TNO APAC

Introduction
TNO Mobility & Built Environment

Asia Pacific 2025

TNO innovation for life

Contents

1. Introduction to TNO

Mission
TNO's mission is to create impactful innovations for the sustainable wellbeing and prosperity of society.

The Netherlands Organisation for Applied Scientific Research (TNO) is the largest independent Research and Technology Organisation (RTO) in The Netherlands. TNO was established by law in 1932 to conduct technical, natural and social scientific research in the public interest, and to make this knowledge applicable for governments and companies. Our mission is to create impactful innovations for the sustainable wellbeing and prosperity of society.

1.1 – TNO strategy & organisation

Innovation is vital for shaping a secure, sustainable, healthy, and digital society in the 21st century. TNO, a trusted independent applied science and technology organisation, collaborates closely with governments, universities, and the private sector to drive technological breakthroughs and inform policymaking and effective governance. Therefore, a keen understanding of customer needs, international supply chains, and the broader landscape of national, European, and global market trends is vital. Global investments in research and development (R&D) surge, and value chains span multiple borders. This means leveraging our unique strengths in specific fields – those that hold the most promise – to secure sustainable competitive advantages and establish strategic footholds (control points) within global value chains.

As a leading R&D provider and venture builder in the Netherlands, TNO has a longstanding tradition of partnering with international organisations to drive technological advancements and address societal challenges.

The evolving geopolitical and economic landscape highlights the need to reduce strategic dependencies and to develop our technological strengths.

Simultaneously, there is a growing focus on strengthening collaborations with our allies. In the APAC region, we find partners and allies with shared interests in key enabling technologies, and therefore I wholeheartedly endorse our international partnerships in this region.

Tjark Tjin-A-Tsoi
CEO and Chairman of the Board of Directors of TNO

TNO as leading innovator

TNO, as a trusted, independent, and pioneering applied science and technology organisation, plays a multifaceted role. We innovate, investigate, and orchestrate, collaborating closely with governments, universities and the private sector. We inform governments on policies and empower evidence-based decision-making through rigorous investigations, cutting-edge scientific insights, and reliable measurements. By building national and international consortia and ecosystems, we drive technological and metho- dological breakthroughs that help to realise a secure, sustainable, healthy, and digital society, and strengthen the earning power of the Dutch economy.

Innovation is crucial in realising a secure, sustainable, healthy and digital society, with TNO as leading innovator

To maximise our innovative impact, we focus on areas where we excel and lead in innovation, ensuring our efforts have significant impact. We base our decisions in this regard on a thorough grasp of societal and market needs, a realistic assessment of emerging value chains and industrial hubs in the Netherlands, as well as the international competitive landscape. These factors co-determine the success or failure of an innovative effort. We remain committed until technical and social inventions evolve into successful innovations. Together, we aim to cultivate a more focused and agile organisation that thrives on collaboration, empowers employees, and creates impactful innovations that contribute to sustainable wellbeing and prosperity.

Figure 1

Core tasks

TNO has two core tasks:

- The first core task is to support the Dutch government in carrying out statutory government tasks in the public interest. Through research and advice, TNO works on the one hand to provide facts and science-based insights as input for policy processes.
- On the other hand, TNO supports the effective and efficient execution of government tasks through research, consultancy, testing, and innovation. This ranges from research for the Ministry of Defence to mapping the subsurface and from policy advice for all ministries to supporting the energy transition.
- TNO's second core task is to strengthen the earning power of the Dutch economy and increase employment through applied research, valorisation, innovation, and collaboration. TNO innovates on behalf of both private and public organisations. In addition, we develop intellectual property, for which licences are granted. TNO also founds new companies (spin-offs) based on technological innovations, in addition to other forms of valorisation. In this way, we support the pursuit of a competitive, innovative, and dynamic knowledge economy that will ensure prosperity in the Netherlands well into the future and provide the financial and economic capacity necessary to finance solutions to major societal challenges.

We introduce innovations commissioned by businesses and civil-society organisations (Contract Research) and through public-private partnerships (PPPs), but also on our own initiative. Throughout the process, we raise issues, initiate movement, and connect industry and government so as to create greater social value together. TNO consists of six units and a centralised Services Organisation (see Figure 1). Each TNO unit has a Strategic Advisory Council made up of representatives from business and industry, the public sector, and knowledge institutions.

TNO key figures

4.4 Client satisfaction

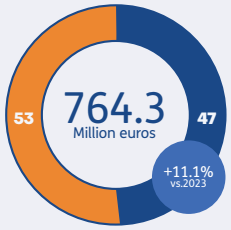
1.345 Public-private partnerships

59 Lecturers professors

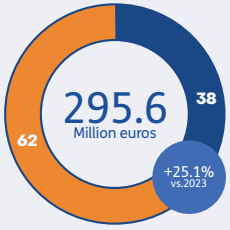
1.014 Patents

Financial indicators 2024

TNO organisation revenue (incl. state funding)



Revenue from national clients

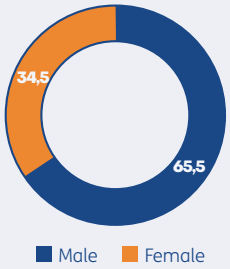


Revenue from international clients

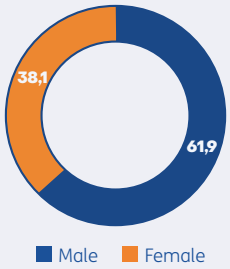
State funding and contracts from business and government

Key figures for employees 2024

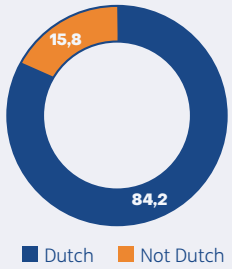
Male/female ratio (total) in %



Male/female ratio top TNO in %
(SB, EB and 1st echelon)



Nationality (63 nationalities) in %



Number of employees

1.2 – Types of research & funding

TNO develops knowledge by carrying out Exploratory Research Programmes (ERPs) and Shared Research Programmes (SRPs). This precompetitive and public-private knowledge development, co-financed by state funding, focuses to a great extent on research areas identified in the Dutch government's Mission-driven Top Sectors and Innovation Policy. The accumulated knowledge forms the basis for solutions to client queries. We find these solutions through Contract Research and Technology Transfer. Contract Research is involved if questions from clients and partners concern specific, potentially competitive applications of TNO knowledge and where there is customisation. This can also take the form of recommendations or consultancy. This type of research is paid for entirely by the client. In this way, knowledge developed by TNO is brought to market through its clients' products and services. In Technology Transfer, TNO brings knowledge to the market by setting up spin-offs and by leveraging its 900 or so active patent families in the form of licenses to existing companies.

Programming TNO's knowledge (intellectual capital)

The agenda and programming of knowledge development at TNO are created through close coordination with partners and clients and are based on national and international (European) policy and on statutory tasks, such as the Geological Survey of the Nether- lands. This forms the basis of our knowledge development.

Propositions

TNO drives strategic research programming through a portfolio of 62 propositions distributed across the units. Propositions are logical combinations of offerings and capacities, with the unique promise of adding value for clients in the relevant market. The propositions set out the social and economic impact of the intended product/market combinations, the required investments in technologies and methodologies, the mix of funding sources, and the research facilities needed.

Exploratory Research Programmes (ERPs)

With the Exploratory Research Programme (ERP), TNO renews and maintains its knowledge, focusing on intensive collaboration with knowledge partners and stakeholders. The ERP focuses on urgent issues with high societal and economic potential and a value increase of the TNO position through contract research, licenses, and spin-offs.

For the purpose of developing, applying and disseminating knowledge, TNO obtains its funding from a number of sources:

- Institutional funding: funds made available by the Dutch government.
- Programme funding: earmarked funds from various ministries, including the statutory public tasks for the Ministry of Defence and the Geological Survey of the Netherlands.
- Competitive funding: contributions from partners in collaborative projects, including EU projects and large-scale public-private partnerships (Shared Research).
- Contract funding: fully external public or private funding for Contract Research.

1.3 – TNO Research Units

Mobility & Built Environment

TNO Mobility & Built Environment is working on innovative solutions to a number of challenges at the heart of society:

- Sustainable buildings
- Safe and sustainable mobility and infrastructure
- Maritime & offshore
- Applications of digitalisation and AI in mobility and the built environment

Defence, Safety & Security

Safety cannot be taken for granted. That is why we use our knowledge and technology to create innovations for people who are committed to our peace and security. Whether it concerns defense, police, justice and security, business or others.

Safety is about experience and reality. Physical and digital. Our field of activity moves between land, sea and air. Between cyber and space. We are pushing boundaries worldwide. With science and innovation on the front line.

ICT, Strategy & Policy

TNO ICT, Strategy & Policy (ISP) works on breakthroughs to help solve societal challenges. We focus primarily on digital technologies and transition methodologies, which are central drivers and enablers, as well as in relation to economic growth opportunities.

High Tech Industry

The Dutch high-tech sector is a research and development hub that plays an essential role in European and global solutions to society's greatest challenges. From advances in healthcare to sustainable energy, from increased security to mitigating climate change. TNO High Tech Industry works with local, regional, and international partners to enable effective, sustainable, and revolutionary technological innovation.

Energy & Materials Transition

As a knowledge partner and driver of innovation, we are ready to accelerate the energy and materials transition, so that the Netherlands will be fully circular and climate neutral by 2050. Our aim is to contribute actively to a climate-resilient, sustainable, and circular society through technical knowledge and policy recommendations, thereby strengthening the competitiveness of Dutch industry.

Health & Work

The world of work is changing rapidly due to globalisation, an aging population, and technology. A high-quality labour force is essential if the Netherlands wants to remain competitive. How do we ensure that employees remain healthy, safe, and productive? Through the main themes of inclusive work, sustainable work, and the future of work, we strengthen the adaptability of people and organisations.

2. Mobility & Built Environment

2.1 – A liveable future for all

Our society is collective, regardless of demographics, income, address, or personal circumstances. Challenges like climate change, resource scarcity, and population growth affect everyone. As we work to enhance our living environment, we must consider how our actions impact society at large. Mobility and Built Environment (MBE) prioritises creating a liveable future for everyone while developing essential structures and functionalities. The concept of a 'living environment' encompasses our homes, workplaces, transportation systems (including vehicles, trains, and ships), green spaces, biodiversity, and infrastructure like roads and bridges. MBE not only seeks to enhance our current living conditions, but also focuses on ensuring that today's innovations contribute positively to future communities. This approach ensures our solutions are sustainable for the long term.

2.2 – Three preconditions, one vision

At MBE, we use our expertise to cultivate collaborations for a sustainable living environment. We provide advice to businesses and governments regarding both the big picture and the details that matter. So they can be as well-informed as possible as they make the crucial decisions that will impact our collective future. Our approach emphasises safety, sustainability, and efficiency in all solutions. Through innovation and integration of knowledge, we create opportunities that align with societal goals, fostering a more balanced future. We enable solutions that contribute to a multitude of agreed objectives. And we provide the building blocks for a more balanced society. MBE will continue to work under the three preconditions, develop and validate the solutions society needs, and contribute to our 'Three Zeros' vision: Zero Calamities, Zero Emissions and Zero Loss* (of resources, time, opportunities, or people).

2.3 – Addressing the complexity

But how do you change a system from within? How do you improve a living environment we all share? And how do you address the intertwined interdependencies, interests, and insecurities of a variety of stakeholders? This complexity is precisely the reason why MBE's contribution is so essential. As an independent, trusted organisation for applied scientific research, we are uniquely qualified to answer stakeholders' tough questions. We can provide integral, fact-based answers like no one else can. So stakeholders can make optimal decisions. Decisions that not only meet our sustainability and efficiency objectives, but also ensure that no one is left behind.

2.4 – Unique expertise for a common goal

From sustainable building materials to predictive infrastructure maintenance to optimal logistics. From more efficient electric vehicle batteries to smart public transport systems that make cities more accessible. From ecology to economy. From prototypes to policies. MBE develops and integrates unique areas of expertise to find the optimal balance between safety, sustainability and efficiency in our living environment, so we can maximise our contribution to a liveable future for all.

2.5 – Propositions

Our work is guided by 7 propositions, which are driven by market needs and external developments – based on our distinctive expertise – and they often need a multidisciplinary approach at system level.

Our propositions & their market segments

Safe & efficient mobility
Automotive, logistics, government

Sustainable mobility
Automotive, non-road mobile machinery, government

Liveable cities & regions
Asset owners, government

Safe and sustainable maritime & offshore
Maritime, offshore, renewable energy, government

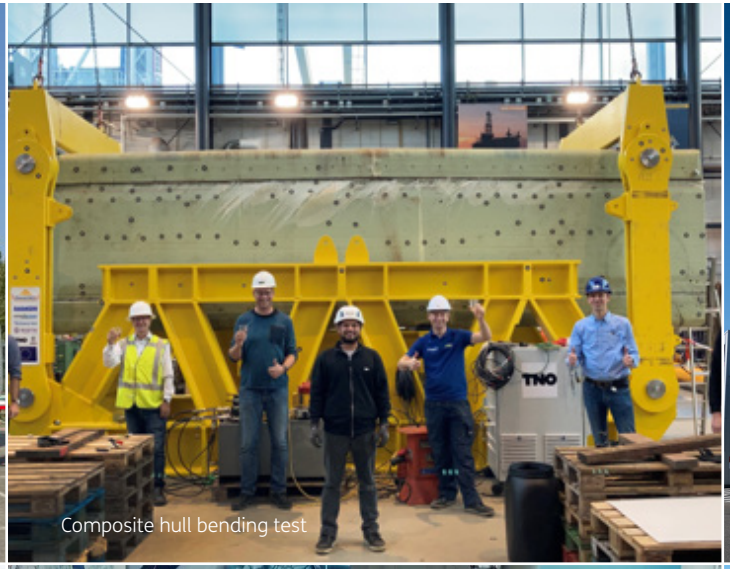
Safe & resilient civil infrastructure
Construction, asset owners, government

Circular & industrial construction
Construction & installation asset owners, government

Energy positive built enviroment
Construction & installation asset owners, government

TNO science in action

CEYAS Automated trailer mover


Composite hull bending test

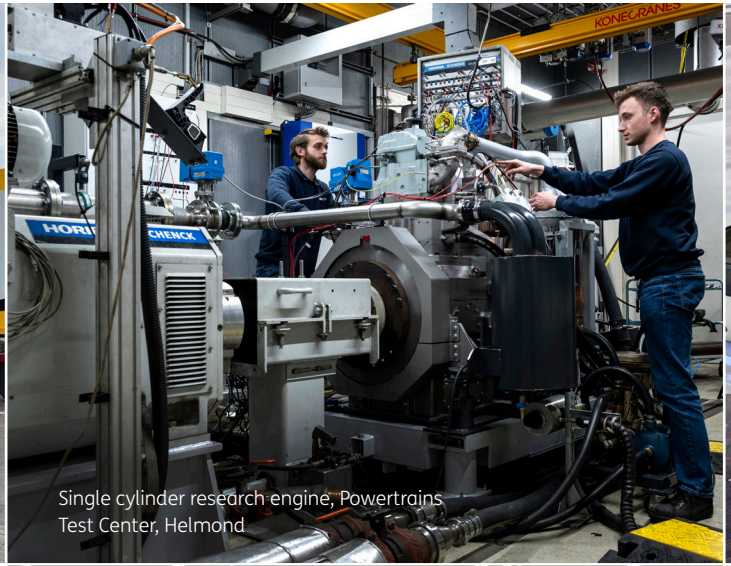
Innovation center for smart mobility - Mobility Applied Research Quarter (MARQ), Helmond

Goodyear and TNO enhance vehicle safety using tyre intelligence


H2-ICE engine running on hydrogen


Liveable cities & regions

MAGPIE Automated ecosystem for container transhipment



Single cylinder research engine, Powertrains Test Center, Helmond


TNO Automated Driving

Powertrains Test Center, Helmond


Structural Dynamics Lab (SD Lab), Delft


TNO Building Innovation Lab, Delft

3. Introduction TNO APAC

TNO stands out for its dual role in propelling technological innovation in close collaboration with industry partners on one hand and guiding successful market deployment on the other, by advising policymakers on the required standards, legislation and infrastructure. The Asia Pacific region provides a unique exposure and opportunities to accelerate disruptive technology that offers solutions for our urbanised society.

Through the creation of a 'knowledge bridge' between the Netherlands and the APAC region, TNO aims to cultivate reciprocal alliances grounded in mutual interest.

With over 10 years of experience in the APAC region, my mission is to initiate strategic collaborations among public, private, and academic organisations in Asia and the Netherlands. I am deeply passionate about cultivating impactful partnerships through technology and innovation. Let's work together on the sustainable wellbeing and prosperity of our nations and society.

Ronnie van Munster
Regional Director Asia Pacific

3.1 – TNO as international knowledge partner

Exponential population growth, intense urbanisation complexities and the intensified impact of climate change, combined with prosperous economic and dynamic geopolitical developments, makes innovation and technological advancement a necessity to future proof the Asian Pacific (APAC) region. This makes certain organisations in the region excellent knowledge partners for **TNO's vision towards the Three Zeros: Zero Calamities, Zero Emissions and Zero Loss.** In APAC, TNO recognises many topics of mutual interest, and similar if not higher urgency, to tackle the challenges of tomorrow. As a leading research organisation in the Netherlands, TNO has a longstanding tradition of partnering with international organisations to drive technological advancements and address societal challenges. Our successful collaborations have spanned various domains, including healthcare, high-tech and energy. In the realm of Mobility and Built Environment, TNO aims to accelerate technological advancements and foster innovation in areas such as Automated Driving, E-Mobility, Sustainable Powertrains, Battery technology and Predictive Digital Twins for strategic urban planning & design. TNO has dedicated its research efforts to understanding the impact on the wellbeing of society, by focusing on measures such as to enhancing safety, redistributing accessibility, improving affordability, and reducing exposure to environmental pollutants. In doing so, TNO and our international partners support cities, and thereby millions of people around the world, by making the complexity of urban transitions manageable. It's TNO's mission to combine our expertise with knowledge and propositions of our international partners into tailor-made, localised, comprehensive solutions.

3.2 – Keys of areas of interest in APAC

TNO APAC organisation consists of 2 offices: Tokyo (Japan) and Seoul (South Korea). In these countries we recognise the importance of enabling technologies and transitions that heavily impact the future sustainability, liveability and safety of our cities. With our partners in the APAC region:

Mission

It's TNO's mission to combine our expertise with knowledge and propositions of our international partners into tailor-made, localised, comprehensive solutions.

- TNO gains access and understanding of uniquely intense, urgent urbanisation challenges and potential scenarios and solutions to issues we will face more and more in the Netherlands in the years to come, such as ageing population, congestion, energy transition, impact of climate change and social equity. Through the joint- development and localisation of state-of-the-art predictive digital twins, successfully deployed in the Netherlands, we continue to future-proof our cities.

- We recognise the importance of innovative methodologies, such as a scenario-based safety assessment framework for automated vehicles, to develop new legislation to enable large-scale deployment of disruptive, new mobility technologies on the public road.

- We have access to a vast and innovative automotive industry in which the demand for expertise drives the acceleration of many key enabling technologies, such as Powertrains, Yard Automation, Connected Cooperative Driving, H2-ICE, Modular Energy Management, Battery Management, and Fuel Cell Technology.

- We see a pressing need to accelerate the development of sustainable powertrains, battery technology, and alternative energy sources. These advancements are essential for achieving international climate goals and directly impact the sustainability of the car fleet, not only in the Netherlands and the EU but also globally.

3.3 – Vision

To develop a knowledge bridge that fulfils strategic collaboration between TNO and organisations in the APAC region, that enables key technological advancement and foster innovation to future proof our knowledge position, thereby improving the competitiveness of our partners and realising a more sustainable, liveable and safe society.

Liveable cities & regions

Creating a safe, vibrant, and sustainable living environment is a complex challenge. How can we design accessible, climate-resilient cities in an increasingly space-constrained world? At TNO, we provide cutting-edge insights and innovations that empower governments, developers, and construction companies to shape cities and regions that remain liveable, resilient, and adaptable for generations to come.

Data-Driven Solutions for a Sustainable Society
Societies worldwide face significant challenges in housing, energy and mobility transitions, and environmental constraints—pressured by climate change and accelerated by rapid advancements in digitisation and technology. With limited space and competing demands, smart, data-driven solutions are essential for creating liveable, sustainable, and resilient environments.
At TNO, we harness predictive modelling, advanced analytics, and AI to help policymakers and experts quickly and reliably assess various scenarios. This enables them to understand the long-term impact of policies and investments, making well-informed decisions that shape the cities and regions of the future.

Independent, Science-based Support
With a broad spectrum of expertise under one roof, TNO provides independent, science-based support and groundbreaking innovations. We collaborate with national and international governments, municipalities, regional partnerships, and industries to develop future-proof solutions. Positioned at the nexus of the market, government, and academia, TNO plays a pivotal role in demonstrating, validating, monitoring, and scaling innovations—from pilot projects to large-scale implementation.
By integrating technology, policy expertise, and real-world application, TNO accelerates sustainable transitions and empowers decision-makers to build a resilient future.

1. **Bridging Knowledge, Technology, and Impact:**
   TNO's strength lies in seamlessly integrating expertise. Our specialists in human behaviour (who travels when and why), networks (traffic flow and congestion), and societal impact (environmental effects, space scarcity) collaborate to deliver holistic insights that drive informed decision-making.

2. **Cutting-Edge Modelling Power:**
   With advanced, interactive modeling, we accelerate scenario analysis from months to weeks—or even hours—optimising solutions across multiple objectives with unprecedented speed and accuracy.

3. **State-of-the-Art Research Facilities:**
   Our dedicated research hubs—such as the Urban Data Facility, Predictive Twin Lab, and Mobility Applied Research Quarter—enable small-scale experimentation and validation, ensuring successful large-scale implementation.

Our expertise areas

Building Resilient Cities and Regions
Climate change is increasingly affecting infrastructure, leading to delays, disruptions, and higher maintenance costs. To build truly resilient cities, we integrate nature-based solutions that combine sustainability with functionality. Using advanced data, predictive modelling, and innovative engineering, we help create infrastructure that withstands climate impacts and improves urban quality of life.

Optimising Space for Mobility
How can we design space-efficient mobility and energy systems that remain accessible to all? And how can we speed up spatial planning decisions? TNO takes a systemic approach, tackling the broader spatial puzzle rather than isolated issues. Our insights and innovations help cities make smarter, future-proof choices that boost resilience and sustainability.

Mobility Transition
TNO integrates both existing and innovative mobility concepts to keep key urban and regional functions accessible to all. Using an advanced agent-based traffic model, we analyse urban dynamics at scale.

Achieving Zero-Emission Mobility
How do we move towards low-carbon, zero-emission transport? The ambition is clear, but challenges remain—grid congestion, charging infrastructure, access to zero-emission zones, and the impact on vulnerable residents who depend on cars but can't afford an EV. Transporters, municipalities, and energy providers are seeking smart solutions to keep cities both clean and accessible.

Safe & efficient mobility

TNO is recognised by OEMs and Tier 1 suppliers worldwide as a trusted knowledge partner, offering unique expertise, tools, and facilities to support safe and efficient mobility. Through the development and evaluation of automated technologies, we help enhance vehicle safety. At the same time, we contribute to futureproofing logistics by advancing innovations in self-organising logistics and yard automation.

Advancing Automated Driving

As Automated Driving Functions (ADFs) become more advanced, safety validation grows in importance and complexity. ADFs must be tested across countless scenarios, making virtual simulation—alongside proving-ground and field tests—essential to ensure safety requirements are met efficiently. TNO's StreetWise uses data based on real-world scenarios.

Building trust in automated vehicles among other road users is equally vital. TNO's StreetProof programme focuses on this challenge.

Cost-Efficient Yard Automation

Rising logistics demand and staff shortages are accelerating the need for automation. Automating repetitive yard tasks makes processes more stable, predictable and manageable. TNO's Cost-Efficient Yard Automation Solution (CEYAS) offers an affordable, scalable and reliable concept for distribution centres, ports and industrial sites.

Large-scale Asset Sharing in Supply Chains

TNO envisions a logistics system shift towards smarter resource use to boost efficiency, reliability, and sustainability goals. The program Future Proof Smart Logistics explores and develops core technology and solutions to support the logistics software sector to facilitate asset sharing at scale within and across connected logistics networks and supply chains, addressing several challenges related to large-scale collaboration, such as trusted data sharing, fair distribution of costs and benefits and complex decentral planning challenges.

Our expertise areas

Connected Mobility

TNO combines deep expertise in vehicle and communication technologies with innovation leadership to unlock the full potential of Connected Mobility and deliver positive societal impact.

Yard Automation

TNO leverages its expertise and track record in automation technology to develop cost-efficient, stable yard automation solutions.

Automated Logistics

Road transport is evolving rapidly through digitalisation and automation. TNO develops and validates concepts like truck platooning, unmanned autonomous vehicles, smart traffic lights and SuperEcoCombis – trucks with two trailers.

Self-organising Logistics

At TNO, we develop solutions for asset sharing in connected logistics networks, combining organisational and technological innovations to improve efficiency, reliability and sustainability in freight transport and supply chains.

Sustainable Logistics

Using precise measurements and in-depth assessments, TNO helps shape effective policy and legislation. We reduce transport's environmental impact while enhancing the efficiency, reliability and sustainability of logistics systems.

Sustainable mobility

At TNO, our mission is to advance towards a sustainable society by guiding governments and businesses in transitioning to a climate neutral mobility system. Leveraging our independent role, we assist industries in developing competitive low-emission technologies and support governments in crafting effective policies to promote the uptake of sustainable transportation solutions.

To meet global climate objectives, the mobility sector must adhere to increasingly stringent emission standards. TNO supports industry partners in transitioning towards future-proof, environmentally sustainable mobility solutions by refining powertrain technologies tailored for specific heavy-duty applications. From fuel cell trucks for emission-free logistics, to battery powered construction equipment, we assist industry partners, regardless of size, with R&D to devise feasible, sustainable solutions. Our development of an H2 Internal Combustion Engine, for instance, is a promising option to drastically and quickly reduce CO2 emissions of heavy-duty equipment, using trusted technology.

Unique Dual Role

TNO has a unique, neutral position when striving for a future with environmentally sustainable traffic and transport. For this goal we fulfill a dual role, on the one hand supporting governments with the development of effective zero emission strategies and policies, and on the other hand aiding industry partners on how to interpret and meet future emission regulations.

Advanced (e-)Powertrain Facilities

TNO's Innovation Centre for Sustainable Powertrains (ICSP) measures, assesses, and validates actual energy consumption and emissions of engines and powertrains. Our experts deliver fact-based information and monitor the effectiveness of emission legislation. At the same time, we have a leading position in helping the industry to develop new cost-effective sustainable propulsion technologies and heavy-duty applications, such as battery electric technologies and H2-ICE.

For real-world validation of vehicles, TNO offers unique testing facilities such as the Climate-Altitude Chamber, capable of mimicking any driving condition on earth for any type of powertrain, even hydrogen vehicles.

Real-world Emission Performance

Our Vehicle Emission Lab is focused on accurately measuring real-world vehicle emissions. Lab measurements are complemented by on-road emission tests using the Portable Emission Measurement System (PEMS) and Smart Emission Measurement System (SEMS). The acquisition and interpretation of recorded real-world data are essential for accelerating the energy transition.

"The mobility sector has the opportunity to demonstrate that powertrain innovations, combined with effective legislation, can truly make a difference in improving air quality and achieving climate-neutral mobility"

Merle Blok,
Proposition Manager Sustainable Mobility

Our expertise areas

Hydrogen Fuel Cell Solutions
Supporting the robust, efficient and reliable application of fuel cell powertrains.

Battery Technologies
Aiding industry partners to safely apply batteries and improve their lifetime, while reducing development time and costs.

Modular Energy Management Strategy
Creating a software platform that enables industry partners to maximise powertrain efficiency of different vehicle configurations to reduce energy consumption.

Real-world Emissions
Measuring real world emissions, both tailpipe and non-tailpipe, including tyre and brake emissions.

Towards Zero CO2 Mobility
Policy advisor for realising a climate neutral mobility system in an effective way that is justifiable from a societal and environmental perspective.

H2 Internal Combustion Energy
Developing a cost-efficient hydrogen alternative to the diesel combustion engine and all other technologies.


Safe and sustainable
maritime & offshore

Improving efficiency and achieving net-zero emissions in maritime and offshore operations demands disruptive innovations and alternative designs beyond current standards. With multi-domain expertise and state-of-the-art facilities, TNO supports industry partners and policymakers. Our work includes advancing offshore wind turbine construction and maintenance, developing floating solar platforms, and enabling the safe and efficient use of alternative fuels such as hydrogen and methanol.

TNO supports the maritime and offshore industries in safely decarbonising by addressing the complex technological and logistical challenges of transitioning to sustainable energy. Our expertise spans materials and structures, process optimisation, power management, emission monitoring, and digitalisation. Collaboration across domains—including mobility, construction, energy transition, defence, and safety—ensures an integrated approach. By combining numerical models with validation in the lab and field, we deliver insights into structural behaviour, material integrity, asset lifetime, powertrain development, and emissions monitoring.

Focus on Structural Safety

TNO takes a structural approach to offshore and maritime safety. For offshore wind, we develop models and conduct tests to analyse friction and material degradation for innovative slip-joint mounting methods in monopiles exposed to seawater. We enhance end-of-life models for composite turbine blades by integrating inspection data, model tests and hybrid models. In the maritime field, we use the same approach to reach affordable safety for the fuel transition. We address corrosion and leak protection by numerical and experimental methods to ensure the alternative design fulfils the safety standards.

Leading in Sustainable Engine Technology

Powertrains, storage, and bunkering facilities must be redesigned for using alternative fuels, alongside safe transport and logistics solutions. With extensive expertise in heavy-duty transport and maritime powertrains, TNO leads in sustainable power technology, combining numerical and experimental methods for development of top notch hydrogen fuel cells, natural gas, hydrogen and methanol combustion engines, as well as battery systems. We develop advanced engine management systems, as well as energy management systems to optimise energy efficiency in vessels using multiple energy sources, including sustainable shore power. Our expertise in testing methodologies ensures compliance with classification standards.

Visualising impact on Emissions

Beyond powertrain technology, TNO helps reduce emissions by assessing and visualising the impact of alternative fuels on vessels. We lead in research, developing models and testing procedures for storage and bunkering under extreme conditions. Our work includes durability and fatigue testing of LNG hoses, studying hydrogen storage resilience at ultra-low temperatures, and enabling the safe transport of ammonia—a key hydrogen carrier—with potential as a combustion fuel. We also conduct real world measurement campaigns of green house gasses (including methane slip) and local emissions (e.g. NOx and PM). Additionally, we are developing Ship-Based Carbon Capture solutions to further reduce maritime emissions. The effectiveness of alternative fuels, engine optimisation and aftertreatment systems is predicted and monitored by our team to verify that the promised reduction in emissions is actually achieved.

Our expertise areas

Offshore Lifetime Prediction
We reduce uncertainty in predicting the lifespan of foundations, blades, and floating structures.

Vessel Life & Recycling
We assess remaining life and explore reuse and recycling through data and structural analysis.

Material in Extreme Environments
We test and advise on materials for corrosive, explosive, high-pressure, and cryogenic environments.

Safe Use of Alternative Fuels
We support risk assessments through testing and simulation of alternative fuel hazards.

Emission Monitoring
We develop methods to measure emissions and support policy-making.

Energy Conversion
We adapt fuel cells, batteries, and engines for reliable maritime use.

Aftertreatment Solutions
We deliver technologies like Ship-Based Carbon Capture to cut air pollution.

Scenario and Policy Development
We guide energy transition policy through modelling and technical insights.

TNO APAC

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TNO aims to develop a knowledge bridge that fulfils strategic collaboration between TNO and organisations in the APAC region, that enables key technological advancement and foster innovation to future-proof our knowledge position, thereby improving the competitiveness of our partners and realising a more sustainable, liveable and safe society.

TNO innovation for life

tno.nl