What(ever) it Takes

to Decarbonize Transportation

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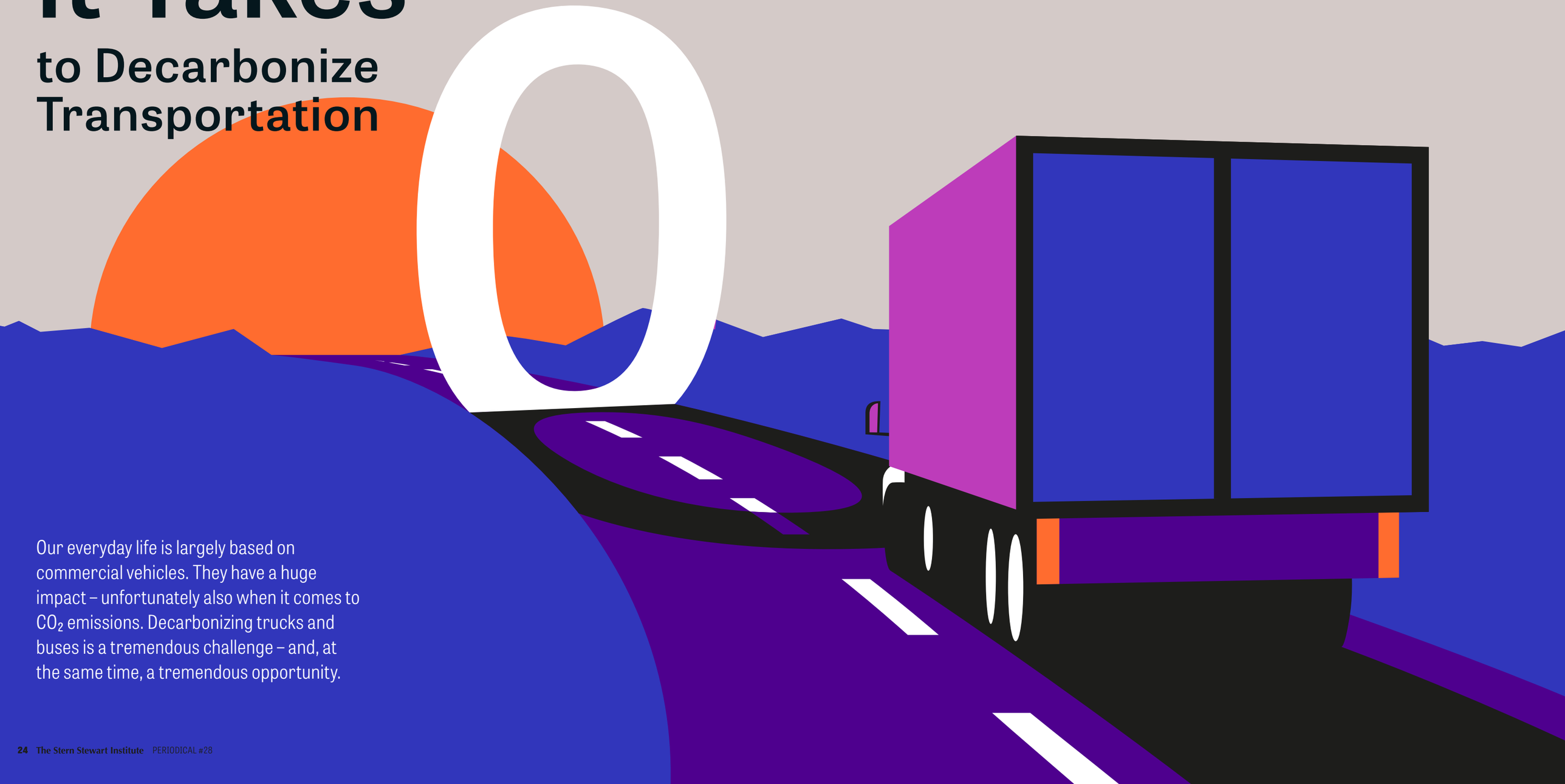

Our everyday life is largely based on commercial vehicles. They have a huge impact – unfortunately also when it comes to CO_2 emissions. Decarbonizing trucks and buses is a tremendous challenge – and, at the same time, a tremendous opportunity.

Monday morning. A new week is starting. Also for Susan. She leaves home early and gets on a bus. Switches to another bus. On her way to work, she calls in at a pharmacy to pick up medication – her son caught a cold. After a short walk, she arrives at work and enters the factory. Susan leads a team of employees working at an assembly line of a global manufacturer. Parts arrive, Susan does her job. Chats with colleagues. More parts come in. After work, she stops off at a supermarket and gets food for the family dinner. Takes the bus home.

Susan is fictional, I just made her up. But for many people across the world days like this are typical for their everyday life. What we tend to oversee: Our daily routines would hardly be possible without commercial vehicles. Without them, major parts of our economy and society would stop functioning. Commercial vehicles take goods to huge shopping malls and small shops, bring supplies to construction sites and hospitals – and they take people to work, on vacation or our kids to school. Trucks and buses keep the world moving. They have a huge impact – unfortunately also when it comes to CO_2 emissions. And we are working hard to preserve the former and change the latter.

Part of the problem

Let's look at the (approximate) figures and take Europe as an example: There are about six million trucks with a gross vehicle weight above 3.5 tons on the road. Every year, these six million trucks clock up around 300 billion kilometers. Every year, these six million trucks consume about 60 million tons of diesel. Every year, these six million trucks emit around 200 megatons of CO_2 – this would translate into approximately 700 terawatt hours (TWh). Every year, these six million trucks (plus the buses on the road) are ultimately responsible for roughly seven percent of Europe's CO_2 emissions.

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Thus, when we look at the global threat of climate change, commercial vehicles are part of the problem. But they are beginning to become part of the solution as well. In fact, there are three crucial factors that determine the decarbonization of transport – and right now, zero-emission vehicles are the driving force of these three factors. The bottlenecks lie elsewhere.

Part of the solution

Today, all major manufacturers are investing massively into zero-emission vehicles (ZEVs) – the transformation in terms of vehicles is in full swing. However, compared to where we need to go, there is only a small number of ZEVs in daily customer operations today, whilst CO_2 reduction targets in Europe are ambitious. The goal is to reduce CO_2 emissions in the new fleet population by 45 percent by 2030, compared to those in 2019. This translates into more than 400,000 ZEVs on the roads of Europe by 2030. That's bold, but not impossible – so how do we get there?

To get the full picture, one thing is important to understand. The decarbonization of commercial vehicles will not rely on one, but on two propulsion technologies: Battery-electric and hydrogen-based drives. There are four main reasons for this:

1 Customers: The transportation tasks of logistics companies are extremely diverse – from vans to street sweepers, from city buses to construction vehicles, from plannable inner-city distribution to long-haul transport with a need for high flexibility. Depending on the customer's use case and other factors like regional energy prices, either drive technology can be the more profitable business case.

2 Infrastructure: Building up both infrastructures, one for batteries and one for hydrogen, requires actually less investment than scaling up the electricity grid alone. Because while the initial cost of electric infrastructure is fairly low – you basically need to install chargers and connect them to the existing grid – the cost of upgrading the power grid is fairly high. In contrast, as demand and utilization increase, hydrogen infrastructure decreases in relative cost. And as all economists – and this includes truck and bus customers – strive for the economic optimum, this clearly leads us to two infrastructures.

3 Green energy availability: Almost every country relies on energy imports. Europe alone imports about 60% of its energy today. Even in the emission-free future, a 100% local energy supply is not realistic and certainly not competitive. Therefore, a global trade in green energy will emerge, based on a molecule being able to store and transport energy around the world: Hydrogen.

4 Efficiency balance: There is a balanced "sun-to-wheel" efficiency for hydrogen trucks and battery trucks. Because with a solar installation in the sunny south, a hydrogen truck can travel a similar range per hour of sunshine as a battery truck with energy coming from a solar installation of the same size in Europe. In short: The higher efficiency of solar panels in sunny regions can compensate the lower efficiency due to electrolysis and drive train conversion.

But which factors are decisive to make a zero-emission truck a business case for customers?

~~Never~~ change a running system

Customers do not buy trucks for fun. Unlike cars, no one takes a truck for a weekend joyride. A truck is an investment good that must earn money for its owner. Therefore, buying a truck is an investment decision. This brings me to the second factor in the equation of decarbonizing transport: Cost parity.

The formula is simple: As long as operating diesel-powered trucks and buses is more cost-efficient than operating battery-electric or hydrogen-based ones, the majority of customers will always stick to diesel. For a good reason, they will not change their running system. Well, what does it take to change it?

Buying a truck means calculating what is known as "Total Cost of Ownership" (TCO). One important cost item is the purchase of the truck – and purchasing a battery-electric truck will always be more expensive than a diesel truck. One example: For the foreseeable future, a 600kWh battery powering a long-distance truck will involve about twice the material cost compared to the main components of a diesel drivetrain. Thus, the operating cost of the ZEV will have to beat the diesel truck by far to make a viable TCO case. Besides paying the driver, the most significant cost item is fuel.

Today, one kilowatt hour (kWh) in Europe costs about 70 cents at public chargers, one kilogram of hydrogen about 10–15 euros at the pump. Truck customers can make a business case with about 40 cents per kWh and about 4–5 euros per kilogram of hydrogen. This means: Prices for green energy will be absolutely crucial in achieving cost parity between a diesel truck and a battery-electric or hydrogen-powered one.

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> CLIMATE CHANGE WILL NOT WAIT FOR OUR INDUSTRY TO TRANSFORM TO CO_2-NEUTRALITY. WE NEED TO ACT. NOW.

As energy prices are hard to predict, especially considering today's geopolitical tensions, we will have to make use of a second steering impulse to speed up the transformation: Making the operation of diesel trucks more expensive. The upcoming CO_2-based toll in Germany is a first step in the right direction. Increasing diesel taxation would be another political option.

In the end, green transport will become more expensive. The sustainable future will come with a price tag – to claim otherwise would be insincere. But even when cost parity between ZEVs and diesel trucks is achieved, customers still need to charge and refill their trucks. And this brings me to the third crucial factor, besides emission-free vehicles and cost parity: Infrastructure.

Chicken or egg?

Not so long ago, manufacturers reasoned not to build zero-emission vehicles due to the lack of charging and refueling infrastructure. At the same time, energy companies decided not to build up infrastructure because there were no ZEVs. That has changed. And besides the ZEVs, commercial vehicle manufacturers have also kick-started infrastructure initiatives, although it is neither their business nor their job.

Once again: Let's take a look at the numbers. A battery-electric long-haul truck needs megawatt charging – at least 700kW of charging power – to recharge sufficiently during a driving break. That equals the charging power of about 200 household sockets. In Europe today, we have less than 50 chargers above 350kW. And we have about 50 hydrogen refilling stations for trucks (most of them today not even suitable for long-haul applications). What do we need to realistically meet the 2030 CO_2 targets in Europe I mentioned above? About 35,000 megawatt chargers and about 2,000 hydrogen stations – starting today, that is approximately 400 high power chargers and 25 hydrogen stations per month (depending on size and performance of the station).

What(ever) it takes

In order to speed up the decarbonization of road freight transport, it is now key to send out the right political signals that will enable the market uptake of battery-electric and hydrogen-based vehicles. These signals must focus on the two factors besides vehicles that are decisive for decarbonization: Infrastructure build-up and cost-parity.

The CO_2-based toll will only make a real difference if it becomes a solution for the majority of Europe. And it only becomes an effective political steering impulse if a change in customer behavior follows. This will only be possible if a dense infrastructure network is available. Thus, a significant amount – about 20 percent – of the revenue stream coming from the CO_2-based toll must be invested into battery-charging and hydrogen-refilling infrastructure. Besides that, we must speed up approval procedures, passing some kind of "bureaucracy reduction act". But no matter which one it will be or not be, one thing is for certain: Climate change will not wait for our industry to transform to CO_2-neutrality. We need to act. Now.

And yes, decarbonizing transportation is a massive challenge. But I rather see it as a massive opportunity. The opportunity of our lifetime to make a real difference. This counts for all stakeholders involved. So that trucks and buses can operate emission-free. So that they can keep the world moving. So that people like Susan can keep their weekly routines. So that generations after Susan can still rely on trucks and buses to be the backbone of their everyday lives, of our economy and our society.