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Future Mobility: Accelerating Towards Net Zero with Smart and Green Tech

Introduction

With the need to address environmental and societal challenges through decarbonisation and digitalisation, transport is a fundamental aspect in the essential and ongoing energy transition.

The Paris Agreement set a target of net zero carbon emissions by 2050, but the world will fall short without accelerating its progress. The automotive industry has even less time to adapt, with many European countries phasing out sales of new petrol and diesel vehicles by 2035 – or sooner.

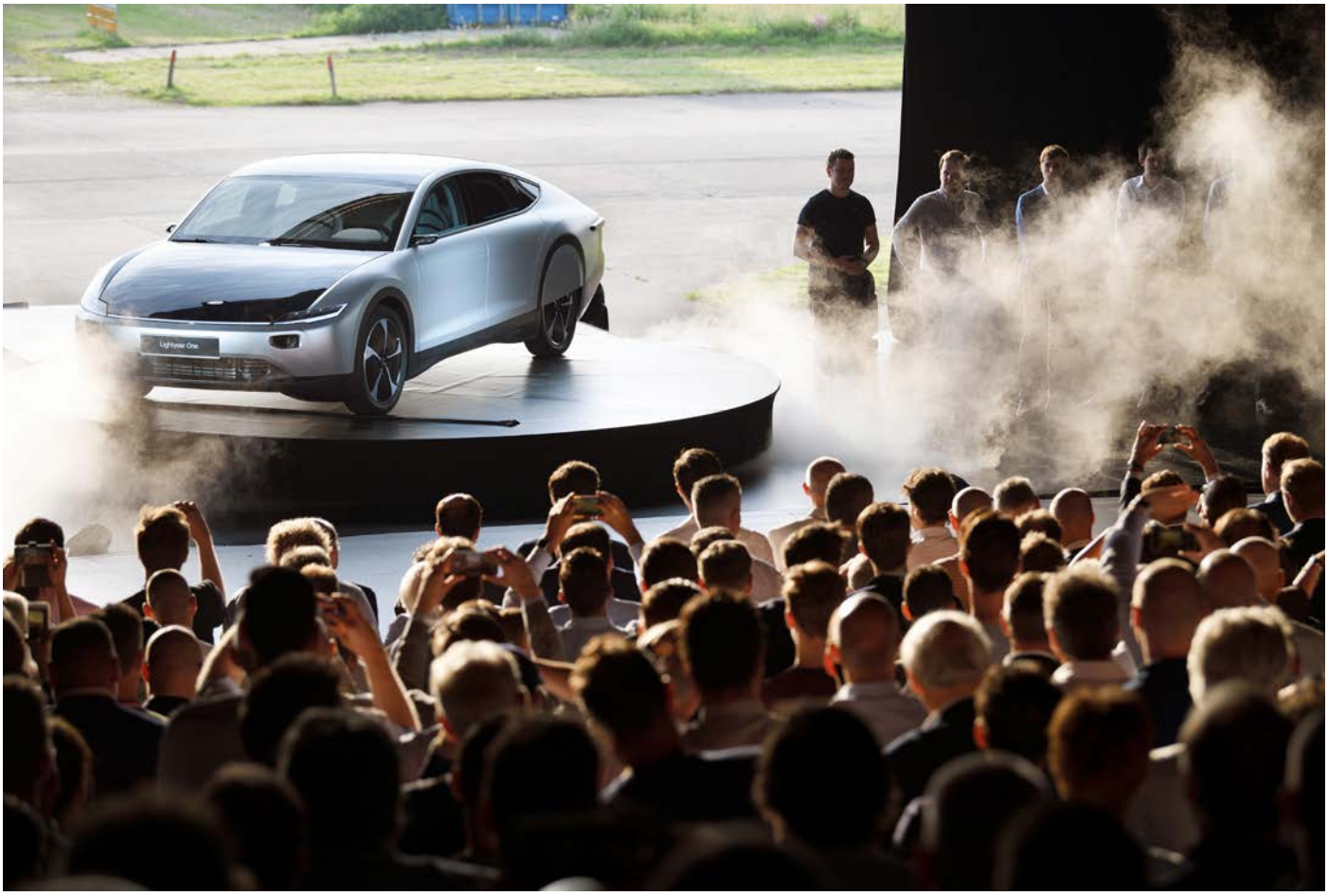
To develop clean technologies, the automotive industry must decrease its overdependence on raw materials such as lithium-ion (Li-ion), for which demand already outstrips supply. With the geopolitical landscape undergoing significant change as well, establishing the presence of a complete value chain closer to home is high on many national agendas. This will also mitigate the environmental impact of sourcing and producing materials that require new technologies to address future mobility challenges.

Many solutions are being provided by the triple helix approach in the highly innovative Dutch province of Brabant, which is experienced in overcoming technological and engineering challenges.

The triple helix model of innovation involves positive interaction between academia, industry and government to foster economic and social development, providing the foundations of an ecosystem. This approach can bring competitiveness and regional development through innovation and entrepreneurship.

“The carbon footprint needs to decline and many targets are set for towards 2035 – it’s a big challenge for automotive. In fact, it’s a big challenge for everybody everywhere. But it’s also a big opportunity for companies that are active in the mobility and energy transition ecosystem,” says Pieter Rahusen, manager of business development and acquisition specialist at the **Automotive Campus** in Brabant, which is home to a high density of high-tech companies active in smart and eco-friendly mobility.

In the following pages, we will explore the environment in Brabant for developing vital green and smart mobility solutions to meet the pressing needs of our time.



Where ideas begin and grow: Brabant's innovative environment

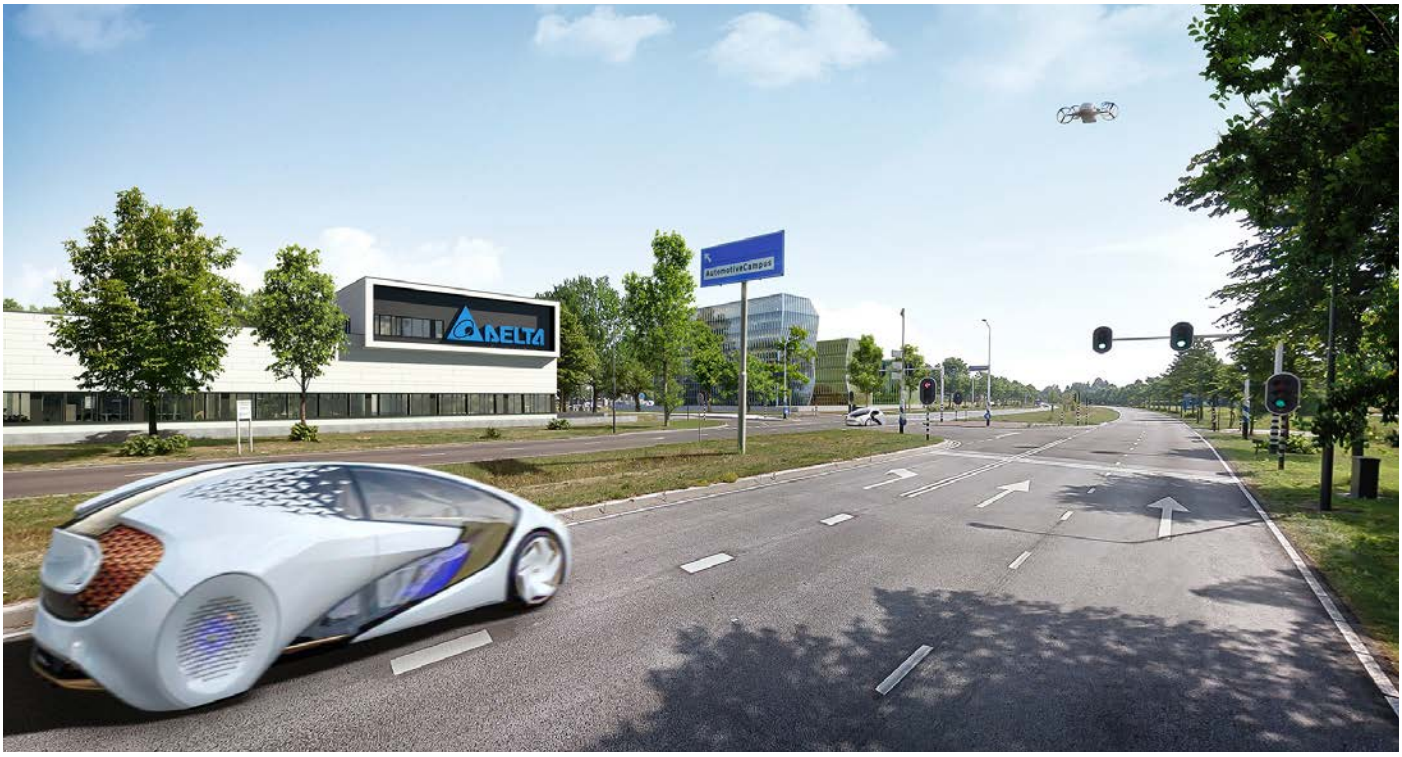
The Brabant region in the South of the Netherlands has been a hotbed of innovation across many sectors for more than a hundred years and today its automotive industry is pushing boundaries.

Companies have been collaborating, and showing what is possible by sharing resources and knowledge to advance technologies more quickly and cheaply together. There have been innovations in heavy-duty trucks and coaches, cars, batteries, charging infrastructure and advanced technologies, which are all helping to make mobility greener and smarter, more efficient and autonomous.

Many start-ups begin life as student teams at university and develop into scale-ups or larger operations. Brabant offers a sheltered environment for them to begin, develop and flourish.

Lightyear has developed a roadworthy electric vehicle (EV) that receives energy through built-in solar panels, offering users the ability to drive for months without having to connect to the grid to recharge.

Alongside several automotive original equipment manufacturers (OEMs) such as **DAF/Paccar**, **VDL** and **Ebusco**, Brabant is home to knowledge entities on the academic (Eindhoven University of Technology), applied sciences (Fontys Eindhoven) and vocational (Summa College) level.



Open environment

National research institutes such as the Netherlands Organisation for Applied Scientific Research (TNO) that have a strong foothold in Brabant are supported by the government to set up public-private partnerships, which accelerate innovation by working closely with the industry. These institutes collaborate closely with Brainport Eindhoven, which is a community of more than 5,000 specialist high-tech and IT companies.

“We aim to have an open, innovative environment where we can use different data from different companies. We can compare different types of vehicles,” says Joelle van den Broek, principal consultant, smart and safe mobility, at **TNO Traffic & Transport**.

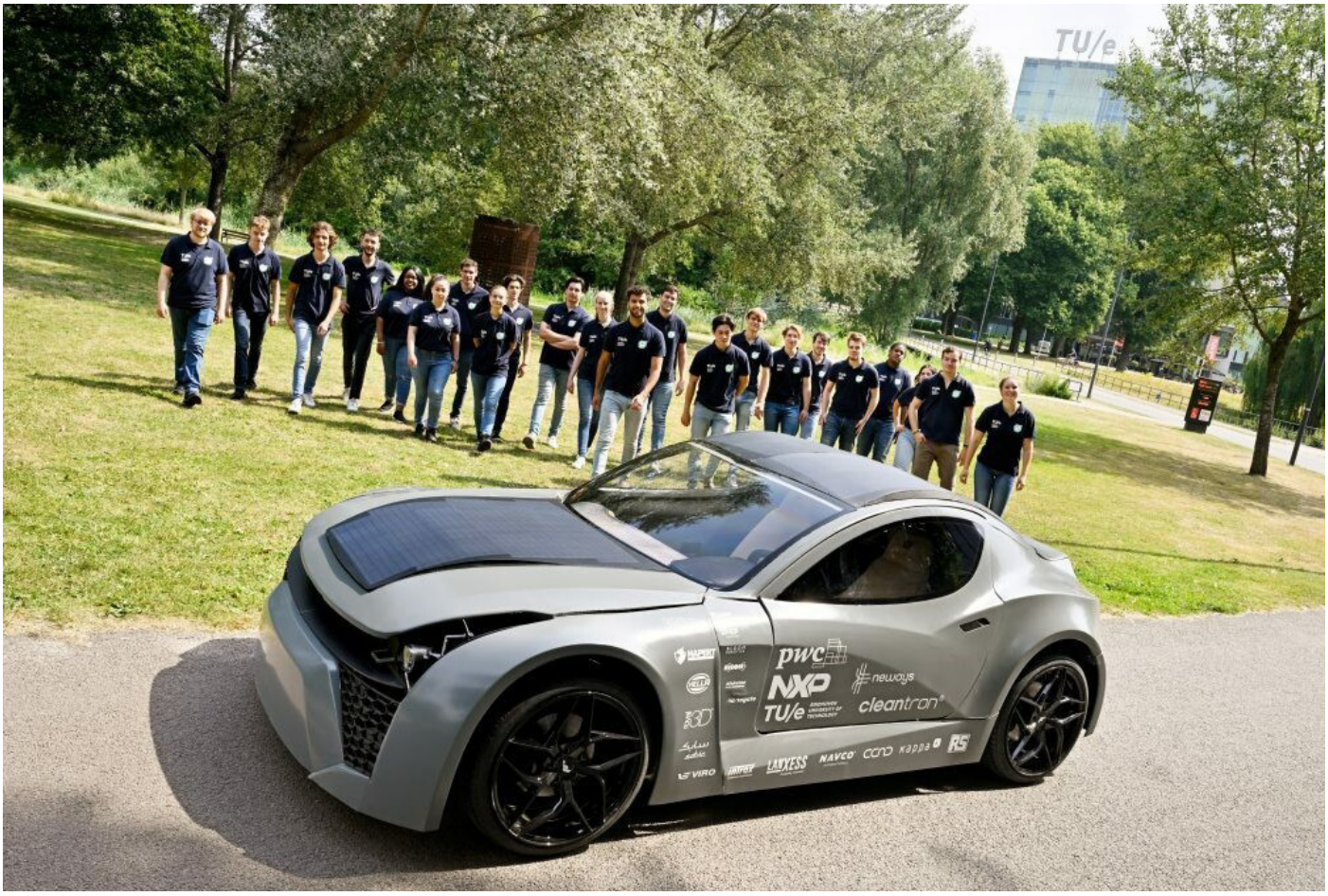
“We need that to stimulate interoperability between different systems. Otherwise, we never get to upscale those systems if each brand has its own solutions,” she adds.

Van den Broek is also Quartermaker at **MARQ – Mobility Applied Research Quarter**, a brand new innovation and research centre specialising in smart solutions at the **Brainport Automotive Campus** in Helmond. Housed in the former Volvo Nedcar development centre, the vibrant campus brings together established industry players, start-ups, education, knowledge institutes and government bodies to create an open, OEM-independent and neutral setting for the development, prototyping and testing of new systems.

“The Automotive Campus is shifting into a mobility campus where decarbonisation and digitalisation are very important – maybe even towards the energy transition,” says Rahusen.

The neutral setting ensures all parties involved put aside competitive thinking by focusing on areas where there is a clear common interest, with collaboration used to achieve faster innovation and commercialisation.

“We also aim for the MARQ Institute at the Automotive Campus to have neutral innovation, where all kinds of parties can work and elaborate on their development, get feedback and make improvements to end in a solution that is open and scalable,” says van den Broek. “If you want to stimulate and accelerate depth development, you need a space that is neutral.”



Triple helix in action

The Automotive Campus is where automotive technology, and smart and green mobility solutions are turned into real business opportunities, exemplifying Brainport's triple helix approach.

"It is the mixture of mechanical, electrical and computer science that we were the first to see," says Maarten Steinbuch, professor in systems and control, and chair of control systems technology at Eindhoven University of Technology. "Automotive companies and numerous start-ups are developing that into a very strong campus. Collaboration is essential to innovation."

"The Brainport-Brabant ecosystem is a testing breeding ground," says Rahusen. "A unique infrastructure offers the industry access to open and state-of-the-art test facilities. Examples are the various test centres of TNO and Siemens/TASS at the Automotive Campus, as well as the Holst Centre (part of TNO) and the AI Innovation Center, both less than a 15-minute drive from the High Tech Campus."

"The Brainport-Brabant ecosystem is a testing breeding ground. A unique infrastructure offers the industry access to open and state-of-the-art test facilities."

Programme-based approach makes the ecosystem more effective

The innovation ecosystem in Brabant aims to turn game-changing ideas into real businesses. Part of the approach is the use of programmes where various stakeholders from the triple helix can collaborate closely on specific themes.

Brainport Development has set up programmes in three large consortia of more than 60 Dutch companies in the mobility sector, together with the government, investing more than €120m to realise technological breakthroughs in electrification, hydrogen applications and future-oriented digital infrastructure in mobility.

Brainport Development and **Rai Automotive Industry NL** jointly provide multi-year management of an innovation programme that explores:

- **GREEN: Green Transport Delta – Electrification**
  This project aims to develop a strong battery ecosystem in the Netherlands and accelerate the transition to climate-neutral mobility

- **SMART: Digital Infrastructure for Future-Proof Mobility (DITM)**
  The partners are developing a system architecture for digital infrastructure, including the critical core technologies associated with localisation, traffic services, digital maps and charging infrastructure

This collaboration fits the Automotive Roadmap 2020-30 of the high-tech systems and materials (HTSM) sector in the Netherlands. It pursues joint long-term objectives.

For the Netherlands to establish a competitive position on a global scale, electrification and digital infrastructure projects are essential, giving a substantial financial boost to the necessary transition to a more sustainable sector. This concept of collaborative innovation is the strength of the Dutch way of working.

“This concept of collaborative innovation is the strength of the Dutch way of working.”

Leading companies collaborating on the Green Transport Delta project include:

VDL
VDL is a Brabant-based conglomerate with wide expertise in automotive and high-tech engineering, assembly and manufacturing. Its main activities span automotive and bus manufacturing, industrial systems, contract manufacturing, subcontracting, technical systems, public transport, equipment manufacturing and services. VDL has a pivotal role within the Brabant ecosystem.

NXP
NXP is a global, leading semiconductor company in chip design and development for automotive solutions, the Internet of Things, and connectivity, security and authentication, identification and access management. Working with leading automotive OEMs, NXP has accrued extensive expertise. It contributes solutions in the fields of processors, sensors, automotive radar, audio and video processing, automotive electronics, analog and power management, lighting control solutions and digital networks.

Heliox
Heliox provides world-class smart energy management solutions that are tailored and scalable within a fast-changing e-mobility landscape for public transport, e-trucks, marine, mining and port equipment. In 2017, the company installed one of Europe's first and largest rapid-charging networks for Eindhoven's e-bus fleet. Recently, it has created 'model city' energy ecosystems around the world in Den Bosch in the Netherlands, Glasgow in Scotland and Montgomery County in Maryland, US. With growing demand for EVs, it is essential to build charging infrastructure and, for this, the Netherlands has a leading position in Europe.

GREEN: Green Transport Delta – Electrification

This project aims to build a strong battery ecosystem in the Netherlands and accelerate the transition to climate-neutral mobility.

Dutch companies can fill a gap in the market by producing battery modules and packs for specific applications where the global supply chain is not yet established. Examples include battery packs for buses, trucks, industrial vehicles and machines, planes and ships. The Netherlands has leading players in all of these markets.

"By bringing parts of the battery production to the Netherlands, we strengthen the competitive position of market leaders like VDL, DAF and Damen Shipyards. We are creating an environment in which promising start-ups like Eelo, Cleantron, LionVolt and LeydenJar can scale up to become successful battery companies," says Geert van Seggelen, project leader for Brainport Development innovations in this project.

"It will be great to have solid-state batteries, although it is hard to make them with long lifetimes at low cost," says Steinbuch. "Li-ion batteries are developing, and we will have a sustainable way of mining and harvesting materials, and the recycling industry will be huge. Already, 98% of all battery materials can be recycled."

Under the leadership of VDL, in close collaboration with the University of Eindhoven, Green Transport Delta has been made possible by the Ministry of Economic Affairs and Climate Policy, with more than €36m in funding. The programme is running until the end of 2024. And it doesn't end there, as the Battery Competence Cluster NL will continue with another new programme to take forward developments in next-generation batteries, production technology and recycling capabilities. In June 2023, a new national growth fund was approved with a value of around €800m.

ELEO
ELEO's goal is to accelerate the evolution to a better and cleaner world by providing high-performance battery systems for an extensive range of vehicles and machines, enabling electrification through hassle-free installation, smart features and a Plug & Play system. All of ELEO's battery systems are expertly assembled at its advanced production facility in Helmond, which was built to enable a highly robust, reliable and scalable manufacturing process to guarantee the highest quality and safety standards.

LeydenJar
LeydenJar enables the world's most powerful batteries with radical silicon anodes. With incredibly high energy density, lightning-fast charging and a low environmental footprint, LeydenJar's anodes can be considered a game-changer and vital contributor to next-generation batteries. The secret lies in ultra-thin, pure silicon battery anodes, which enable a lower CO2 footprint with significant cost savings.

LionVolt
LionVolt is an innovative battery start-up, spun out of TNO at the Holst Centre, located in the High-Tech Campus. Founded in early 2020, its mission is to develop and scale 3D solid-state batteries that are safe and sustainable, and deliver high performance. Backed up by seven years of R&D, the company has solid foundations on which to build. LionVolt's vision is to establish a scalable gigafactory within the next five years and become a key player in the global battery industry.

Battery Competence Cluster NL

The Automotive Campus is home to the Battery Competence Cluster NL (BCC-NL), which represents a collaboration between leading companies such as DAF Trucks, VDL Groep and Damen Shipyards, start-ups, world-class knowledge institutions, national industry associations and the government. Initiated by industry association RAI Automotive Industry NL, economic development agency Brainport Development and Oost NL, BCC-NL intends to build a national consortium.

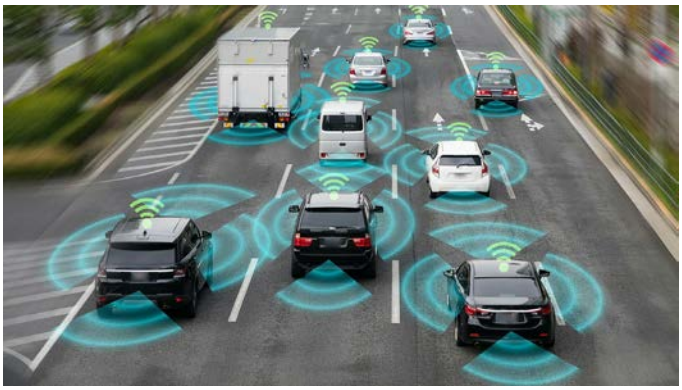
BCC-NL initiates both national and international innovation programmes and collaborations, with charging infrastructure and energy storage, recycling, electric cars, ships and even planes all within its remit.

"In Brabant, we have DAF Trucks, which is electrifying more and more, and they are including hydrogen in their roadmap too," says Steinbuch. "And we have the Battery Competence Center in Helmond, in which many automotive companies are involved.

"There are billions at this moment being put into researching batteries worldwide, because everybody understands the battery is not only a solution for mobility but also for energy transition, or to lower the loads on the electricity grid and be able to store daytime energy for use at night. Batteries are the key in the whole climate discussion."

With a focus on next-generation batteries, and new production processes and equipment, Brabant offers a wide range of expertise through companies such as ELEO, LeydenJar, and LionVolt.

SMART: Digital Infrastructure for Future-Proof Mobility (DITM)



Within the DITM project, partners are developing a system architecture for digital infrastructure, which includes critical core technologies associated with localisation, traffic services, digital maps and charging infrastructure. This is the basis for:

- Enabling higher levels of autonomous driving
- A cyber-secure and reliable interconnection of EVs and the management of energy infrastructure

The consortium provides an integrated approach, bringing together developments from the (international) automotive industry, information and communications (ICT) industry, traffic management and mobility innovation. This demonstrates how cooperative, connected and mobility systems (CCAM) can work – being safe, effective, cyber secure, scalable and brand-independent.

“DITM will enable the Netherlands to make mobility more efficient and safer on a national level, create a stronger export position for Dutch technology and influence international standards,” according to Ana Karen Analis, project leader, DITM at Brainport Development.

As map data is essential in DITM, navigation device leader and Brabant-based company TomTom is closely involved in the programme with TNO. Under the leadership of Brainport Development, the project partners are working to develop:

- Autonomous functions related to the connectivity, localisation and navigation of different vehicle platforms (bus, car) in different use cases; e.g. yard manoeuvring, lane navigation, automatic approach and stopping at bus stops, and platooning
- An energy exchange system (EnergyPod), as the crucial link between autonomous EVs and the electricity grid, offering energy-to-grid operation in a cyber-secure, reliable way
- An innovative map production system, which produces and updates maps based on continuous sensor observations of the road infrastructure and the increasing number of smart vehicles on the road. The current fleet of mobile mapping vehicles are insufficiently scalable and up to date to enable autonomous driving
- A Validation Lab – consisting of a virtual simulation and a physical test environment (including test road A270, FABULOS route and intelligent intersections) – to validate technological developments and macro-scale simulations for improved substantiation of (future) system choices regarding mobility design and investment decisions

As with the Green Transport Delta – Electrification project, the DITM works within clear lines and takes a structured approach to meet set objectives. The programme has been made possible by the Ministry of Infrastructure and Water Management (I&W) and it will run until the fourth quarter of 2026, with a total budget of €60m.

Smart mobility and ecosystems for key technologies

Alongside greener technologies, the automotive sector will require smart mobility systems to help EVs become safer, more efficient and more autonomous. What gives Brabant a further advantage is that it is home to ASML, a key supplier of machines that give the world's leading chipmakers the ability to mass-produce patterns on silicon.

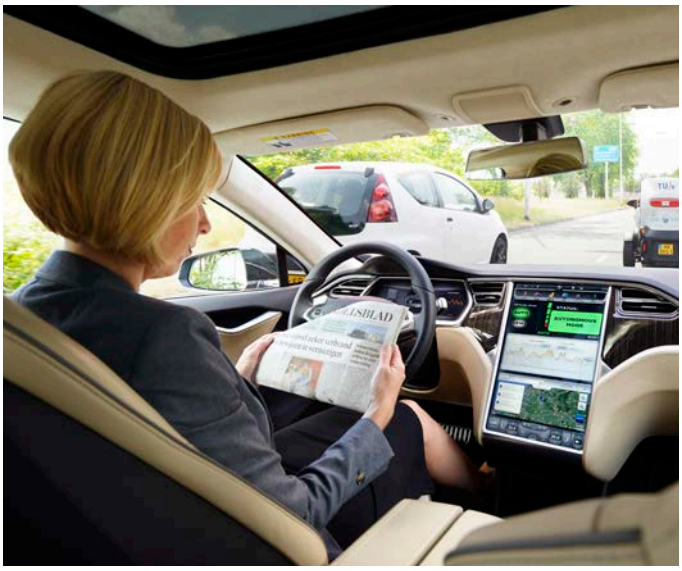
The equipment used to make chips requires the collaboration of many suppliers, all delivering equipment modules and components that must meet the highest specifications. A high-tech ecosystem has built up around ASML over the past decades, offering the expertise and means of collaborating that is needed for digitalisation and making mobility smarter.

For example, artficial intelligence (AI) is becoming an essential part of vehicle design, route optimisation, managing vehicle energy consumption and autonomous driving, while digitalisation is changing the face of mobility through the advanced use of large datasets to reshape navigation and safety features.

With the need to make applications smaller, less energy consuming and able to handle more data, the next generation of chips enabled by integrated photonics will make a strong contribution to developments such as autonomous driving and new ways of sensing that can be used for battery management systems.

Brabant is also home to PhotonDelta, a Dutch organisation focused on running a national programme to build, expand and solidify the ecosystem for integrated photonics for various application areas, including mobility.

The table below shows the relevance of integrated photonics to mobility by linking them to various application types and vehicle areas, showing how various ecosytems are complementary in the field of smart and green mobility.



Vehicle area	Application
EV powertrain	Temperature, torque, strain sensing for engine
Battery	Temperature and pressure monitoring, strain for cells sensing
ADAS & autonomous driving	Lidar and sensing systems
Connectivity & networking	Li-fi/V2I-V2V In car optical network for sensor fusion Quantum security
Cabin & comfort	Air quality monitoring Driver wellbeing (3D camera, IR, vital sign detection) Attention detection
Body & suspension	Gyroscope Strain, load monitoring for trucks

Connecting green and smart technologies for future mobility

With so much development of green and smart technologies, the key will be to combine both strands of innovation to help define the automotive industry of the future.

“A lot of the smart developments will be put in place to get a more sustainable society,” says van den Broek. “We do big projects on digital infrastructure about smart and sustainable mobility for both automated and electric vehicles.”

There are many examples already taking place of this overlap between smart and green mobility, including in truck platooning, where two or more trucks are linked in a convoy by using connectivity technology and automated driving systems.

“If you do platooning with trucks then you save energy. You use smart technology to make the fleet greener,” says Steinbuch. “If you talk about mobility, there are only two important future transformations – smart and green – and basically they have the same application area and the same type of people working on them.”

“If you do platooning with trucks then you save energy. You use smart technology to make the fleet greener.”

Digital twins

Increasingly, digital twins and simulations are playing a crucial role in the use of smart technology to boost sustainability through driving efficiencies, while reducing the number of tests and quantity of materials required in the real world. Digital twins are set to be a core activity at the MARQ Institute when it officially opens in 2024. Simulations enable the testing of scenarios that are difficult to replicate in the real world.

“If you want to know as much as possible about the safety and security of the system before it is launched, you should test as many scenarios as possible beforehand,” says van den Broek. “Virtual testing is not only necessary because of shortening the development time, but it’s also necessary to prove the safety and security of those new systems beforehand.”

In addition, with more cars on the road collecting multiple points of data, it will be easier to refine and optimise vehicle models more quickly in future.

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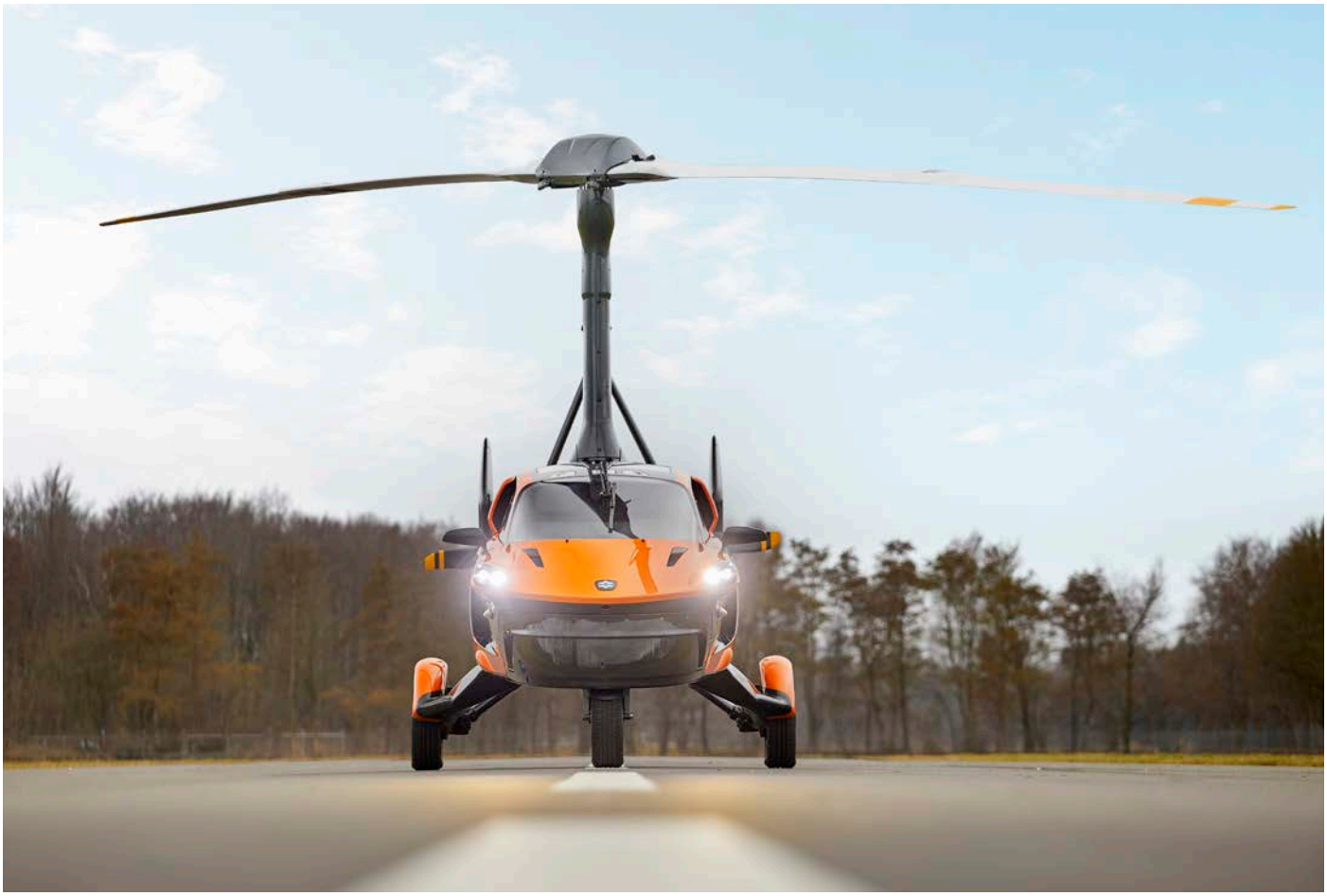

The need for new opportunities in Brabant

An ecosystem should always remain in development, meaning the strong base seen in Brabant should be complemented by companies that bring specific expertise to the ecosystem. It should also help companies engaged in foreign investment to make full use of the available expertise and bring products to market more quickly, while retaining their focus on their core technology and competencies.

Brabant Development Agency (BOM) offers support to companies that want to create value and collaborate in the automotive industry. It underpins the automotive ecosystem in Brabant, which brings together a comprehensive range of experts and specialists from across the value chain to reduce the risk involved in developing new technologies.

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