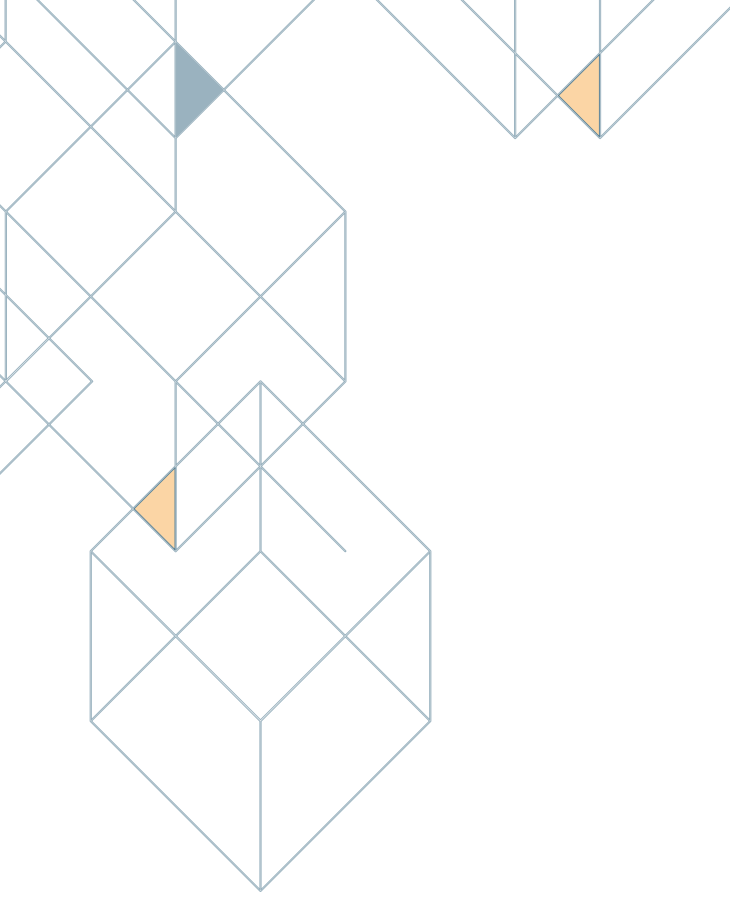


NATIONAL KNOWLEDGE AGENDA LOGISTICS

2024-2027





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PREFACE

Dear reader,

We are proud to present the National Knowledge Agenda for Logistics. This agenda has been compiled with the help of researchers, policy makers and professionals, all of whom have made valuable contributions. We would like to thank everyone who has been involved in the preparation of this agenda. The enthusiasm with which you have all contributed is fantastic!

The contributions we received from different disciplines and backgrounds allowed us to include a wide range of topics and issues. Thanks to this diversity of perspectives, we believe we have created an agenda that is responsive to society's current needs and challenges.

We hope that this agenda will help guide knowledge development for the logistics sector and for logistics as an enabler of solutions to several major societal challenges. It provides a guide for researchers and policy makers to work in a focused and effective

way to increase our collective knowledge in specific areas. In addition, this Knowledge Agenda acts as a compass for collaboration and the realization of synergies between projects. In doing so, we aim to stimulate the interdisciplinary collaboration needed to address complex issues.

TKI Dinalog and the Top Sector Logistics will certainly put a lot of energy into this. We cordially invite you to put your shoulders to the wheel with us.

Finally, we would like to emphasize that this Knowledge Agenda is a dynamic document. It is meant to evolve and adapt to new developments and insights. We therefore invite everyone to stay involved and actively contribute to the further development of relevant knowledge for logistics, supply chains and other sectors, as well as to the testing and deployment of new innovations in the field.

Best regards,

Prof. dr. Iris F.A. Vis
Captain of Science
Topsector Logistiek

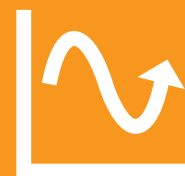
Prof. dr. ir. Niels A.H. Agatz
Scientific Director
TKI Dinalog



THEMES IN THE NATIONAL KNOWLEDGE AGENDA

CIRCULAIRE
ECONOMIE

ENERGIETRANSITIE

VEERKRACHT EN
VERSTORINGENBEVOLKINGSGROEI
EN DEMOGRAFISCHE
ONTWIKKELINGENMAATSCHAPPELIJK
VERDIENVERMOGEN
EN BREDE WELVAARTINTERDISCIPLINAIRE
ANALYSE

INTRODUCTION

The National Logistics Knowledge Agenda was developed by TKI Dinalog in collaboration with representatives of the Logistics Top Team, knowledge institutions, companies, and government. TKI Dinalog is the leading independent institute for logistics knowledge development in the Netherlands. Logistics is both a relevant economic sector with many jobs and an enabler that plays an important role in the transition to a sustainable, liveable, circular, safe, and resilient society. The Knowledge Agenda has been developed in conjunction with the new implementation program of the [Top Sector Logistics](#) for 2024-2027 and the missions as formulated in the Mission-Driven Top Sectors and Innovation Policy. The purpose of this new Knowledge Agenda is to be the compass for developing research calls and assessing research proposals within TKI Dinalog and in collaboration with, for example, [NWO/NWA](#), [SIA](#), crossovers with [other TKIs](#) and future growth fund initiatives for the coming years. The Knowledge Agenda shows the logistics design, acceptance, adoption, and scale-up issues that play a role in addressing several major societal challenges and further developing and making the logistics sector sustainable. The societal challenges are large and complex, and logistics is a critical part in solving these societal challenges.

The Knowledge Agenda focuses on strategic transdisciplinary knowledge issues that guide practical applications. The combination of knowledge development, field experiments and implementation creates a flywheel for the advancement of valuable knowledge. From the practical applications, new research questions can in turn follow. The goal is to develop knowledge and innovations in co-creation, or partnerships between knowledge institutions, companies and governments that contribute to long-term renewal and fundamental system change within the logistics sector and society at large. We can build on the knowledge base created in the previous implementation programs and in the international research community.

Below we present five challenges, each with two general knowledge questions - one focused on the short-term renewal of supply chains and one focused on longer-term system changes with logistics as an enabler. In addition, we discuss the broad range of possible general solution directions. For clarity, we structure the discussion around different challenges,

recognizing interrelationships and dependencies. For example, some challenges are at the intersection of several issues. In addition, some challenges are also opportunities for the logistics actors in the chain. The general themes are relevant to all domains and application areas. Important application areas include international hubs and chains, retail, manufacturing, food, agriculture, service environments such as healthcare and emergency services, and construction and infrastructure. We define of supply chains as the collection of parties responsible for organizing and executing logistics activities such as planning and control, warehousing, inventory management and transportation. The Dutch logistics landscape is characterized by fragmentation and many parties (from large to small) within these chains. It includes shippers (who purchase logistics services) and logistics service providers and carriers (who provide logistics services), but also platform operators, suppliers of logistics software and IT infrastructure, consulting, and hardware (including robots and vehicles). It also includes the logistics function within companies and chains, such as service technicians, e-commerce, and project-specific logistics (for example, for events and in construction).

1 CHALLENGE 1 CIRCULAR ECONOMY



HOW TO DEVELOP EFFECTIVE LOGISTICS CIRCULAR SYSTEMS FOR CONSUMPTION AND PRODUCTION?

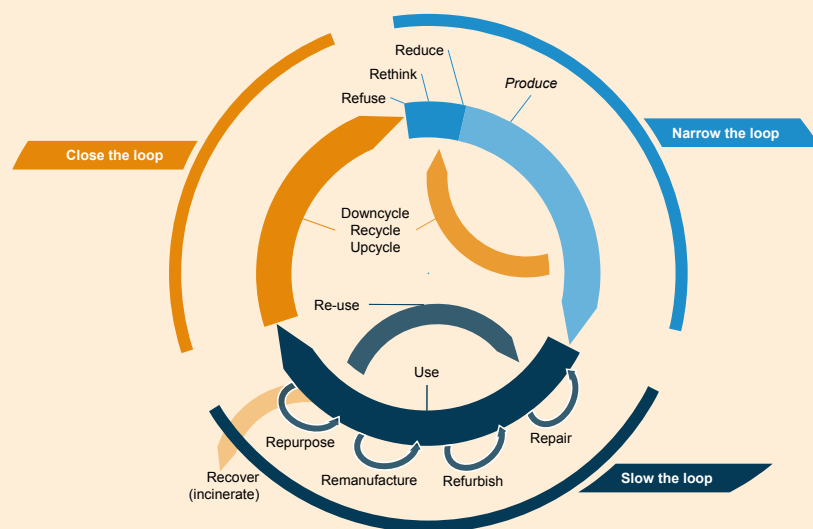
Circular consumption and production systems can help to reduce the use of (scarce) materials and raw materials, and to reduce waste in supply chains. In a circular system, products and buildings are designed to last longer and to be reused and/or parts reused at the end of their life cycle. This requires efficient and effective logistics infrastructure, processes and chains for distribution, maintenance and repair, reuse, refurbishment, recycling, and recovery. It also requires information on the location and exact composition of the various products on the

market, for example through a digital product and material passport. An important knowledge issue concerns the scale (regional, European) of collection and recycling for different types of products and materials, and the location of the associated logistics infrastructure. An effective logistics system can support the better use of components, materials, and raw materials within existing products, thereby reducing dependence on the international market for materials and raw materials and strengthening strategic autonomy. Conversely, the question arises as to what the circular economy will mean for the transport of goods.

CIRCULAR ECONOMY AND THE R-LADDER

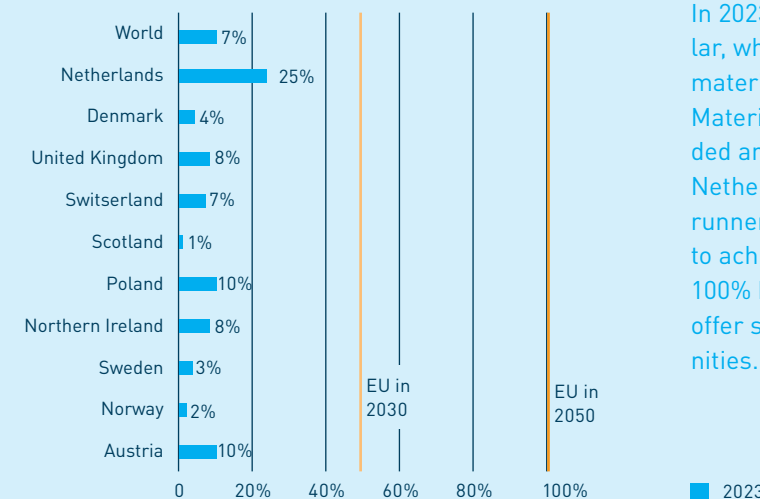
The idea behind a circular economy is to reduce resource consumption to ensure that we do not use more resources than our planet has to offer us. This is because currently we are, in fact, crossing four of the 10 planetary boundaries

and for four more we are close to it. We reduce by using less using fewer raw materials, using other materials, using products for longer and recycling materials. This is expressed in different R-strategies, as shown below.



HOW CIRCULAR ARE WE?

Source: [Circularity Gap Reporting Initiative](#)



In 2023 the world is about 7% circular, which means that 93% of the raw materials we use are "virgin materials." Materials that, after use, are discarded and not recycled. Although the Netherlands is considered to be a front runner a large gap remains if we want to achieve 50% circularity by 2030 and 100% by 2050. Dutch knowledge may offer significant international opportunities.

HOW CAN LOGISTICS ENABLE NEW CIRCULAR PRODUCTION, DISTRIBUTION, AND SERVICE MODELS?

The circular economy is driving the emergence and growth of new concepts and business models around servitization and the sharing economy. This includes leasing, rental, product-as-a-service and pay-per-use, where products remain the property of the manufacturer but can be used by customers. This increases the utilization rate of products, and fewer goods are needed to provide the same level of service. Lifetime can also be extended through

better maintenance and monitoring. Facilitating the sharing and co-use of products and services creates new logistics flows, concepts, processes, and planning issues. It may also require different choices for logistics infrastructure. These are also issues related to the transition from linear to circular chains and the development and scaling up of circular ecosystems.

2

CHALLENGE 2 ENERGY TRANSITION AND EMISSIONS REDUCTION



HOW CAN WE REDUCE HARMFUL EMISSIONS IN SUPPLY CHAINS TO ZERO?

Supply chains face major challenges in transitioning to alternative - non-fossil and renewable - energy sources for transport and storage, and in reducing harmful emissions such as CO₂, NOX and particulates in the chain. Much progress is being made in the electrification of smaller vehicles and urban logistics. However, much remains unclear about the alternatives for longer distance transport by road, water and air, their integration into the logistics system and the implications for business revenue models. A common challenge is the high level of uncertainty surrounding technological developments, laws and regulations, the role of government, and the distribution of investment costs in the chain. It is important that companies share responsibility for reducing emissions in the chain. Loading and fuelling infrastructure constraints and electricity grid congestion cause delays. Matching (limited) and uncertain (renewable) energy supply with demand creates the need or necessity to better predict, monitor, coordinate, manage and demonstrate energy demand in logistics. Cooperation between companies with different energy consumption patterns can be a way to grow within the current grid capacity. In addition, a fluctuating energy supply leads to new planning issues for logistics processes, for example to better respond to dynamic energy tariffs. New energy sources and corresponding new vehicle characteristics also require a different way of organizing logistics, for example by having more hubs closer to the customer and cooperating in the broader mobility domain. Companies in the logistics sector will have to take big steps in the coming year to meet carbon accounting obligations and broader CSRD regulations. A key challenge is how companies can gain insight into the carbon emissions of their suppliers and customers. There are also many questions about how different governments can best use existing or new policy instruments to support, promote and stimulate the energy transition in cooperation with market actors and civil society.

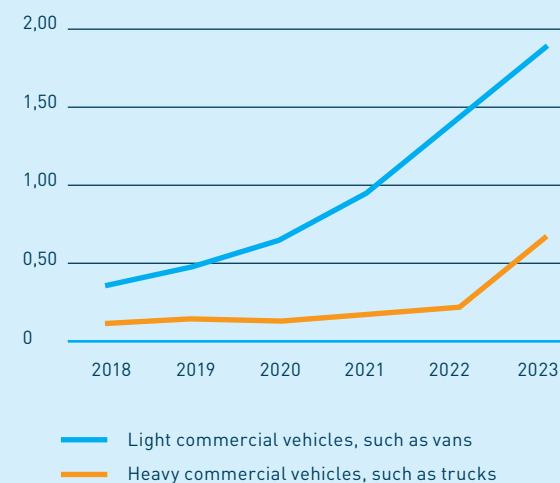
HOW CAN LOGISTICS FACILITATE THE ENERGY TRANSITION?

New logistics flows and processes play an important role in facilitating the energy transition and reducing harmful emissions. For example, if large industrial processes and the chemical sector cannot be fully electrified, hydrogen and hydrogen compounds such as ammonia will play a greater role. We are also seeing developments in the capture and storage of carbon dioxide. This will create different logistics flows, possibly new revenue models for logistics. This will require new supply chains and infrastructure to organize them efficiently, effectively, and safely. In addition to water and rail transport, pipelines are a possible alternative. This also includes the logistics flows associated with the construction, renewal, and maintenance of new energy infrastructure, such as offshore wind farms. With developments in bi-directional charging, the logistics sector itself - with large fleets of electric vehicles and solar panels on logistics infrastructure - can play an important role in balancing the energy grid by returning power to the grid when needed.



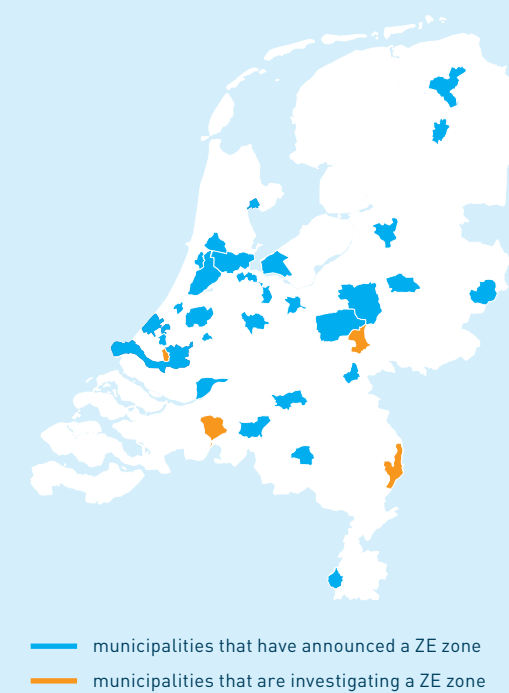
SHARE OF ELECTRIC COMMERCIAL VEHICLES AS PERCENTAGE OF THAT RESPECTIVE FLEET

Source: [Netherlands Enterprise Agency](#)



MUNICIPALITIES WITH ZERO EMISSION ZONES

Source: [OpwegnaarZES](#)



3

CHALLENGE 3 RESILIENCE AND DISRUPTIONS



HOW CAN WE MAKE SUPPLY CHAINS MORE RESILIENT AND RELIABLE?

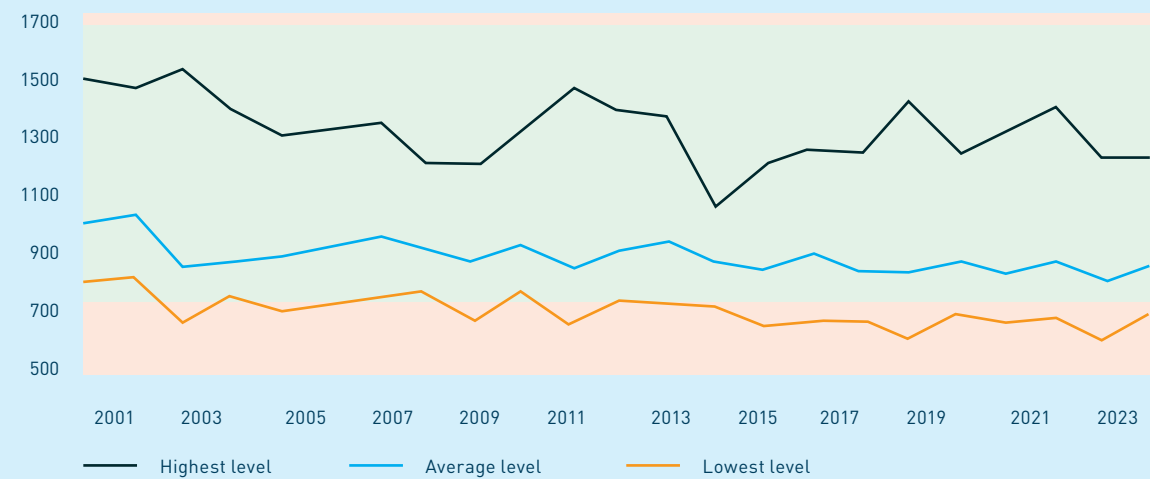
Logistics supply chains are characterized by many uncertainties in supply and demand. Geopolitical tensions, extreme weather, pandemics, undermining, cyber-attacks, and scarcity of materials can disrupt international food and production chains and affect the Netherlands' role in supply chains and hubs. These disruptions affect both the availability of products themselves and the logistics infrastructure, such as through low water levels. Reliable chains facilitate the structural and timely availability and affordability of products, food, medicine, and services but also guarantee the safety, authenticity and legitimacy of the products and chain processes.

In addition, chain responsibility - taking joint responsibility for wrongs and risks in the chain - is becoming an increasingly important factor. Making these chains more resilient - enabling them to absorb disruptions and greatly reduce the impact of disruptions - presents a trade-off between higher short-term costs to prevent and reduce long-term risks. This includes the potential tension between resilience and sustainability. Technology can help increase visibility in chains to more timely detect and act on disruptions. In addition to technology, this also requires appropriate organizational and leadership structures.



WATER LEVEL OF THE RHINE NEAR LOBITH

Bron: [Rijkswaterstaat](#)



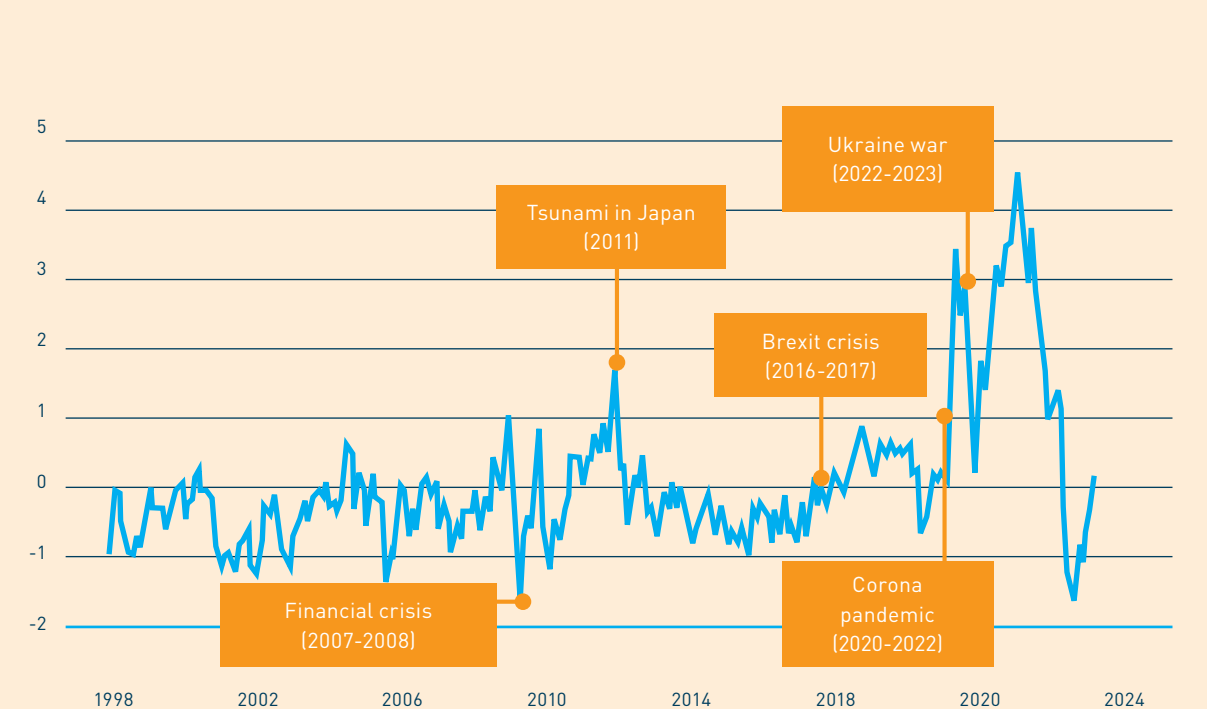
HOW DO WE MAKE THE NETHERLANDS/ EUROPE LESS VULNERABLE TO DISRUPTIONS IN INTERNATIONAL SUPPLY CHAINS AND MATERIALS?

Making chains more resilient may require a complete redesign of international chains and a more localized use of suppliers, production capacity and materials. This involves concepts such as derisking, reshoring, nearshoring, and multisourcing, as well as political cooperation, strategic autonomy, and changes in trade agreements and related import tariffs. On a smaller scale, it means redesigning local supply

chains and addressing fundamental questions about managing supply and demand and "post-growth" scenarios, such as directing demand toward local seasonal products. Related questions are also where the responsibility for reliable chains lies, what the role of government is in creating resilience, and in case of disruptions with many negative social consequences in supply chains, and how government can prepare for them. We can think, for example, of allocation issues in times of scarcity and questions about possible takeovers of strategic logistics infrastructure, such as ports.

GLOBAL SUPPLY CHAIN PRESSURE INDEX

Source: [Federal Reserve Bank of New York](#)



4

CHALLENGE 4 POPULATION GROWTH AND DEMOGRAPHIC TRENDS



HOW CAN SUPPLY CHAINS CONTINUE TO SERVE A GROWING (URBAN) POPULATION WITH LIMITED SPACE, INFRASTRUCTURE, AND A TIGHT LABOUR MARKET?

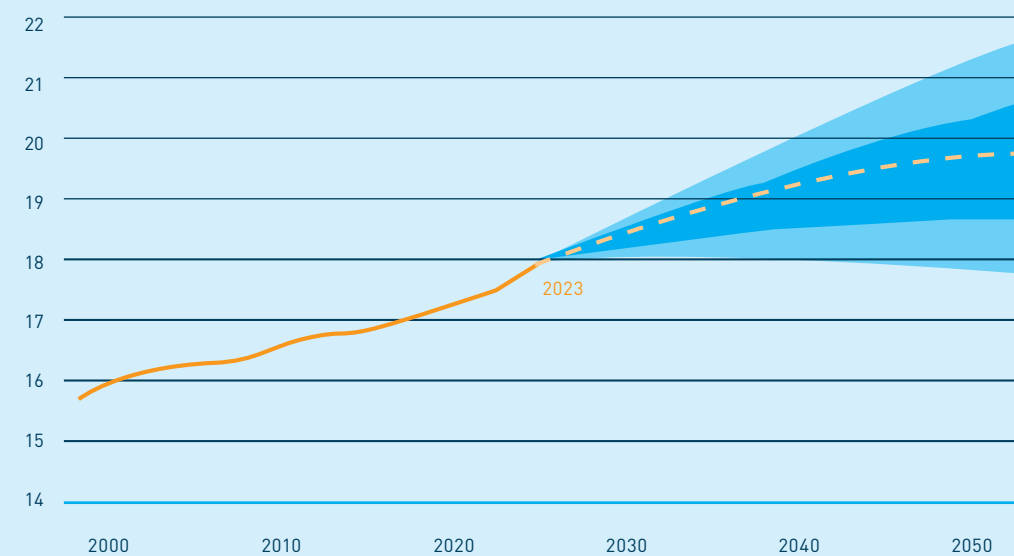
Continued population growth and urbanization will lead to increased pressure on existing infrastructure and demand for faster logistics, for example related to online shopping patterns in urban areas. This leads to more congestion, delays, and wear and tear. This calls for research at the intersection of mobility and logistics into concepts that can help reduce this pressure and smooth out peaks, such as pricing policies and nighttime distribution. The demand for e.g. new housing, logistics infrastructure and more green space is putting pressure on the limited space available. Some of the current infrastructure is outdated or inappropriate and will need to be

renewed and/or replaced in the coming years. The goal is to keep the Dutch urban and rural areas liveable and accessible in the future. In doing so, it is important to include the impact on logistics systems (and the broader mobility system) in spatial plans. This also affects equity and inclusiveness, for example regarding the availability and affordability of products and services for all households (both socio-economically and regionally). Logistics chains in different sectors will enable a more efficient use of space. This can be done, for example, through co-location and better clustering of certain activities. New chains and activities can also be considered. For example, logistics food chains, which are changing due to the transition to more plant-based proteins and new protein sources such as microorganisms.



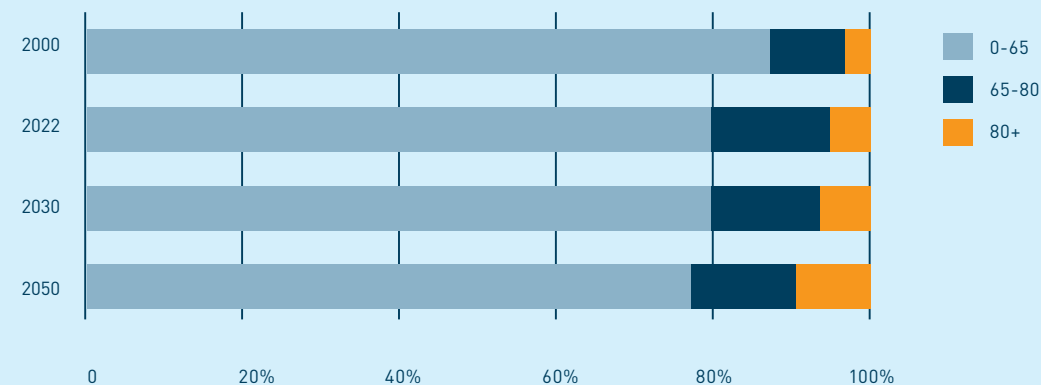
SIZE OF DUTCH POPULATION

Source: Statistics Netherlands



COMPOSITION BY AGE GROUP

Source: Statistics Netherlands



HOW DOES LOGISTICS ENABLE NEW CONCEPTS FOR VITAL SECTORS THAT RESPOND TO DEMOGRAPHIC TRENDS IN THE NETHERLANDS?

The gradual aging of the Dutch population is expected to have an impact on the labour market, healthcare, education, and housing. Logistics innovations can be developed to improve processes in vital sectors such as healthcare, education, and the housing market. As people age, they are more likely to require more medical care, which is expected to increase healthcare spending. This

increasing demand for care is putting pressure on the healthcare system. A significant part of the care process is logistical in nature (e.g., scheduling of ICU beds, surgeries, waiting lists, delivery of medical devices, and medication), and there are still many unanswered questions about how to properly organize the logistical process, especially in the growing area of extramural care. In addition, demographic shifts require different types of homes and cities.

5

CHALLENGE 5 SOCIAL EARNING CAPACITY AND BROAD PROSPERITY



HOW CAN WE POSITIVELY IMPROVE AND INNOVATE THE LOGISTICS SYSTEM?

Broad prosperity plays an important role in shaping logistics for the future. A fundamental question is how a logistics system can maximize its contribution to human well-being while minimizing its impact on the climate and the living environment. Related questions are how to operationalize broad prosperity within this framework and what challenges are involved. On this basis, possible solutions for chains and (new) policies can be considered.

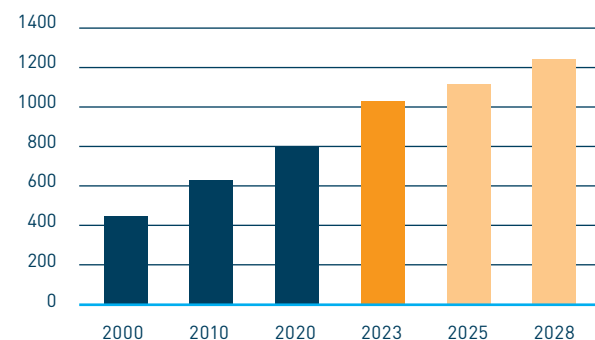
To maintain the leading position in logistics and international supply chains and to limit the negative impacts of logistics activities, it is important to continue to innovate in logistics. The tight labour market is a major obstacle. An important question is what new occupations and skills are needed in the sector to cope with all the developments and transitions. Technology can make working in logistics more attractive by reducing the regulatory burden and physical strain. This can help attract a wider range of workers, making the sector more diverse and inclusive. The starting point is a well-functioning socio-technical system in which human-centred technology is implemented. Technological innovations such as automation and digitalization can increase capacity utilization and reduce waste. Digitalization facilitates the exchange of information between market participants and streamlines supply chains. The standardization of load carriers and the bundling of physical flows through concepts inspired by the "physical Internet", the sharing economy and synchromodal transport - in this context, logistics and the broader mobility system can be explored.

WHAT IS THE ROLE OF LOGISTICS AND THE LOGISTICS SECTOR IN THE FUTURE EARNING CAPACITY OF THE NETHERLANDS?

More economic growth often goes hand in hand with environmental pollution, material depletion, and more emissions. Scarcity of space, labour shortages, changing demographics, recycling, and the phasing out of fossil fuels mean that the old model of the Netherlands as a distribution country is not sustainable. The logistics sector will have to adapt to long-term changes in water and soil because of climate change. There is a public debate about the desirability of various national and international logistics activities in the Netherlands. It is important to collect reliable data to gain insight into both the positive and negative effects of local logistics activities and infrastructure. Research into alternative systems and revenue models is also needed. It is also about finding the right balance between exploiting current - unsustainable, but profitable - activities and exploring new - future-proof - activities within the logistics ecosystem.

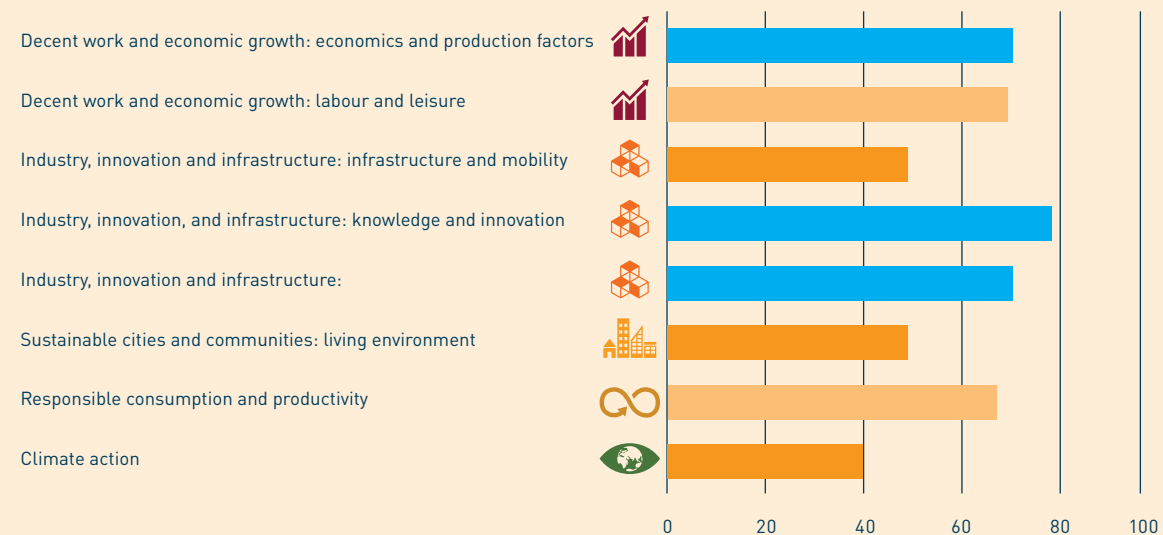
HISTORIC AND FORECASTED GDP 2000-2028

Source: [Statistics Netherlands](#)



POSITION OF THE NETHERLANDS WITHIN EU BY SDG GOAL

Source: [Statistics Netherlands](#)



6

INTERDISCIPLINARY ANALYSIS OF CHALLENGES AND POSSIBLE SOLUTIONS



Some of the challenges mentioned can be qualified as “wicked” problems: complex issues without clear and simple solutions, characterized by multiple, often conflicting perspectives and interests. Addressing these challenges requires a broad and interdisciplinary approach, as well as a deep understanding of the local and international logistics context. A thorough analysis of the problem context is necessary for an effective approach, which focuses not only on the development of new technological applications, but rather on an integrated approach in which, from the outset, technology development goes hand in hand with issues related to innovative organizational forms and revenue models, behavioural management, ethics and law, and effective policies at the local, national, and European levels, among others. This requires cooperation between knowledge institutions, companies and governments within different disciplines and the creation of intersections between the different top sectors. Cooperation within the broader mobility system of freight and passenger transport and between different modes is required, for example in the development and renewal of road, loading and fuelling infrastructure.

TECHNOLOGY AND CONNECTIVITY

Within technology, we distinguish between hardware and software. Hardware includes new vehicles, fuel carriers, process automation (autonomous vehicles, robotics in distribution centres) and local manufacturing (3D printing, mobile manufacturing).

In terms of software, it is mainly about technologies and physical and digital connectivity for secure and easy data exchange and sharing (digitization, data spaces, ledger technology, mobile communication, and connectivity), improving logistics decisions, planning, and self-organization in the chain through decision support software, data analysis, analytics, operations research, and intelligent agents (artificial intelligence, cloud computing, digital twins, platforms). For both types of technologies, safety-by-design and privacy-by-design are essential.

Methodologies must be developed to minimize system vulnerabilities and to keep hardware and software secure. It is also important to develop scale-up concepts for digitization and system change in the logistics sector.

BUSINESS MODELS AND ORGANIZATIONAL FORMS

With the introduction of sharing and circular economy concepts in logistics, new organizational forms are needed that allow companies to share data, resources, infrastructure, freight, and risks. This includes building trust. It may also require the development of incentives to encourage collaboration. It is expected that the objectives of companies within the chain will change and that new service offerings will emerge that fit within the concepts of the sharing economy and the circular economy. Another question is what revenue models will be involved. Within companies, it is important to consider what possible changes in organizational structures are needed to achieve set goals and resilience, and to deal effectively and safely with innovations in areas such as automation and digitalization. This includes analysing changes in the labour market and leadership styles.

BEHAVIOURAL

This includes issues related to human behaviour, such as increasing acceptance and adoption, and effectively and efficiently embedding new technologies into existing work processes. In addition to addressing the acceptance, adoption, and scale-up issues associated with new technologies, addressing the above challenges also requires changes in the behaviour of consumers (as individuals and in groups), organizations, and industries. This requires a clear change management vision for organizations to understand, plan and lead the necessary changes.

GOVERNMENT POLICY

The above transitions require an interdisciplinary approach that considers the co-evolution of economic, social, political, and technical systems. This requires a broadly inclusive perspective on



international supply chains, networks, and systems, with attention to large and small enterprises. It also addresses (international) issues of adapting policies and regulations to new technologies (such as the introduction of a digital waybill) and stimulating different transitions. A related issue is the role of government in achieving the goals outlined. The aim here is to ensure that national and local policies are mutually reinforcing and do not work at cross-purposes. And whether, for example, the government actively provides incentives for companies to implement (system) changes in their operations. Security and combating illegal practices are also concerns.

ETHICAL AND LEGAL ISSUES

The introduction of sub-concepts and systemic changes in logistics related to the above issues raise legal and ethical questions. Some examples are: What shared values and norms play a role in sustainable and resilient supply chains? What is risk sharing between companies and what is shared responsibility? And what does “together” mean in terms of liability when things go wrong? The introduction of new technologies such as artificial intelligence into the chain also requires good agreements. For example, who is responsible for a disruption in the chain if the AI software makes a wrong decision?

PHYSICAL ENVIRONMENT

Several challenges related to limited space and infrastructure maintenance and replacement have been outlined above. When introducing new logistics concepts and modes, it is important to consider the impact on the living environment. For example, what is the environmental impact of using drones in urban areas and building a hyperloop route? How do logistics (micro)hubs relate to urban infrastructure development? What do systemic changes in the logistics system require of infrastructure, and what does infrastructure obsolescence mean for the continuity of the sector?

ABOUT THE TOP SECTOR LOGISTICS AND TKI DINALOG

TOP SECTOR LOGISTICS

In the top sectors companies, knowledge institutions and governments work together on innovation and knowledge development. Together, the government and industry invest in sectors in which the Netherlands has a strong international position and which are essential importance for the Dutch economy. The Top Sector Logistics is one of those top sectors. The logistics sector makes an important contribution to the Dutch GDP and also provides many jobs. The Topsector Logistiek is a cooperation between the Ministry of Economic Affairs and Climate Policy, the Ministry of Infrastructure and Water Management, Connexxion and TKI Dinalog.

TKI DINALOG

By 2050, the Netherlands will be a sustainable, resilient, and circular society with a good balance between ecology, economy, and social welfare. The transition to such a society requires new solutions in which logistics plays an essential role. The importance of knowledge and innovation in logistics and international logistics chains is therein visible and obvious to all. TKI Dinalog is the leading independent institute for logistics knowledge development in the Netherlands. TKI Dinalog establishes new connections to arrive at inspiring and practical insights.

Our mission, strategy and knowledge agenda are determined by the partners within the foundation. The Executive Board is responsible for its implementation. Together with a small team they form the TKI Bureau that works daily to implement that mission.

TKI Dinalog provides direction to and stimulates joint knowledge development for the logistics of the future in the Netherlands. We do this by:

- Defining a demand-driven, national research and innovation agenda in the field of logistics and supply chains
- Initiating and organising (co)financing in research and innovation programmes and by supporting these programmes
- Ensuring the wide accessibility of this knowledge, experiences, and solutions
- Strengthening the knowledge infrastructure by connecting the business, knowledge institutions, governments, and civil society organizations



WITH THANKS TO

This National Knowledge Agenda for Logistics was created with the cooperation of the following individuals.

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Wando Boevé	Chairperson steering committee Multimodal Corridors
Rob van Wingerden	Chairperson steering committee Mobile Tools and Construction Logistics

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