DRIVE

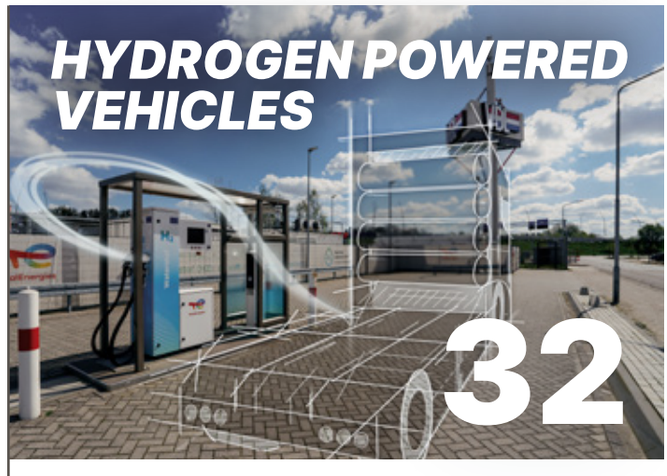
HYDROGEN POWERED VEHICLES

AUTONOMOUS DRIVING

FULL ELECTRIC MOBILITY

ACE automotive center of expertise

CRAFTING A VISION OF SECURE, ECO-CONSCIOUS AND INTELLIGENT MOBILITY



Colophon

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At ACE Mobility we recognize the importance of extensive research and innovation to address the challenges facing our industry.

Saskia Lavoo:
COLLABORATION IS A DRIVING FORCE FOR ME.

General Manager ACE Mobility

Dear reader,

In this edition of Drive Magazine, we delve into the future of mobility. At ACE Mobility we recognize the importance of extensive research and innovation to address the challenges facing our industry. To tackle these challenges head-on, we emphasize the importance of collaboration, with ACE Mobility playing a pivotal role as a facilitator. I am convinced that together with the Universities of Applied Sciences, HAN and Fontys, we wield significant leverage.

I'd like to highlight three key initiatives aimed at fostering collaboration and facilitating the dissemination and application of knowledge. First, we actively engage in regular discussions with various research groups to develop a joint strategy for innovation and research. Additionally, we are in the process of creating our own platform to serve our community for accessing knowledge, offering a range of courses, workshops, and challenges.

The third and final initiative is directly aligned with one of our organization's core objectives: fostering connections between research, education, and industry. In the upcoming period, we are dedicated to taking a leading role in the establishment of a collaborative Research Department involving six research groups from HAN and Fontys. This initiative will be supported by SPRONG subsidy from the SIA Steering Body. The aim is to establish a dedicated facility with specialized staff. While we are currently in the exploratory phase, our progress towards the next phase is steadily gaining momentum.

On a more personal note, I'd like to add that collaboration is a driving force for me, as it yields greater satisfaction than trying to achieve something alone. Over the years, I've had the privilege of being a member of the ACE Mobility team in various roles. However, I believe that there is still room for improvement in scaling up research efforts and fostering collaboration. Fortunately, the universities of applied sciences share our ambition in this regard.

As ACE Mobility, we prioritize communication to ensure that knowledge reaches a wider audience. It is my hope that this magazine sparks further discussion and inspires the companies and organizations in our ecosystem to come together and collaborate towards a shared vision of the future.

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ACE MOBILITY IS DRIVEN BY: Fontys HAN UNIVERSITY OF APPLIED SCIENCES

together we create the future of mobility

Practice-oriented research is a crucial pillar in the institutes and academies of both HAN and Fontys. ACE Mobility plays a role as a connector, initiator, and intermediary in practical research between educational institutions and the automotive and mobility sector.

Gerrit Averesch:

RESEARCH AND EDUCATION ARE DEEPLY INTERTWINED.

Director of HAN Academy of Engineering and Automotive

Photo: Eva Broekema

How do you perceive the role of ACE Mobility within the ecosystem?

"What I consider paramount is the cross-pollination facilitated by the collaboration between ACE Mobility and the HAN Automotive Research department. It's a potent synergy. HAN Research boasts substantial expertise and plays a pivotal national role in automotive practice-oriented research, albeit as a department. Within a Centre of Expertise (CoE), knowledge is consolidated and disseminated to stakeholders, functioning as an incubator of knowledge."

"The essence lies in how the professional field can effectively leverage the expertise of ACE Mobility and the HAN Automotive Research Department. Hence, research conducted by HAN Automotive Research should invariably involve ACE Mobility, and vice versa. When a broader spectrum of stakeholders and partners from ACE Mobility can engage in research endeavors, the outcomes become more impactful and relevant. Encouraging greater investment from the professional field in research would foster a sense of ownership and further enhance its value."

How is research integrated in education and vice versa?

"At HAN, research and education are deeply intertwined. Students are actively involved in conducting research at the HAN Automotive Research Department. The master's program in Automotive includes a mobility track, which is developed by the HAN Automotive Research Department. Soon, within job classifications, the distinction between researcher and lecturer will be obsolete; an employee will be a lecturer/researcher. Therefore, a researcher will also teach, and vice versa. While I understand that this may not immediately apply to everyone, some degree of nuance is appropriate. However, the integration of research, education, and business services - the third pillar in the field of knowledge - is becoming increasingly prominent. It requires a mindset shift, so the transition won't occur overnight."

What is the ideal ratio between education and research?

By acknowledging that we no longer have a clear understanding of this balance. What we mean is that research and education have become so deeply intertwined that the distinction between them has blurred. In the realm of research development, the eagerness of the professional field to learn plays a pivotal role. Often, the short-term objectives of businesses, driven by financial goals, tend to overshadow the long-term objectives. However, the outcomes of practice-oriented research projects typically yield results over the long haul. This indeed raises some concerns."

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What is your view about the role of ACE Mobility in the ecosystem?

"I view ACE Mobility, along with our Research Departments at HAN and Fontys in the automotive and mobility fields, as key drivers of research conducted within the universities of applied sciences. At Fontys, our goal is to ensure that our research institutes are well-known among companies, making it easier for them to locate us. As far as I'm concerned, ACE Mobility and the Research Departments serve as the R&D gateway. They not only conduct research but also actively seek out organizations where we can offer our expertise. I see this happening already, which is fantastic, but Fontys doesn't enjoy the same recognition as institutions like TNO. We should strive for that level of recognition."

What, in your opinion, is the role of Centres of Expertise and Research Departments?

"Research often remains abstract, requiring translation from theoretical concepts to practical applications. How do we bridge this gap? This is an opportunity for our intervention, extending beyond automotive and mobility sectors, to diverse technical research domains like nanotechnology and photonics. While SMEs recognize the potential of such technologies, they often lack guidance on practical implement-ation. This is precisely where the Centres of Expertise and Research Departments play a pivotal role. We aim to serve as an accessible R&D gateway for SMEs, facilitating the transition from research to real-world solutions."

How is research currently integrated into the curriculum at Fontys?

At Fontys, our educational approach intertwines seamlessly with research. Both students and educators actively engage in collaborative research endeavors. Moreover, the reciprocal nature of this relationship ensures that fresh insights derived from research findings are seamlessly integrated into our curriculum. This integration not only enhances the educational experience but also provides tangible benefits for small and medium-sized enterprises (SMEs), as students actively contribute to real-world projects, preparing them for future employment. In fact, our third and fourth-year students are already equipped with skills akin to junior engineers. Our performance in this regard, as evidenced by the HBO monitor, surpasses the average of other technical programs in the Netherlands.

How is education designed to accommodate this?

"At Fontys Engineering, we provide a solid foundation for first and second-year students, emphasizing core subjects such as mechanics, mechanical engineering, programming, and mathematics within a structured framework. During these initial years, students have limited choices and encounter a significant amount of structure, reflecting a more traditional approach compared to contemporary trends. Beyond the second year, there is a shift from full-time to part-time learning. This transition occurs through internships and hands-on projects, where students collaborate with businesses and SMEs to tackle real-world challenges."

What is the role of the teacher in this regard?

"In the third and fourth year, teachers shift their focus towards nurturing the professional growth of students. Our aim is to align the focal points of research with those of education, effectively transforming teachers into researchers. While this integration is not yet fully realized, our goal is for all teachers in the third and fourth year to embody this dual role, bridging the gap between academia and the business community. However, it's important to note that we hold teachers from all years in equally high regard. Engaging first-year students and motivating them to master fundamental knowledge in technical programs can pose significant challenges for educators."

Fontys

Ella Hueting:

WE ARE THE R&D GATEWAY FOR COMPANIES.

Director of Fontys School of Engineering

Charging the transition:

FULL ELECTRIC MOBILITY

As of 2030, cars with combustion engines will no longer be allowed for sale in the Netherlands. Fortunately, the electric passenger car is becoming an increasingly affordable alternative. Car manufacturers are betting heavily on the future of electric driving. But electric driving has its downsides: the earth does not have infinite supplies of lithium, cobalt and copper. Moreover, the electricity grid in the Netherlands is packed - grid congestion is a major obstacle in the course of the energy transition. Will electric driving be the future? Or should we start thinking about mobility in a different way?

This article zooms in on the future of electric mobility in consultation with Frans Tillema (Leading Lector at HAN University of Applied Sciences), industry expert Jeroen Vaessen (Director at Nijwa Zero), Desiree Seo (Research Team Lead Energy Storage Systems at Fontys University of Applied Sciences), Robbert Smolders (Managing Director of VDL Special Vehicles) and Hans Schreuder (Lecturer Academy of Engineering & Automotive at HAN University of Applied Sciences).

The evolution of electric driving

In 2008, Elon Musk said he believed that electric driving was the way to go. As soon as Musk entered the market as the first Silicon Valley car maker, other established automotive OEMs in Europe and the United States also committed to manufacturing electric passenger cars. Since then, the development of lithium-ion battery technology has accelerated. Batteries are, and increasingly so, lighter, and more efficient. In addition, the cost of a battery has dropped dramatically: li-ion batteries are at least 30 times cheaper than they were when first launched 30 years ago. Because there are more electric cars on the road, there is also more data available about what impacts battery performance: weather, air conditioning, but also driving style accounts for at least 30% of battery performance. Battery related developments have ensured electric vehicles are currently the biggest contender to replace their polluting passenger car siblings.

But electrification poses a significant challenge to the traditional production methods of automotive OEMs. Every aspect of the process undergoes transformation, and not every manufacturer is equipped to adapt. This is where integrators like VDL Special Vehicles step in, playing a crucial role in the electrification of vehicles. Robbert Smolders, Managing Director at VDL Special Vehicles, explains:

"Our clients lack the knowledge, expertise, or time to convert their fleet. We assist them with advisory on developing certain technologies or integrate the technologies into existing vehicles. We recently started such a project for an OEM. It requires a broader set of competences from our people to address these questions. For example, in electrification, we help verify feasibility through concept thinking, engineering, prototyping, and testing,"

Robbert Smolders
Managing Director
of VDL Special Vehicles

The need for standardization

Plenty of positive developments are underway. Battery technologies are advancing and becoming increasingly affordable. Original Equipment Manufacturers (OEMs) are swiftly adjusting their production methods to meet the growing demand for electrification.

Despite all efforts, the road ahead towards a clean future is long and bumpy. KPMG outlines a scenario for 2030 in case only electric passenger cars will be sold in the Netherlands. Assuming that 1.3 million cars will be on the road by then, collectively covering 28 billion kilometers, will require 1.9 million charging stations connected to a well-equipped power grid. In comparison: in 2023 there were just under 140,000 charging stations available. Grid congestion and the lack of a complete European-wide charging infrastructure and regulations on battery standards, now appear to be the biggest obstacles along the path to full electric mobility.

The good news is that the technology for building a charging infrastructure is available. There are many different solutions, including fast and slow charging, or battery switching. Yet what is lacking are policies that regulate the charging infrastructure. Take for example the charging plug: different types of chargers exist. Each and every country has a different one, but the technology inside is basically the same. In other words, standardization is needed to build a robust infrastructure for charging electric vehicles.

A parallel scenario unfolds with regulations for a battery's life cycle. The battery is the costliest component of the car. If for some reason it requires replacement within the warranty period, purchasing a used electric car may prove financially advantageous. However, buying a second-hand electric car that surpasses its warranty is a risk that few buyers are willing to take. That is why there are plenty of experiments to give car batteries a second life. A beautiful example is the battery installation consisting of old Toyota car batteries powering the Johan Cruijff Station. Other examples of used car batteries applications are batteries to capture energy peaks in the power grid or functioning as a home battery to supplement solar panels.

Desiree Seo
Project Lead
of RAAK PRO
Sustainable Batteries

"These are all good ideas, but before giving batteries a second life, you need to know more about the battery's health," remarks Desiree Seo (Project Lead of RAAK PRO Sustainable Batteries): "There are rules about safety. Yet these do not yet prescribe exactly how to store and work with a battery in a safe manner. The existing rules prescribe how to work with high voltage, but not specifically with electric vehicles."

The Battery Passport

Oftentimes, such car batteries are still in good condition. That's why the EU recently introduced the 'battery passport' initiative, aiming to standardize battery technology. It's a praiseworthy effort. However, according to Seo, a reliable standardized test is required to assess a battery's health. Unfortunately, such trustworthy standardized tests are currently unavailable.

The RAAK PRO project was established with exactly this aim: to create an accurate standardized method to determine battery health. One of the aims is to look at the commercial feasibility of this system but would also greatly benefit the government and other public services. Such standard measurement methods to be developed in the project are based on open information: as the project is in its initial phase, partners are building an open test setup of which the open-source software is developed by Fraunhofer, an algorithm at Eindhoven University of Technology. Fontys University of Applied Science in Eindhoven is working on setting limit values in the system. The much-needed data for developing prediction models, are received from the industry partners Hyster Yale, Van Udenhout and Van Deijne. Seo explains:

"In the RAAK PRO project, we are developing a measurement method and a test setup that determines the health of a battery. The aim is to build an open system. So-called commercial residual tests already exist, but the question is how accurate they are. To build a good test, you need extensive data. Once there is a standard method to test the health status of batteries, we are already one obstacle further and policy can be made on the sale of secondhand batteries."

Sustainability as business model

As the shift to more sustainable mobility for a clean future is beginning to take shape, companies active in the business-to-business market are also starting to recognize a shift in business models. Simply replacing the entire fleet with electric cars may sound sustainable, but in reality, this might not always be a solution. Jeroen Vaessen, General Manager at Nijwa Zero, part of Nijwa, a traditional family business focusing on the B2B market, supports companies in

We would like to see improved versions of all kinds of electric vehicles, including electric bicycles

making the switch to zero emission mobility. Only very recently, they received a request from a public housing company to replace all eighteen company vehicles with electric ones. When analyzing the business case, they quickly realized that this was not a feasible solution. Instead, the housing company was advised to replace part of its fleet with vans running on HVO Diesel - or frying fat. This would result in 90% CO_2 reductions. To bridge the time till electric vehicles will appear on the market meeting their requirements, a flex lease construction now helps to avoid having to pay high fines if the lease is ended prematurely.

According to Vaessen, sustainable forms of mobility require large investments, without a quick return on investment. However, as we are in the beginning of the transition, now is the time to build a sustainable foundation for the future: all the accumulated knowledge will give yearly adopters a head start. Vaessen recognizes that this is a steep learning curve. In their experience as a company they have to "learn to ride a bicycle all over again":

"It requires a big change - and you can't just do that as a job on the side. Not only will products change, but also the regulations and everything around it. It is enormously complex. But if you don't get on board now, by the time things really start to change, you'll be too late. The big challenge is that customer demand is much broader than just a 'product', such as an electric van or truck."

"Suppose a company wants an electric truck with an additional charging station capable of 500 kw or more. Then we need to be able to ask the question, okay, what do you actually need? For example, are you going to be driving in shifts, so that an electric truck needs a certain amount of time to recharge? The building also needs to keep running, the machines need to keep running, computers need to keep running. So you have to have knowledge of more than just the product, but the whole business case of a customer."

Meanwhile the obstacles towards providing sustainable forms of mobility are high. Grid congestion plays a big role, for Nijwa Zero and their customers. But Vaessen remains optimistic: "Building and sharing knowledge is the way to tackle and solve these challenges."

Thinking differently about mobility

As said before, we are only in the beginning of the transition. Just by buying a new EV or electric truck to reduce emissions, is part of the solution - but is only a part of it.

Frans Tillema, Leading Lector in Intelligent Mobility at HAN University of Applied Sciences, has no doubt that much of our future will be electric. But to replace every fuel car for one with electric propulsion, he says, is a hopeless task:

"If we want to stay within the 2% heat increase as laid down in the Paris Agreement, according to modeling studies, we will have to cut back by about 70% across the entire width of our mobility sector. The remaining 30% of vehicles that remain are more likely to be a combination of electric, hydrogen and biofuels."

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Frans Tillema
Leading Lector
Intelligent Mobility

According to Tillema, the academic discourse is rapidly changing, resulting in a different view on innovation. The real challenge is to make students aware of the larger context of system change, while understanding and identifying the cogs. Take the example of a traffic jam. Imagine a traffic jam full of

NIJWA

Jeroen Vaessen
General Manager

roaring diesel vehicles, or one with only electric vehicles. Is sustainability still an issue - or is the traffic jam itself the real problem? In other words, the right innovations are the ones that make sense in the larger picture of system change.

"This is now the big discussion we are having within academia. We map out what major system innovations are needed and link the smaller innovations at product level to the larger ones. So you need smart minds who map out what system innovations are needed and link the smaller innovations to them. That is a big change in thinking that is no longer just about innovation, but also linking the social and societal layers to it. Only then can you see which innovations make sense - and which do not."

From building a charging infrastructure to a battery passport: all of it is necessary to facilitate the energy transition. But another transition will also need to happen. This requires a mindshift in how we as people interact and think about mobility. According to **Seo**, it begins with thinking about what is the difference between good and bad mobility:

"For someone who drives a few miles a day to work, a small vehicle with a small battery should be enough. This suffices for driving back and forth and recharging at night with a slow charging connection. But everyone is used to a car with which you can drive far and which you can basically charge anywhere ... and quickly. Then you're asking too much of the power grid. Do we all have the need to drive cars with a range of 400 kilometers?"

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Hans Schreuder
Lecturer Academy of Engineering & Automotive

Fewer cars, more bicycles

There is, however, low-hanging fruit in terms of desirable innovation - a form of mobility that is sustainable and contributes to a healthy society. In the eyes of Hans Schreuder (Lecturer Academy of Engineering & Automotive at HAN University of Applied Sciences), there is no time left to wait for innovations to become affordable for everyone to drive a large electric car. There is a sustainable low-threshold alternative in which great strides can still be made: the bicycle. At HAN, Schreuder is the initiator of 'Kenniscentrum Fiets': the Centre of Expertise is currently being established, but has already been allocated a budget and a manifesto has been written. The vision is that it will be a place where expertise from different disciplines comes together to rethink the applications and benefits of the humble bicycle:

"We naturally tend to think about sustainability in terms of CO_2 reduction. Speed pedelecs are fast becoming a serious alternative to commuting by car for some people. But we also want to look beyond technical developments, in terms of electric support. We have to think further: what is sustainable and livable? With the Bicycle Knowledge Center we want to offer a kind of counterweight. This means that on the one hand, technical research has to be done. We would very much like to see improved versions of all kinds of electric vehicles, including electric bicycles. But in terms of sustainable mobility, the bicycle is very accessible, so we just have to fully commit to that and create new applications around it. Then we will make great head way."

How is ACE Mobility going to play a role in this?

At ACE Mobility, we want to contribute to the energy transition by supporting the developments of affordable, recyclable electric mobility that is produced in a sustainable manner.

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ELECTRIC MOBILITY PROJECTS

ZEBRH Zero Emission in Inner-City Regions - Fully Electric and Hybrid Trucks

The organizations behind ZEBRH are taking important steps towards a sustainable transportation sector. By deploying 100% electric trucks, ZEBRH aims to spur innovation in transport sector. These electric trucks will not only emit less CO_2, but also minimize air pollution and noise. Through this extensive testing initiative involving industry leaders, the organizations aim to expedite the transition to electric trucks and facilitate their widespread adoption. This endeavor is expected to enhance the competitiveness of participating partners, suppliers, and the overall market.

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NGF Material Independence & Sustainable Batteries

The Material Independence & Circular Batteries project focuses on realizing a strong position for the Dutch manufacturing industry in the global battery chain with sustainability and circularity at its core. This is essential to achieve climate goals and sustainable economic success in the Netherlands. Within three program lines, the program develops a well-organized and integrated chain that develops application-oriented battery technology by connecting application markets with technology developing parties. The consortium consists of a broad group (65 parties in total) of large companies (companies with more than 100 employees), Battery Competence Cluster - NL (BCC-NL) is the lead partner and coordinates the implementation of the program. ACE Mobility is involved in the Human Capital work package of the NGF program.

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NGF Charging Energy Hubs

The Charging Energy Hubs project was awarded a grant from the National Growth Fund in 2023. Led by Heliox, a leading supplier of fast charging solutions, the partnership consists of 29 companies and knowledge institutions, with the goal to accelerate the electrification of the logistics sector through collaboration, research, and innovation.

With the high demand for electric transport, the challenge lies in the limited capacity of the power grid to meet the growing demand for high-performance charging infrastructure. To address this challenge, this project envisions the efficient use of smart energy systems to maximize grid efficiency through smart energy solutions.

In the future, new skills and competences are required and new jobs created for charging station engineers and technicians. SEECE and ACE Mobility are involved in the Human Capital section with the aim to develop courses, modules, masterclasses and programs for (future) employees.

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ELECTRIC MOBILITY PROJECTS

Empowering Zero Emission Supply Chain

With the aim of transitioning towards a zero-emission supply chain, Innocent is in the process of constructing an ‘all-electric’ production facility at the Port of Rotterdam. Innocent, in collaboration with H.N. Post & Zonen, Fontys Hogescholen and BREYTNER, wants to realize zero emission for a substantial part of the supply chain of their new factory 'the blender'. It is specifically about the supply of orange juice from the Rotterdam fruit ports (M4H area) to the blender. Through this project, Innocent aims to gain insights into the energy requirements of the supply chain and production processes. The project serves as a model and blueprint for the entire Dutch manufacturing industry to achieve carbon-neutral production processes and zero-emission supply chains.

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SPRONG Greening Corridors

The research group Greening Corridors investigates the development and operation of sustainable logistics corridors. Three themes are central to this research: optimizing the capacity of infrastructure and transportation modes, clean, safe, and autonomous modalities, and digitization of the supply chain. ACE Mobility is involved in this project as a partner.

Contact and information

Electric Green Last Mile

Researchers from the Research Department Future Automotive and from the Fontys CoE Logistics for Society will research the first fully electric zero emission of 44-ton trucks driving around Europe. This research in Helmond includes monitoring the deployment of these vehicles, and the testing and monitoring of the associated charging infrastructure. The vehicles drive in short rounds of up to 150 km around the region of the European logistics hotspots Venlo (Netherlands) and Duisburg (Germany). The research is part of the multi-year European INTERREG project “electric Green Last Mile” (eGLM). For this research, students and teachers from Fontys and from the Fachhochschule Aachen work together with employees of FIER Automotive (also located on the Automotive Campus).

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ACE Mobility serves as a catalyst, initiator, and knowledge-sharing hub, bridging the automotive and mobility sector with research institutes to accelerate innovation and transition challenges. We've curated a comprehensive overview of our ongoing projects. Interested in learning more? Don't hesitate to contact the designated person for each project.

LEVERAGE

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This research aims to uncover the potential of Light Electric Vehicles (LEVs) in enhancing mobility, particularly through effective cooperation between public and private stakeholders. Urban areas are pushing for a transition to sustainable mobility, yet face challenges due to high car dependency. The rapid adoption of LEVs, including e-scooters, e-bikes, and micro-cars, appears to be a significant game-changer. These compact and eco-friendly vehicles produce minimal CO2 emissions and offer opportunities for enhancing both pre- and post-transport connections to public transit. Moreover, users find LEVs to be a pleasant mode of travel.

Contact and information

RAAK PRO
Sustainable Batteries

ACE automotive center of expertise

Fontys

Fontys University of Applied Science is conducting a study to determine practical methods for assessing the health and remaining life of used batteries. This knowledge will provide valuable insights into the (re)usability of batteries in various sustainable applications. The reuse, second life and recycling of batteries, contributes to national and European sustainability goals. Several companies from industry and knowledge institutions are involved in the research.

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Roads’ heavyweights:

MOVING GOODS ACROSS CONTINENTS

The transportation sector is facing challenging times. First, there is the need for decarbonizing the transport sector. After all, our roads' heavyweights, heavy duty trucks (HDT's), account for no less than 20% of the total emissions in Europe's transportation and mobility sector. Secondly, there is a huge shortage of drivers and with the average age of a third of the drivers being above 55. So, what is the future of road freight transport?

In this article, dr. Karel Kural (Senior Research Engineer Automotive Research at HAN University of Applied Sciences) provides the academic insights for possible solutions. From the perspective of truck manufacturers, Patrick Dean (Chief Engineer at Paccar and DAF) explains the measures taken by DAF to ensure a sustainable future for road freight transport in the years to come.

Decarbonizing the roads' heavyweights

According to the EU Environment Agency, the transportation and mobility sector is responsible for 25% of the total greenhouse gas emissions in the EU. Of these emissions, the heavy-duty truck sector emits 20% of greenhouse gasses of the total greenhouse gas emissions despite only representing 2% of the total vehicle fleet in the EU.

Rabobank has looked at these claims and has identified two bottlenecks in the EU's policies: the first being that e-HDT (Electric Heavy-Duty Trucks) are expensive, priced at almost 2.5 times more than the diesel alternative. The share of registered e-HDTs represent considerably less than 1% of the total HDT fleet in Europe. The second bottleneck, probably the largest challenge of all, is the lacking high performance charging infrastructure along the main European corridors. However, expanding the infrastructure is not something that is easily done: some regions in the EU are already congested, such as the Netherlands.

When we speak of long-haul transportation, the average length between destinations is more than 400 kilometers. Yet, the kilometers of e-roads in the EU are limited and the charging facilities are lacking. This is especially true for the Spanish section of the Atlantic corridor, the Swiss-Italian sector of the Rhine-Alpine corridor and the North Sea-Baltic connection between Germany and Poland. What can we do about this in both the longer and shorter term?

A promising future for e-HDTs?

Although for various reasons, most companies still choose diesel over electric or hydrogen, there are pioneers who make the exception. Take for example the Innocent juice factory in Rotterdam which works with a fleet of 100% fully electric 50-ton trucks. But a fully electric fleet, calls for a smart charging strategy.

In the project 'Empowering Zero Emission Supply Chain', Fontys University of Applied Sciences collaborates with Innocent, and other partners, to find an integrated solution in which the fleet is considered a part of the whole energy system. By way of energy modeling the entire system of plant, solar parks, wind turbines and the electric fleet, the Fontys team can formulate smart charging strategies for when, and where, to charge, or for using the batteries as stationary storage.

However, for long-haul road freight, the scenario for electrifying trucks is far more complicated. One of the most pressing challenges lies in the absence of a robust high-performance charging infrastructure along the primary transportation arteries - often referred to as the Mega Watt Charging System (MWC) - which is currently in the developmental stages.

This charging network would facilitate efficient charging of truck battery packs within 45 minutes. With such swift charging capabilities, electric trucks could operate in an almost similar way to their diesel counterparts, adhering to typical operational schedules of 4.5 hours of driving, a 45-minute break, and another 4.5 hours of driving. However, scaling up this charging system is an obstacle, as it currently lacks the capacity to accommodate the entire fleet of thousands of long-haul electric vehicles. Besides, the workload for the grid is gigantic if you charge heavyweight vehicles. Karel Kural (Senior Research Engineer Automotive Research at HAN University of Applied Sciences) compares the workload of charging heavy e-trucks with charging a town:

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Karel Kural
Senior Research Engineer Automotive Research

"If you want to have ten trucks using the MegaWatt Charging System and 20 passenger cars fast charging at the same moment near a highway, you require the same amount of peak energy as a town of 8 to 10,000 people."

Kural underscores that, in addition to the absence of a charging network, several other hurdles impede the widespread adoption and implementation of e-HDT's. Foremost the total cost of ownership is a pivotal factor influencing the decision-making process for most end users. Another significant obstacle lies in regulations governing the maximum allowed weight of vehicle combinations. Kural highlights that the substantial weight of the battery necessitates a compromise on loading capacity to avoid exceeding the maximum weight limit. Adjustments to existing legislation are needed to facilitate the uptake of e-HDTs, ensuring that regulatory frameworks align with the evolving landscape of electric transportation.

The ultimate platooning solution

What else could be done in the effort to decarbonize the heavy-duty trucks that travel distances of more than 400 kilometers at a time? In the DUO2 project, started in 2012, four test vehicles with a 32-meter trailer combination - also called Long Combination Vehicles (LCV), EcoCombi trucks or road trains - drove between the Swedish cities of Gothenburg and Mälmo. Each vehicle carries double the load compared to a conventional European truck with a single trailer of 16.5 meters. In a period of ten years these long combination trucks traveled approximately 1,400,000 kilometers – that's about 3.2 times the distance to the moon.

One might naturally assume that a vehicle twice the length of a conventional truck would consume double the fuel. However, a different picture emerges when fuel consumption is normalized by the amount of cargo transported. Data reveals that a DUO2 vehicle consumes more fuel per trip than a classic tractor-semitrailer. However, given its increased capacity, the DUO2 achieves significant efficiency gains. For every 1-tonne heavy pallet transported, the DUO2 saves approximately 27% of CO_2 emissions compared to its traditional counterpart.

This efficiency translates to tangible environmental benefits: three high-capacity vehicles can effectively replace six regular trucks, resulting in a remarkable 27% reduction in CO_2 emissions. Additionally, the utilization of these super-long truck combinations offers additional advantages. Fewer drivers are required, and less road space is occupied, further optimizing efficiency, and reducing operational costs. Kural further emphasizes the potential of these innovations:

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Karel Kural
Senior Research Engineer Automotive Research

"Research proves that the introduction of the longer and heavier vehicles is really a well spent effort: you can gain a double-digit advantage compared with conventional vehicles. But we need to be careful where we're going to allow these vehicles, because they cannot operate everywhere. So, they should really stay on the highway, or mainly in the vicinity of the highway. Ideally, the very long trucks will travel between hubs. Upon the time of arrival at a hub the vehicle can be somehow split, or shortened, and distribution can take place. In the end, the vehicle needs to fit the infrastructure - there must be a good matchmaking between the vehicle and the infrastructure."

Advocating the road train

Truck manufacturer DAF has been advocating long combination trucks for years. However, because of fragmented regulations throughout Europe, such combinations are rare. Also, exceptional transport may not exceed the limit of 25,25 meters. But in Australia, there is a real market need for road trains because of the lack of a railway network. DAF's parent company, PACCAR, which also includes the US truck brands Kenworth and Peterbilt, manufactures the towing vehicle of the so-called road trains – a combination of a truck with four trailers which may be up to 53.5 meters long. They have proven to be very efficient in the outback from a logistics point of view. Even in densely populated regions, such as Northwest Europe, the logistic benefits are evident.

Road trains could be considered the ultimate platooning solution, as Patrick Dean, Chief Engineer at DAF, explains:

"A road train is the ultimate platooning solution. Platooning has always been a much talked about

Hybridization is the solution for the years to come with the ability to cover zero-emission zones while still having the range flexibility that comes with diesel fuel.

DAF
A PACCAR COMPANY

Patrick Dean
Chief Engineer

subject, and we've had some extensive research done in the UK specifically. Road trains can make sense: physically connecting the trailers together is the best approach. But that requires legislation and regulatory changes."

The in-between solution

Another solution to cut back emissions in the short term, is the introduction of some kind of electric element into the vehicle combination. At HAN University, Kural is currently looking into the possibility of electrifying the trailer with an electric axle. The battery trades parts of the energy from the diesel, for the clean energy coming from the batteries. In fact, it's a kind of hybrid combination, without changing anything to the truck. Instead, new components are used in the existing trailers. The overall emission level from the combination of vehicles is cut back because part of it is offset by the clean source. **Kural** explains:

"If you look at this from the perspective of hybridization, there is a lot to be gained from using energy from breaking. Such kinetic energy is just wasted in the air. If we are able to capture part of this energy and convert it back to the batteries, you could save energy."

From the perspective of the truck manufacturer, Dean is a strong believer in hybridization for the years to come because it allows the clean combustion engine to operate at a peak efficiency range, with an electric motor as support. That's one opportunity. A second one, is the ability to drive fully electric to cover zero-emission zones while still having the range flexibility that comes with diesel fuel, and in the realization that diesel is very energy dense and far cleaner than it used to be, Dean adds:

DAF
A PACCAR COMPANY

Patrick Dean
Chief Engineer

"I think that in the future, what you will see is that trucks come in three main flavors: fully battery electric, hydrogen combustion, and hybridized diesel. We may refer to them as diesels, but they will be in fact hybrid diesel electric. And with the addition of plug-in capability, there is a significant fuel economy advantage possible. Plus, the ability, of course, to run zero emission, which is, I think, really interesting."

Tools to make the right decisions

From an innovation perspective, there are different opportunities to reduce emissions in the short term, although it might be difficult to convince transport operators to upgrade their fleet. The transport industry is not a segment where you're going to make millions or zillions, because it typically operates with very small margins of 2 to 3%. Most truck operators still opt for diesel trucks for long haul transport.

To help companies to make different decisions, Kural thinks that tools could be provided to see what it means for them to really invest in new technologies – whether it is hybrid, electric or in the future even hydrogen:

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Karel Kural
Senior Research Engineer Automotive Research

"They can use their data to see how the use of the electric vehicles can be made suitable for their conditions and needs and logistics. It will provide insights into the implications. That's very important, because once you get such insights many question marks will disappear. It means the decision maker of a big fleet can make decisions based upon solid facts. These are the kind of tools we are currently building together with a number of partners in the EU-project ZEFES."

Say to transport something from Amsterdam to Munich, by tomorrow. First, you need to make sure that you choose the right vehicles - you can use six normal trucks or three big ones - taking into consideration various criteria such as estimated time of arrival, charging infrastructure availability, or the width of roundabouts to accommodate the longer vehicle combinations. You could even calculate how much the tire-wear will be. This is based on all kinds of data gathered by a digital twin of the vehicle, which can be used to create a tool. In this tool the potential end user can enter his data and receive objective answers which helps to make the most cost-effective and sustainable decisions possible.

Solving the shortage of truck drivers

According to a report by the IRU, the truck driver's population is aging. Only 5% of Europe's drivers are younger than 25. With more and more retiring drivers in the next five years, the shortage will increase. It is calculated that over 7 million truck driver positions could be unfilled by 2028. In Europe, the shortage is predicted at 17% of the total vacant positions, resulting in road transport operators losing clients and revenues. **Kural** comments:

"It's a huge shortage. Raising is an option but it will not resolve the problem. At the end of the day, high salaries do not make economic sense. Therefore, there is a big push for autonomous driving. Platooning, too, appears to be attractive but is still a far cry away."

In order to understand how technology could contribute to cutting back the shortage of drivers, Kural participated in the recently finalized 5G Blueprint project. In this project, a truck is operated by a teleoperator from a control center. This means that there is a driver, but not behind a wheel. It requires a very good and stable network so that steering the vehicle, which can be up to 1,000 kilometers away, is not interrupted in any way. Teleoperators can switch between multiple vehicles.

But what happens in the last part of the journey, when the truck must be parked at the docking gate?

"A problem that we solved in this project was the automatic parking of a vehicle at a docking gate. Typically, what truck drivers do is, they open the window, and park the trailer against the docking gate. So, we developed a functionality where, basically, the teleoperator brings the vehicle near to the distribution center, where then the truck itself parks autonomously at the docking gate."

Vehicle-to-infrastructure

In the world of trucks, there is the act of driving the truck, but there are many other facets of truck transportation that require an individual to be involved. At DAF they applied technical upgrades in their recent generation of trucks. **Dean** explains:

"So, that's where things like advanced driver assistance systems might help a driver to be more efficient, or adaptive cruise control. Things that take the cognitive load, the stress load, off the driver. He will be more refreshed and operate the vehicle

more safely. And we just launched a number of updates here at the beginning of January to expand those capabilities on our truck standard for every truck. In fact, we're creating a basic platform."

Building on that platform, DAF is now looking into autonomous driving: whether the vehicle can drive by itself, or it's guided by a central control station, or driven guided by a teleoperator. However, as said, for the teleoperation approach, you still need a driver - but not in the truck.

Dean thinks that it might even mean that more drivers are required, because you still need somebody in the vehicle to handle non-driving tasks, as well as somebody at a central location doing the driving. Instead of the teleoperation approach, DAF is more interested in the vehicle-to-infrastructure approach:

"We are very interested in vehicle-to infrastructure connectivity and are actively following this technology as it develops. I think that the first implementations of autonomous are going to be focused on protected environments,in yard operation environments. We have a program (MagPie) with the European Grant program in which we partner with the Port of Rotterdam and TNO for doing exactly that. Operating a vehicle autonomously, within the confines of a protected space like a port."

"What happens is that a truck is driven (by a driver) into a gate. This is where potentially a driver gets out. The vehicle is directed from an existing control tower The vehicle is sent to where it needs to pick up a load, and perhaps even robotically charged along the way, if it's an electric truck. It then returns to the gate where a new driver or that same driver, after doing their document requirements, can get back in to drive the truck. And then the next step could even be hub to hub autonomous driving. But I still see that as being something in the far future."

The future of heavy-duty trucks

Even with the challenges, road freight remains the undisputed choice for long distance transport on our continent. According to the Federal Office for Goods Transport (BAG), trucks accounted for around 85% of the transport volume in 2021. BAG expects a comparable distribution in freight flows for the coming years also.

Dean points out that trucks have an extreme amount of flexibility and suspects that this is the reason why now, and in the future, will continue to be used extensively for the transportation of goods worldwide. He comments:

"I think that trucks will be at the heart of our transportation network for a long time to come. They will maybe change into powertrain solutions or without a driver operating 100% of the time. But in essence, there's going to be a flexible vehicle that can go anywhere."

Although innovation plays an important role in making road freight transport more sustainable, **Kural** thinks that it also requires a different mindset and change in habits from us, as consumers:

"When it comes to heavy duty or, let's say freight transport, we would need to step out of our comfort zone and say: 'Ok, well, we just cannot expect that if I'm going to order something that it is going to be delivered tomorrow.' Maybe delivery will be in a week - only when the trailer gets really fully packed and 100% loaded. I think we should also reconsider our habits as a society to think more carefully about a sustainable future by changing our own habits."

How is ACE Mobility going to play a role in this?

At ACE Mobility we aim to improve the logistical infrastructure and limit the workload on the grid by reducing congestion through new logistics and mobility concepts - such as hubs, improvements in charging infrastructure. For heavy duty freight transport, we aspire to reduce the CO_2 reduction and proceed towards a zero-emission scenario, while keeping road freight affordable for transport companies.

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HEAVY TRANSPORT PROJECTS

VISTA (Vision Supported Truck Docking Assistant)

With support from Euregio Rhine-Waal, the VISTA project consortium aimed to develop a Technology Readiness Level 7 solution for efficient and damage-free truck docking. The project focused on enabling fast, damage-free docking without requiring modifications to existing trucks or trailers. Through the use of a vision system employing high-resolution cameras, VISTA aimed to locate vehicle combinations in real-time and calculate precise docking maneuvers. Although the project has concluded, ongoing technological advancements ensure its relevance for future applications.
VISTA's vision system promises widespread applicability across the entire vehicle fleet, addressing congestion and damage concerns associated with traditional docking processes.

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CHange (Competitive Heavy-vehicles using AI to create Next Generation Efficiency)

Transport accounts for a quarter of EU greenhouse gas emissions. While innovations in freight transport focus mainly on towing vehicles, data-driven innovations have made freight traffic cleaner and more efficient, achieving a 17% CO_2 reduction from 2010 to 2020. However, with growing truck traffic, similar innovations have yet to reach semi-trailers or trailers, representing a missed opportunity. The CHANGE program aims to address this gap by exploring the added value of designing smarter towed equipment, either independently or in conjunction with towing vehicle systems, for cleaner, more efficient, and productive transport. This initiative is part of the 4-year Raak PRO program.

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Project MORE (Modulair Research Vehicle)

Initiated in the academic year 2020-2021, MORE Vehicle is an international project inspired by Thyssenkrupp Modular Research Platform, aiming to construct a vehicle. However, the focal point of MORE (Modular Research Vehicle) is not the vehicle itself but rather the training of future engineers through this multidisciplinary project. HAN University of Applied Sciences fosters the engineers of tomorrow by engaging students in the complete design and construction of this vehicle, offering hands-on experience with cutting-edge automotive innovations.
The vehicle's modularity ensures versatility, with components easily interchangeable. Currently, the team is developing a modular trailer with a powertrain for drivability and regenerative braking, with plans for integrated intelligence in the pipeline.

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ACE Mobility serves as a catalyst, initiator, and knowledge-sharing hub, bridging the automotive and mobility sector with research institutes to accelerate innovation and transition challenges. We've curated a comprehensive overview of our ongoing projects. Interested in learning more? Don't hesitate to contact the designated person for each project.

eTrac Electric Transport Route Planning and Charging Tool

The use of electric trucks in the transport sector is still in its infancy. Transport companies want to use these vehicles as efficiently as possible and charge at the lowest possible energy price. This requires a different way of planning. And how do you give the driver the most up-to-date info on the battery of his electric truck? The research project eTrac focuses on making optimal use of electric energy for electric trucks. It is also working on a prototype of a user-friendly route-planning application that will advise the driver on the most optimal charging strategy.
The goal of the research associated with eTrac is to model the energy consumption of electrically powered vehicles. The research team will also work on creating a user-friendly (prototype) route-planning application that will provide drivers with instant and reliable advice on the most optimal charging strategy.

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EFRO Zero Emission Heavy Duty Equipment

The main objective of the EFRO project Zero Emission Heavy Duty mobile equipment is the development, demonstration and validation of electric-powered and hydrogen-electric powered heavy duty mobile vehicles. Due to regulations regarding emissions (Dutch Climate Agreement, long-term strategy European Commission) and a market transition towards automation, there is a growing market demand for sustainability and digitalization of heavy duty mobile equipment.

The annual emissions of the entire fleet of vehicles for the partners in this project Hyster-Yale and Hobelman are significant, highlighting the importance of sustainable alternatives. Among other things, ACE Mobility, HAN and Fontys are developing a modular and scalable technology in this project so that it can be implemented in making other heavy mobile vehicles more sustainable. In addition, we are working on several (digital) innovations related to data analytics.
Thus, it is possible to create a predictive maintenance model, which can signal timely maintenance and, in this way, maximize the operational time of the mobile vehicles.

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Sharing is caring:

THE GAME-CHANGING POTENTIAL OF MAAS


BUSBAAN

Once upon a time, shared mobility was invented to alleviate traffic congestion and pave the way for greener, cleaner roads. However, a different reality unfolds when we see images of abandoned bikes and vandalized scooters - casting doubts about the efficiency and reliability of shared mobility. Nevertheless, the game-changing potential of Mobility-as-a-Service remains untapped for now, awaiting further exploration of the opportunities.

In this article we dive into the world of shared mobility with Ger Post (lector Entrepreneurship at the Industrial Engineering & Entrepreneurship Research Department at Fontys University of Applied Sciences) and Wimco Veerman (Smart Mobility researcher at Fontys University of Applied Sciences). From the industry we spoke with Bart Horstman (MaaS Strategist and Marketing Manager at Shuttel) and Allard Hansma (CMO at Greenwheels) about solutions to access various forms of mobility.

Ten years of shared mobility

For the Dutch Ministry of Infrastructure and Water Management, shared mobility is seen as a solution to reduce congestion and parking pressure and to minimize environmental impact. To encourage car sharing, the Dutch Government, together with other mobility providers - including providers of shared cars - entered the so-called Green Deal in 2015 and 2018. The idea is that by providing enough shared cars, the proportion of car ownership will decrease. Per car sharer, this could reduce greenhouse gas emissions. Part of the deal was the ministry's commitment to Mobility-as-a-Service (MaaS) and create a platform offering an all-in-one solution for the traveling public.

To examine the effects of the incentives, a study was conducted by the Knowledge Institute for Mobility Policy (KiM) in 2021. The study showed that even though the size of providers increased, the shared car was used by 1-6% of the population. Among these users, car ownership decreased slightly. Unfortunately, the environmental impact could not be determined with the available data. Why is it difficult to determine the effects?

Allard Hansma, CMO at Greenwheels, which is the largest shared mobility provider in the Netherlands, offers an explanation:

"I understand that most of the government's pilots were primarily software-based. Looking at Mobility as a Service (MaaS), for instance, there were indeed about seven pilots launched, all revolving around consolidating various mobility options within a single app. I believe that the concept is excellent, but I think those pilots were very technically oriented and less focused on user adoption. Trying to attract users would require a long-term effort."

greenwheels **Allard Hansma**
CMO

At the (very) beginning of MaaS

While shared mobility holds significant promise, it may still be too early to determine whether MaaS truly has the potential to be a gamechanger. We are still at the very beginning, and it takes time for people to embrace the opportunities. Moreover, there is a need to figure out how smart mobility, like MaaS and shared mobility, could fit into a smarter, more sustainable future.

This is also something cited by Ger Post (leading lector Entrepreneurship at the Industrial Engineering

& Entrepreneurship Research Department at Fontys University of Applied Sciences). He firmly believes that education and knowledge institutions will be pivotal in shaping a future where all forms of mobility converge - although this is still in the orientation phase. Recently, the Municipality of Eindhoven, published the mobility plan for the city of Eindhoven. Fontys is in dialogue with the municipality to see how students can work on this plan:

Ger Post
Leading lector entrepreneurship

"Nothing is concrete yet and we're still in the orientation phase but it shows that societal questions are finding their way to our knowledgeinstitutions. Whereas in the past, students worked on, for example, improving production efficiency in factories, now they are asked to research societal changes and issues."

Governance and inclusivity

Shared mobility offers opportunities for tackling major challenges, such as grid congestion. Especially with the increasing prevalence of electric vehicles, smart charging strategies optimize the use of our infrastructure. Wimco Veerman, Researcher in Smart Mobility at Fontys University of Applied Sciences, underscores the potential impact of shared mobility concepts. However, he sees significant hurdles that must be addressed before MaaS can truly take off:

Wimco Veerman
Smart Mobility researcher

"The primary challenge lies in the fragmented nature of policies governing mobility. Each municipality operates under its own set of regulations and various providers hold different permits. For instance, the city of Nijmegen boasts shared scooters, while in Arnhem, just across the bridge, the service is not available. Another pressing issue is the lack of inclusive shared mobility options. Shared mobility is not sponsored by the government leading to relatively high costs. As a consequence it is mainly used for business travels or by (highly educated) people in the major urban centers."

In other words: shared vehicles are expensive and unaffordable for a larger population. Can we imagine a future in which shared mobility converges into a framework of affordable and inclusive transport?

Station-based car sharing

To answer the question, we should first understand the status of shared mobility. How are providers experiencing the evolving market? Greenwheels, is a prominent player in the Dutch shared mobility landscape since its establishment in 1995 and is one of the largest providers in the country. With a presence of shared cars at nearly 170 NS train stations, and in 185 towns in the Netherlands, Greenwheels has significantly contributed to the evolution of shared mobility over the past two decades.

Allard Hansma, the Chief Marketing Officer at Greenwheels, acknowledges the diverse regulatory landscapes across municipalities in the Netherlands, noting the lengthy lead time for permit requests. However, amidst these challenges, he observes a shifting mindset, particularly in areas characterized

by high parking demand and robust public transportation systems where there is a growing demand for alternative mobility solutions, like car sharing. Hansma comments:

"I wouldn't say there are more municipal mobility advisors in the Netherlands - than cars on the street. But public transportation is being considered equally to shared modes of mobility. All the ingredients are there for shared modes of mobility to really complement public transportation, especially within urban and metropolitan areas. It provides a very good alternative to car ownership because station-based car sharing is the only proven system that contributes to more street space, reduced CO_2 emissions and an efficient use of scarce resources and raw materials."

greenwheels

Allard Hansma
CMO

According to Hansma, introducing a single station-based car-share vehicle can potentially remove 11 to 14 private cars from the road. Moreover, car sharing significantly reduces vehicle idle time. Car-share vehicles are utilized up to 20%, including nighttime hours. There are two locations in the Netherlands - Amsterdam and Groningen - where the shared car was in use almost 70% of the time. Although the average usage of a Greenwheels shared car stands idle at 21%, this figure surpasses the 5% utilization rate of a private car.

The car-sharing market appears to be on an upward trajectory, marked by a significant shift in user demographics following the COVID-19 pandemic. Previously dominated by business users, the Greenwheels fleet now sees a notable increase in private users. More and more people are embracing shared mobility, viewing car-sharing as a viable addition to public transportation. However, it's premature to draw definitive conclusions about this emerging trend. "Because without a robust public transportation network, the transition to car sharing isn't feasible," adds Hansma.

MaaS for business-to-business

Another player in the shared mobility market is Shuttel: a business mobility solution from Pon and Volkswagen Financial Services that facilitates multimodal travel for the B2B market targeted at companies with more than 100 employees. The Dutch government is its largest client. Shuttel provides comprehensive support to companies in implementing their mobility policies, while recognizing the diverse travel needs of employees for commuting and business meetings. Whether individuals opt for their own car, bicycle, public transport, or shared car or scooter - the Shuttel App and mobility card, streamline mobility solutions for both employees and employers.

From Shuttel's perspective, Mobility as a Service (MaaS) represents an opportunity to transition gradually from ownership to multimodal mobility. Currently, privately owned cars and bicycles dominate 75% of commuting and business travel. But with a growing emphasis on sustainability and flexibility in corporate mobility strategies, the dependence on private vehicles might reduce significantly. Bart Horstman underscores that MaaS fosters a modal shift, promoting the uptake of sustainable travel options such as shared bicycles, public transport, and shared cars. It complements the efforts to change to a more 'multimodal' mode of mobility. It provides flexibility and efficiency in fulfilling business travel requirements.

A finely meshed nationwide MaaS network

But the potential of Mobility as a Service (MaaS) extends beyond facilitating changes in commuting and business travel purposes. It can also serve as a broader extension of conventional public transportation. On-demand public transport holds promise, particularly for fairly rural areas, such as the Province of Zeeland in the Netherlands, where traditional public transport coverage is limited.

In collaboration with Pon and other stakeholders, Shuttel is developing digital services tailored to match the demand and supply of mobility. Bart Horstman sheds light on how MaaS is transforming the landscape of public transport:

"While the exact future demand and supply of mobility remain uncertain, one thing is clear: change is inevitable. Shuttel is committed to driving innovation and promoting the adoption of new mobility solutions. One such initiative involves partnering with the Province of Zeeland to introduce an 'on-demand' public transport service as an extension of the existing network."

Shuttel

Bart Horstman
MaaS Strategist
and Marketing Manager

On-demand transportation serves as a complement to traditional public transport. Horstman outlines two approaches to on-demand services: one is the already existing shared transportation model, such as shared cars and bikes, and the other are the 'flex' solutions; consisting of smaller vehicles that can be booked via a mobile app, offering travel options from Renesse to Middelburg.

Flex on-demand transport operates in a manner similar to traditional bus routes. It operates between designated stops, but the key distinction lies in the ability to reserve the service in advance through the app. The execution of these reservations is managed by the mobility center. This setup allows for the establishment of multiple flex stops within villages or towns, primarily benefiting individuals without access to a personal vehicle, such as students, schoolchildren, and the elderly in Zeeland.

The collaboration between Shuttel and the province to offer flex on-demand transportation will start this year. If it works well in Zeeland, a similar network could be rolled out also in other areas such as Limburg, the Achterhoek, Northwest Groningen. If you start linking all those local maps, you actually get a kind of finely-meshed network of public transport that is also affordable and more inclusive. In this way, the government would be trying to work toward complementing the current public transport system - under the heading of MaaS.

The early stages of change

In an attempt to answer the question if Mobility as a Service is a game changer or not, the correct answer might be that we have just been given just a taste of the possibilities. As of July 1, 2024, new legislation will come into effect in the Netherlands, requiring companies with more than 100 employees to record all trips made by employees. That means there will be more insights into the actual emissions resulting from business- and commuting trips. Horstman foresees a shift in which more sustainable alternatives than driving your own car to work can be pushed:

"Then there is probably going to be a whole shift whereby there will be much more use of sustainable alternatives, such as bicycles and other forms of mobility, such as shared mobility, instead of bringing one's own car to work. The government is going to establish standards that will require companies to become more sustainable, if not such companies will incur significant fines."

In addition to new legislation, other innovative opportunities can be unlocked through shared mobility models, such as on-demand flex modes of shared transport. This innovative example serves as a valuable addition to the existing public transport network, offering potential for further exploration and development.

As a preliminary conclusion, it seems wise to suggest that Mobility as a Service holds promise as a solution to significant mobility challenges. However, the optimal path for further investigation may involve exploring how different modes of mobility (including MaaS) can complement each other synergistically - and create real solutions for the challenges today, and tomorrow.

How is ACE Mobility going to play a role in this?

At ACE Mobility, our goal is to improve infrastructure and reduce traffic jams. We want to achieve this by shaping new logistics and mobility concepts.

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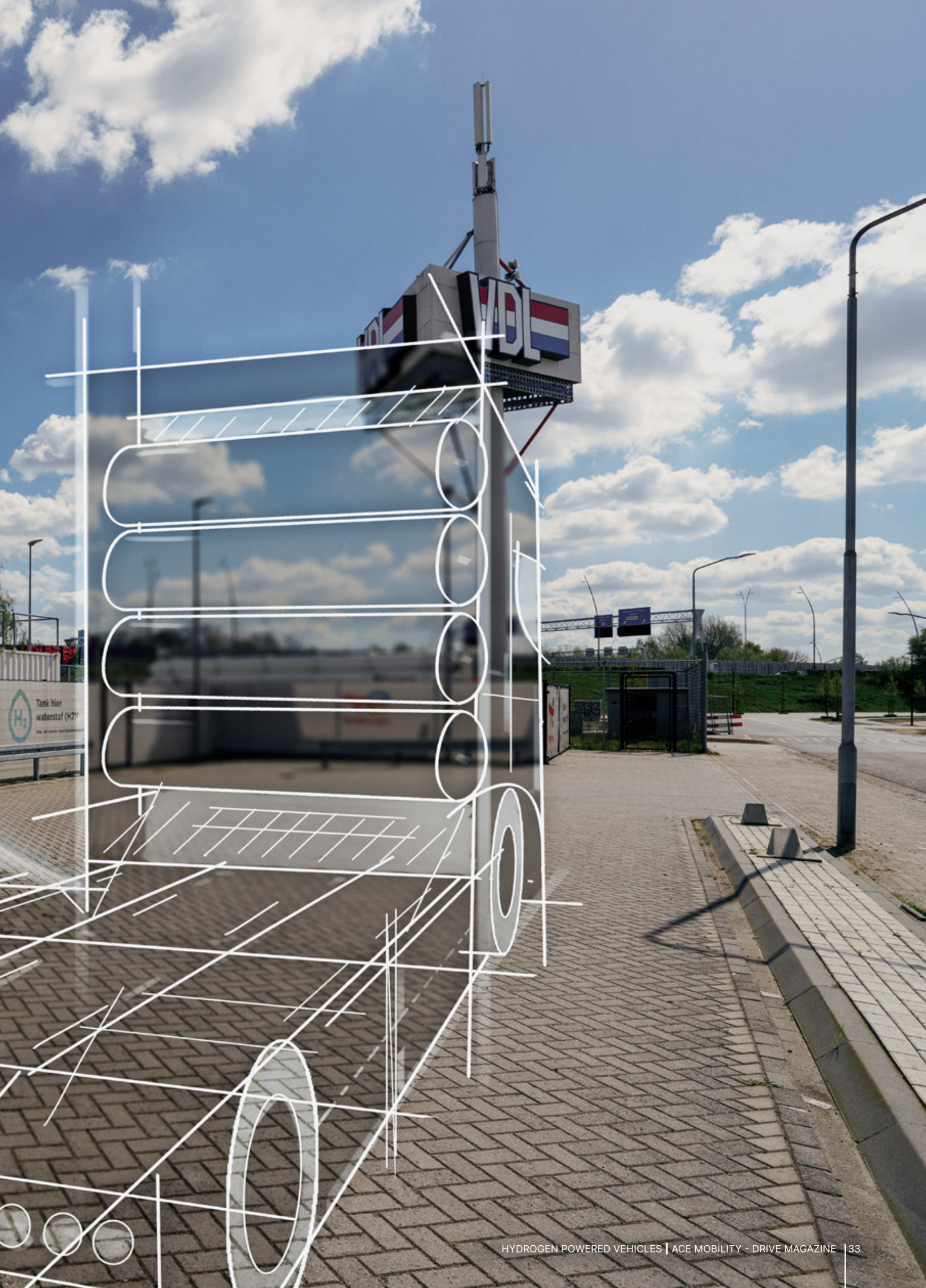
In the race for a
better tomorrow:
HYDROGEN
POWERED
VEHICLES
H2
Waterstof
TotalEnergies


VDL
Tank hier
waterstof (H2)

Hydrogen produced with renewable energy is often mentioned to help decarbonize the mobility sector. Despite its potential, hydrogen powered vehicles are not a common good. Will this mean the end of hydrogen fueled vehicles? Or is something larger brewing behind the scenes?

In this article, we aim to get a picture of the state of hydrogen powered vehicles and the scenarios that are currently on the table. We spoke with several experts from the ACE Mobility ecosystem: Bram Veenhuizen (Professor in Vehicle Mechatronics at the HAN University of Applied Sciences), Neha Roy (Innovation Lead at Hyster-Yale), Gerard Doll (Director at the Netherlands Vehicle Authority RDW), Patrick Dean (Chief Engineer at PACCAR, DAF), Robbert Smolders (Managing Director at VDL Special Vehicles), and Peter van der Heijden (Managing Director at NPS Driven).

The history of the fuel cell

The first simple fuel cell was discovered in 1842 by the physicist William Grove when he recombined hydrogen with oxygen in order to produce electricity. After that, it took a while before the first fuel cell car hit the road. For a 'trip down memory lane' you can visit the Mercedes-Benz Museum in Stuttgart which boasts Europe's first fuel cell van: the 1994 NECAR, or New Electric Car. After that, in 2013, fuel cell technology made its way into passenger cars when Hyundai launched the first fuel cell based passenger car on the market and soon after that, Toyota's Mirai appeared - which was taken off the market last year.

Is the end of a fuel cell passenger car, also the end of hydrogen applications in the broader sense? Despite its many advantages as a clean fuel, there are many reasons why hydrogen hasn't taken off. For Bram Veenhuizen (Professor Vehicle Mechatronics at the HAN University of Applied Sciences), the challenges in the field of hydrogen applications are great. The fuel cell car has to compete with the popularity of all-electric driving, whereas fuel cells are currently only used in heavier trucks and city buses. Two major challenges appear to be the production of green hydrogen, and the lack of large-scale infrastructure.

Hydrogen's color

To understand why hydrogen powered vehicles aren't dominating the streets yet, you must look at the production process first. In the North Sea, huge amounts of wind-generated electricity are lost because of grid congestion. Here, electrolyzers could convert the excess renewable electricity into hydrogen which then can be transported to the mainland through a pipeline. But the current generation of electrolyzers is expensive and produce very small quantities of hydrogen. This means that green hydrogen is a factor of two, to three times more expensive than gray hydrogen produced from natural gas.

According to research by TNO, green hydrogen will only really begin to play a role in an emission-free future when the following conditions are met, that is; in case an abundance of green electricity is produced, the number of electrolysers are scaled up by a factor of 1,000, and a pipeline is constructed between the North Sea and the mainland. The question then arises, however, whether enough green hydrogen will be left for mobility applications because most of the hydrogen will flow to energy consuming industries first.

But this doesn't mean the North Sea is the only place to produce green hydrogen. Hydrogen could be made available for storing energy, as a battery solution at industrial sites, such as truck charging stations. Bram Veenhuizen is investigating this in so-called 'energy hub' projects:

"The idea is that special charging platforms for trucks will be constructed at industrial sites where grid congestion plays a major role. At that charging station, a battery or a fuel cell is placed that stores energy at night - when little electricity is drawn from the grid- or is filled up during the day by solar panels. That electrical power is stored in batteries or in a hydrogen tank, or a combination. When those trucks start charging, you take that energy from the fuel cell so you don't have to draw electricity from the high-voltage grid. The advantage is that this also means you don't have to build an infrastructure of hydrogen charging points but can focus very specifically on certain central locations."

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Bram Veenhuizen
Professor in Vehicle Mechatronics

The Flevopolder also known as the Hydro polder

Near Marknesse, the Flevopolder in the Netherlands, lies a gigantic field covered with solar panels. It is connected to a private, closed distribution system. However due to grid congestion, large amounts of renewable energy is wasting away. With such an abundance of renewable energy, this could be the perfect place to produce hydrogen. In fact, there are plans to build a hydrogen factory here. A statement of intention has been drawn up by the province of Flevoland in collaboration with commercial parties.

Once hydrogen is available in larger quantities, this would open up a scenario where research of its applications can be carried out. According to Gerard Doll Director at RDW, and one of the trailblazers of an initiative to build up a hydrogen test site, RDW has plans for moving their current emissions test site from Lelystad, to the Noordoostpolder. He explains why the Flevopolder is the RDW's preferred location for a test site:

"We believe that hydrogen is necessary to make a real step forward in terms of sustainability. As RDW we can conduct extensive research into the emission differences between electrolysis and the combustion of hydrogen. Therefore, we want to build a large test track to test hydrogen-powered vehicles. Car manufacturers will also be able to use this track for testing. If we can gather institutes and companies, who share the aim of researching hydrogen and mobility applications, on the same site we can create some great dynamics. The site boasts the largest wind tunnel in Western Europe. Here vehicles can be tested for aerodynamics."

RDW

Gerard Doll
Director at RDW

Fuel cells for heavy-duty container handlers

The quest for sustainable solutions in the heavy-duty sector continues, and hydrogen fuel cells are emerging as a promising contender. While a fully developed hydrogen infrastructure is not yet available, strategic implementation at key global locations - like ports - can pave the way for a clean future.

Hyster-Yale Group, a global leader in lift truck manufacturing, is taking concrete steps towards sustainability. Recognising the potential of hydrogen fuel cells, it has acquired Nuvera, a company specializing in this technology. This strategic move enables Hyster-Yale to develop zero-emission solutions for heavy-duty container handling equipment. Such solutions will include reachstackers, empty container handlers, and terminal tractors: machines known for their demanding operational schedules. Neha Roy, Innovation Lead at Hyster-Yale, emphasizes the operational benefits of hydrogen:

"The key to achieving sustainability lies in diversification. Both battery electric and fuel cell technologies will play crucial roles in different applications. Compared to lithium ion batteries, hydrogen fuel cells offer significant advantages. They eliminate the need for lengthy recharging times and downtime at stations. This means faster refueling and improved operational efficiency, keeping container terminals running smoothly."

HYSTER-YALE GROUP

Neha Roy
Innovation Lead

While hydrogen may not boast the overall efficiency of other options, it offers distinct advantages in specific contexts. As Roy points out:

"The refueling process for hydrogen is fast, similar to filling a diesel tank. This minimizes downtime and keeps operations running smoothly. Ports, like Rotterdam, which already have some hydrogen infrastructure, are ideal locations for establishing dedicated refueling stations. Developing a network of such stations within key logistical hubs will be instrumental in fostering wider adoption of hydrogen technology."

Hyster-Yale's investment in hydrogen fuel cells underscores its commitment to innovation.

This technology holds immense potential for transforming the heavy-duty equipment landscape: paving the way for a cleaner and more sustainable future.

Decarbonizing the roads' heavyweights

Hydrogen systems are lower in mass than electric batteries, and can refuel quickly,which makes it possible to apply in heavy-duty applications, such as long haul trucks. Last year VDL launched its first hydrogen fuel cell truck in collaboration with Toyota. "Together, we aim to decarbonize European logistic operations. A fruitful collaboration of two companies having the same vision", confirms Robbert Smolders (Managing Director VDL Special Vehicles).

A similar Toyota partnership is in full steam in North America with PACCAR, the holding company of DAF, Kenworth and Peterbilt. At the North American truck divisions of PACCAR fuel cell heavy duty transport is being developed. For PACCAR and DAF, hydrogen fueled trucks can be a great solution for longer haul and heavy loads, as part of an overall suite of highly efficient powertrain solutions including battery electric and diesel electric hybrids. Hydrogen can be applied in two ways: you can inject it in an engine and combust it, or put it in a fuel cell and convert it together with oxygen to create electricity – and with only clear water vapor leaving the truck's tailpipe.

A hydrogen fuel cell is in fact an electric powertrain, supplemented with a fairly large battery that drives an electric motor. In a way, it is comparable to an electric truck, but the electricity is produced on board of the truck via a hydrogen conversion process, whereas a battery electric truck has all its electricity stored in the battery. But even with the fuel cell truck, a weighty battery is essential as the output of the fuel cell does not meet the power needs of the vehicle. Hydrogen fuel cells are developing and still relatively early in their development cycle.

That is why at the same time, a lot of research time is spent on hydrogen engines at the DAF site in the Netherlands. Patrick Dean, Chief Engineer at PACCAR and DAF, explains:

"We demonstrated a hydrogen combustion engine truck a couple of years ago that was awarded 'Innovation Truck of the Year' in 2022. What we're focused on right now is further engine development. For the engine's development we need to really make sure that the system is operating as efficiently as possible with the power needed. And there's a wide range of factors to consider. For example, the fuel injection and combustion system of a hydrogen engine is very different from a normal diesel engine."
"You can make hydrogen combustion work in two ways. You can combust it by adding a little bit of

diesel fuel and having the diesel fuel create the ignition. But that's not really zero emission in our mind if you're having to put diesel fuel in. So we think that the spark ignited approach is the right way to go. And so it's development work that needs to happen, and that's the state we're in right now."

Patrick Dean
Chief Engineer

Transforming a diesel engine into a hydrogen engine

In addition to the internal developments at DAF in the area of hydrogen combustion engine, the Green Transport Delta Hydrogen Project is a project under the penmanship of DAF set up with the support from the Dutch government. WIthin this project, NPS Driven has been working on re-designing a DAF six-cylinder diesel engine into a hydrogen combustion engine for non-road and inland waterway applications.

NPS Driven is a manufacturer and distributor of powertrain components, power generation and engine solutions for industrial and marine markets. Managing Director Peter van der Heijden, himself an engineer, feels the obligation and moral duty to give back to society by creating sustainable powertrain solutions. He feels that the company has the know-how and expertise to find solutions that actually work for a clean future:

"In the next 20 years we have to get rid of carbon emissions. All the traditional fossil fuels are built up from carbon and hydrogen, and if you take out the carbon content, you get hydrogen which is, as you know, a very tricky molecule because you need to put it under pressure. But I believe that there will be an efficient storage solution for hydrogen. In the end hydrogen will enable a sustainable future."

Peter van der Heijden
Managing Director

In the Green Transport Delta Hydrogen Project, the engineers started with converting a basic DAF diesel engine into a hydrogen engine. Recently they finished the second engine with which a first test will be carried out at a customer's premises in the summer. Van der Heijden is convinced that the hydrogen combustion engine is the future.
With it, you don't have to reinvent the wheel. The largest part of the engine can remain the same but requires some modifications while the rest of the truck, such as the drive train, remains the same.
What does it take to adapt a diesel engine to a hydrogen engine? Van der Heijden explains:

"Adapting the diesel engine is nonetheless complicated, because the internal part of the engine, the piston rings, and the cylinder head needs to be redesigned. We developed the engine management system (ECU plus controls) from scratch. Also the wiring harness including electronics and sensors was modified completely. So it's a major tweak, so to speak, to make a diesel engine suitable for hydrogen."

Why did they choose the hydrogen engine instead of developing a fuel cell solution?
Van der Heijden explains that a fuel cell requires a rigorous modification and electrification of the complete drive train. Moreover, a battery and management system has to be added to make everything work together. In comparison to a fuel cell, the cost of ownership of a hydrogen combustion engine is also a factor of 4 to 5 lower. On top of that, the quality of hydrogen in fuel cells has to be incredibly pure, while for the combustion engine the quality of the hydrogen fuel is less important.

The Green Transport Delta Hydrogen project will run for at least another year, during which there are extensive tests scheduled with the hydrogen combustion engine. The goal is to develop a proof of concept hydrogen combustion engine. Next step is to proceed with funding from the National Growth Fund, because, according to Van der Heijden, it would be a great loss if this project would not be continued.
He thinks that the government has an important role to play in driving the transition with hydrogen:

"The government has a strong role in this. You actually need the government to give the ecosystem a push. For instance, by promoting investments in a hydrogen distribution network. Once there is a network in place, it is likely that OEMs and end-users would also be willing to invest. The Dutch government can encourage this, as it did with electric cars, until the moment it reaches a momentum and the ecosystem is a fact. But there has to be a kick start: everybody is now waiting for each other to make the next step."

A sense of urgency

A large-scale hydrogen infrastructure is lacking and the production of green hydrogen requires an awful lot of investment. But we are not going to be able to

H2 Racing

This project proposal aims to investigate the feasibility of a sustainable Ford Fiesta cup race. The condition here is that hydrogen is used as a fuel where it is injected directly into a gas combustion engine. To make a statement regarding feasibility, both technical and organizational feasibility will be investigated. If both studies conclude that a sustainable Ford Fiesta cup is feasible, then the consortium will be expanded to include other stakeholders of the Ford Fiesta cup so that a follow-up project can be started.

achieve the sustainability goal with electric vehicles alone. According to Veenhuizen, hydrogen does play an important role in enabling the transition to a sustainable future for our mobility sector:

HAN_UNIVERSITY OF APPLIED SCIENCES

Bram Veenhuizen
Professor in Vehicle Mechatronics

"People often ask which alternative is going to win: electric driving or hydrogen. I don't consider this approach, simply because there is too little investment in the development of sustainable alternatives. Hydrogen especially has been short of investments. But I think we need both. We need batteries and all the technological innovations, but aso fuel cells and the development of ways to produce green hydrogen. We need it all. At some point, it's also going to sink in that it's going to require lots more than what's happening now."

Dean also believes that overall the most challenging aspect of the energy transition is not the technology on the vehicle - it's the development of the infrastructure:

DAF
A PACCAR COMPANY

Patrick Dean
Chief Engineer

"When you see the trucks parked in all those parking lots along the highways, think about how many chargers would be needed or how many hydrogen fueling stations would be needed: it's a lot. So in Europe, we have a long way to go in order to make this a reality from an infrastructure standpoint. And I try to tell everybody I talk to that this is the most critical aspect of the energy transition."

Educating students on hydrogen

The curtain certainly hasn't fallen on hydrogen. Behind the scenes, numerous companies and projects continue to work on this potentially sustainable alternative and possible applications. The road seems long, but the horizon of hydrogen powered vehicles is getting closer every day.

But to make sure that these developments can continue, this is why at HAN, hydrogen is included in the curriculum. Students can even choose for a hydrogen module in the master program that deals entirely with applications of hydrogen. Furthermore courses are created on hydrogen aimed at professionals.

Also in the Greensky project, funded by Interreg and approved in January this year, 40 NorthWest European partners will collaborate on establishing new educational programs on hydrogen. ACE Mobility together with HAN and Fontys are partners in this project. They are looking into transmitting knowledge about hydrogen to teachers and make students aware of the career options in this field.

How is ACE Mobility going to play a role in this?

At ACE Mobility we believe hydrogen is important in combination with other alternatives in the energy transition because of the opportunities it has for solving energy shortage and dealing with grid congestion. It can be applied as an alternative for fossil fuels, particularly in heavy duty applications, as additional to long distance transport and the maritime sector.

Please reach out to us if you want more information.

Student project

A team from HAN University of Applied Sciences participates in the Shell Eco Marathon Europe and Africa 2024. The competition takes place from May 19- 24, 2024 at the Circuit Paul Armagnac in France. An interview with Mees de Groot, Team Manager HAN Hydromotive.

What is the Shell Eco Marathon?

”We participate in the Shell Eco Marathon. So, the team whose vehicle consumes the least fuel wins. This entails completing several laps within a specified time frame. The competition spans various classes. We participate in the hydrogen class, which is divided into two categories. While we participate in the urban concept category, there is also the prototype category with fewer constraints.
Our car resembles a typical road car complete with lights, windshield wipers and mirrors.”

”Regarding our choice for hydrogen, I find it promising because it's a versatile carrier. Fuel cells have been around for a long time, there is untapped potential waiting to be explored. Nonetheless more research is needed. ”

How much time do you dedicate to the development?

”We're highly motivated. It's a second-year elective project that is part of our standard school curriculum. We've been working on the project for a year now. In the beginning we each spent 10 to 20 hours per week on the project, while in the second year this grew to 16 to 26 hours. What sets us apart, is that we don't pursue this outside of our regular school curriculum. Unlike other teams that take a gap year solely dedicated to the project and are affiliated with universities. We've been told that we might be the sole university of applied sciences team in the race, but I can’t confirm this with absolute certainty.”

Why the choice for the Shell Eco-marathon?

”Because it's an international competition that fosters critical thinking and engagement. It receives media attention and inspires people. Personally, I admire the organization for its focus and impact.”

How do you notice among fellow students that they are engaged in sustainability?

”There are many positive changes within our school. At HAN, we have a Formula Student team working to make their powertrain fully electric. Additionally, we have a rally team using biofuels, which means they have zero net emissions.”

How are the developments progressing?

”We're refining last year's design with some subtle tweaks. Visually, the exterior remains like its predecessor. However, under the hood, we've introduced a new, better-suited fuel cell that boasts a slight uptick in efficiency. Additionally, we upgraded the capacitor system to achieve a higher efficiency of the powertrain.”

”In our quest for optimization, weight reduction has been a key focus. We've fine-tuned the steering system to reduce friction during maneuvering. While these adjustments may seem minor, they're pivotal in enhancing performance. Admittedly, they won't shave off hundreds of kilograms, but every ounce counts when your vehicle weighs a mere 100 kg.”

Can you share some results with us?

”We can now cover up to 2500 kilometers on just 1 kg of hydrogen. With that achievement, we snagged second place in our class last year. I'm optimistic about this year's performance, aiming for a solid 15% improvement over our previous run. Yet, as they say, the proof is in the pudding; road results can be unpredictable. That's why we're knee-deep in testing to gauge our performance under real driving conditions.”

”Our testing adventures have taken us to unexpected places - like an ice rink. But what we're really itching for is a run on a proper circuit. That's why we've reached out to the police academy in Lelystad, organizing a test day there. Additionally, we've tapped into the circuit in Assen, as it mirrors the type of track we'll be racing on. Here's hoping these plans materialize soon; after all, the competition date is looming closer and closer!”

Scan if you want to learn about the competition

Connecting the dots:

CONNECTIVITY, AUTOMATION & COLLABORATION

Imagine our European cities without traffic jams, where public transport services run smoothly, and pedestrians and vehicles have a continuous flow. One of the enablers of such a scenario is smart and intelligent mobility. Will this mean that our cars, taxi's, trucks, and buses soon have a robot behind the wheel? Or is the reality of our future mobility more nuanced and multifaceted?

Frans Tillema
Leading Lector
Intelligent Mobility

To understand what the transition to connected, cooperative and autonomous mobility (CCAM) means, we spoke with Frans Tillema (Leading Lector at HAN University of Applied Sciences), Gerard Doll (Director Vehicle, Regulation and Admission at RDW the Netherlands Vehicle Authority) Avinash Visagan (Group Lead Functional Safety at BRACE) and Robbert Smolders (Managing Director VDL Special Vehicles).

Robots on wheels

In Beijing, heavily subsidized driverless robotic taxis drive around the business district, ready to pick you up for the last or first mile of your commute. A robocab can be summoned for the price of a bus ticket – a very attractive deal. Currently, these vehicles in Beijing are at level four (highly autonomous) on the scale of five (fully autonomous). Also in California, the driverless Zoox navigates the streets, and recently in London, automaker Nissan tested a version of a robot cab - but with a human driver behind the wheels to interfere when needed.

An autonomous vehicle must be able to make its own decisions based on the data it receives from cameras, lidars, sensors and other input. To make that happen, you need much technology: sensor technology, software applications, AI, digital twins and an awful lot of data. But one thing is certain: what is technically possible is important, but we shouldn't overlook the importance of manufacturing and regulation.

According to Leading lector at HAN University of Applied Sciences Frans Tillema, CCAM (or mobile robotics) requires a broad view. In the end, robotization should make our traffic safer and more efficient - not the other way around. While we are at the forefront of the new applications coming our way, we should tread carefully. Frans Tillema adds:

"We are developing cars that need to be able to steer autonomously. That is still the preliminary phase of mobile robotics. The next step is testing. The question is not only what technology we need, think of sensors, algorithms and more. Now, we also need to think about what the application is and its broader context: what system change is needed and how can mobile robotics contribute to it?"

From cars, taxis, trucks to agricultural machinery: should we automate everything now, or rather in stages? For innovations to really work, there must be a perfect fit between the technical possibilities (i.e. technology readiness) and what is acceptable for society at large (i.e. societal readiness)? What types and levels of innovations are acceptable might vary between countries, regions, and even continents.

Regulations! What regulations?

We can state that the technology for autonomous driving is already very advanced. Automotive companies are experimenting with ways to learn and train their AI systems. But to ensure safety, you need to test the applications on the streets - extensively. But how to do this when street testing is not allowed? That is the challenge, especially in Europe where safety is regulated by law.

BRACE Automotive, a pioneering automotive engineering company based in Eindhoven, is looking to bridge the gap between regulation and innovation. BRACE specializes in automotive functional safety and cybersecurity engineering.

According to Avinash Visagan Varadarajan (Group Lead Functional Safety), the technological systems are largely ready and set to go (and already available in many cars):

BRACE

Avinash Visagan Varadarajan
Group Lead Functional Safety

"The car can drive by itself, but can we expect the system to drive by itself all the time? Or maybe if there is snow and the road is white, how does the car really know where the road is? We need to improve the reliability of the technology - and that's really where the focus should be."

BRACE specialists work with companies to improve the functional safety and cyber security. In this way, it is expected that new technologies can be introduced at a much faster rate - even though there are many regulations in place. According to Visagan, it is these regulations that form the obstacles for innovation:

"What we see as a very big challenge in automation is the existing regulations and legislation. To release a new feature in the market typically requires lengthy procedures and much paperwork. Many companies are not up to speed with the regulations that are imposed by the EU. It makes the introduction of new technologies not only cumbersome, but investments will only be forthcoming if all legal requirements are met."

Furthermore, policymakers need to realize that technology is changing rapidly. The EU is lagging in innovation rates compared to the US and China. In the US everything is driven by innovation: you are free to put any product in the market. The downside is that if something goes wrong the company is legally liable. Are we too strict in Europe?

Safety first

A Tesla in America is different to its European counterpart. For example, the software is tweaked for several functionalities. One example is the Smart Summon feature. In Europe, you can summon a Tesla car within a 6-meter radius, while in the USA it works within approximately 65 meters of distance between the phone and car. The question is whether this feature makes sense in Europe as the car is only a few steps away.

The service that assesses whether vehicles are safe enough for Dutch and European roads is called RDW (Netherlands Vehicle Authority). The RDW is a self-managing administrative body of the Dutch government that handles the registration of motorized vehicles and driving licenses. Less well known is that its inspectors also assess vehicles for the European roads from manufacturers abroad, such as China, South Korea, and the United States. They have contacts with car factories and governments worldwide. Some of the testing they do by themselves, and some is done by other technical service companies.

Gerard Doll, Director of the Regulation and Admission Division at RDW, cites differences between countries when it comes to what is socially acceptable and what is technologically possible. This is reflected in the different existing standards for vehicle certification:

"When Tesla's Smart Summon functionality had to be evaluated, I asked if the car could drive autonomously from the South of Amsterdam, towards Dam Square to the North, three times and without interventions. That could not be guaranteed. Hence, the Smart Summon function was truncated in Europe. In America, the policy is reactive because they work with self-certification: manufacturers are allowed to put a car in the market themselves, but if something happens, they take the consequences. In Europe it is exactly the other way around, here regulation is built in at the front end. The law dictates what safety norms a car must meet before it is allowed on the road."

RDW

Gerard Doll
Director at RDW

In a city such as Amsterdam, cyclists, pedestrians, trams, and cars share the public road - an autonomous vehicle is not yet trained to handle that. In theory a vehicle by itself can be safe, but will it contribute to overall traffic safety? Once it is allowed on the road, safety must be guaranteed through extensive testing. Countries such as China and the United States set the bar lower for testing than Europe does. Also, each member state also has different rules regarding testing. The Dutch government is very cautious about allowing testing on public roads, whereas Germany does allow such testing.

Drivers without experience

RDW has another major challenge. For their 120 inspectors, the work hasn't become any easier.

RDW

Gerard Doll
Director at RDW

As formerly trained mechanical engineers, they were used to physically assessing a car. Advances in technology now require them to be knowledgeable in cybersecurity, legal requirements and regulations and supporting systems. With the advent of AI, their role will become even more demanding. The question then will be whether the system or viable regulation, suffices:

"I think that's the biggest nightmare. You have to dive in to understand how it was trained, what data did it ingest? Who decides what is acceptable, and what not? Imagine, what if it then also starts learning to drive, just like a novice driver? The question is whether the regulations are sufficient or that we need to look into a mix of field certification and regulations?"

Currently, a robot driver is considered a 'novice driver' by RDW in terms of driving skills. Inexperienced drivers are well known for causing a high number of accidents. By gaining experience, driver skills usually improve. Should a robot driver be allowed on the road to gain experience?

Gerard Doll explains that a robot is trained to perform so-called 'desirable human behavior' - which means in practice that it is instructed to 'maintain an undulating flow along with the traffic'. Human drivers might be trained in a similar way - but do not always behave like that. Thus, they could show unpredictable behavior. When this occurs, the robot must hand the wheel back to the driver. But what if the driver is asleep, or has become unwell? In this case, the vehicle is instructed to seek a safe haven, which is often the right side of the road. Might robot drivers perhaps end up creating more traffic jams? We don't know.

To understand the possible scenarios and impact of robot drivers cooperating with humans, large-scale testing must take place - but if road safety comes into play, the question is whether governments will allow it.

A new way of manufacturing

With the rise of automated driving, the traditional pillars of engineering, testing, and certification are undergoing a profound evolution. Challenges in the automotive landscape are numerous, one of them is in manufacturing. How should we manufacture vehicles when every facet is undergoing revision?

Robbert Smolders, Managing Director of VDL Special Vehicles, reinforces the notion that the industry is in a state of great flux: "Now, more than ever, we need to be flexible to meet customer demands." VDL Special Vehicles provides smart mobility solutions for on-and off-road vehicles, including contract manufacturing, zero-emission vehicles and providing special integrated solutions for authority vehicles. According to Smolders this requires a shift in manufacturing methods:

"Today, we require a completely different production approach. That's why we are setting up a new modular factory in Born for high mix and low volume production. This production capacity caters to small to medium-sized series of special vehicles. Instead of fixed production lines, we opt for a modular method to meet customer-specific requirements, making us a flexible production partner."

Robbert Smolders
Managing Director
VDL Special Vehicles

A futuristic mobility solution is the collaboration between Schaeffler and VDL, where both companies team up to create self-driving shuttles. As with any other special vehicle project, VDL adopts a pragmatic approach to grow with market demand. When demand rises, production ramp-up follows accordingly.

At VDL they understand it requires collaboration across various disciplines, a flexible and modular factory, and highly skilled employees proficient in vehicle conversion and curious about technical advancements and integrated technologies. Smolders recognizes the challenges but considers the company's ability to adapt as its greatest strength:

"Wim van der Leegte (founder of VDL Groep) had a famous saying: 'Making things difficult is quite simple. Keeping things simple is quite difficult.' I believe this is VDL's strength, combining a great deal of expertise without overcomplicating things. In a world of ever-increasing technical advancement speeds, this proves to be quite a challenge, but it is nevertheless our focal point for the future!"

The future of CCAM

Technically, there are endless possibilities to make our traffic safer and more efficient in the long term. But to achieve this, there are still quite a few hurdles to take. Within the automotive field, regulation will have to adapt to the changes. How do you go about testing in a safe and large-scale manner to prove that robot drivers are competent enough to drive? And what mistakes are allowed? A machine's mistake is considered far more dangerous than a human making mistakes. The second hurdle to take is the adaption of production techniques by automotive OEMs to allow for the integration of new technologies.

Finally, the incorporation of robot drivers is a topic of considerable debate. As a society we should start to reflect on the implications of automating and robotizing traffic. Up to what level can we adopt autonomous vehicles? How much can we allow on our public roads in the learning process of these systems?

How is ACE Mobility going to play a role in this?

As ACE Mobility, our goal is to enable connected and autonomous driving at level four which means highly autonomous but not yet fully self-driving. In addition, we want to actively support the regulation of robotic vehicles. Finally, we want to establish programs to increase technology adoption in society.

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CONNECTIVITY & AUTOMATION PROJECTS

Durable CASE (Durable Cooperative Agrobotics Systems Engineering)

ACE automotive center of expertise — HAN_UNIVERSITY OF APPLIED SCIENCES

Durable CASE is a collaborative initiative aimed at developing sustainable solutions for collaborative robot vehicles in the agricultural sector, led by HAN Automotive Research. With the agricultural industry facing a growing shortage of labor, the use of robots has become increasingly imperative. This innovative approach not only addresses labor scarcity but also holds significant potential for enhancing sustainability practices. By employing multiple compact robots to perform tasks traditionally carried out by large machines, Durable CASE aims to reduce soil compaction while ensuring greater operational reliability. In the event of a robot malfunction, the system allows for seamless task delegation among functioning units. Supported by NWO SiA, Durable CASE is a RAAK PRO project dedicated to driving advancements in agricultural robotics."

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SAVED - Cooperative Autonomous Transport on industry hubs

ACE automotive center of expertise — HAN_UNIVERSITY OF APPLIED SCIENCES

Logistics firms face ongoing challenges in maintaining cost-effective, reliable, and sustainable supply chains amidst evolving demand, heightened competition, and increased service expectations. Efficient, cost-conscious processes are essential for staying competitive, with first and last-mile logistics posing difficulties due to low volumes, extended wait and shipping times, and intricate scheduling. These bottlenecks can inflate transport costs by up to 40%. SAVED seeks to explore how automated, collaborative hub-to-hub transport can be optimized and its impact assessed across different industrial estate sizes, layouts, and traffic scenarios, with a focus on People, Planet, and Profit (PPP) considerations within the logistics value chain.

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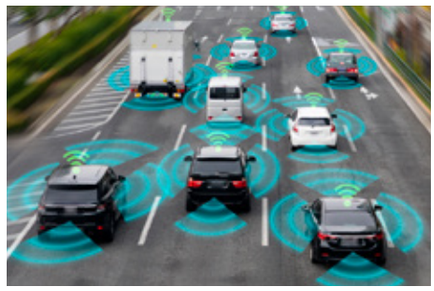

HUBRIS (HUman-like Behaviour of Robotic In-vehicle Systems)

ACE automotive center of expertise — HAN_UNIVERSITY OF APPLIED SCIENCES

HUBRIS aims to pioneer a sophisticated self-learning operating system, dubbed the 'human counterpart,' designed to bridge the gap between human drivers and Automated Driving Systems (ADS). To address this challenge, the Phase-2 consortium of expert academic and industry partners within HUBRIS endeavors to develop an advanced self-learning high-level control system, known as the Human Counterpart. The central research inquiry of this endeavor is: How can we develop and demonstrate a human counterpart system capable of fostering socially responsible, human-like behavior within automated driving systems? Through HUBRIS Phase-2, the development of this human counterpart system aims to enhance driver trust and acceptance of ADS. In this RAAK-PRO project, the development of this system is validated in two use-cases: I. Highway: non-professional drivers; II. Distribution Centre: professional drivers.

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ACE Mobility serves as a catalyst, initiator, and knowledge-sharing hub,bridging the automotive and mobility sector with research institutes to accelerate innovation and transition challenges. We've curated a comprehensive overview of our ongoing projects. Interested in learning more? Don't hesitate to contact the designated person for each project.

SafeCLAI

SMEs implementing vehicle automation face the critical need for adherence to sector-specific standards and legislation, particularly concerning the safety of automated vehicles within their designated domains. SafeCLAI addresses this challenge by devising a generic safety framework for autonomous vehicle control, drawing from cross-sectoral knowledge and experience.
By consolidating and applying relevant standards and procedures, SafeCLAI aims to streamline development processes and assessment procedures, promising shorter lead times and greater efficiency. Focusing initially on low-speed applications - considered both in-demand and technically feasible - the framework remains flexible for future expansion to higher-speed contexts. Completed recently, the project marks a significant step forward in advancing safe autonomous vehicle deployment.

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SPRONG FAST

Fontys, HAN and ACE Mobility are conducting research for the next four years with a SPRONG grant.
The research group's full name is Future Autonomous Sustainable Transport (FAST). The future of mobility demands a paradigm shift towards cleaner, quieter, and more efficient transportation systems that prioritize safety, affordability, and inclusivity for all citizens and businesses. Embracing modern, smart mobility solutions is essential for achieving these goals - streamlining travel, slashing emissions, enhancing safety measures, and ensuring accessibility for everyone. This multifaceted challenge extends beyond borders, necessitating collaborative efforts on international, national, and regional scales.

To address these pressing needs, six Research Departments and Centres of Expertise from Fontys and HAN, in partnership with ACE Mobility, have embarked on a four-year collaborative research initiative: Future Autonomous Sustainable Transport (FAST).
The overarching objective is to drive down CO_2 and NOx emissions from transportation while bolstering the Dutch economy's competitiveness. Within the SPRONG project framework, the focal points are energy transition and cooperative connected & automated mobility (CCAM), with a specific emphasis on freight and collective passenger transport.

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OUR PROGRESS IS TRIAL AND ERROR

Student project

The RDW Self Driving Challenge edition 2024. The Self Driving Challenge edition 2024 will take place on June 14, 2024, at the RDW Test Track in Lelystad.

Nine student teams from across the country demonstrate their self-driving vehicles at the RDW test track in Lelystad. New this year is the release of the open category in which teams compete with self-engineered vehicles. For the first time, a multidisciplinary team from Fontys joins the challenge.

We asked Dr. Teade Punter (professor in High Tech Embedded Software at Fontys University of Applied Sciences) and Frans Mouws (Project Manager at Fontys ICT) about the challenges in competing in the open category.

What sparked the interest in participating in the challenge?

”From the High-Tech Embedded Software department, we always sought connection and collaboration with the automotive departments of Fontys and HAN. The Self Driving Challenge requires a broad scope and close collaboration with other disciplines. Together with Bas Geleijns, we established a joint venture within Fontys.”

Why did you apply for the open competition?

”It started with the question of what type of vehicle we would need in this challenge. We hoped to obtain an existing vehicle, but that turned out to be a bit more challenging as we didn't have funds available to purchase a vehicle.

We decided to build our own vehicle and participate in the open competition to be able to work with the newest technologies. Based on the knowledge accumulated from previous projects, we are now developing our own autonomous vehicle."

What makes participating in the open competition particularly challenging?

"The major hurdle we face is that open category vehicles must meet basic road approval requirements. This makes it very complicated. However, we firmly believe that once you commit, you must see through to the end."

How is the collaboration in a multidisciplinary team beneficial for students?

"System integration is a different mode of operation. The value of teamwork for students begins with organizing and executing a mechatronic project, and to collaborate with students from other disciplines. Traditionally, software has always been the final piece – but in today's high-tech industry, software engineers play an integral role. Companies like ASML and Van der Lande are organized in a similar way. By incorporating such learning opportunities, we offer students a firsthand glimpse into the real world. Engaging in such projects prove to be beneficial for students, providing them with valuable skills and insights."

Which specific research questions would you like to have answered?

"The implications of AI in self-driving systems are evolving fast and are far reaching. One pressing question arises: who bears ultimate responsibility for errors that may occur? Moreover, achieving a determined and safe system depends upon a nuanced understanding of the relationship between software and AI. The insights we gain are particularly significant for regulatory bodies, such as the RDW, as they seek to refine their grasp of the evolving technology to govern and regulate autonomous vehicles. Furthermore, we believe that by demonstrating the behavior of self-driving cars, we can enable a broader discussion about how to deal with these new technologies."

How's the development currently going?

"The progress we are making is really a matter of trial and error. This extends not only to our students but also to us as teachers and mentors. Each week we find ourselves reinventing the wheel."

"Simultaneously we truly enjoy the beauty in the diverse disciplines coming together to create something new. Our students are developers collaborating in a team with different backgrounds spanning engineering, automotive, advanced software, and design. These interdisciplinary exchanges prove to be enriching. In our own realm of software, we work with binary codes - ones and zeros. The realm of automotive introduces another tangible dimension of physical forces. This underscores the importance of instilling in software engineers the understanding that reality transcends binary digits – not everything can be reduced to one's and or zero's."

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We are ACE Mobility!

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ACE automotive center of expertise

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