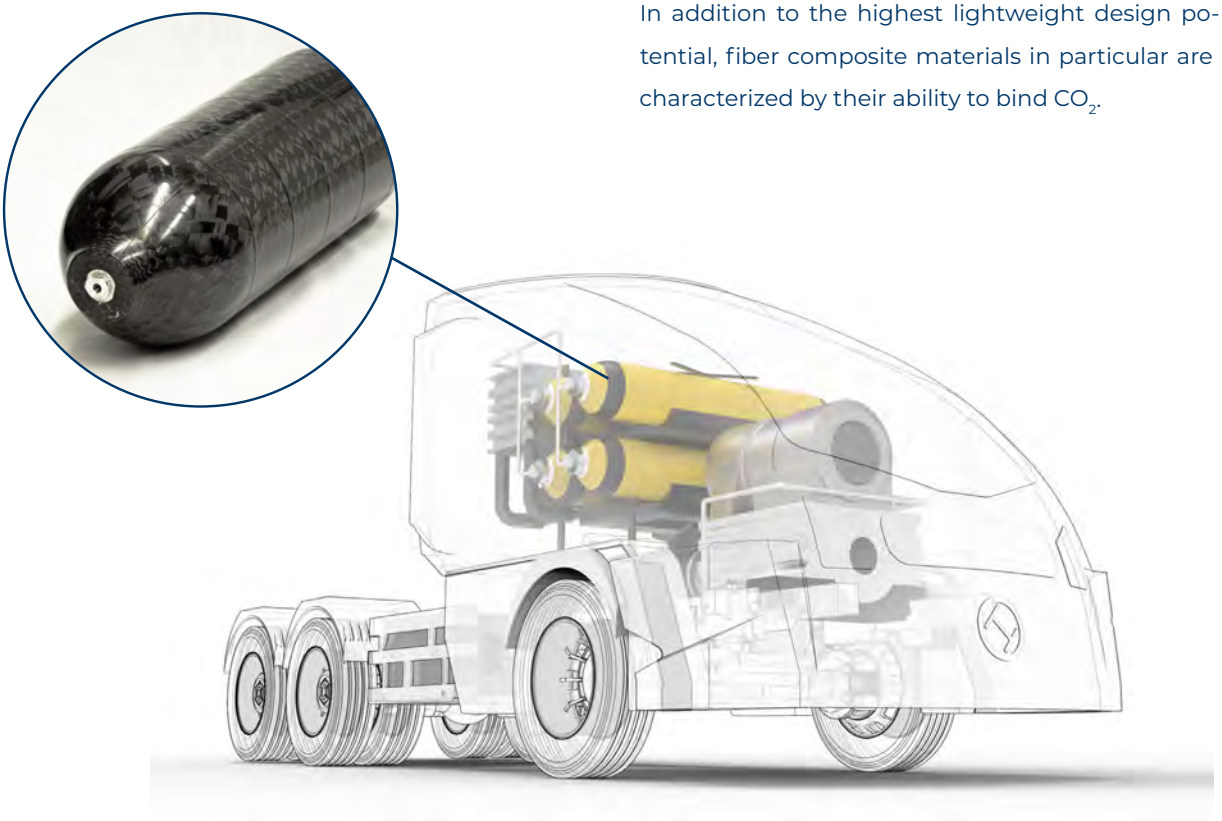
High durability and safety

This means that CO_2 can already be removed from the air during production. In addition, less energy is required during the use phase, e.g. of an automobile or an aircraft, and thus further resources are saved, which is also particularly important for e-mobility and batteries. Fiber-reinforced composites also have a longer service life and increased safety. For aircraft, for example, the service life of 50 years is almost doubled, as shown by experience from helicopter engineering, where FRP have already been used for a longer amount of time. Longer durability and lower weight are also paving the way into the construction industry, whether as carbon concrete, in bridge building or as structural functional elements. And safety is significantly increased, not only in Formula 1, thanks to a much higher crash absorption.

FRP recycling for a circular economy

After reaching the end of their service life, FRPs must and can be recycled. In addition to the already industrially established process of pyrolysis, which primarily recovers the fibers, or the remelting of thermoplastics, further solvolytic recycling processes are currently being introduced to the market, which also recover the polymers. This makes it possible to recycle the entire material. Other processes, such as the utilization of glass fiber-reinforced plastics in cement production or the use in calcium carbide furnaces for carbon fiber-reinforced plastics, involve raw material recycling for FRP. Fibers and plastics are fully utilized as energy and raw material source for the production of new products.

Lightweight design in general, regardless of the material used, will thus be an important building block for the Green Deal in mobility and industry. In addition to the highest lightweight design potential, fiber composite materials in particular are characterized by their ability to bind CO_2.



Fuel cell vehicle: Visualization of a commercial vehicle with hydrogen tanks. The CFRP pressure tanks are lighter, thinner-walled and smaller than comparable metallic designs (CFRP tank: © LZS GmbH).

Lightweight design as an industrial policy opportunity for Europe

In addition to the ecological aspect, lightweight design and, in turn, fiber composites in particular, also offer a major opportunity in terms of industrial policy. Companies can only maintain their market position through new, innovative solutions. The ability to develop and produce lightweight products is one such know-how advantage. With its traditional strength in the fields of design, mechanical engineering and chemistry, the German economy offers unique prerequisites for generating innovative solutions across all sectors. This is also demonstrated, for example, by the leading-edge cluster MAI Carbon, whose members created more than 8,000 high-quality industrial jobs in the area of FRP between 2012 and 2017.

Conclusion and wishes for politics

In order to exploit the potential of lightweight design for the environment and the European economy, the solutions developed in research in recent years must now be applied industrially. To this end, the appropriate framework conditions must be developed, which on the one hand accelerate the transfer of knowledge from science and on the other hand support industrial scaling and application in order to reduce costs through economies of scale. To this end, the BMWI's lightweight design technology transfer program must be made permanent and provided with at least twice as much funding. Adequate funding must be made available especially for the sustainable production of carbon fibers as a major contribution to the energy transition and establishment as a CO_2 sink. The goal is to establish and expand an efficient, high-performance and, in the long term, climate-neutral lightweight design industry in Germany that can hold its own in international competition. Then it will be possible to combine industrial and environmental policy for the benefit of all.

The construction industry is one of the biggest CO_2 „producers", mainly caused by energy-intensive concrete production. One possibility for a much more sustainable building culture is the use of alternative building materials such as fiber composites. These materials offer excellent structural properties with comparatively very low material input, they are weather-resistant, durable and also allow particular design freedom.
(Left image: Bridge made of carbon fiber-reinforced plastic, BaltiCo GmbH; right image: ICD ITKE University of Stuttgart).

CLIMATE NEUTRALITY THROUGH INNOVATIVE LIGHTWEIGHT DESIGN

Composites United e. V.
Jägerstraße 54-55
10117 Berlin // Germany
www.composites-united.com
info@composites-united.com

Status: December 2022