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eHighway

Innovative electric road freight transport.



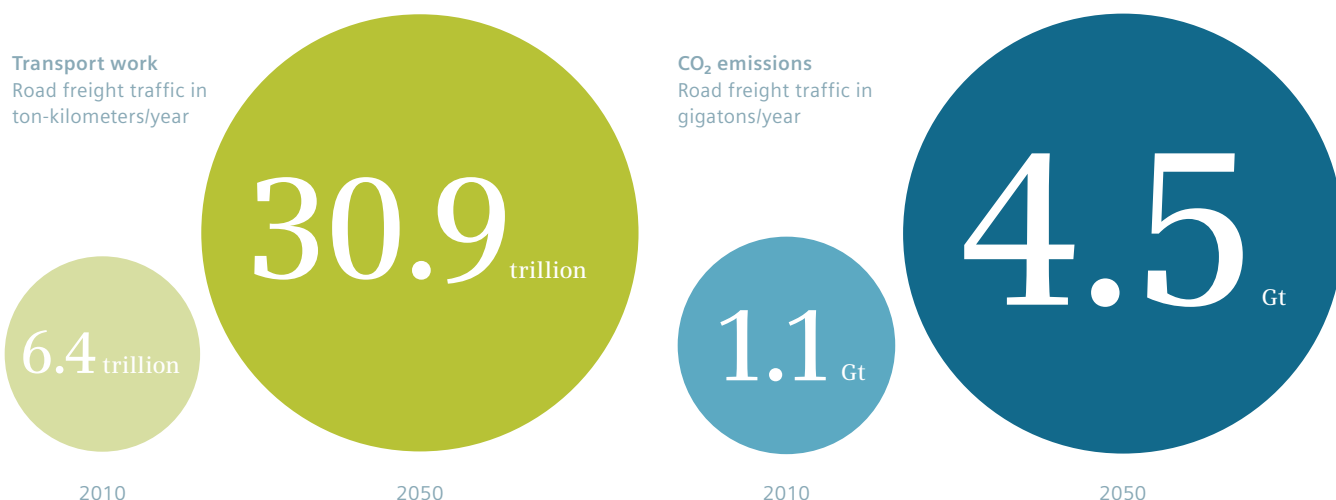
Road freight challenges

Transport remains the end-sector that is most dependent on fossil fuels, which makes it a leading source of greenhouse gas (GHG) emissions. Due to the expected growth in demand for transport, the International Transport Forum (ITF) estimates that emissions from road freight transport will grow from 1.1 gigatons of CO₂ in 2010 to 4.5 gigatons by 2050. According to the ITF, the total emissions from surface freight transport is overtaking those from surface passenger transport. This trend has been confirmed by other organizations.

To counter the trend of growing GHG emissions caused by road freight transportation and to achieve significant

reductions in line with defined climate goals, there are several policy options. Avoiding road transport and shifting freight to other modes, such as upgraded rail systems, may play an important role. However, road freight is anticipated to remain a large and vital part of the transport system. Solutions to improve its efficiency and performance are therefore essential in order to achieve the climate goals that have been set.

Increased vehicle efficiency as well as the use of bio-fuels can play a role: But given the huge gap between predicted emissions and the reduction goals, much larger improvements are necessary.



Source: ITF Transport Outlook 2015

Electrified solutions

Electromobility offers a variety of benefits, including improved local air quality, fuel diversification into renewable sources to reduce dependency on fossil fuels, and increased energy efficiency, which lowers operating costs.

Given that several countries already have a very low carbon footprint for electricity, and that the global trend is toward the decarbonization of power generation as part of the cli-

mate mitigation measures, it makes sense to explore solutions that utilize electricity for freight transport.

The main obstacle to electrified road freight has been the size and weight required for on-board storage of electrical energy. For example, a road truck weighing 40 tons travelling 1,000 kilometers would need approximately 20 tons of batteries. This problem can be solved by providing power to the truck as it is driving.

Hybrid-drive technology and smart power supply

The eHighway combines resource-efficient railway technology with the flexibility of road transport. The eHighway adapted hybrid trucks are supplied with electricity from overhead contact lines via the active pantograph, which can connect and disconnect at speeds up to 90km/h.



The eHighway system – Safe, reliable and efficient

The direct transmission of electric current enables the system to have a high well-to-wheel efficiency: 80-85 percent from substation to the wheel. This is twice as high as that of conventional diesel engines. The eHighway also makes it possible to regenerate electricity and store it on-board or feed other trucks on the system, thanks to long sections of contact lines. These energy savings translate into higher system efficiency, lower emissions, and lower energy costs.

An additional operating cost reduction comes from reduced maintenance expenditures. When implemented on routes with traffic volumes that ensure sufficient utilization, the savings can cover the cost of investment. Those routes are especially sensitive to disruptions; therefore, the eHighway system is based on proven, reliable, and open-standard contact-line technology that does not interfere with the road surface. This minimizes disruption during installation, operation, and maintenance of the

eHighway, and allows road operations to continue as usual. By using long sections of proven contact-line technology, the lifetime cost of the infrastructure can be kept low and stable.

In collaboration with the Technical University of Dresden and the Federal German Highway Research Institute (BAST), various types of traffic- and road-specific challenges have been analyzed. This research examined many different safety issues as well as the adjustment of the electrification infrastructure to a wide range of road conditions such as bridges and gantries. The performance of the eHighway truck, the energy supply, the connection to the grid, and the maintainability of the system as a whole have also been tested. All components of the electrification infrastructure and the hybrid drive of the eHighway-adapted truck were proven to be reliable and user-friendly. The eHighway system is well-prepared to face the next-level challenges of electrified road freight transport.

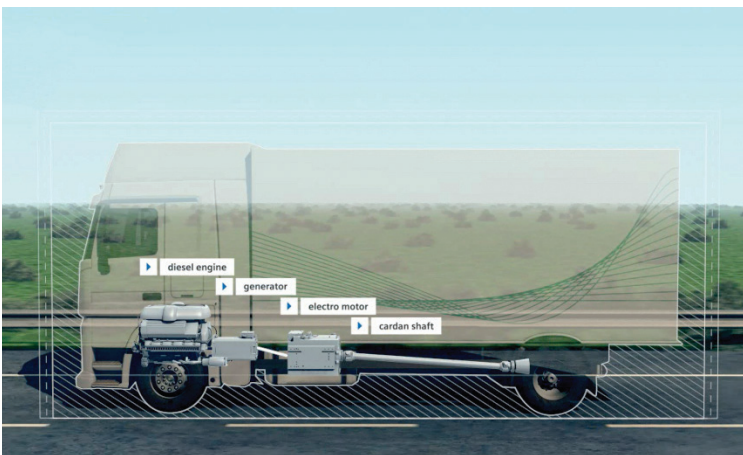
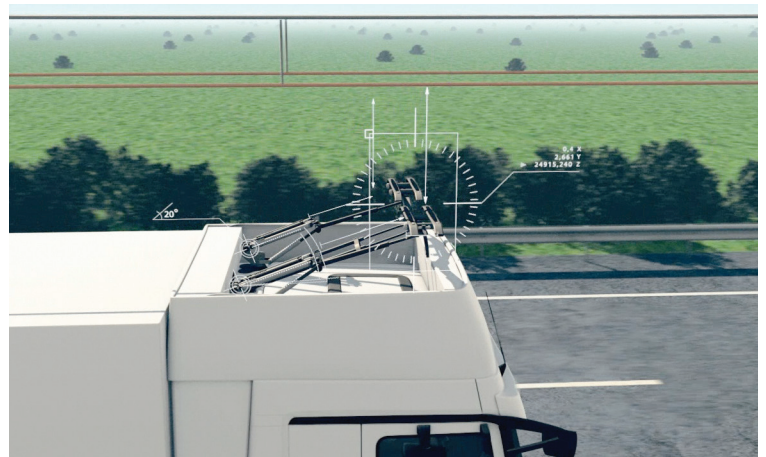


Power supply and distribution

A constant power supply is guaranteed by the substations along the eHighway. For power distribution to the hybrid trucks, a specially designed two-pole contact-line system ensures a secure energy supply even at speeds of up to 90 km/h.

Active pantograph

The key innovation of the eHighway system is the active pantograph. It can connect and disconnect the vehicle to the contact lines at all speeds. The pantograph transfers energy directly from the overhead contact line to the electric motor of the eHighway adapted truck. A specially designed sensor technology allows the movable pantograph to automatically adjust its position under the contact line to compensate for lateral movements of the truck in the lane. The mechanism also minimizes wear across the pantograph to ensure a long lifespan.



Hybrid drive

The eHighway adapted truck's hybrid drive system enables its full electrical operation within the electrification infrastructure. It also ensures flexibility by switching between electric and hybrid mode to bridge non-electrified parts of the road and to cover the first and last mile of each journey. The eHighway system is open to adopt a variety of hybrid configurations such as parallel or serial energy concepts and combinations with on-board energy storage. During braking the electric machines act as generators, which allows otherwise unused braking energy to be fed back into the grid and used as needed by other trucks on the eHighway.

Realization and applications

Proof of concept and test track

The first demonstration track of the eHighway system has been in operation since 2010 on a private road outside Berlin. The proof of the concept was achieved here, which enabled further development and testing: for example, tests as integrated part of a development cooperation with the global truck manufacturer Scania.



Public road demonstration in the U.S.

A 12-month public road demonstration of the eHighway system in Southern California includes several trucks, one of which is being provided in collaboration with Mack, a brand of the Volvo Group. Using a one-mile-long road (1.6 kilometers) with contact lines going in both directions, it will collect data and evaluate the benefits of eHighway operations for Southern California, especially for the intensely used road freight operations connecting the nearby ports of Los Angeles and Long Beach with local rail yards.

Shuttle and mining operations

For the near and mid-term, the system will demonstrate its benefits in shuttle applications with a high volume of truck transportation. Connections of ports with logistics centers and mines with rail yards are two relevant applications. This echoes the development of rail electrification, which began in mines before eventually spreading to broader and longer-distance applications.



National highway networks

With the specialized design of its infrastructure and the highly innovative vehicle components, the eHighway system is the ultimate solution for future long-haul transport.

In order to achieve the environmental goals and reduce CO₂ emissions, road freight transport requires a global shift from fossil fuels to alternative drive technologies. Siemens is pioneering this field, and is providing not only the technical solution for the electrification of freight transport but is also demonstrating a strategic approach to achieving a large-scale implementation on highway systems.

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