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Vehicle Concepts for TOMORROW

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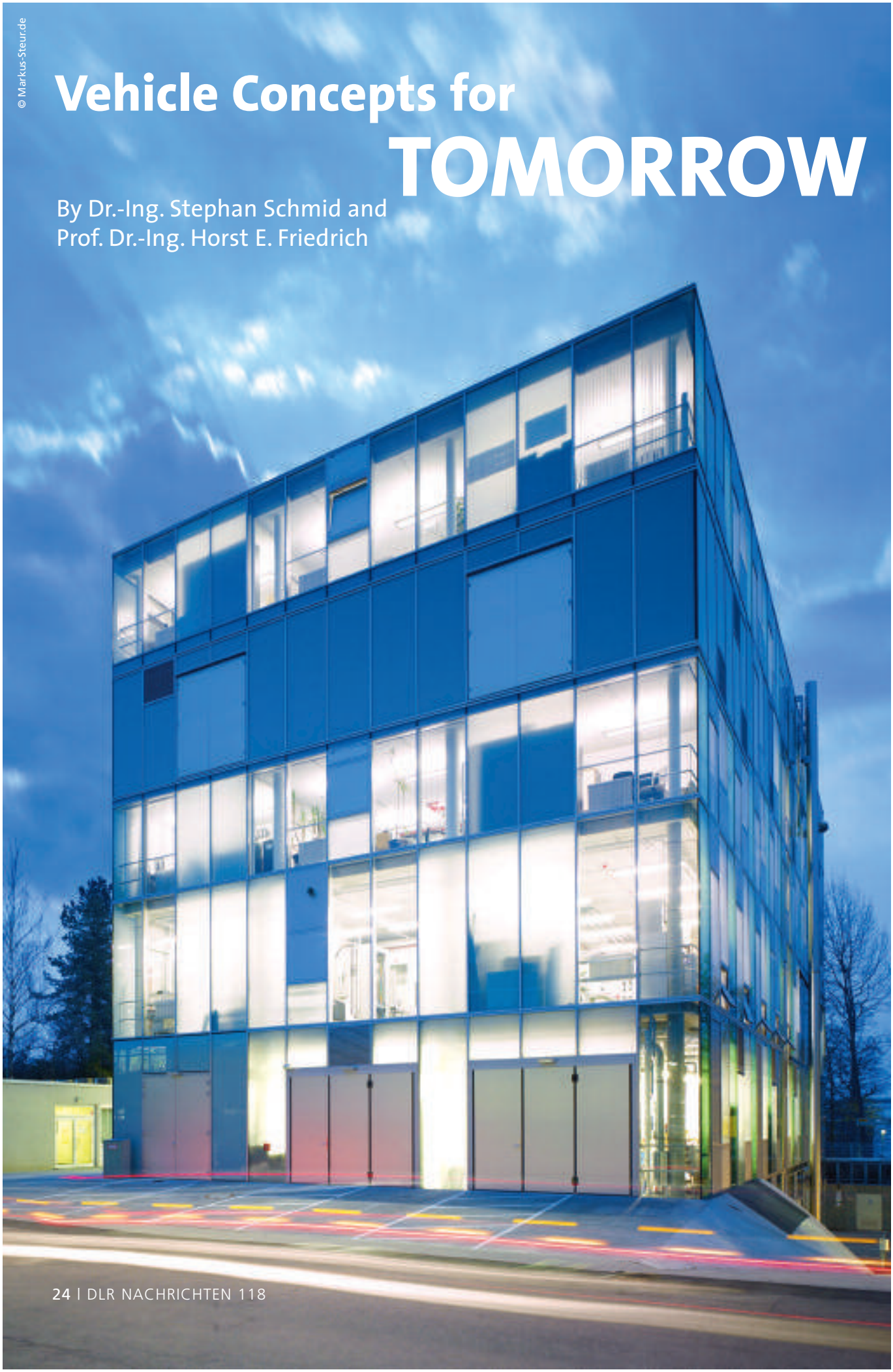

Traffic causes almost a quarter of the world's carbon dioxide emissions (CO_2). It is true that CO_2 emissions of newly sold cars have decreased by 40 percent within the last 30 years. However, the expenditure required to reduce CO_2 emissions is still estimated to cost approximately 100 to 500 Euros per ton of carbon dioxide. By now, this is much more expensive than in other sectors such as, e.g., electricity generation (5 Euros per ton of CO_2) or construction (10 Euros per ton of CO_2). Therefore, creativity is required to align new environmentally friendly technologies with economic constraints.

DLR is developing complex evaluation models to calculate the energy efficiency of future technologies, to account for their emissions from manufacturing to operation and up until disposal, and estimate the corresponding costs in advance to implementation. Very often, many different technical solutions compete with one another and the following questions arise: Which has the greatest potential to develop or reduce costs? What technical solutions deserve an investment? Therefore, models that are able to depict the decisive contexts and provide conclusions about potential market success are also in the focus of research.

THE OTTO ENGINE IS NOT YET PAST ITS SELL-BY DATE

The main areas in which vehicle technology acts today are the drive train, the overall energy efficiency, the reduction of all drive resistances and the utilization of alternative fuels. Is there life in the old dog yet? Yes, the internal combustion engine will still be around successfully for a long time – not in the way we know it today, but technologically advanced. The Otto engine can be enhanced to become 25% more efficient; in combination with an electric engine even a lot more so. Hybrid vehicles are already on the market and offer a path for developing electrified vehicles in the medium-term. Replacing conventional combustion engines/generator concepts with alternative electricity generation units – such as the free-piston linear generator, which is a flexible fuel combustion engine that transforms chemical into electrical energy in a compact format (patents at DLR) – and in the long-term with the fuel cell, is conceivable.

LESS RESISTANCE, LESS CO_2

Manipulating drive resistances also harbors great potential. This especially concerns lightweight vehicle construction. If the vehicle weighs less, it will gain a more agile driving behavior as well as consume less energy. These effects can be achieved by using lighter materials, saving material and conceptually enhancing components and joints. The path here leads from conventional lightweight construction to the more advanced concept lightweight construction. 100 kilogram of weight loss in a vehicle reduces its CO_2 emissions up to 10 grams per kilometer. There is a lot to be achieved with current cars of an average weight of 1,300 kilograms.

Additionally, better tires enable a car to run smoother and easier. Through innovations in tire production, tire resistance could be reduced by as much as 50% in the next 25 years, which translates into a saving of 10 grams of CO_2 per kilometer. Last but not least, aerodynamic drag hinders energy-free floating. The relevant measure here is the product of frontal area and aerodynamic drag coefficient. A 0.1 square meter reduction saves 3.5 grams of CO_2 per kilometer in the driving cycle, even more at higher speeds.

Today, a car engine in everyday use only converts 25% to 35% of the chemical energy stored in the fuel into mechanical energy. The rest is lost to the environment through engine cooling and exhaust. This is why DLR is working on waste energy recovery. The following article in this edition focuses in this aspect.

LOW CARBON FUELS

Which fuel will power our vehicles in 50 years time? Oil and gas will no longer be an option to the extent that we use them today. Climate change, however, will force us much earlier to emit less carbon to the atmosphere than we do today. A greater diversity of fuels is on our doorstep: natural gas and bio fuels will be added, hydrogen, electricity and others are being discussed. DLR provides solutions such as innovative production concepts for gas tanks and modular and robust architectures for fuel cell drive trains.

It remains to be seen whether a single energy carrier or a mixture will lead the way. DLR is actively engaged in analyzing scenarios with renewable energy sources, in technical feasibility evaluations, process chain analyses and in cost evaluations at the interface of energy system and vehicle.

NEW VEHICLE CONCEPTS

The key to the car of the future, however, lies in the symbiosis of new drive technologies and new construction concepts. Using this approach, new differentiated, lightweight and cost-effective vehicle generations will be created. Cost effective options for making these a reality need to be found. DLR's researchers engage in vehicle concepts and technologies that create a new type of mobility that is environmentally friendly, affordable and free of compromises.