1. OPERATIONAL RANGE

Facts about climate-friendly road freight transportation

What's the best strategy for realizing climate-friendly road freight transportation? Let's take a look at the facts.

Sustainability isn't just the challenge of the 21st century but it will be a duty and responsibility forever. Hence it is only justified that sustainability should be at the top of all political agendas and an integral part of a company's strategy.

The European Union, for example, has set itself the goal to reduce CO_2 emissions by 55 percent by 2030 and to become carbon-neutral by 2050.[1] Germany's goal is to cut emissions by 65 percent by 2030 and become carbon neutral by 2045.[2] However, the clock is ticking, and therefore a concerted effort by governments and industries is necessary in order to achieve these targets. Which role does transportation play in all this? Quite a big one as transportation causes 24% of global CO_2-emissions.[3] Most of these emissions are related to passenger transportation, but the share of road freight transportation is also considerable and it's growing.[4] In Germany, for example, road freight transportation is responsible for one-third of the CO_2 emissions from transportation sector.[5] Even with ambitious scenarios to shift materials transportation to electrified rail, road freight is expected to grow in absolute terms and remain the largest source of CO_2 from all freight. Road freight therefore has a huge potential to help reduce CO_2.

SIEMENS

But what's the right strategy for making road freight transportation climate-friendly?

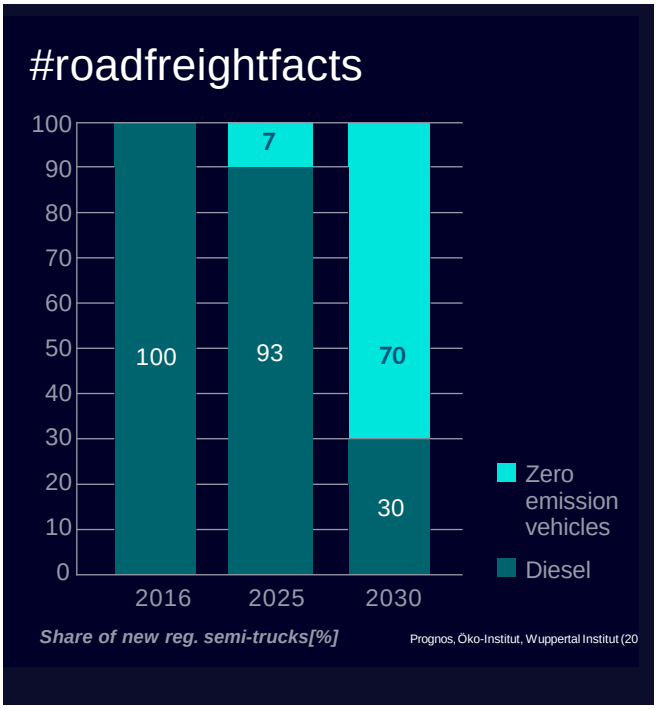
For short journeys and for light commercial vehicles, there's a strong consensus in favor of battery-powered electric vehicles and low-power charging solutions. However, for heavy long-haul trucking, the picture is more complex. Currently, the four main concepts for climate friendly long-haul trucking are discussed:

1. Electric or hybrid trucks equipped with pantographs that connect to an overhead contact line (OCL)
2. Battery-electric trucks with stationary mega charging (BEVs)
3. Fuel-cell electric trucks using hydrogen from new fuel infrastructures (FCEVs)
4. Renewable fuels for conventional trucks and existing fuel infrastructures (RFs)

Siemens AG is active in all of these four technology fields across several industries. All the technologies have one thing in common: they all have the potential to eliminate CO_2 emissions. However, the key question is: are these concepts also suitable to reach the necessary CO_2 reductions in the required time?

By 2030, CO_2 from heavy-duty vehicles in the EU must drop by -30 percent according to the 2019 legislation.[6] Given the agreement on April 21, 2021, to increase the EU's economy-wide ambition to 55 percent, it's plausible that road freight transportation sector will also see an increase in their 2030 goal. The analysis for Germany shows that achieving these ambitious goals will require 70 percent of new trucks sold in 2030 to be electrified.[7] The goal for 2030 is a crucial milestone on the path to becoming CO_2-free no later than 2050.

A strategy for achieving this has to begin by recognizing the workhorses of today's road freight system: semi trucks. They pull heavy trailers over long distances and face specific challenges, including restricted space on the vehicle and the need for high operational flexibility. Because they do most of the road transportation work (as measured in ton-km), they also emit most of the CO_2.[8]



Equally important to their operational needs is the economic element. This is important for a speedy transition in Europe, where trucking is a low-margin and highly fragmented business.

Finding the best solution requires looking at the four concepts, assessing their advantages and disadvantages, and exploring the potential for an intelligent combination of several concepts. In a series of articles, we will look at practical, economic, and ecological aspects and compare the four concepts using the following seven criteria:

1. Operational range

2. Time to market

3. Scalability and resource efficiency

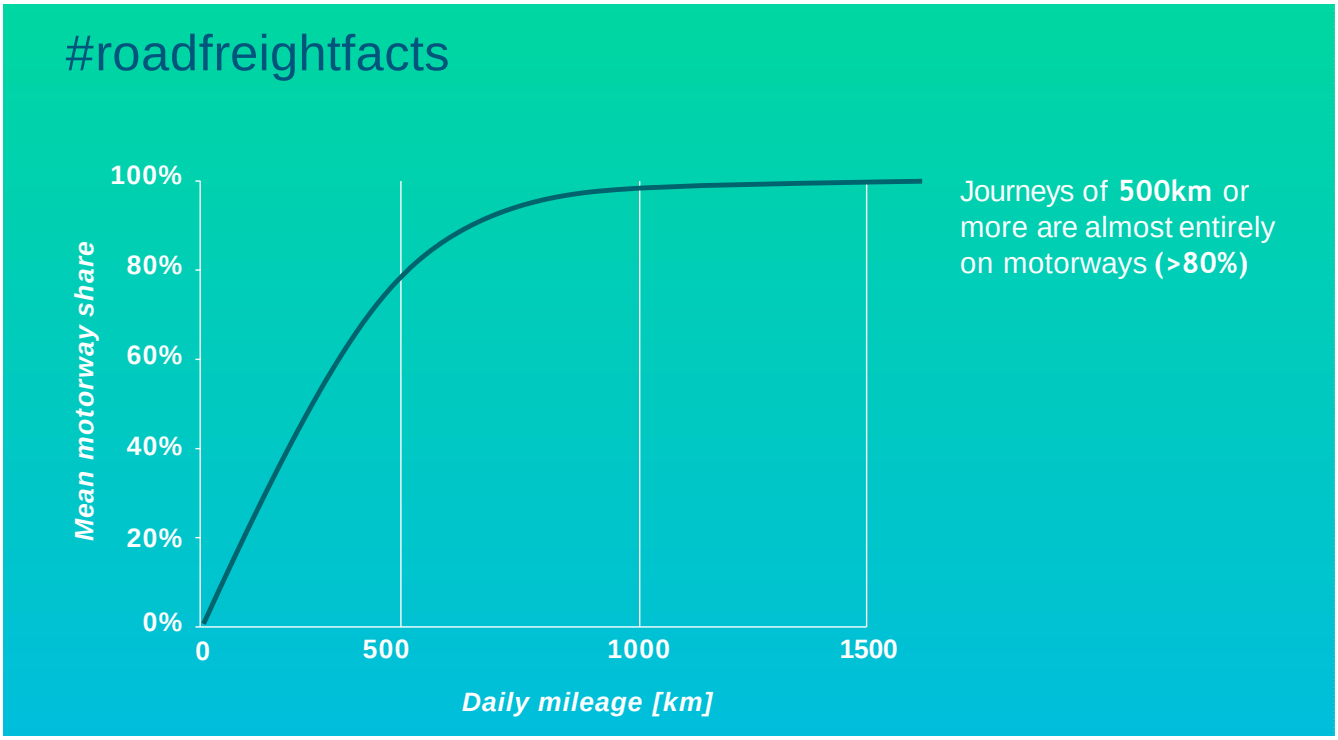
4. Energy efficiency

5. Total cost of ownership

6. Flexibility

7. CO_2 abatement cost

Operational range



This first article is about operational range, which is a major concern for electric heavy-duty vehicles in particular.

First, let's consider that today's trucks have diesel tanks that provide a range of up to 2,300 km.[9] That distance isn't driven in a single day, but it gives us an indication of how far trucks can go before needing to refuel. If we consider what range a truck used by one driver might travel in a day, then 750 km is a more realistic upper limit.[10] Some trucks are used in shifts and will travel more, but most trucks on average will travel less, albeit occasionally they'll come close to this maximum.

A second important observation about long-haul trucking is that 80 to 90 percent of it takes place on highways.[11 and 12] Furthermore, this activity is highly concentrated: More than two-thirds of the fuel burned in long-haul trucking on German highways happens on the busiest 4,000 km,[13] which constitute just one-third of the highway network and about two percent of the national road network.[14] For purposes of discussing operational range, it's especially noteworthy that 89 percent of German truck trips that depart from the highways are only 50 km or less away from them.[15]

Now let's turn to the four technologies.
Overhead Contact Line (OCL) enables unlimited operational range under the infrastructure. When the truck leaves the OCL, the range depends on its propulsion system.

For instance, hybrid trucks with a combustion engine would have the same range as conventional trucks. In any case, all OCL trucks have a battery that provides a certain electric range outside the infrastructure.

Battery-electric trucks (BEVs) with the typical daily mileage of long-haul trucks have to manage a trade-off between range, payload, and charging stops. The BEV 40-ton trucks currently on the market have a maximum range of 200 km,[16] and models have been announced for the coming years with a maximum range of 400 to 500 km.[17,18,19,20]

Fuel cell electric trucks using hydrogen from new fuel infrastructures (FCEVs) have the potential to offer sufficient range for long-haul trucking, especially if they use liquid-hydrogen storage, which is more compact: and there's also less risk of affecting the volume of goods that can be transported.[20]

Renewable fuels for conventional trucks and existing fuel infrastructures (RFs) have the same range as conventional trucks thanks to the similar energy density of their fuels,[21] and they can even use existing refueling infrastructure.

This was our first assessment on operational range.
Stay tuned for the articles to come over the next weeks, covering the topics of time to market, scalability and resource efficiency, energy efficiency, total cost of ownership, flexibility, as well as CO_2 abatement costs and our final conclusion.

[1] European Commission. Climate Strategy and Targets - 2050 Long-term Strategy (2020): https://ec.europa.eu/clima/policies/strategies/2050_en

[2] BMU https://www.bmu.de/media/statement-von-bundesumweltministerin-svenja-schulze-zum-neuen-klimaschutzgesetz/

[3] International Energy Agency (IEA). Tracking Transport 2020: https://www.iea.org/reports/tracking-transport-2020

[4] International Transport Forum (ITF): Transport Outlook (2019: https://www.oecd-ilibrary.org/transport/itf-transport-outlook-2019_transp_outlook-en-2019-en

[5] German Federal Ministry for Transport (BMVI). An Overall Approach to Climate-Friendly Commercial Vehicles (2020): https://www.bmvi.de/SharedDocs/EN/Documents/overall-approach-climate-friendly-commercial- vehicles.pdf?__blob=publicationFile

[6] EU https://ec.europa.eu/clima/policies/transport/vehicles/heavy_en

[7] Agora Verkehrswende: https://static.agora-energiewende.de/fileadmin/Projekte/2020/2020_10_KNDE/2020-12-03_Praesentation_KNDE2050_Deep_Dive_Verkehr.pdf

[8] Öko Institute. Alternative drive trains and fuels in road freight transport – recommendations for action in Germany (2019): https://www.oeko.de/fileadmin/oekodoc/Climate-friendly-road-freight-transport.pdf

[9] Wietschel et. al - Electric Trolley Trucks – A Techno-Economic Assessment for Germany (2019)

[10] TNO https://ec.europa.eu/clima/sites/clima/files/events/docs/0121/assessment_en.pdf

[11] Commercial Vehicle of the Future (2017) https://www.iru.org/resources/iru-library/iru-report-commercial-vehicle-future

[12] Fraunhofer ISI und IML et al. Machbarkeitsstudie zur Ermittlung der Potentiale des Hybrid-Oberleitungs-Lkw (2017): https://bmvi.de/SharedDocs/DE/Anlage/G/MKS/studie-potentiale-hybridoberleitungs-lkw.pdf?__blob=publicationFile

[13] Oeko Institute – StratON report https://www.oeko.de/fileadmin/oekodoc/StratON-O-Lkw-Endbericht.pdf

[14] BMVI https://www.bmvi.de/SharedDocs/DE/Artikel/G/infrastruktur-statistik.html

[15] Fraunhofer ISI und IML et al. Machbarkeitsstudie zur Ermittlung der Potentiale des Hybrid-Oberleitungs-Lkw (2017): https://bmvi.de/SharedDocs/DE/Anlage/G/MKS/studie-potentiale-hybridoberleitungs-lkw.pdf?__blob=publicationFile

[16] BYD https://en.byd.com/wp-content/uploads/2018/07/8tt_redesign6-23-18.pdf

[17] Nikola (2019) IVECO, FPT Industrial and Nikola Corporation unveil the Nikola TRE (retrieved 05.03.2021): https://nikolamotor.com/press_releases/iveco-fpt-industrial-and-nikola-corporation-unveil-the-nikola-tre-71

[18] Daimler: https://media.daimler.com/marsMediaSite/ko/de/48289226

[19] Roland Berger. Trends in the truck & trailer market (2018) https://www.rolandberger.com/publications/publication_pdf/roland_berger_trucking_industry.pdf

[20] Daimler AG. Homepage Investors/Financial news (retrieved 05.03.2021): https://www.daimler.com/investors/reports-news/financial-news/20201210-refuelig-liquid-hydrogen-trucks.html

[21] US Department of Energy. Alternative Fuels Data Center Fuel Properties Comparison (2021) https://afdc.energy.gov/files/u/publication/fuel_comparison_chart.pdf

Published by
Siemens AG
Siemens Mobility GmbH
Otto-Hahn-Ring 6
81739 Munich Germany

E-mail: electrification.mobility@siemens.com
www.siemens.com/mobility/eHighway