Hessen Mobil Road and Traffic Management



**ELIS**Å

# ELISA eHighway

A pilot project for sustainable heavy goods traffic

# Climate protection is a widely debated, important issue.





t present, there is no issue that is more widely debated in society than climate protection. In order to be climate-neutral by 2050, the transport sector, for example, has to lower its  $CO_2$  emissions by 95 per

cent compared to 1990. This means that road freight transport must be largely climate-neutral by then as well.

This is where the ELISA project comes in. Headed by Hessen Mobil, the operation of electrically driven heavy commercial vehicles using energy supply by overhead catenary in real traffic is being tested on a public road in Germany for the first time on a section of the A5 autobahn - Germany's first eHighway. What makes the Hessian test region special, is the integration of climate-friendly technologies into the system network of cooperative automated transport. This will enable the traffic of the future to be made more environmentally friendly, safer and more efficient. In the Rhine-Main area, Germany's transport hub, Hessen Mobil has been developing and testing solutions for the mobility of the future for many years and has long-term experience in carrying out major projects for the development, testing and introduction of innovative transport technologies. It was therefore a logical step for Hessen Mobil to take on the project management of this ambitious venture and to make an important contribution to the vision of largely emission-free road freight transport with this pilot project.

fit hypellites

Gerd Riegelhuth President Hessen Mobil

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To meet climate protection goals, vehicles will have to use electricity-based fuels in future. The direct use of electricity is most efficient.

# A clever solution

### FOR A SMALL BUT ESSENTIAL PART OF A BIG CHALLENGE

Meeting climate protection goals requires major efforts. The transport sector has to make a significant contribution: changing to alternative drives.

#### ELECTROMOBILITY IS THE KEY ELEMENT OF AN ENERGY TURNAROUND IN TRANSPORT

Electricity is most efficient. Avoiding transport, a modal shift in transport and improving efficiency save up to **60 per cent**  $CO_2$ . An almost complete reduction of  $CO_2$  emissions in freight transport can only be achieved by using alternative fuels and drives.

#### ALTERNATIVE DRIVES MEAN

- electromobility (incl. plug-in hybrids, range extender vehicles and catenary vehicles)
- fuel-cell vehicles with hydrogen from regeneratively produced electricity
- combustion engines with liquid and gaseous fuels generated from electricity

# <u>Energy is</u> valuable, so it should be used wisely.

# What mode of transport is currently being used to take goods from A to B?





Traffic forecast 2030\*: Compared to 2010, truck traffic will increase by

38%

\*Source: Federal Ministry of Transport and Infrastructure



# CO₂ emissions in road traffic



## Electricity requirement for a distance of 100 kilometres

The power required per 100 kilometres for electrically powered vehicles is up to 90 per cent lower than for combustion engines and 50 per cent lower than for fuel cells.

In the end the question remains: How does the electricity get into the truck?

# One goal already achieved

1995 - 2017

Sulphur dioxide emissions in truck traffic have fallen by more than 99 per cent per tonne-kilometre since 1995 due to better engines, exhaust technology and better fuel quality.



# eHighway Hesse: on track to the most environmentally friendly motorway in Europe

### The pilot track in the Rhine-Main area

he ELISA project represents Germany's first eHighway and thus a new dimension of electromobility: Truck transport along state-of-the-art infrastructure as an important component in the electrification of

heavy goods transport. ELISA shows the way how the transport sector can make a significant contribution to achieving national climate protection goals. This is to be scientifically proven by a comprehensive field trial.

As a first part of the ELISA project, the eHighway Hessen was built on about ten kilometres of the A5 motorway between the Langen/Mörfelden and Weiterstadt junctions. Within two years, Hessen Mobil, with scientific support from the Technical University of Darmstadt, built a catenary system that can supply power to catenary hybrid trucks. This created the technical prerequisites for the field test.

#### **PILOT TRACK A5**

The densely populated **Rhine-Main area** close to **Frankfurt Airport** and the "Frankfurter Kreuz" motorway junction provides optimal test conditions.

8-lane motorway: 134,000 vehicles/day Share of heavy goods traffic: approx. 10% Overall length: electrification of the righthand lane for 5 kilometres in each direction The key criteria for the selection of the test track were:

- the representation of the track with regard to the transferability of the research results to further sections of the motorway,
- a challenging operational environment with high public visibility,
- the location of the test track with regard to its potential to handle as many journeys as possible within existing transport networks.



# The test track in Hesse was established in 2018.





### THE EHIGHWAY TECHNOLOGY: **COMBINATION OF INNOVATIVE INFRASTRUCTURE AND ADVANCED** AUTOMOTIVE ENGINEERING.

The catenary system provides energy via two overhead catenaries above each right-hand lane. When a catenary truck equipped with an electric motor and a battery reaches the catenary, the integrated current collector is extended and contact to the overhead catenary is established. The electric motor is supplied with electricity and the battery is charged simultaneously. As soon as the overhead catenary ends or the catenary truck starts to overtake, the battery takes over the power supply of the electric motor. This means that the power supply can be disconnected while the truck is moving without reducing its speed.

### **ELISA - OVERALL PROJECT** MANAGEMENT BY HESSEN MOBIL

- Monitoring of the safe operation of the roadside ٠ infrastructure of the eHighway system
- Responsibility for the evaluation from the road and catenary infrastructure operator's point of view
- Research of the expansion of the system
- Operation of the catenary system control centre at the Traffic Centre Hesse (Verkehrszentrale Hessen, VZH)

# 75% less



Sensors recognise the overhead catenary Hybrid drive

Innovative

current collector

Source: Siemens Mobility GmbH

is returned



# Did you know?

# 1

# IS THERE ANY INTEREST AT ALL IN CATENARY TRUCKS?

The field test involves transport companies that use or will use the catenary truck in their everyday business. There are more transport companies that have shown interest in participating in the test operation than there are catenary trucks available.



### WHY DOES THE FEDERAL GOVERNMENT NOT FOCUS EVEN MORE ON AVOIDING / REDUCING FREIGHT TRANSPORT?

The further increase in freight traffic is a consequence of our economic system and our lifestyle. In order to reduce freight transport significantly, these factors would have to be changed.



#### BUT CATENARY TRUCKS ARE COMPETITION FOR RAIL TRANSPORT!

No, catenary trucks are a vital complement. Even today, 80 per cent of all freight transport is by truck and only 8 per cent by rail. In addition, freight transport overall is increasing. For these transports, environmentally friendly drive solutions are required. After all, many regional truck transport operations, like e.g. delivery of goods to supermarkets, are not possible by rail.



### WHY IS THE TEST BEING CARRIED OUT WITH ELECTRIC TRUCKS AND NOT WITH TRUCKS WITH FUEL CELLS OR SYNTHETIC FUELS BASED ON RENEWABLE ENERGY SYSTEMS (RES ELECTRICITY)?

The electricity required by the transport sector is electricity which has to be generated additionally compared to today. As this electricity has to come from renewable energy sources, it is important to keep this additional electricity demand for the transport sector as low as possible and to use the electricity as efficiently as possible. Compared with fuel cell concepts, the direct use of electric power is by far the most efficient in the transport sector. For electricity-based liquid fuels (called "power-to-liquid" or "e-fuels") the conversion losses are higher. This is also reflected in the system costs. In the long run, RES-electricity-based fuels should thus only be used for modes of transport for which electrification in the foreseeable future is unrealistic (air and shipping traffic).

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### BIOFUELS ARE A BETTER SOLUTION FOR ROAD FREIGHT TRANSPORT!

No. The sustainably usable potential for biomass is limited as the use of biomass to supply energy competes with food supply and nature conservation.

# 6

IN NOVEMBER 2017, TESLA PRESENTED A CONCEPT FOR A PURELY BATTERY-ELECTRIC HEAVY TRUCK WITH A RANGE OF UP TO 800 KM. IS A BATTERY-ELECTRIC CONCEPT WITHOUT CATENARY NOT MORE PROMISING?

At present it is still not clear whether Tesla's latest announcements will come true – and whether this concept, developed for the US American market, can easily be transferred to Central Europe. Besides, a battery supposed to provide a truck with such a wide range is very heavy. The weight of the battery decreases the payload a truck can transport and thus also adversely affects the economic efficiency of this approach.

# 7

#### ARE ALL ROADS MEANT TO BE EQUIPPED WITH CATENARIES IN FUTURE?

No. Only individual sections of the most heavily used motorways are to be equipped with catenaries in order to be able to save a large part of the CO<sub>2</sub> emissions from trucks. This is about one third of the kilometres of motorway in Germany.



### FREIGHT TRANSPORT PARTLY RUNS THROUGHOUT EUROPE: TAKING THIS INTO ACCOUNT, DOES THE CONCEPT HAVE ANY CHANCE?

First the eHighway concept has to prove itself and meet expectations during test operation. Considering that all European countries are facing the challenge of significantly reducing  $CO_2$  emissions from traffic, chances for an expansion of the eHighway in Europe are good from today's point of view. Many European regions are interested in the system and have sought detailed information in Hesse.

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#### WILL CLIMATE-DAMAGING CO<sub>2</sub> EMISSIONS BE AVOIDED BY THE EHIGHWAY?

The CO<sub>2</sub> emissions per kilometre driven by an electricity-powered truck are considerably lower than those of a truck with a conventional diesel-fuelled combustion engine. This is mostly due to two factors:

- **1.** The electric motor allows the efficient conversion of electricity into kinetic energy.
- Even today, more than 40% of the entire electricity consumption in Germany is covered by renewable energy sources without producing CO<sub>2</sub> emissions.

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#### WHEN WILL A DECISION BE MADE ON A GERMANY-WIDE EXPANSION OF THE SYSTEM?

First, experience will be gathered in the field tests until 2022. For this purpose, the field tests will be scientifically supported. Possible expansion scenarios and financing or operator models will be developed in parallel studies.

## You haven't found an answer to your question here?

Write to us: info@mobil.hessen.de

# Global CO<sub>2</sub> emissions as room volume

GLOBAL CO₂ EMISSIONS 2017:



# GIGATONNES



If you represent this quantity as spatial volume, you get a cube with an edge length of over 25.5 kilometres. It is almost **three times as high as the Mount Everest** and reaches into the Earth's ozone layer.

## 20 km ozone layer

13 km cruising altitude of a passenger airplane

### 8,846 km Mount Everest

GERMANY 2017:

2.2 %

of the global



25.5km

emissions



### Average CO<sub>2</sub> emissions (in kg per person)







TRAVEL TO WORK BY CAR \* TRAVEL TO WORK WITHOUT CAR PRODUCTION OF ONE PORTION OF BEEF GOULASH TRIP OF 10 KM IN A SMALL CAR

# What can you do to save CO<sub>2</sub>?

Write to us: info@mobil.hessen.de and read the articles on eHighway.hessen.de

# <u>The</u> ELISA field test until 2022



n the second phase of the ELISA project, the eHighway system will be tested over a period of four years until the end of 2022, both on the vehicle and infrastructure side. To this end, the German Federal Ministry

for the Environment, Nature Conservation and Nuclear Safety is initially providing five catenary trucks for the Hessian field test. These will be used by the logistics partners in their real transport processes.

The test track between Darmstadt and Frankfurt has officially been in operation since May 2019. A short time later, the first catenary hybrid truck used the track and now runs on the eHighway several times a day. The complete delivery of all catenary trucks (by mid-2020) will provide the basis for a comprehensive evaluation.

### Since 2019 ELISA 2

- Operation of the catenary system
- Evaluation
- Road safety
- Energy management
- Ecology
- Economy
- Road operations incident management



#### **PROJECT PARTNERS**

Hessen Mobil manages the overall project as project coordinator and, being the responsible road and infrastructure operator, is in charge of the safe operation of the roadside infrastructure of the eHighway system. Project partners are the Institut für Verkehrsplanung und Verkehrstechnik der TU Darmstadt (Institute of Transport Planning and Traffic Engineering of the Technical University of Darmstadt), Siemens Mobility GmbH and ENTEGA AG.

#### **TRANSPORT PARTNERS**

Various regional logistics companies have agreed to use at least one catenary truck each in their daily logistics processes, thus contributing to a successful pilot operation as associated partners.

#### These are:

Spedition Hans Adam Schanz GmbH & Co. KG Ludwig Meyer GmbH & Co. KG Contargo GmbH & Co. KG Knauf Gips KG Merck KGaA

# ELISA system setup

The overall system and its subsystems in public road space under real traffic conditions.



#### **TRAFFIC ENGINEERING**

- Traffic data collection
- Vehicle data
- Radio communication between vehicle and control centre

#### **ELECTRIC CONTROL SYSTEM**

• Operation and control

#### TRACK

• Passive safety equipment

### VEHICLE

- Current collector
- Drive
- Energy storage

### ELECTRICAL INSTALLATIONS

- Power supply
- Catenary

# By 2050 -80% to -95%

greenhouse gas emissions

### with alternative drives

### Electromobility

incl. plug-in hybrids, range extender vehicles, motor vehicles and catenary trucks

# vehicles

**Fuel-cell** 

with hydrogen from regeneratively produced electricity

# **Combustion engines**

with liquid and gaseous fuels generated from electricity





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# ELISA project partners

For the success of the ELISA project, Hessen Mobil, as in many other research and development projects, is counting on innovative and experienced regional partners who will contribute to the success of the overall project with their expertise.

# Technical University of Darmstadt

The Institute of Transport Planning and Traffic Engineer--ing (IVV), headed by Prof. Dr.-Ing Manfred Boltze, supports the field test with a comprehensive scientific evaluation. In ecological matters, the evaluation is supported by Prof. Dr. Liselotte Schebek (Department for Material Flow Management and Resource Economy).

Substantiated answers are to be provided for questions that are already known today, but also those that arise during test operation. Based on these research results, reference documents will be produced which can serve as a basis for the decision on a later system expansion. In addition, the IVV maintains an exchange with other eHighway field tests, for example in Schleswig-Holstein and Baden-Württemberg, as well as with affected stakeholders, partners and interested parties.

### TAKING A CRITICAL LOOK AT THE EHIGHWAY SYSTEM IN ORDER TO PROVIDE MEANINGFUL AND SUBSTANTIATED ANSWERS TO ALL QUESTIONS



TECHNISCHE UNIVERSITÄT DARMSTADT

# Siemens Mobility GmbH

Siemens Mobility GmbH is involved in the research and evaluation programme; it assesses and documents the knowledge gained from the system provider's perspective.

In realistic test operations, the team checks the robustness of the pantograph system and identifies possible improvements. As the inventor of the eHighway system, Siemens Mobility GmbH provides general support for all questions concerning energy supply, automotive engineering and system integration.

Development of the eHighway from 2010 Siemens has been working on the technology since 2010. As part of the research projects ENUBA1 and 2 (electromobility in heavy commercial vehicles to reduce the environmental impact on densely populated areas), Siemens developed a concept for the electric, catenary-bound operation of heavy commercial vehicles in cooperation with Scania and tested its technical feasibility.

### HALF AS MUCH ENERGY CONSUMP-TION AND SIGNIFICANTLY LESS LOCAL AIR POLLUTION.



### Entega AG

ENTEGA AG is working on energy technology issues as a project partner.

Another task will be the development and application of an exemplary billing system as well as the creation of a billing-specific reference paper. It also supports the evaluation from the power company's perspective. During the pilot operation, ENTEGA AG will also be available as a contact for all energyrelated, and regulatory and legal questions. ENTEGA AG, a municipal company headquartered in Darmstadt, provides energy and infrastructure services to the cities of Darmstadt and Mainz as well as the southern part of Hesse. With around 2,000 employees, it is one of eight large municipal energy service providers in Germany.

Its subsidiary ENTEGA Energie supplies around 2.67 terrawatt hours of green electricity and 2.18 terrawatt hours of climate-neutral natural gas to its customers each year. This makes it one of the largest suppliers of climate-neutral energies.

SUSTAINABLE ENERGY SUPPLY: AVOIDING, REDUCING AND COMPENSATING CO<sub>2</sub>



### **Transport partners**

Various regional logistics companies have agreed to use at least one catenary truck each in their daily logistics processes.

#### SPEDITION HANS ADAM SCHANZ GMBH & CO. KG

LUDWIG MEYER GMBH & CO. KG CONTARGO GMBH & CO. KG KNAUF GIPS KG MERCK KGAA

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# With ELISA into the future