



REDUCING CARBON EMISSIONS IN
THE SUPPLY CHAIN

ZONE 3 DIGEST

DECARBONIZATION

A condensed look at the road to decarbonization as explored
at the Era of Sustainable Logistics Global Summit.

RESHAPING BUSINESS

THE ROAD TO DECARBONIZATION

Many companies have defined net-zero targets in line with the Science Based Target initiative (SBTi)¹ for 2050, 2040, and, in some cases, as early as 2030. However, many of these same companies have been focusing on reducing the direct greenhouse gas (GHG) emissions that originate from owned or controlled sources (Scope 1) and indirect emissions from purchased electricity, heat, and steam (Scope 2). But Scopes 1 and 2 represent only a fraction of an organization's total emissions: 80-90% of corporate indirect emissions occur up and down the value chain, including purchased goods and services, transportation, product usage, and other external sources beyond its direct control (Scope 3). On average, two-thirds of Scope 3 emissions are related to the supply chain.

Without a massive decarbonization of their supply chains, many companies will not achieve their emission targets.

The road to decarbonization starts with understanding where GHG emissions occur along the supply chain and then setting defined targets to reduce them. Once a company understands its carbon footprint, sets reduction targets, and

allocates sufficient budget – a necessary foundation for success – three steps are critical: optimizing the supply chain, switching to sustainable fuels, and adopting the latest technology. The first step alone, though complex, can cut emissions by up to 20%. But step 2 is currently the most effective lever for decarbonizing supply chains. Finally, it's important to monitor trends and integrate state-of-the-art technology to capitalize on decarbonization opportunities early.

In the following pages, we review the current potential, outline the challenges, and map the journey to decarbonized supply chains.

“Decarbonization is not a choice between economy and environment, it's a choice between prosperity and decline. The future belongs to those who embrace it.**”**

Kristalina Georgieva

Managing Director of the International Monetary Fund

THE POTENTIAL OF NOW

LOGISTICS AND SUPPLY CHAINS ARE KEY TO DECARBONIZING YOUR BUSINESS

The scientific community has been warning, with increasing urgency, of the need to reach net-zero emissions globally in the coming years if we hope to avoid the worst impacts of climate change. This means achieving a swift and sweeping transition to sustainable practices – including deep decarbonization across all areas of economic activity.

Consumers, suppliers, shareholders, and regulators are demanding progress here, and many companies have responded by setting ambitious, science-based emissions reduction targets.²

Supply chains harbor a tremendous potential for reducing a company's carbon footprint. Today's

technologies cannot eliminate emissions, but they do offer an opportunity to make a significant impact. Focusing on the supply chain makes it possible to reshape business into a model of sustainability that reduces emissions now and is ready to achieve net zero soon.



“The solution for making supply chains greener is not less globalization or trade. It's more collaboration and innovation. By prioritizing cleaner, greener logistics and working together, we can drive meaningful progress. And we owe it to future generations to take bold action and make commitments to protect our planet now.”

Katja Busch

Chief Commercial Officer and Head of Customer Solutions & Innovation, DHL Group

THE CHALLENGES

A THREE-PRONGED APPROACH WITH MANY MOVING PARTS

1. Optimize the supply chain

There are many ways to optimize supply chains to reduce GHG emissions. Large-scale network and route optimization make supply chains more efficient, minimizing emissions and costs. Mode optimization means understanding the impact of each mode of transport and finding the best one or mix for your needs. Load optimization reduces emissions by consolidating items to minimize empty space. This step is the obvious start, but it can only take you so far down the road to decarbonization.

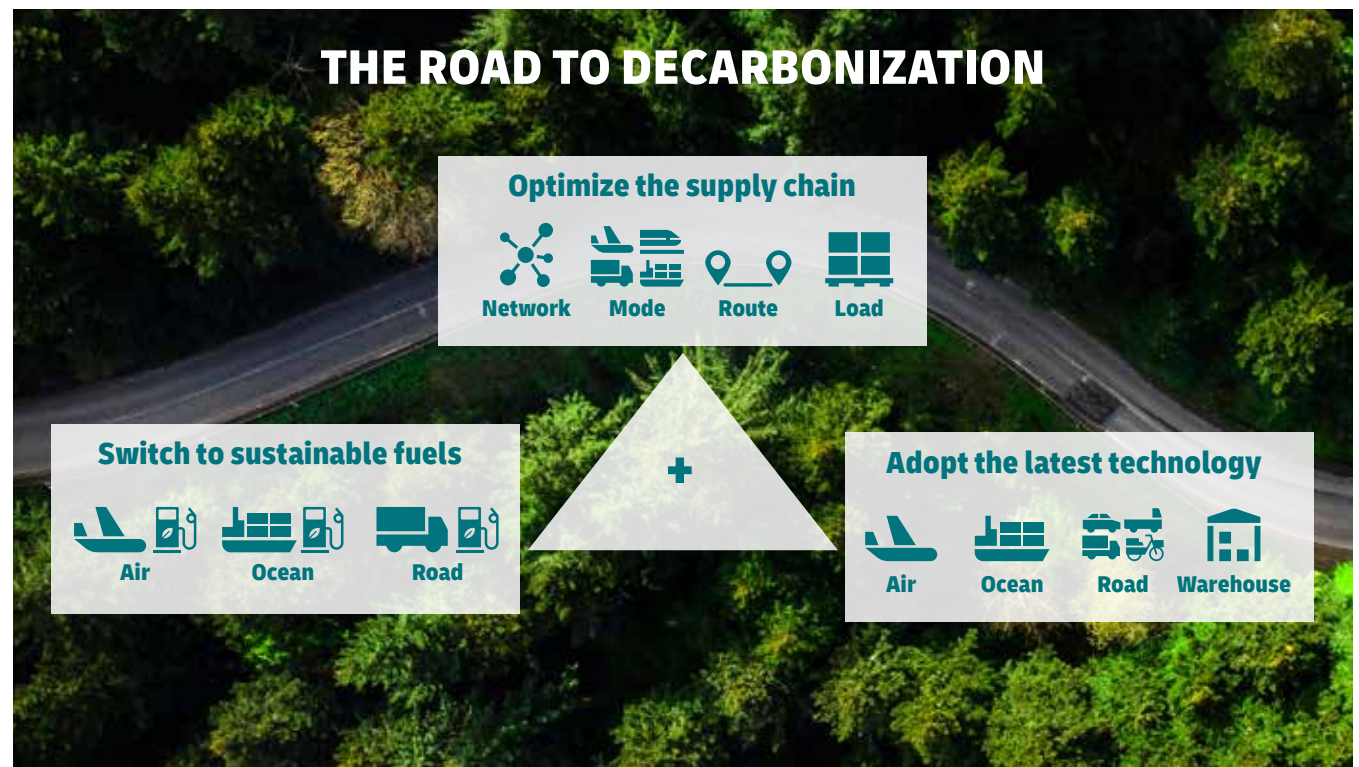
2. Switch to sustainable fuels

Currently, the best option for reducing supply chain emissions is the use of sustainable fuels (biofuels and synthetic fuels). The net environmental impact varies depending on the source, production process, and application, but today's sustainable aviation fuels (SAF) can, for example, reduce air freight emissions by 70-99% in some cases. Production is ramping up, so companies can switch from fossil fuels now to meet decarbonization targets in the short- and mid-term.

3. Adopt the latest technology

Adopting the latest technology across the supply chain is a crucial component of decarbonization. In ocean freight, the best option is currently sustainable marine fuels (SMF), although today's advanced vessel technology can also notably

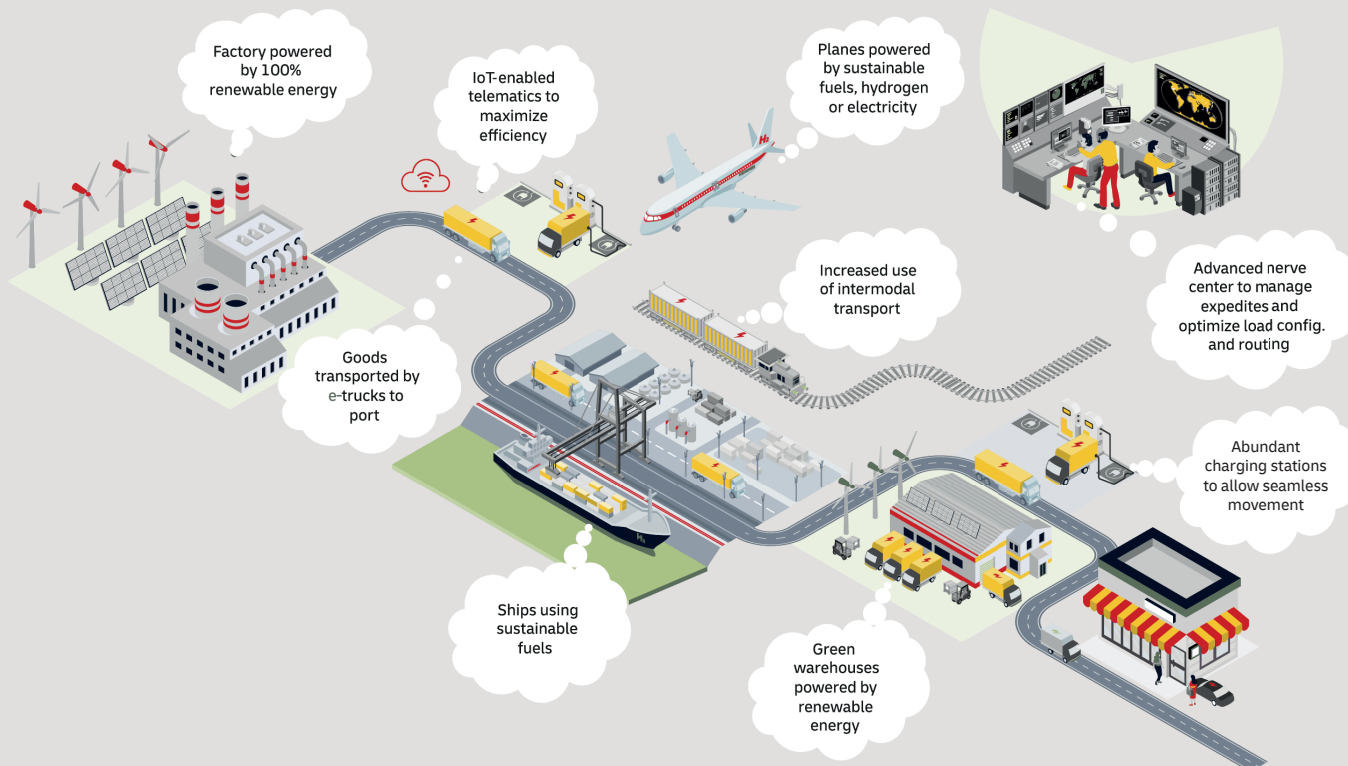
reduce GHG emissions. In road freight operations, electric vehicles and sustainable fuels are already being deployed. In warehouses, many energy-efficient options are now standard technologies, with more advanced decarbonization levers also now available.



THE DECARBONIZED SUPPLY CHAIN OF THE FUTURE

STATE-OF-THE-ART AND SUSTAINABLE FROM FACTORY TO FRONT DOOR

DECARBONIZING TODAY FOR A NET-ZERO SUPPLY CHAIN TOMORROW



Decarbonization is a marathon, not a sprint. But just imagine how taking the steps outlined above could lead to the carbon-neutral supply chain of tomorrow:

The net-zero supply chain starts with new factories and distribution centers powered 100% by renewable energy. IoT-enabled telematics guide first-mile electric trucks along the most efficient route – at the optimal time of day – to the seaport, where massive vessels running on sustainable marine fuels deliver the cleanest mode of transport per kilogram of moved goods on offer. Or to airports, where advanced aircraft powered by SAF carry carbon-neutral express shipments. Sophisticated nerve centers with state-of-the-art transportation management systems optimize load configuration and routing, diversifying to intermodal options where appropriate. Carbon-neutral warehouses powered by renewables minimize emissions when products are not in transit, and an end-to-end charging infrastructure ensures all e-vehicles move seamlessly between touchpoints, including the all-important last mile.

DECARBONIZING AIR FREIGHT

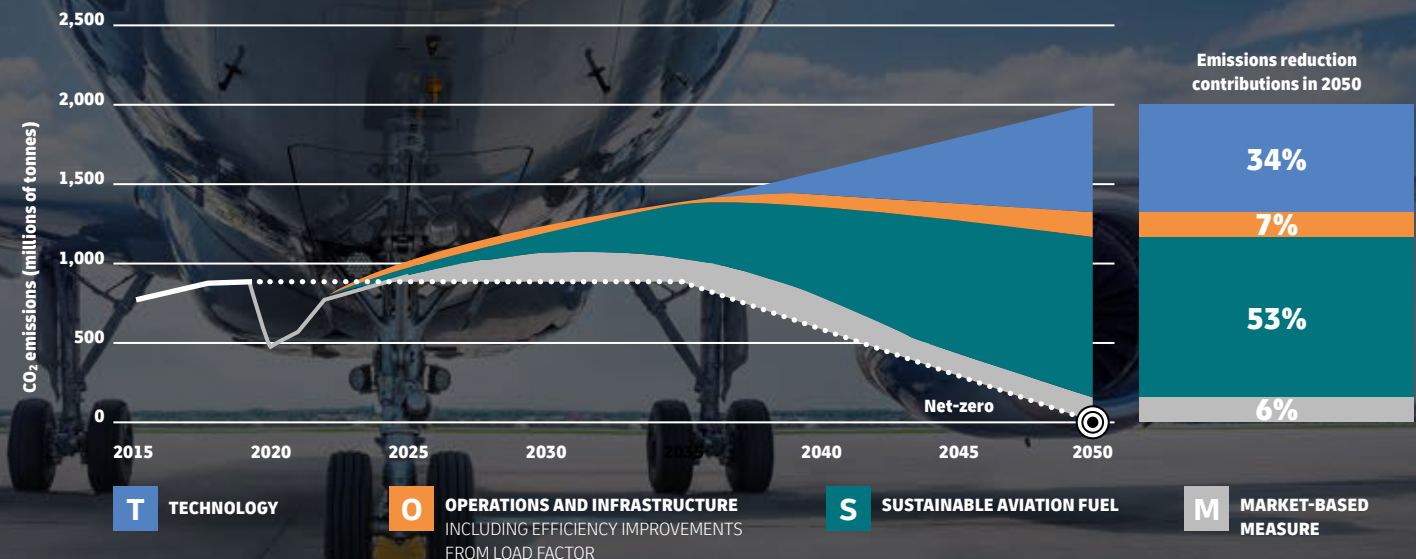
A CALCULATED FLIGHT PATH TO NET-ZERO AVIATION

From 2005 to 2019, the aviation industry improved fuel efficiency by 39%, but absolute growth in emissions far outpaced those gains.³ To achieve its goal of carbon neutrality by 2050,⁴ the industry must take a complex mix of actions, such as continuing to renew fleets and increase operational efficiencies, transitioning to SAF, adopting new propulsion technologies, and removing remaining GHG emissions.

Electric and hydrogen-powered aircraft are considered the future, but these emerging technologies aren't expected to be commercially available for at least another decade. Furthermore, these propulsion systems will only allow for smaller payloads and not provide sufficient range for intercontinental flights for some time. In the meantime, the industry must continue to optimize operations while introducing next-gen aircraft and transitioning to SAF, which offers the best and most immediate option for decarbonization, reducing air freight emissions by up to 70-99%.⁵

WAYPOINT 2050: ASPIRATIONAL AND AGGRESSIVE TECHNOLOGY

Under this scenario, the ATAG⁶ demonstrates how very ambitious technology improvements along with operations and infrastructure improvements and the use of SAF could reduce emissions by 94% by 2050. Offsets (mainly carbon removals) would be required to reduce remaining emissions.



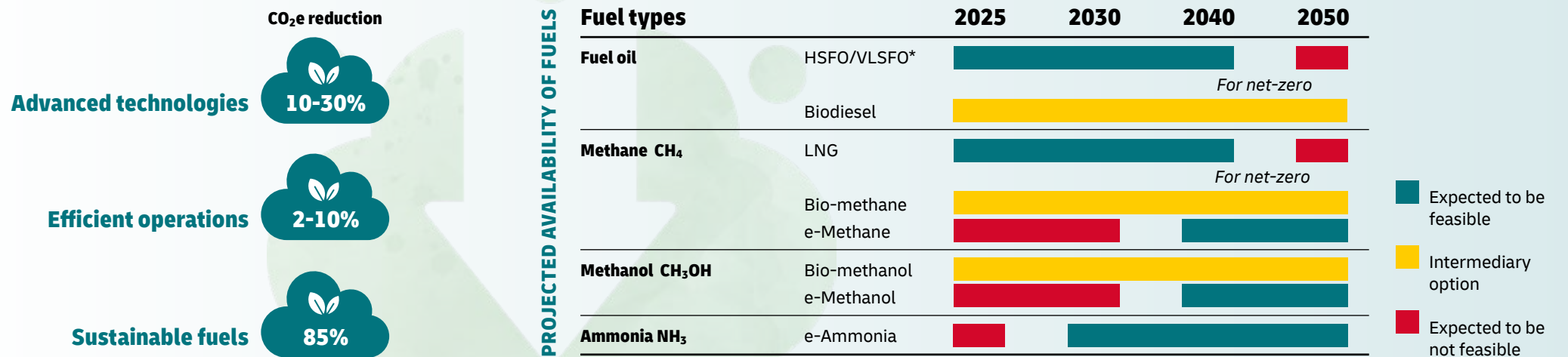
DECARBONIZING OCEAN FREIGHT

PLOTTING A CLEAN COURSE FROM WELL TO WAKE

Ocean freight accounts for about one billion metric tons of GHG emissions annually. Although new technologies, like wind-powered cargo ships, could reduce emissions by up to 30%, improving efficiency alone will not decarbonize ocean freight.⁷ The maritime shipping industry must increasingly introduce sustainable marine fuels (SMF) to achieve net-zero emissions. However, new technologies and efficient operations still play an important role. For example, optimizing a ship's hull could reduce emissions by up to 20% and less-resistant coating could increase carbon efficiency by up to 15%.

Currently the best lever for eliminating ocean freight emissions is SMF. The industry is pursuing two types: drop-in and non-drop-in fuels. While drop-in fuels, such as Fatty Acid Methyl Ester (FAME), can be used in existing engine technologies, non-drop-in fuels, such as those using methanol or ammonia, require new engine technologies. Which solution will prevail remains to be seen, but the International Energy Agency (IEA) projects that ammonia will play a key role by 2050.⁸

THE COURSE TO NET ZERO INCLUDES TECHNOLOGY, EFFICIENCY, AND SUSTAINABLE FUELS



* HSFO: High Sulfur Fuel Oil; VLSFO: Very Low Sulfur Fuel Oil

Source: McKinsey NavigaTE Model, McKinsey Hydrogen Practice

DECARBONIZING ROAD FREIGHT

THE ROAD TO NET ZERO HAS MANY MILESTONES

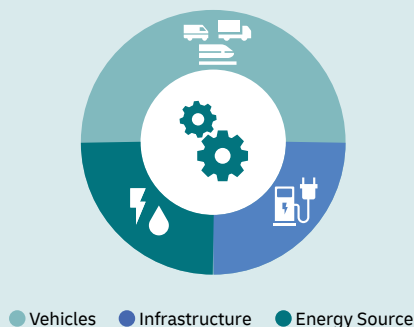
Road freight is responsible for around 70% of the 3.4 billion metric⁹ tons of emissions generated during overland transportation. The good news is that developments in green technologies, such as battery electric vehicles (BEV) and hydrogen fuel-cell electric vehicles (FCEV), are advancing at an accelerated pace. Many logistics companies

already utilize BEVs for first and last-mile transportation. For longer distances and larger trucks, a range of biodiesel and biogas solutions are becoming available, and the first heavy-duty BEVs and FCEVs are also on the road. Many manufacturers plan to offer these technologies at scale by the end of the decade.

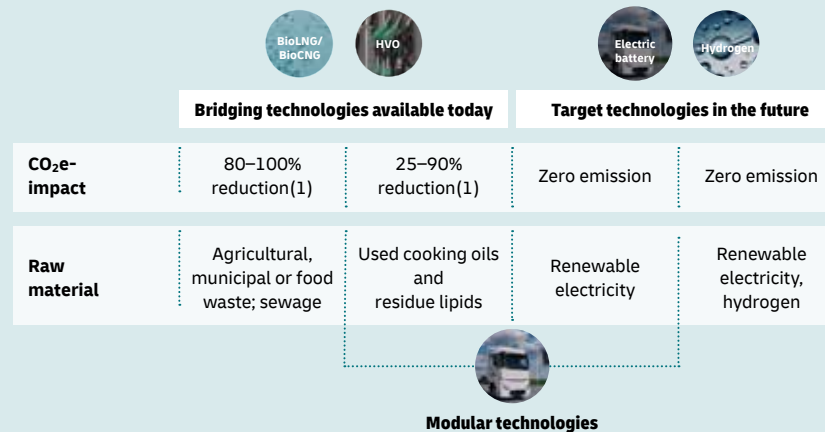
Net-zero-emission vehicles are essential to decarbonized road freight, but green electricity sources and efficient charging infrastructure must also be in place. In areas with scarce renewable energy sources, bridge technologies like biofuels will provide effective alternatives for reducing GHG emissions. Using biodiesel and compressed natural gas can reduce emissions between 50-70%.¹⁰

THE PATHWAYS TO NET ZERO IN ROAD TRANSPORT

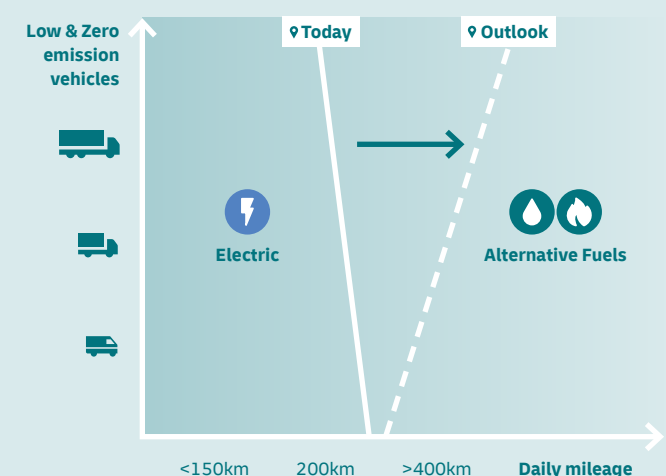
Green road transport components



Road transport decarbonization technologies



Electric vehicle capabilities

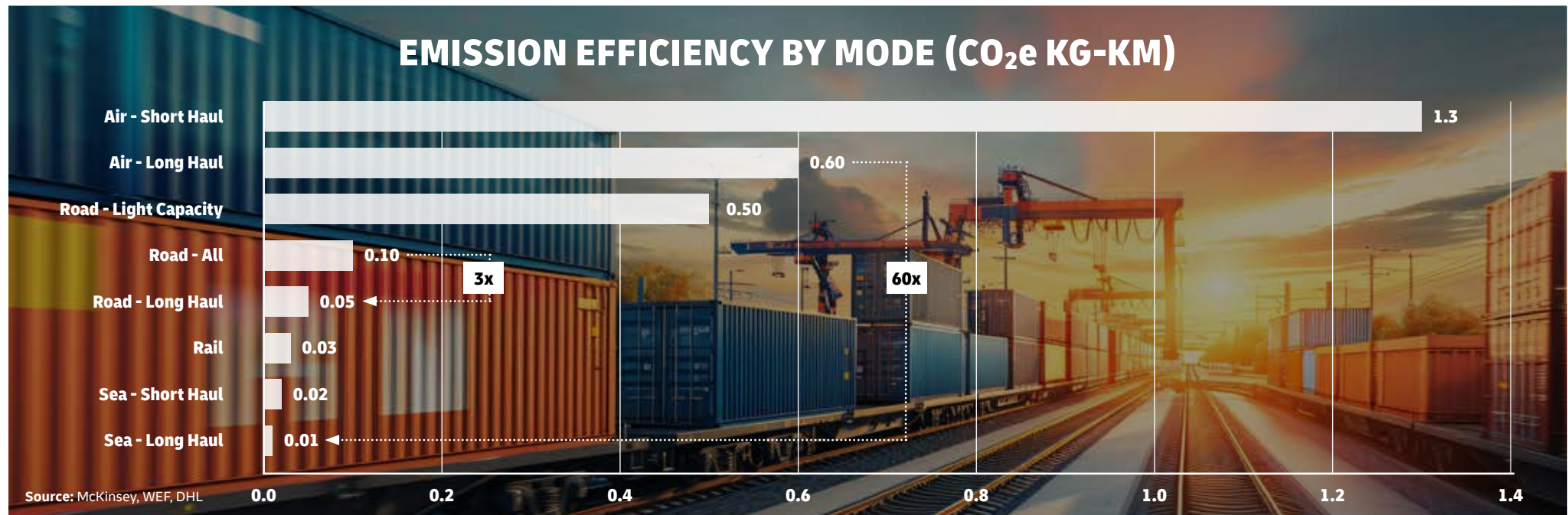


DECARBONIZING OVERLAND TRANSPORT

RAIL AND MULTIMODAL SOLUTIONS ENHANCE EFFICIENCY

Rail is one of the most emission-efficient modes of transport, especially when powered by renewable electricity. Therefore, it plays an important role in sustainable transportation. Multimodal freight transport, for example, can reduce GHG emissions by up to 90%.¹² Rail and multimodal transportation solutions also reduce traffic congestion on the road.

As a result, the rail and multimodal connections between Asia and Europe have increased in recent decades, with several major corridors now offering a fast and reliable alternative to ocean freight between the continents. At the same time, the number of rail connections within Europe and Asia has grown significantly, while most recently new multimodal connections have been added in the Middle East.



DECARBONIZING WAREHOUSES

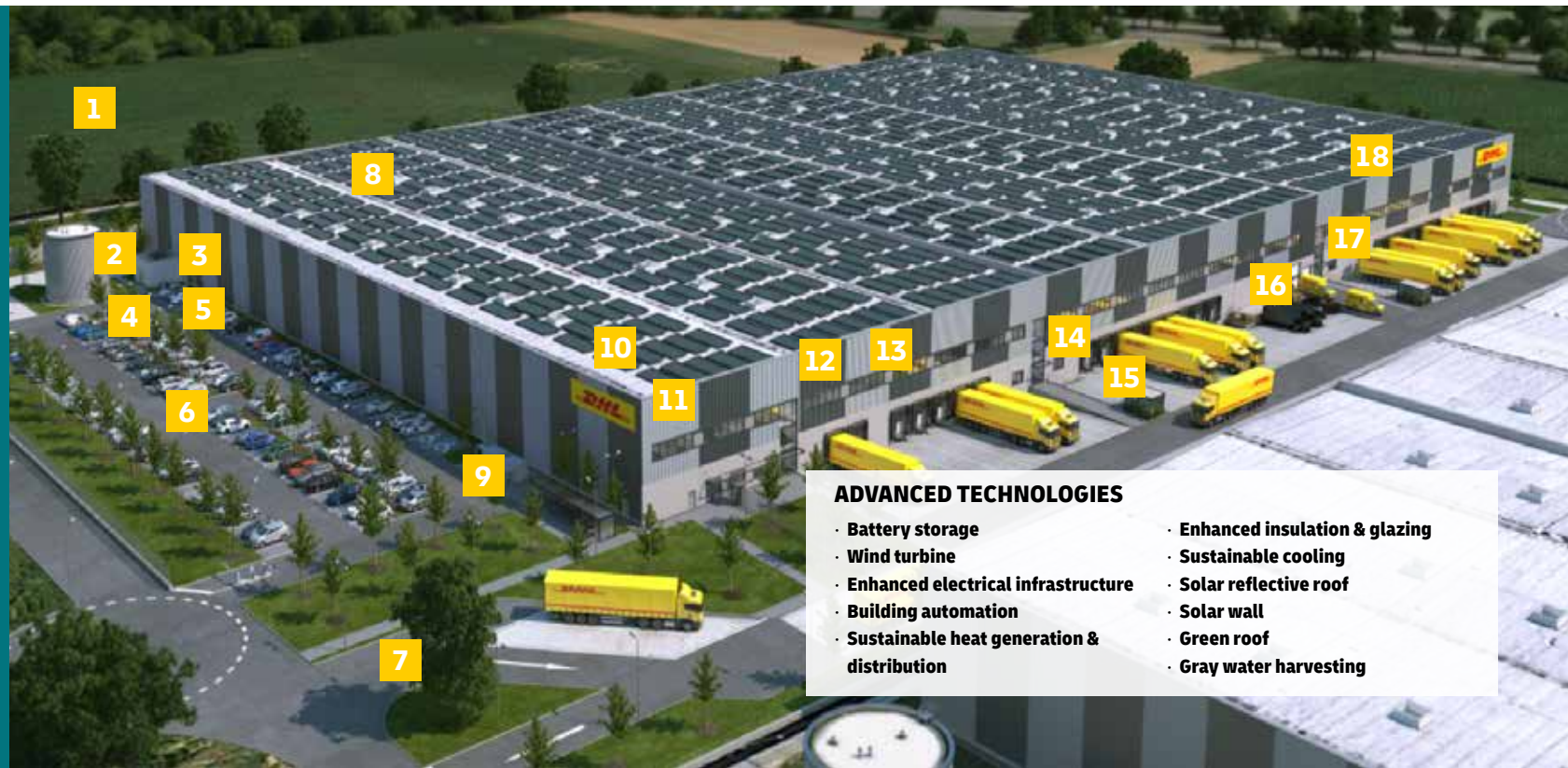
THE TECHNOLOGIES OF A CARBON-NEUTRAL WAREHOUSE

Although warehouses often only account for a small portion of a company's GHG emissions, carbon-neutral buildings designed with the latest technologies are becoming the new normal and can help reduce the carbon footprint of the supply chain. Some now standard technologies, such as LED lights, sustainable heating systems, and rooftop solar panels can be used to retrofit

existing facilities. Carbon-neutral buildings are becoming the gold standard for new constructions, enabled by a host of advanced technologies, like battery storage for on-site, solar-generated electricity. Carbon negativity is even achievable in some cases. Efforts should be made to increase the use of sustainable and reusable building materials in the coming years.

STANDARD TECHNOLOGIES

- 1 Renewable energy from the grid
- 2 Battery storage ready
- 3 Efficient transformers
- 4 Main meter energy monitoring
- 5 Sub meters advanced energy monitoring
- 6 Electric vehicle charging (cars)
- 7 Biodiversity (sustainable landscaping)
- 8 Solar panels (PV)
- 9 Efficient HVAC
- 10 Natural ventilation, automated controls
- 11 Low use water appliances
- 12 LED lighting with smart controls
- 13 Solar shading
- 14 Rapid rise doors
- 15 Efficient dock seals/air tightness
- 16 Electric vehicle charging (commercial)
- 17 Vertical skylights
- 18 Rain water harvesting



ADVANCED TECHNOLOGIES

- Battery storage
- Wind turbine
- Enhanced electrical infrastructure
- Building automation
- Sustainable heat generation & distribution
- Enhanced insulation & glazing
- Sustainable cooling
- Solar reflective roof
- Solar wall
- Green roof
- Gray water harvesting

DECARBONIZING ACROSS THE SUPPLY CHAIN

SWITCH TO SUSTAINABLE FUELS NOW

Sustainable fuels are currently the most effective solution for decarbonizing supply chains. Now that these fuels are commercially available at small scale, early adopters can invest in them and claim the emissions reductions, even if the fuels are not used in the vehicles that transport their freight. This process, known as insetting, physically replaces fossil fuels in logistics networks.¹³ Buyers use a ‘book and claim’ system to purchase sustainable fuel and receive externally verified emission reduction certificates that they can immediately apply to their business, reducing their carbon footprint.¹⁴

There are two types of sustainable fuels: biofuels and synthetic fuels. Their environmental impact varies depending on their source, the production process, and where they are used, such as in air, ocean, or road freight. Biofuels use raw materials, known as feedstock, that absorb carbon dioxide, such as agricultural waste. When burned in an engine, they release the same amount of carbon dioxide as absorbed, making the combustion carbon neutral. Synthetic fuels, or e-fuels, are made using captured carbon dioxide emissions and hydrogen. Here too, the carbon dioxide released when e-fuels are burned is equal to the

amount taken out of the atmosphere to produce the fuel. E-fuels are considered carbon neutral if the hydrogen is produced with green electricity.

Synthetic fuels will not become abundant until enough green electricity is available. However, biofuels are available now and being scaled up rapidly across the air, ocean, and road freight sectors as production sites ramp up worldwide, so now is the time to switch from fossil fuels to help meet environmental goals and emissions requirements.

SUSTAINABLE FUEL SOURCES – TODAY AND TOMORROW

Used cooking oil
Waste oil from cooking



Animal fat
Food industry waste



Lignocellulosic



Algae



Fish fat
Fish processing waste



Residues from vegetable oil processing



Technical corn oil
Residue from ethanol production



Municipal solid waste



Renewable power

TODAY

NEAR FUTURE
5 - 10 YEARS

FUTURE
>10 YEARS

KEY TAKEAWAYS

YOUR ROLE ON THE ROAD TO DECARBONIZING THE SUPPLY CHAIN

**Know your business**

Decarbonization starts with clearly understanding your carbon footprint, setting science-based reduction targets, and allocating sufficient budget. This builds the necessary foundation for success.

**Optimize your supply chain**

Optimize your network locations, select optimal routes and modes of transport, and fully utilize container space. These efforts alone could reduce your GHG emissions by up to 20%.

**Switch to sustainable fuels**

Use sustainable fuels and adopt green technologies as they become available. This is the quickest way to decarbonize your supply chain.

**Act today, think tomorrow**

Right now, it is possible to build carbon-neutral buildings and net-zero last-mile networks. Retrofit existing facilities, leverage today's technologies, and start planning the next steps on your road to decarbonized supply chains.

“Decarbonization is not just about cutting emissions, it's about investing in a cleaner, healthier, and more prosperous future for all.”

Ban Ki-moon

Former Secretary-General of the United Nations



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