DPC Town Meeting 2026

The Dutch Physics Council is working towards a new strategic vision for physics research in the Netherlands

The Dutch Physics Council is updating their strategic vision for academic physics in the Netherlands. Our new vision will connect to the National Technology Strategy, which defines our country's top ten innovation priorities, the upcoming Wennink report on innovation and industrial competitiveness and the Draghi report that also calls for renewed support for early-stage research.

Our previous vision paper stems from 2015 and given the turbulent geopolitical development it is now the time to share with the world what makes physics so special. The DPC is very happy that Prof Albert Polman (AMOLF, UvA) will chair the writing team in their effort to write a new vision paper.

Our new strategy, to be finished in May 2026, will call for:

- A clear national vision: physics as a cornerstone of innovation, talent, and sustainable growth.
- Sustained investment in fundamental research — the source of tomorrow's breakthroughs
- Continuity across the full knowledge chain — from blue-sky ideas to high-tech applications.
- Collaboration with industry and policy, turning insight into impact.
- Focus on talent — training the high-tech experts for the industry of tomorrow.
- Support for education and early-career scientists, ensuring the next generation of physicists can thrive.

For the content of the report we collect advice and input from: academic physicists, via our advisory board members, the NWO Round Table Physics, The Science Deans, Board of NNV, Ministry of OCW, Physics teachers' network and from industry.

Town hall meetings

What can you, as a physicist working in The Netherlands, expect from us the coming months?

December 2025/January 2026: town hall meetings will be organized by your local representative in the DPC's advisory board at each university/institute.

- The input that will be gathered encompass:
  - What are future key areas of research in physics?
  - What additional funding is needed, for what goal (PIs, PhDs, …).
  - What big investment needs are needed?
  - Are there important and relevant areas that have a risk to disappear?
  - In what areas can we collaborate with industry?
  - How can we train talented people with the proper skills for society?
  - How do we make physics more visible in society and policy making, show the importance of physics to create jobs, technology, sustainability, etc.
  - How can we better support early career researchers?
- This input will be used by the writing team to address the most important topics in physics

19, 20, 21 January 2026: we will be around at NWO Physics where we will also announce this endeavor and present the writing team. You are welcome to discuss with the writing team members any suggestions you may have.

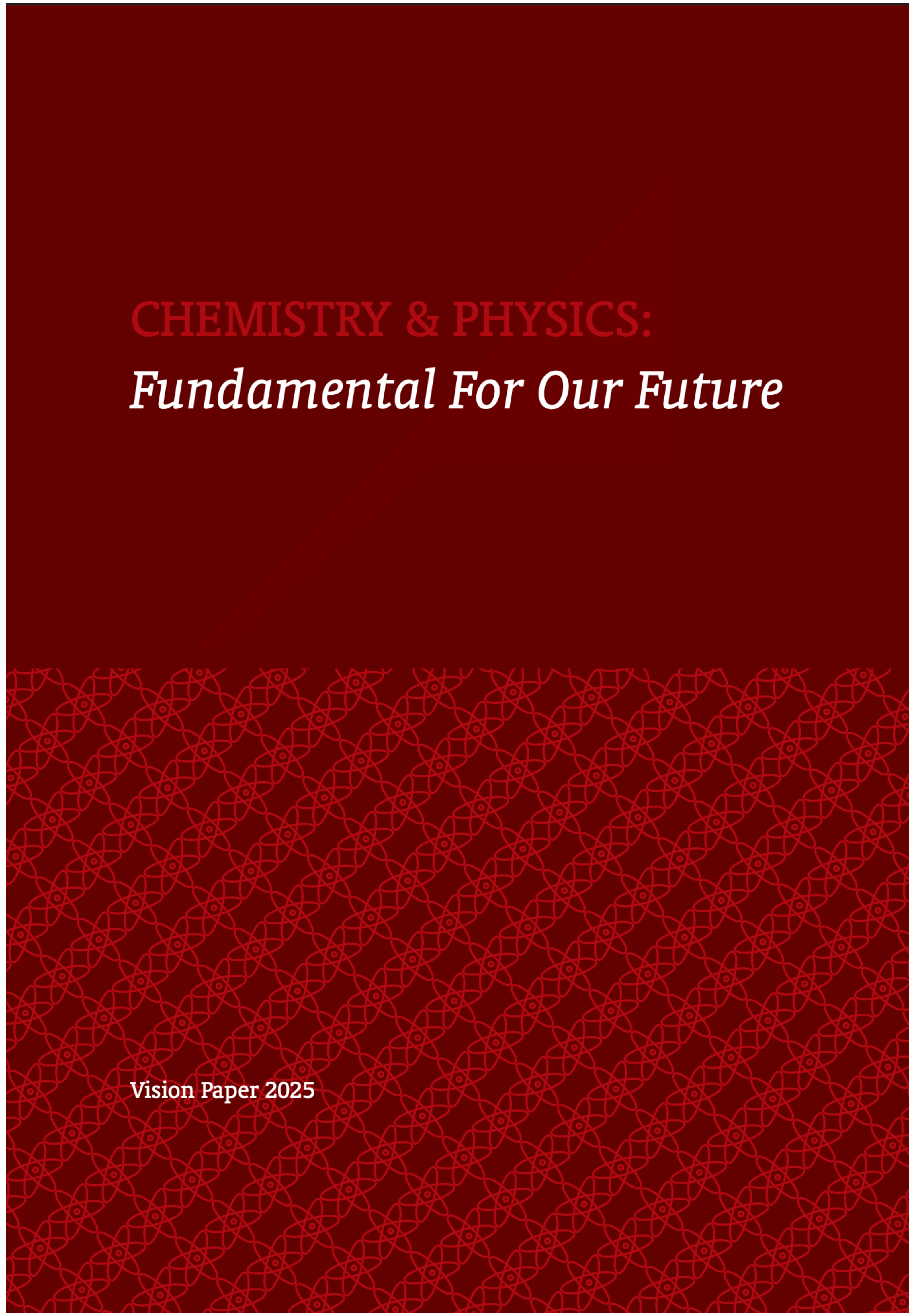
DPC writing team

The writing team will be working in February-April 2026 and use input that DPC Advisory Board members collect in local Town Hall meetings that they organize in December 2025 – January 2026.

- Albert Polman (AMOLF, UvA, chair)
- Kjeld Eijkema (VU, ARCNL): atomic, molecular, optical physics
- Stan Bentvelsen (Nikhef): high-energy physics
- Maria Loi (RUG): energy materials
- Renate Loll (RU): physics theory
- Shuxia Tao (TU/e): machine learning, AI
- Daniela Kraft (LEI): soft and biological matter
- Ingmar Swart (UU): nanoscience
- Hans Hilgenkamp (UT), high-tech materials and systems
- Maz Ali (TUD): quantum (also NextGenPhys@NL young PI network)
- Patrick Decowski (Nikhef/UvA): Large scale research infrastructure
- Marleen Kamperman (Beta-lerarenkamer): teacher's education
- Liedewij Laan (TUD, BiBB): beta in bestuur & beleid
- Maarten Voncken (ASML): physics for industry
- Esther Alarcon Llado (DPC): DPC, link to Dutch Chemistry Council

Scientific secretaries: Arlette Werner, Naomi Chrispijn-Steenbeek (NWO, DPC)

Rapport Dijkgraaf 2015



Samenvatting Vision Paper 2025

De wereld en de wetenschap staan voor grote uitdagingen: oplossingen vinden voor maatschappelijke problemen (duurzaamheid, energie, gezondheidszorg, materiaalschaarste, klimaatverandering), globalisering van wetenschap en onderwijs, en de opkomst van regionale innovatiegebieden. In de wetenschap zelf spelen ook nog drie grote wereldwijde trends: steeds meer informatie en big data, leren van en ontwerpen voorbij de natuur, en het slechten van grenzen tussen disciplines en samenwerken met de technische wetenschappen. Chemie en fysica zijn bij uitstek vakgebieden om al deze uitdagingen aan te gaan. De Nederlandse chemie en fysica zijn toonaangevend in de wereld en verkeren in een uitstekende positie om bij te dragen aan een gezonde toekomst van Nederland. Om zowel die toppositie te behouden als de mogelijkheden voor Nederland zijn nieuwe initiatieven, inspanningen en investeringen in wetenschap, onderwijs en samenleving nodig. In dit document beschrijven de Nederlandse chemische en fysische gemeenschap hun wetenschappelijke ambities voor 2025. De gekozen onderwerpen van onderzoek sluiten goed aan bij eerdere keuzes in het Sectorplan Natuurkunde en Scheikunde en de Research Agenda van de KNAW en dichten gaten die in het topsectorbeleid zijn gevallen. Het document sluit af met een aantal aanbevelingen om de excellente en cruciale positie van de Nederlandse chemie en fysica te versterken en te benutten. Dit visiedocument kan dienen als uitgangspunt voor een toekomstige actualisering en uitbreiding van het succesvolle Sectorplan.

Ambitie

De opstellers van dit document hebben een groot aantal gesprekspartners in Nederland gevraagd wat naar hun idee in 2025 aan nieuwe wetenschappelijke ontwikkelingen gerealiseerd zou kunnen zijn, en op welke terreinen je dan het komende decennium onderzoek moet doen. Dat heeft geleid tot het identificeren van onderzoekslijnen die alle aansluiten op onderzoek waar de Nederlandse chemici en fysici wereldwijd gezien in uitblinken, gegroepeerd in 7 terreinen.

1. *De chemie en fysica van leven en gezondheid*
2. *Energie*
3. *Nanowetenschap, nanotechnologie en geavanceerde materialen*
4. *Complexe (moleculaire) systemen, zachte materialen en vloeistoffen*
5. *Duurzame (bio)chemische proceskunde*
6. *Het (quantum) heelal*
7. *Quantumtechnologieën*

Het visiedocument beschrijft per onderzoeksterrein lijnen van onderzoek waarin Nederland kan excelleren.

Aanbevelingen

De aanbevelingen richten zich op vier aspecten.

1. Het pre-universitaire onderwijs versterken.
2. Aanvullende maatregelen om een carrière in de wetenschap aantrekkelijker te maken en toponderzoekers naar Nederland te halen en ze hier te houden.
3. Meer aandacht voor multi- en interdisciplinair onderzoek, inclusief samenwerking met de technische wetenschappen.
4. Acties om de kloof tussen wetenschap en innovatie te dichten.

European context

Draghi report:
Europe is lacking behind and needs focus, set clear priorities
Competitiveness is less about relative labor costs and more about knowledge and skills

3 transformations:
Accelerate innovation, bring down energy prices, less stable geopolitics (can not rely on others)

Countries are responding but fragmented causing more damage

THE FUTURE OF EUROPEAN COMPETITIVENESS — PART A | FOREWORD

Foreword

Europe has been worrying about slowing growth since the start of this century. Various strategies to raise growth rates have come and gone, but the trend has remained unchanged.

Across different metrics, a wide gap in GDP has opened up between the EU and the US, driven mainly by a more pronounced slowdown in productivity growth in Europe. Europe's households have paid the price in foregone living standards. On a per capita basis, real disposable income has grown almost twice as much in the US as in the EU since 2000.

For most of this period, slowing growth has been seen as an inconvenience but not a calamity. Europe's exporters managed to capture market shares in faster growing parts of the world, especially Asia. Many more women entered the workforce, lifting the labour contribution to growth. And, after the crises of 2008 to 2012, unemployment steadily fell across Europe, helping to reduce inequality and maintain social welfare.

The EU also benefitted from a favourable global environment. World trade burgeoned under multilateral rules. The safety of the US security umbrella freed up defence budgets to spend on other priorities. In a world of stable geopolitics, we had no reason to be concerned about rising dependencies on countries we expected to remain our friends.

But the foundations on which we built are now being shaken.

The previous global paradigm is fading. The era of rapid world trade growth looks to have passed, with EU companies facing both greater competition from abroad and lower access to overseas markets. Europe has abruptly lost its most important supplier of energy, Russia. All the while, geopolitical stability is waning, and our dependencies have turned out to be vulnerabilities.

Technological change is accelerating rapidly. Europe largely missed out on the digital revolution led by the internet and the productivity gains it brought: in fact, the productivity gap between the EU and the US is largely explained by the tech sector. The EU is weak in the emerging technologies that will drive future growth. Only four of the world's top 50 tech companies are European.

Yet, Europe's need for growth is rising.

The EU is entering the first period in its recent history in which growth will not be supported by rising populations. By 2040, the workforce is projected to shrink by close to 2 million workers each year. We will have to lean more on productivity to drive growth. If the EU were to maintain its average productivity growth rate since 2015, it would only be enough to keep GDP constant until 2050 – at a time when the EU is facing a series of new investment needs that will have to be financed through higher growth.

To digitalise and decarbonise the economy and increase our defence capacity, the investment share in Europe will have to rise by around 5 percentage points of GDP to levels last seen in the 1960s and 70s. This is unprecedented: for comparison, the additional investments provided by the Marshall Plan between 1948-51 amounted to around 1-2% of GDP annually.

If Europe cannot become more productive, we will be forced to choose. We will not be able to become, at once, a leader in new technologies, a beacon of climate responsibility and an independent player on the world stage. We will not be able to finance our social model. We will have to scale back some, if not all, of our ambitions.

This is an existential challenge.

Europe's fundamental values are prosperity, equity, freedom, peace and democracy in a sustainable environment. The EU exists to ensure that Europeans can always benefit from these fundamental rights. If Europe can no longer provide them to its people – or has to trade off one against the other – it will have lost its reason for being.

The only way to meet this challenge is to grow and become more productive, preserving our values of equity and social inclusion. And the only way to become more productive is for Europe to radically change.

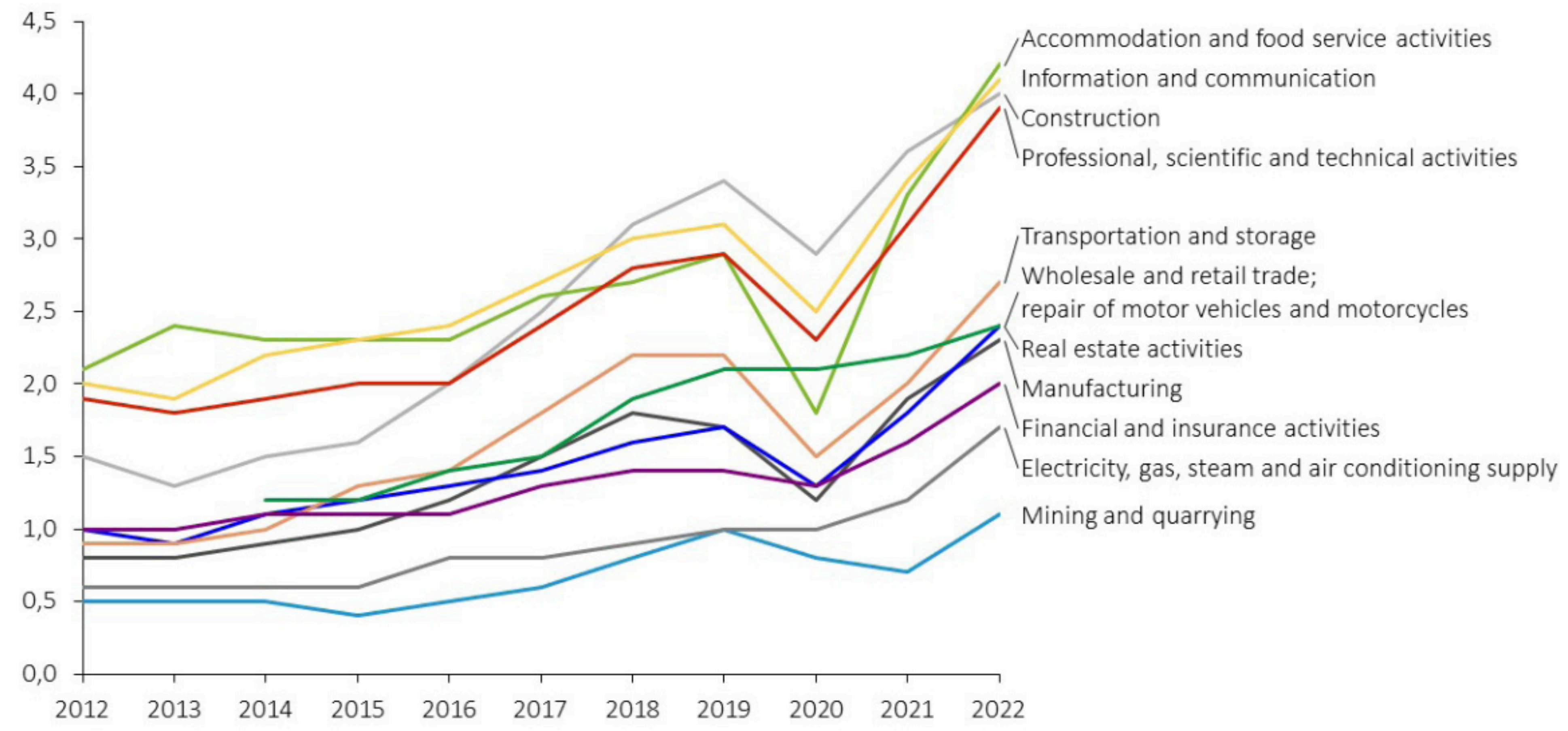
05

European context

FIGURE 10

Skills shortages in the EU

Job vacancy rate (% of total posts)



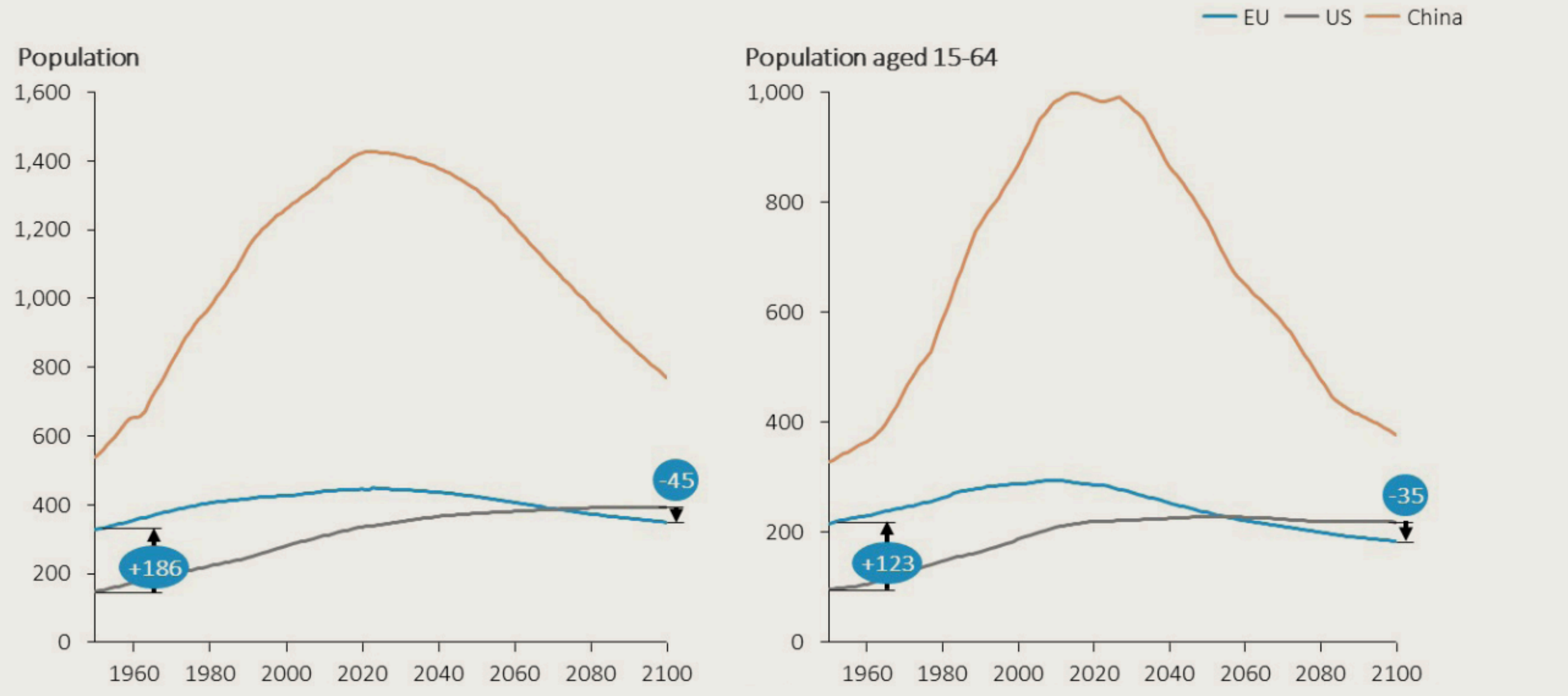
Source: Eurostat

Skills shortages are acting as a barrier to innovation and technology adoption and could potentially hinder decarbonisation as well. Europe produces high quality talent in the fields of science, technology, engineering and maths (STEM) but their supply is limited. The EU turns out around 850 STEM graduates per million inhabitants per year compared to more than 1,100 in the US. Moreover, the EU's talent pool is depleted by brain drain overseas owing to more and better employment opportunities elsewhere. Skills are also lacking to diffuse digital technologies faster through the economy and to enable workers to adapt to the changes these technologies will bring. Almost 60% of EU companies report that lack of skills is a major barrier to investment and a similar share report difficulties in recruiting ICT specialists. At the same time, European workers are generally unprepared to take advantage of the widespread digitalisation of work: around 42% of Europeans lack basic digital skills, including 37% of those in the workforce[09]. Decarbonisation will also require new skills sets and job profiles. The rates of job vacancies for clean tech manufacturing in the EU doubled between 2019 and 2023, with 25% of EU companies reporting labour shortages in the third quarter of 2023. Shortages of high-skilled workers are likely to become more acute over time. Projections to 2035 indicate that labour shortages will be most pronounced in high-skilled, non-manual occupations – i.e. those requiring high level of education – driven by replacement needs owing to retirements and the changing demands of the labour market.

FIGURE 4

Long-term population developments and projects

Population, million



Note: The population projections are based on the probabilistic projections of total fertility and life expectancy at birth. These projections were made using a Bayesian Hierarchical Model. The figures display the median projections. The projections reflect a contribution of historical migration patterns. Paper on methodology.

Source: United Nations World Population Prospects, 2022.

Projected overall population dynamics are also reflected in the growth of the European working age population, which started to decline around 2010. The projected decline in the Chinese working age population exceeds that of the EU. It is expected to drop from about 1 billion people aged 15-64 years to around 600 million in the next 40 years.

"Productiviteit is niet alles, maar op de lange termijn is het bijna alles. Het vermogen van een land om zijn levensstandaard in de loop van de tijd te verbeteren, hangt bijna volledig af van zijn vermogen om de productie per werknemer te verhogen."

– Nobelprijswinnaar Paul Krugman

European context

The Horizon Europe programme has multiple weaknesses. For the 2021-2027 period, it has a budget close to EUR 100 billion. Horizon Europe is an important tool to support research and innovation in the EU. It is a unique instrument in the global context, covering a wide range of Technology Readiness Levels (TRLs) and thematic areas, and relying on diverse tools. It builds on the successes of its predecessors, but:

- **Its resources are split across too many fields and priorities**. As a result, the programme lacks focus and some EU-wide top priorities are covered only thinly.
- **Access to the programme tends to be excessively difficult**. Newcomers experience difficulties in accessing the programme, resulting in Horizon Europe funding being concentrated among too few existing beneficiaries. Moreover, the programme has historically experienced a very high level of oversubscription, with around 70% of high-quality proposals not receiving funding[05]. There is a general perception among beneficiaries and stakeholders that the programme's rules (both for submitting proposals and for managing projects once successful) are excessively complex, and should be simplified.
- **The determination processes for priorities and budget allocation are overly complex**. The programme involves a wide range of Commission departments, Member States and the European Parliament through complex governance arrangements. Additionally, there is no explicit mechanism to align the R&I spending priorities set under the programme with the national priorities set independently by Member States.
- **The potential of public-private partnerships is not fully seized**. The structure and governance of its partnerships with the private sector are inefficiently designed, leading some partnerships to fall short of their initial objectives.
- **Support for breakthrough disruptive innovation remains limited**. Even though Horizon Europe's mission is to promote disruptive research and innovation, the programme is neither sufficiently funded nor well-structured for the purpose. For example, the European Innovation Council's (EIC) Pathfinder instrument, which should support bold ideas for radically new technologies at low Technology Readiness Levels (TRL), has a budget of only EUR 250 million for 2024. In comparison, the US ARPA agencies have significantly higher budgets (DARPA: USD 4.1 billion for 2023; ARPA-H: USD 1.5 billion; ARPA-E: USD 0.5 billion). Similarly, the UK's ARIA has a budget of GBP 800 million over several years and the German Federal Agency for Disruptive Innovation (SPRIN-D) has a budget of EUR 220 million for 2024. Moreover, governance issues undermine the success of the EIC: it is mostly led by EU officials rather than top scientists and innovation experts; there are few project managers; selection procedures are highly bureaucratic; collaborations are mandated through a top-down approach rather than being managed cooperatively; and the disbursement of funding is slow[xvii].
- **Furthermore, the performance of the programme is difficult to measure in terms of output, notably patent registration.**

BOX 2

The CERN success story

A notable example of the remarkable returns from the joint collaboration of European countries is the creation of the European Organization for Nuclear Research (CERN) in 1954. CERN started with an initial coalition of 12 European countries. Today, it comprises 23 European Member States, along with 11 non-European Associate Member States and 4 Observers (the EU, UNESCO, Japan, and the US). CERN made it possible to set up and sustain investment in high-energy physics research that any single European country would have regarded as unsustainable over such a prolonged period of time. The pooling of country-specific resources allowed single countries to share the considerable risks and uncertainty inherent to fundamental innovative research. Its collaborative effort has yielded remarkable successes, including two most notable discoveries: the invention of the World Wide Web, invented at CERN 35 years after its inception, and the discovery of the Higgs Boson particle, announced on 4 July 2012. CERN scientific leadership spans various domains, including superconductivity, magnets, vacuum, radio frequency, precision mechanics, electronics, instrumentation, software, computing and Artificial Intelligence. CERN's technologies have generated significant societal benefits, including advancements in cancer therapy, medical imaging, autonomous driving with artificial intelligence, and environmental applications of superconducting cables.

The Large Hadron Collider has propelled CERN to global leadership in particle physics – a mantle that has shifted from the US to Europe – and it stands as CERN's flagship facility. One of CERN's most promising current projects, with significant scientific potential, is the construction of the Future Circular Collider (FCC): a 90-km ring designed initially for an electron collider and later for a hadron collider. Chinese authorities are

236

THE FUTURE OF EUROPEAN COMPETITIVENESS — PART B | SECTION 2 | CHAPTER 1

also considering constructing a similar accelerator in China, recognising its scientific potential and its role in advancing cutting-edge technologies. If China were to win this race and its circular collider were to start working before CERN's, Europe would risk losing its leadership in particle physics, potentially jeopardising CERN's future.

PRESIDENTIAL ACTIONS

LAUNCHING THE GENESIS MISSION

Executive Orders | November 24, 2025

By the authority vested in me as President by the Constitution and the laws of the United States of America, it is hereby ordered:

Section 1. Purpose. From the founding of our Republic, scientific discovery and technological innovation have driven American progress and prosperity. Today, America is in a race for global technology dominance in the development of artificial intelligence (AI), an important frontier of scientific discovery and economic growth. To that end, my Administration has taken a number of actions to win that race, including issuing multiple Executive Orders and implementing America's AI Action Plan, which recognizes the need to invest in AI-enabled science to accelerate scientific advancement. In this pivotal moment, the challenges we face require a historic national effort, comparable in urgency and ambition to the Manhattan Project that was instrumental to our victory in World War II and was a critical basis for the foundation of the Department of Energy (DOE) and its national laboratories.

This order launches the "Genesis Mission" as a dedicated, coordinated national effort to unleash a new age of AI-accelerated innovation and discovery that can solve the most challenging problems of this century. The Genesis Mission will build an integrated AI platform to harness Federal scientific datasets — the world's largest collection of such datasets, developed over decades of Federal investments — to train scientific foundation models and create AI agents to test new hypotheses, automate research workflows, and accelerate scientific breakthroughs. The Genesis Mission will bring together our Nation's research and development resources — combining the efforts of brilliant American scientists, including those at our national laboratories, with pioneering American businesses; world-renowned universities; and existing research infrastructure, data repositories, production plants, and national security sites — to achieve dramatic acceleration in AI development and utilization. We will harness for the benefit of our Nation the revolution underway in computing, and build on decades of innovation in semiconductors and high-performance computing. The Genesis Mission will dramatically accelerate scientific discovery, strengthen national security, secure energy dominance, enhance workforce productivity, and multiply the return on taxpayer investment into research and development, thereby furthering America's technological dominance and global strategic leadership.

Sec. 2. Establishment of the Genesis Mission. (a) There is hereby established the Genesis Mission (Mission), a national effort to accelerate the application of AI for transformative scientific discovery focused on pressing national challenges.

Secretary Wright has designated Under Secretary for Science Darío Gil to lead the initiative. The Genesis Mission will mobilize the Department of Energy's 17 National Laboratories, industry, and academia to build an integrated discovery platform.

The platform will connect the world's best supercomputers, AI systems, and next-generation quantum systems with the most advanced scientific instruments in the nation. Once complete, the platform will be the world's most complex and powerful scientific instrument ever built. It will draw on the expertise of roughly 40,000 DOE scientists, engineers, and technical staff, alongside private sector innovators, to ensure that the United States leads and builds the technologies that will define the future.

The Genesis Mission will focus on addressing three key challenges of national importance:

- **American energy dominance:** The Genesis Mission will accelerate advanced nuclear, fusion, and grid modernization using AI to provide affordable, reliable, and secure energy for Americans.
- **Advancing discovery science:** Through DOE's investment and collaboration with industry, America is building the quantum ecosystem that will power discoveries—and industries—for decades to come.
- **Ensuring national security:** DOE will create advanced AI technologies for national security missions, deploy systems to ensure the safety and reliability of the U.S. nuclear stockpile, and accelerate the development of defense-ready materials.

European context

European Commission

EUROPE'S BUDGET

HORIZON EUROPE (2028-2034)

JULY 2025

Horizon Europe (2028-2034) will build on the achievements of its predecessors, scaling what works, simplifying what is possible, and focusing investment where Europe needs it most. It will be tightly connected to the European Competitiveness Fund.

Why is this a priority?

Horizon Europe (2028-2034) will boost Europe's productivity and competitiveness, while also improving the well-being of millions of people across the continent.

What is the Commission proposing?

With a proposed **€175 billion** budget, the new programme will be based on four pillars.

Pillar I	Pillar II	Pillar III	Pillar IV
EXCELLENT SCIENCE	COMPETITIVENESS AND SOCIETY	INNOVATION	EUROPEAN RESEARCH AREA
€44.079 BILLION	€75.876 BILLION	€38.785 BILLION	€16.262 BILLION
EUROPEAN RESEARCH COUNCIL	COMPETITIVENESS[1]: 1. Clean Transition and Industrial Decarbonisation 2. Health, Biotech, Agriculture and Bioeconomy 3. Digital leadership 4. Resilience and Security, Defence Industry and Space	EUROPEAN INNOVATION COUNCIL	ERA POLICIES
MARIE SKŁODOWSKA-CURIE ACTIONS	SOCIETY: 1. Global societal challenges 2. EU Missions 3. New European Bauhaus Facility	INNOVATION ECOSYSTEMS AND THE KNOWLEDGE TRIANGLE	RESEARCH AND TECHNOLOGY INFRASTRUCTURES
SCIENCE FOR EU POLICIES			WIDENING PARTICIPATION AND SPREADING EXCELLENCE

[1] Consistent with activities under the European Competitiveness Fund

How will the budget make a difference in this area?

Simpler, faster access

- Less red tape with shorter work programmes, open-topic calls by default, and unified funding rates
- Speedier grants, reducing time between application and funding
- Simplified costs with lump-sum funding options for easier budgeting

Strengthened European Research Council

- Funds frontier research by excellent researchers
- Promotes Choose Europe

Expanded European Innovation Council to boost innovation

- Supports deep tech startups in sectors like quantum, biotech, clean tech
- Offers agile funding for innovative projects
- Supports high-tech dual use and defence startups and scaleups

Collaborative research

- Addresses societal challenges like disinformation and climate change and boosts EU competitiveness, aligned with the objectives of the European Competitiveness Fund

Streamlined partnerships with Member States and the private sector

- Simplifies their organisation and operations
- Envisions more focused partnerships aligned with strategic industrial sectors for our competitiveness, security and resilience
- Leverages private investments
- Pulls R&I investments between the EU and Member States

More support for research and technology infrastructures

- Funds cutting-edge research and technology infrastructures
- Supports facilities, resources and services

Spreading excellence

- New tailored approach, focusing on actions to increase R&I performance, enhance research capacity and ecosystems and combat brain drain.

Moonshots

Objective: ambitious technology driven projects that boost the EU's strategic autonomy through research, development and deployment.

the future circular collider ▸ clean aviation ▸ quantum computing ▸ next-generation AI ▸ data sovereignty ▸ automated transport and mobility ▸ regenerative therapies ▸ fusion energy ▸ space economy ▸ zero water pollution ▸ ocean observation

Publications Office of the European Union

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KI-01-25-147-EN-N

EUROPE'S BUDGET

National context

DE ROUTE NAAR TOEKOMSTIGE WELVAART

Een sterk Nederland in een relevant Europa

Trage groei en technologische afhankelijkheid: waarom Nederland nu moet ingrijpen

RAPPORT WENNINK

Daarmee worden Nederlandse investeringen in kennis de facto ontwikkelingshulp voor landen als Singapore en de VS.

INHOUDSOPGAVE

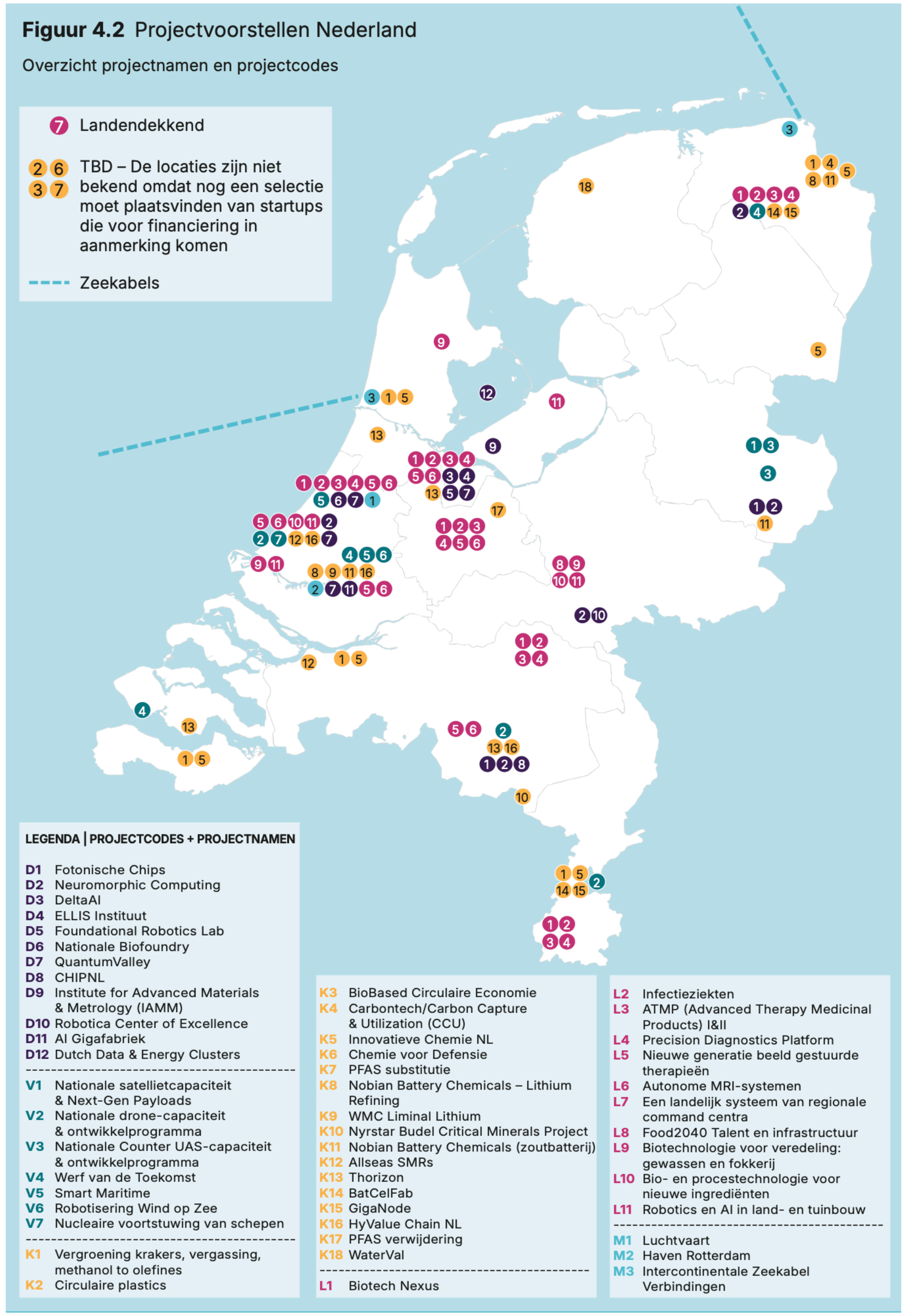
- Digitalisering & AI;
- Veiligheid & Weerbaarheid;
- Energie- & Klimaattechnologie.
- Life sciences & Biotechnologie;

European Competitiveness Fund

- Versnel vergunningverlening en versimpel regels;
- Kies voor het talent dat de toekomst nodig heeft;
- Zorg voor betaalbare en betrouwbare energie; en
- Versterk de economische infrastructuur.

Nationaal Groeifonds -> Nationaal Agentschap voor Baanbrekende Innovatie

National context



European Competitiveness Fund

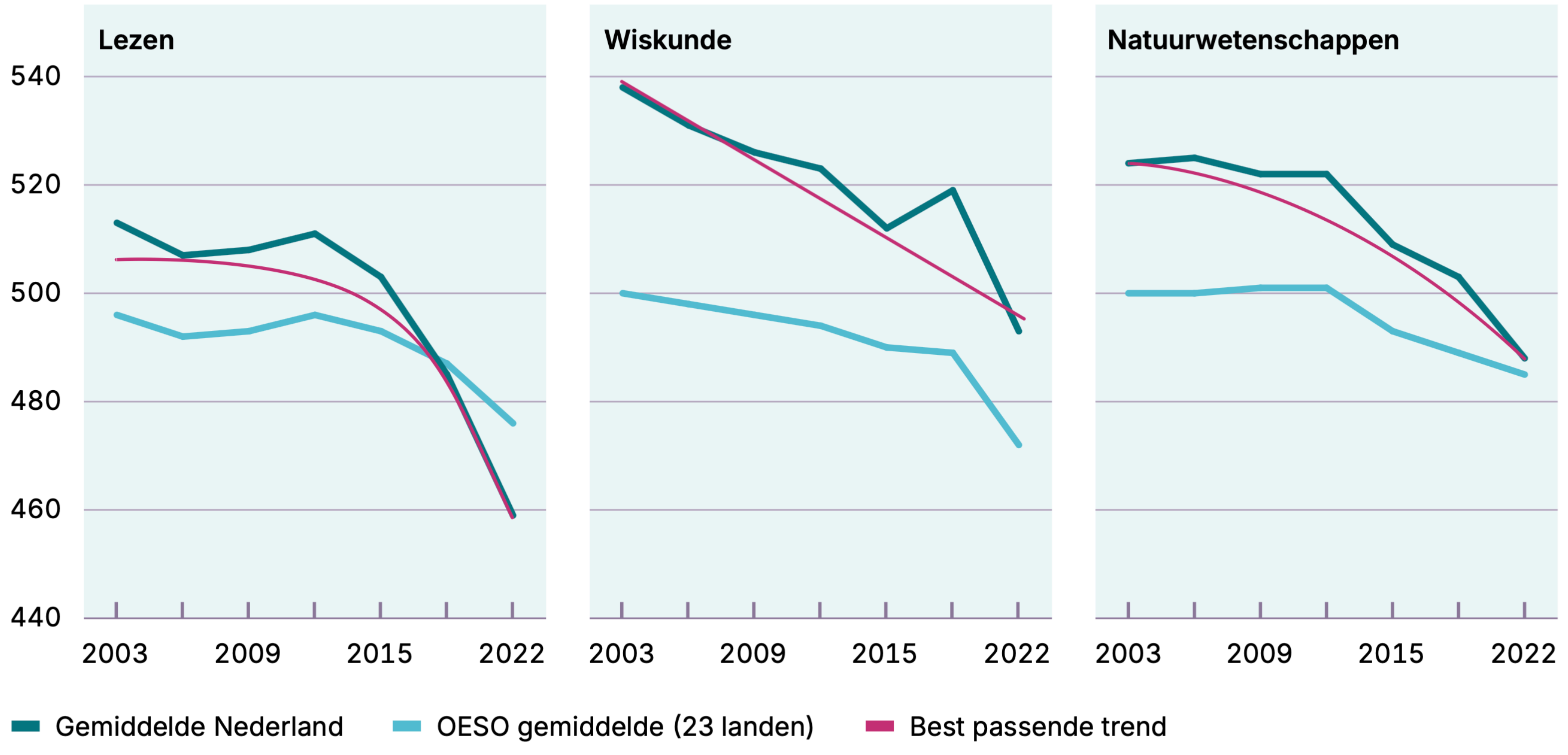
National context

We verliezen onze basis in het onderwijs

Juist nu Nederland een hoogproductieve beroepsbevolking het hardst nodig heeft, daalt een van de sterkste bepalende factoren van productiviteit: de kwaliteit van het onderwijs. Hoewel de overheidsuitgaven aan het onderwijs sinds 2000 als percentage van het bbp zijn gestegen, zijn onze onderwijsprestaties in diezelfde periode juist hard gedaald, zoals te zien in Figuur 3.7. Nederlandse jongeren presteren steeds slechter in lezen, wiskunde, en natuurwetenschappen, zowel vergeleken met vorige generaties als met hun internationale leeftijdsgenoten. Vooral onder vmbo-leerlingen is de daling groot: twee tot vier keer zo hoog als bij havo en vwo. Die prestatiedaling wordt verbloemd door steeds simpelere examens. In wis- en natuurkunde wordt nu 40 tot 50% minder stof getoetst dan 30 jaar geleden, en ook het niveau van de vragen is gedaald. Dat betekent dat de examencijfers in Wiskunde A, Wiskunde B en Natuurkunde gemiddeld met 0,7 punt zijn gestegen, maar de kennis van onze leerlingen hard daalt. We sturen simpelweg niet genoeg op excellentie.

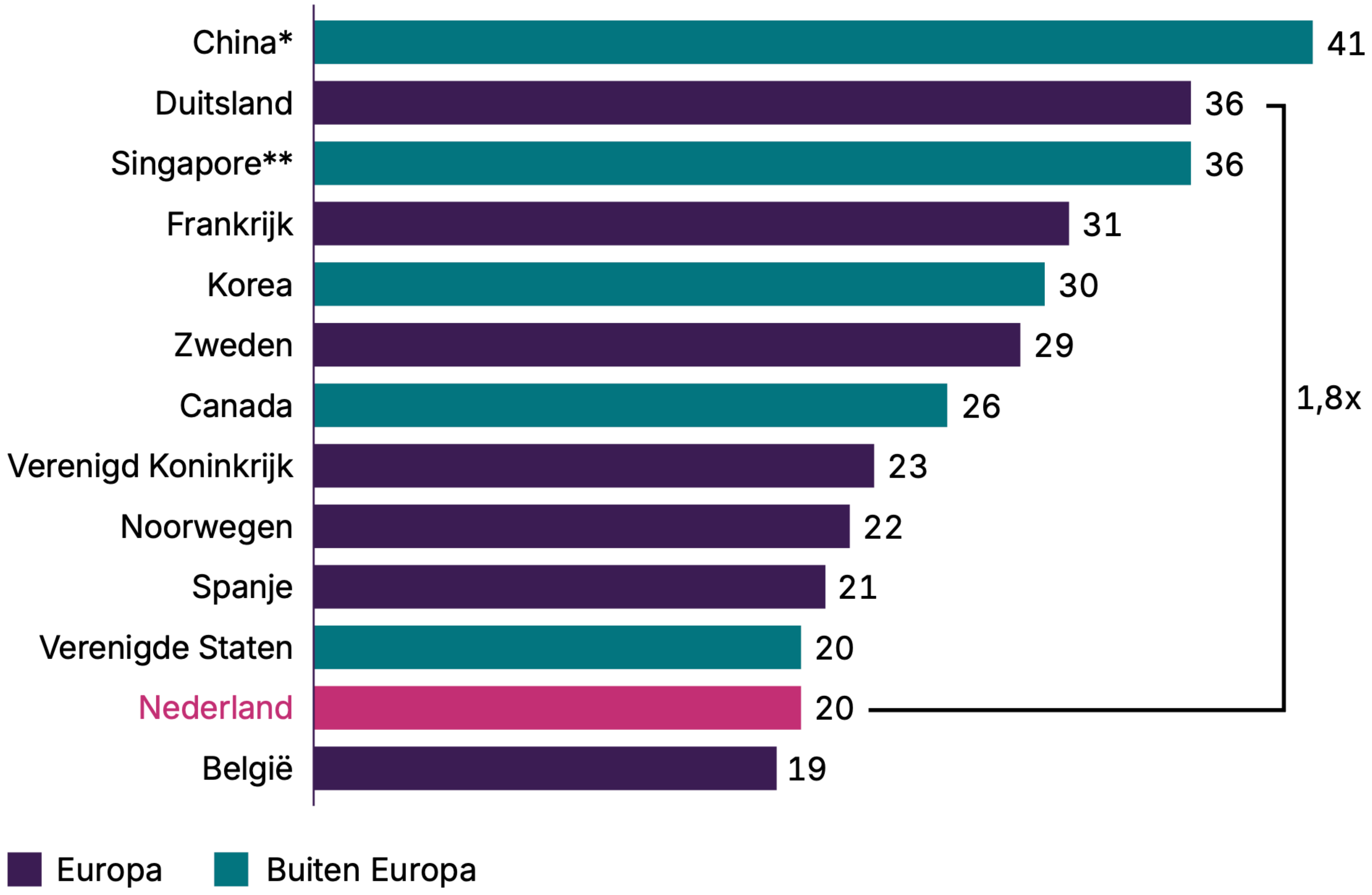
Figuur 3.7 Ontwikkeling van Nederlandse 15-jarigen gemeten in PISA-scores (Programme for International Student Assessment) sinds 2002, afgezet tegen het OESO gemiddelde[49]

In PISA-scorepunten



Figuur 3.8 Aandeel STEM-afgestudeerden in het hoger onderwijs, per land[59]

Als percentage (%) van het totale aantal afgestudeerden



National context

Ministerie van Economische Zaken en Klimaat

De Nationale Technologiestrategie

Bouwstenen voor strategisch technologiebeleid

Managementsamenvatting

Waarom nu?
- Internationale technologische competitie is sterk toegenomen
- Andere landen zetten gerichter (slimmer) in op strategische sleuteltechnologieën
- Technologie kan uitdagingen op gebied van bijvoorbeeld zorg of veiligheid oplossen

Wat is de NTS?
De NTS prioriteert 10 sleuteltechnologieën die:
1. een grote bijdrage leveren aan ons verdienvermogen
2. cruciaal zijn voor maatschappelijke uitdagingen
3. belangrijk zijn voor de nationale veiligheid
4. Nederlands technologisch leiderschap mogelijk maken

Wat doen we nog meer?
- Inzet op alle 44 sleuteltechnologieën via het missiegedreven innovatiebeleid
- Brede basis: Inzet op ontwikkeling, toepassing en opschaling van technologie met innovatie-, ondernemerschaps-, en industriebeleid

Sterktes Nederland
- Hoge kwaliteit wetenschappelijk onderzoek
- Goed opgeleide bevolking
- Sterke internationale verbindingen
- Veel publiek-private samenwerking

Zwaktes Nederland
- R&D-investeringen lopen achter
- Toepassing van technologie (valorisatie)
- Beperkte gerichte inzet op sleuteltechnologieën

De 10 prioriteiten
- Optical systems and integrated photonics
- Quantum technologies
- Process technology, including process intensification
- Biomolecular and cell technologies
- Imaging technologies
- Mechatronics and optomechatronics
- Artificial intelligence and data science
- Energy materials
- Semiconductor technologies
- Cybersecurity technologies

Agenda's en ambities
Per prioriteit formuleren we één agenda met ambities: stippen op de horizon. Hoe kunnen we Nederland positioneren in 2035? Wat is er nodig om dit te bereiken?

Wat is er nodig?
- **Talent** Aantrekken, behoud en doorontwikkelen (top)talent, op alle niveaus
- **Faciliteiten** Voldoende opschalingsfaciliteiten voor de ontwikkeling en toepassing van technologieën
- **Financiering en marktcreatie** Zorg voor voldoende opschalingsfinanciering en goede markttoegang. Kijk waar de overheid als launching customer op kan treden

5 Conclusions and Recommendations

Much has been achieved since the writing of the Sector Plan visions for chemistry and physics in 2007 and the installation of the Breimer Committee in 2009. The focus areas identified by the deans of the Faculties of Science have been strengthened with excellent researchers and the international influx of students has increased.

Now is the moment to ensure that the excellent position of Dutch physics and chemistry is maintained. This should not be taken for granted, as the world has changed considerably since 2007 and there is fierce international competition for talent. Germany for instance is increasing significantly its investments in top research (at an annual level of 5% for key institutions and funding agencies), aggressively recruiting leading researchers and enabling innovation.

In Chapters 2 and 3 we have outlined important societal and scientific challenges that need to be addressed. They require interdisciplinary approaches based on robust and vigorous chemistry and physics disciplines. We strongly recommend an extension of the current Sector Plan, taking into account the observations and recommendations listed below and translating them into a concrete action plan for which adequate funding should be made available.

Whereas many recommendations can be seen as a continuation of the current Sector Plan, we have added essential new elements for a follow-up:

- education needs to be strengthened at the pre-university level (1 and 2);
- attraction of top researchers calls for additional measures (5 and 6);
- multi- and interdisciplinary research needs more attention, including engineering (7, 8, 11);
- and actions are needed to bridge science to innovation (12).

The recommendations of this report have been grouped into three clusters: education, research, and society and innovation. Taken together they should enhance the quality of Dutch science education, boost the international influx of talent at all levels, and increase the volume of support for research and innovation, nourished by bottom-up initiatives.

Education

1. START EARLY

Observation: Young children are very interested in the grand questions of life and the universe, yet there is little in the curriculum of primary schools to feed this natural curiosity. When this curiosity is not nurtured, it tends to disappear quickly. As a result, many adults are not aware of the prominent role of science in the welfare of our everyday lives.
Recommendation: *Educate and appoint dedicated science teachers at each primary school to educate children for a few hours per week on the grand questions and to encourage the fun and fascination for science and technology. Provide good teaching programmes and materials.*

2. EMPOWER THE CHEMISTRY AND PHYSICS TEACHERS

Observation: Academically trained teachers in secondary school are crucial to provide the scientific literacy, flexible curriculum, and career awareness required for students to choose a future in chemistry and physics. The number of teachers with an academic degree in physics or chemistry however is gravely insufficient and further declining.
Recommendation: *The number of academically trained teachers has to increase. Physicists and chemists who opt for a career change towards teaching should get maximum financial and educational support. Universities should foster a strong coupling between teacher education centres and physics and chemistry departments. Teacher education must be of an excellent academic standard, reflecting modern developments in chemistry and physics as well as methods to transfer this knowledge to the future. Establishing a national centre of expertise in science teaching should be explored.*

3. ATTRACT THE BEST STUDENTS IN THE WORLD

Observation: University education will soon be a global enterprise with a majority of international students at major institutions. There will be an increased international competition to attract the best students.
Recommendation: *Dutch physics and chemistry departments should unite and jointly recruit the best international students under the name 'University of the Netherlands' with branches at the various locations. Physics and chemistry can act as a pilot in establishing attractive scholarships for the best students, e.g. through a public-private partnership as in the Chemiebeurzen-initiative in the Top Sector Chemistry. [We propose 40 fellowships for physics and chemistry, each k€ 12 per year plus waiver of tuition fees.]*

4. ATTRACT MORE FEMALE AND MINORITY STUDENTS AND FACULTY

Observation: Chemistry and in particular physics attract constant low percentages of female students or students from minority groups, thereby missing out on a considerable talent pool. Recommendations 1 and 2 should improve this in the future. International recruitment, where chemistry and physics are well positioned, provides another opportunity to increase the number of female and minority students. The efforts to recruit more female faculty members show encouraging results, although the growth rate is too low to meet the target of 20% female staff in 2020.
Recommendation: *Recruitment of women and minorities needs continuous emphasis, e.g. by establishing a larger number of role models at all career levels. Create incentives to reward the selection of women and minorities in funding schemes (see Recommendations 5 and 6 below).*

Research

5. ATTRACT THE BEST EARLY-CAREER RESEARCHERS

Observation: Recruitment of early-career researchers has become an international competition with start-up packages being vitally important. Recently, the Netherlands has been increasingly losing this competition for talent, for two important reasons: (1) the start-up packages fall short compared to international offers, and (2) assistant and associate professors in the Netherlands do not have the 'ius promovendi' which is taken as a lack of trust.
Recommendation: *Establish a scheme for start-up grants with a short evaluation time to create a significant advantage for institutions during competitive negotiations. [~M€ 1 per start-up package.] Give qualified junior professors the 'ius promovendi'.*

6. ATTRACT AND RETAIN THE BEST SENIOR SCIENTISTS

Observation: Inspiring senior scientists have a special role in attracting and developing new talent, i.e. 'making school'. To attract and retain these role models financial support is needed beyond the NWO Vici grant that can match offers made by other countries.
Recommendation: *Establish a national fund to attract world-leading senior professors, such as the M€ 5-Alexander von Humboldt Professorships in Germany. To retain top senior scientists personal grants should exist beyond the level of Vici for the full length of an academic's career.*

7. BOTTOM-UP FUNDING

Observation: Despite the fact that scientific breakthroughs are often the result of bottom-up, curiosity-driven research, there is a growing trend to define research programmes within strategic frameworks. Consequently, the options for non-thematic projects and programmes have decreased and will decrease further. Good ideas usually cross borders of disciplines and create innovators rather than followers.
Recommendation: *Good ideas need funding, irrespective of strategic choices. The level of funding for undirected small-scale grants urgently needs to be restored to the level in the year 2000.*

8. FUTURE-PROOF CHEMISTRY AND PHYSICS

Observation: The natural multidisciplinary of both disciplines does not easily obey organisational boundaries. An undesirable side effect of strategic research funding is the formation of a fragile cluster of a small number of excellent groups in narrow focus areas. The grand scientific and societal challenges call for a broader range of expertise than covered by current funding models, which are leading to non-funded 'blank spots' of excellent and relevant research, such as the molecular life sciences that are mostly outside chemistry departments.
Recommendation: *Include the full research agenda of chemistry and physics outlined in Chapter 3 into a future Sector Plan, to maintain the inherently multidisciplinary nature, sustain critical mass and avoid blank spots.*

9. RESEARCH INFRASTRUCTURE

Observation: Equipment infrastructure is a sine qua non. The increasing complexity of research requires more advanced equipment, no longer affordable to individual research groups.
Recommendation: *Infrastructure programmes and funding for national or regional facilities should ensure national/regional access. These programs should be adapted such that they include support for infrastructure and research facilities over periods of time that extend beyond the 2-4 year funding cycles. Participation in and access to research infrastructure facilities at the European and global scale should be a high priority and coordinated nationally. The Netherlands should be a strong advocate for a more coherent European large-infrastructure policy.*

Society and Innovation

10. PUBLIC AWARENESS

Observation: Physics and chemistry lie at the basis for many of the solutions for grand societal challenges. The general public is not aware of this importance, and political appreciation is poor and needs to be improved. Exemplary cases of effective public outreach by scientists exist, but they are too few in number and remain unstructured.

Recommendation: *Continue the growing number of successful outreach activities such as Lowlands University. Science should strive for a sustainable presence in the popular media. Universities, schools, funding agencies and professional societies should highlight more effectively the important role that physics and chemistry play in addressing societal challenges motivating potential new groups of students and researchers.*

11. BRIDGE SCIENCE TO ENGINEERING

Observation: Major scientific questions, major societal challenges, and industrial problems often call for researchers in engineering disciplines to work alongside researchers in basic science. This requires a change of mentality and understanding in both teaching and research. Scientists and engineers together need to generate breakthrough solutions that go beyond incremental progress, also outside the technical universities.

Recommendation: *Establish new funding for 'breakthrough engineering' research with an associated honours-level curriculum.*

12. BRIDGE SCIENCE TO INNOVATION: THINK GLOBAL – ACT LOCAL

Observation: Big challenges require coordinated interdisciplinary approaches that go beyond the scale of individual research groups. The Netherlands has a good tradition in building and maintaining contacts and dynamics between academia and existing industry. The Netherlands, however, lacks high-risk funding systems such as venture capital, hampering start-ups and their growth to a hundred employees and on to new industries and ecosystems. To compete worldwide, the Netherlands should strengthen research and technology hotspots containing small and large companies around universities.

Recommendation: *A part of the innovation (e.g. top sector) policy should focus on future industries based on current scientific strengths in the Netherlands. The equipment infrastructure at universities should be easily available to SMEs. National and local governments should stimulate regional ecosystems around universities, where start-ups are supported by experienced management. Such ecosystems will multiply human capital and infrastructural investments. In these ecosystems mission-oriented research centres should be supported that address big challenges requiring a multi- and inter-disciplinary approach, such as the Dutch Institute For Fundamental Energy Research (DIFFER) and the ASML-FOM-UvA-VU Advanced Research Centre for NanoLithography.*

- What are the key future research areas in physics?
- What additional funding is needed, and for what purpose (e.g., PIs, PhDs, postdocs, technical support)
- What major investments will be necessary in the coming years?
- Are there important areas at risk of disappearing?
- In which areas can we collaborate with industry?
- How can we train talented people with the right skills for society?
- How can physics be made more visible to society and policymakers, showing its importance for jobs, technology, sustainability, etc,?
- How can we better support early career researchers?
- Any other questions you think are relevant

Thank you!