NATIONAL COOPERATION AGENDA COMPOSITE

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Source: Fiberneering

“In order to contribute to the societal challenges and to seize the economic opportunities, we have to join forces as a small composite country”

SUMMARY

In order to tackle the global social challenges and to seize economic opportunities, the government is committed to a mission-driven innovation policy with impact. Pressure is high but if we want to preserve our prosperity and at the same time address the social challenges, we need to change our ways and develop new and pioneering technologies. Composites or fibre-reinforced plastics can play an important role in finding solutions and answers to these social challenges, such as reducing the CO2 footprint, circularity and energy transition. Composite technology is highly valuable because of its product characteristics and the potential to adapt these properties and add (smart) functionalities. Through the development and use of new materials and technologies, new functions become possible and old functions can continue to exist with significantly lower impact on the living environment, at comparable costs as other materials (such as steel and aluminium).

In the Netherlands, composites are mainly applied in aerospace, in the maritime sector, the automotive sector, energy & offshore and construction & infrastructure. The Netherlands traditionally hold a strong position in the European composites industry, driven by parties such as the Netherlands Aerospace Laboratory, Fokker, Damen, Ten Cate and VDL. A number of innovative SMEs such as Airborne, Dutch Thermoplastic Components (DTC) and KVE Composites group were recently added to the above group. From a technological perspective, the Netherlands are global players in the field of the design and industrialisation of products, material development and sustainability in high-grade fibre-reinforced plastics. Worldwide, the pace of innovation is increasing and increasingly stringent requirements are attached to robust, automated production solutions. Everything is aimed at reducing the cost price of composite products or products containing composite. The Dutch composite sector mainly consists of SMEs and collaborative projects are largely regional.

The reason for drawing up this National Cooperation Agenda for Composite is the fact that working on sustainability and the associated energy transition give a new dimension to the economic and social importance of lightweight materials and applications that have long service lives and which are increasingly suitable for reuse at the same time. Composite technology can make a tangible contribution to achieving the international and national climate goals, for example, by facilitating electric transport.
This will strengthen public-private partnership, also because the Dutch government is developing a mission-driven policy in which the global social challenges serve as a departure point, also in terms of the economic policy.

The Dutch composite sector aims to make a significant contribution to the reduction of CO_2 emissions by using more composites and by making the production and use of composites more energy-efficient and more circular. This strengthens the competitive position of the Dutch sector, which will translate into growth in terms of turnover and employment.

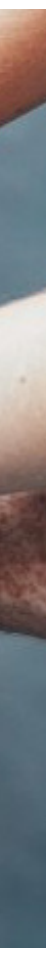
Increasing demand for strong, lightweight structures with long service lives and low maintenance and the development of materials and applications with very specific properties ensure that the international market continues to grow steadily by 4 to 5% per year. This creates a positive perspective for the global composite sector. In the maritime sector, automotive sector and the construction & infrastructure sector, composite has a market share varying from 2 to 4% compared to other materials. The market for composites offers great opportunities for economic growth and new employment. Measured by composite production per capita, the Netherlands are leading together with Germany.

Based on the above departure points, the composite sector has expressed the ambition to grow faster than the international average and to double current turnover levels (2018: €1.0 billion) by 2030.

In order to realise this ambition, the technological development of the Dutch composite sector focuses on the following spearheads:
- Radical cost reduction
- Sustainability
- Accelerating the adoption and acceptance of composite technology.

Six national action programmes have been defined within these spearheads:
1. Sustainable Composites
2. SME Scale-up
3. Automated Composites
4. Digital Composite Manufacturing
5. Next Generation Thermoplastics
6. Large structure composites

As part of this approach, parties unite in clusters that reinforce each other and that collaborate specifically on innovation and the development of composite technology. Many parties in this area of expertise and application domains have already found each other, particularly at a regional level and in projects per sector. This already involves extensive investments in public-private partnerships (€ 90 million over the last 5 years). In the future, these will be brought together in national programmes through the National Cooperation Agenda for Composite, which form a prelude to future projects. The implementation of the 6 action programmes requires an investment of €180 million for the next 5 years, i.e. € 36 million per year. This equals a doubling of efforts compared to the recent past.



In order to contribute to the social challenges and to seize the economic opportunities, the Netherlands, being a small knowledge country, have to join forces. In order to ensure a successful positioning within the European and worldwide markets, the Netherlands need to present themselves as a single Dutch composite cluster, in which the various stakeholders and regions work together. This collaboration is given shape through the Dutch Composites Platform, a small flexible organisation that will work out the National Cooperation Agenda for Composite in an implementation plan and supervise the implementation itself. Within the DCP, CompositesNL, the regional development companies and the current top sectors (HTSM and Chemistry in particular) play an important role, especially when drawing up new Knowledge and Innovation Agendas (KIAs) for the mission-driven policy. As part of the efforts, a link-up is sought with other clusters (robotics, photonics, mechatronics) and new areas of application.

The Dutch Composites Platform will use existing research programme structures (Materials NL), field labs and open innovation centres, with regard to technology development through all technology readiness levels (TRL). Other critical policy areas such as Human Capital, internationalisation and laws and regulations are also included in the elaboration of the implementation plan.

This National Cooperation Agenda for Composite is supported by many companies, knowledge institutions, other trade associations (Netherlands Aerospace Group, AutomotiveNL, Netherlands Maritime Technology) but also by the top sectors Chemistry and High Tech Systems and Materials.

PREFACE

We are proud to present the National Cooperation Agenda for Composites!

The Netherlands is a strong country in the field of composites, distinguishing themselves internationally through globally leading material and process technologies, progressive applications in many market sectors and a leading position in automation and digitisation.

The Netherlands has a rich and diverse landscape for knowledge and innovation development for composite technology, often embedded in regional initiatives and field labs. For the first time in history, these innovation activities are bundled at a national level through this agenda, creating synergy and critical mass in the process, enabling better coordination and strengthening our international standing.

The main objective of this agenda is to improve national cooperation. Composite is a cross-sectoral technology, with applications in many market sectors, from aerospace to deep-sea offshore, from maritime to automotive and from bridges to consumer products. All these applications do require specific materials, designs and production technologies, of course, yet there are many challenges the different parties face that are, in fact, comparable. Hence there is much to learn by working together across the sector boundaries. Some markets are very high-quality but require lower production volumes, whereas other markets are much more optimised towards costs and/or focussed on mass production. By working together, we can learn from each other and innovate much more efficiently and quickly.

This cooperation agenda describes the future development of composite technology in the Netherlands. Composites are a crucial technology to make our society more sustainable. To name a few examples: thanks to the low weight of composite, energy consumption can be reduced. Composites last longer than conventional materials so that the ecological impact of products can be reduced. Thanks to their excellent mechanical properties, high-quality products such as wind turbine blades or high-pressure hydrogen tanks can be made that can accelerate the energy transition.

The ambition of this agenda is to make a material and international contribution to the sustainability of our society. The Netherlands can become leaders in this, as we have all the in-house knowledge and skills required. This not only benefits ourselves, but also means we can create an attractive export product at the same time. Traditionally, the Netherlands has been strong in disruptive composite innovations that help to innovate the international production chain, and we can further strengthen that position.

This agenda describes the technological challenges that have to be addressed in order to realise this ambition, the national action programmes needed for this and how we can organise the far-reaching cooperation at a national level. It forms the basis for further elaboration in an implementation plan and will be embedded in the knowledge and innovation agendas of the top sectors as part of the new mission-driven government policy and in the national key technologies. In addition, it will be introduced to the new MaterialsNL platform, set up by the top sectors HTSM, Energy and Chemistry to coordinate material research.

This agenda has been made possible with broad involvement of the entire sector and is a collaboration with the top sectors HTSM and Chemistry and is directly supported by the Regional Development Companies. We would like to thank everyone for their contribution to this National Cooperation Agenda for Composite and look forward to the further elaboration and realisation of the ambitions. Time to roll up our sleeves!

Kind regards,

Marc Hendrikse
Chairman of the Dutch Governmental
High Tech Systems and Materials Top Team

Emmo Meijer
Chair top sector chemistry

Marcus Kremers
Chairman CompositesNL

COMPOSITE

Composite is a material that consists of at least two materials which combined properties outperform those of its individual components.
In the composite sector, this is referred to as high-grade fibre-reinforced materials such as carbon, glass, aramid, polymer or natural fibres embedded in a matrix.

The many possible combinations of materials and production technologies offer great freedom in terms of the design of end products, taking maximum advantage of the most important properties of composite materials, viz. lightweight, strength, rigidity, long service life and many other properties, such as the generation of light and the transmission of radio signals.

An important aspect therein is the potential of composite to adapt these properties and to fully integrate new functionalities , making composite much more of a technology rather than just a material.

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Source: NLR – Netherlands Aerospace Centre

1 COMPOSITE CAN BEAT THE CHALLENGE

The Paris climate agreement (end of 2015) has major consequences for the economic policy and associated technological developments. In the future, prosperity will be linked to sustainability. This poses major challenges for governments, companies and knowledge institutions. In order to provide a framework for this, new, pioneering technologies are needed.

Composite technology offers a lot of potential in terms of contributing to this future sustainable prosperity. Primarily because composite makes lightweight applications possible, which is important for transport and moving parts, for example. Not only do lightweight properties make it possible to reduce the consumption of fossil energy in existing applications, but also to develop alternatives that use renewable energy based on an improved mixture of costs and environmental impact. Examples include the transition from diesel and petrol-driven vehicles to electric transport. Windmills are a good example of a new application aimed at CO2 reduction and the potential is even far greater (for example, in all forms of transport). In addition, composite has the ability to be completely bio-based, both in resins and fibres. Finally, composite applications have properties that lead to less maintenance, longer service lives and various possibilities for high-quality reuse.

High-quality (continuously) fibre-reinforced plastics already play a role in many industrial products, particularly in aircraft, yachts, cars, windmills and sports products, such as tennis rackets or hockey sticks. However, the unused potential in shipbuilding, construction and infrastructure and the health sector is still enormous. Composite can play a role in all Climate Tables that prepare the sustainability policy for the next 20 to 30 years.

SMART, GREEN AND INTEGRATED TRANSPORT

The current transport systems and the manner in which we use them are not sustainable. We rely too much on dwindling stocks of oil, which hold us back in our efforts to secure more energy. And transport-related problems such as congestion, road safety and air pollution have an impact on our daily lives and health.

CLIMATE ACTION, THE ENVIRONMENT, RESOURCE EFFICIENCY AND RAW MATERIALS

The era of infinite cheap resources is coming to an end; access to raw materials and clean water can no longer be taken for granted. Biodiversity and ecosystems are also under pressure. The solution is to invest in innovation now in order to support a green economy.

SAFE, CLEAN AND EFFICIENT ENERGY

Energy drives the modern economy, but even just maintaining our current standard of living requires enormous amounts of energy. As the world's second largest economy, Europe is too dependent on the rest of the world for its energy supply: energy from fossil fuels that accelerate climate change. The urgency to use less energy and the need for energy from natural sources is undisputed.

Traditionally, the Netherlands are leaders in the field of composite technology. In the beginning, this mainly focused on aerospace, through Delft University of Technology. From here, all sorts of new applications and associated companies and knowledge centres were developed and formed. The Netherlands are known for its high-quality academic knowledge in the field of materials chemistry, which is one of the reasons why many international material suppliers are based in the Netherlands. The processing of composite materials into products takes place in the Netherlands at innovative SMEs which, from an international aspect, are deemed technology leaders. The industry is supported by a close-knit network of research institutions, innovation centres and field labs. The Netherlands are a global player in the field of design and industrialisation of high-grade fibre-reinforced plastics.
Based on this ecosystem, the Dutch composite sector is able to contribute to tackling the new social challenges.

MISSION-DRIVEN INNOVATION POLICY

The Dutch government, the Ministry of Economic Affairs and Climate in particular, has the challenge to focus the existing innovation policy based on the top sectors towards the new social challenges of our time, such as sustainable energy use, circularity and sustainable food production. The government aims to achieve this by preparing missions for these social challenges together with companies, knowledge institutions and social partners, based on economic opportunities. These missions will be adopted in April 2019. Long-term programmes are drawn up with the parties involved for key technologies in order to ensure that innovations come to fruition quicker.

KEY TECHNOLOGY

Four social themes are at the centre in the Mission-driven Innovation Policy and within the top sectors: agriculture, water & food; health & care; energy transition & sustainability and safety. The Netherlands can provide solutions to global challenges in these areas. As such, these themes are important not only to innovation but also to our future society and economy.

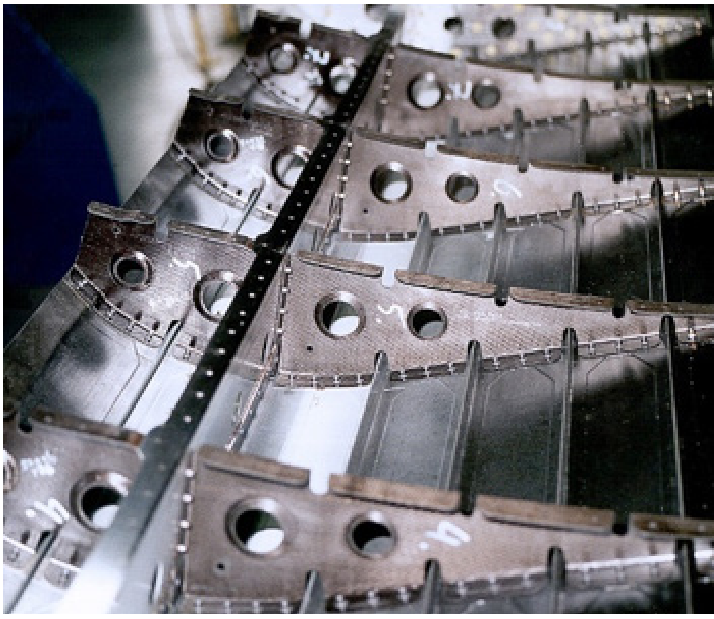
Technological developments are of paramount importance in order to achieve innovations aimed at these challenges. The central government focuses its innovation policy on the development of key technologies such as photonics, artificial intelligence, nanotechnology, quantum technology and biotechnology and lightweight materials. These innovations will change the way we live and work. For example, they help to develop efficient and sustainable agriculture or CO2-neutral energy sources.

At a European level, key technologies are referred to as Key Enabling Technologies (KETs). These are technologies that enable European industries to maintain their competitive positions and play a role in new markets. The EU distinguishes six KETs: micro-electronics and nano-electronics, nanotechnology, industrial biotechnology, advanced materials, photonics and advanced production technologies. KETs are the actual 'raw materials for innovation and a green economy'.

Composite technology is one of the technologies in which the Ministry of Economic Affairs and Climate sees potential within its mission-driven policy. Hence this National Cooperation Agenda for Composite, of which an important part is formed by the Knowledge and Innovation Agenda (KIA). The Dutch composite sector holds a particular social and economic potential to contribute to tackling the social challenges. Intensified and improved cooperation at national and European level is vital therein.

INNOVATION ENGINE

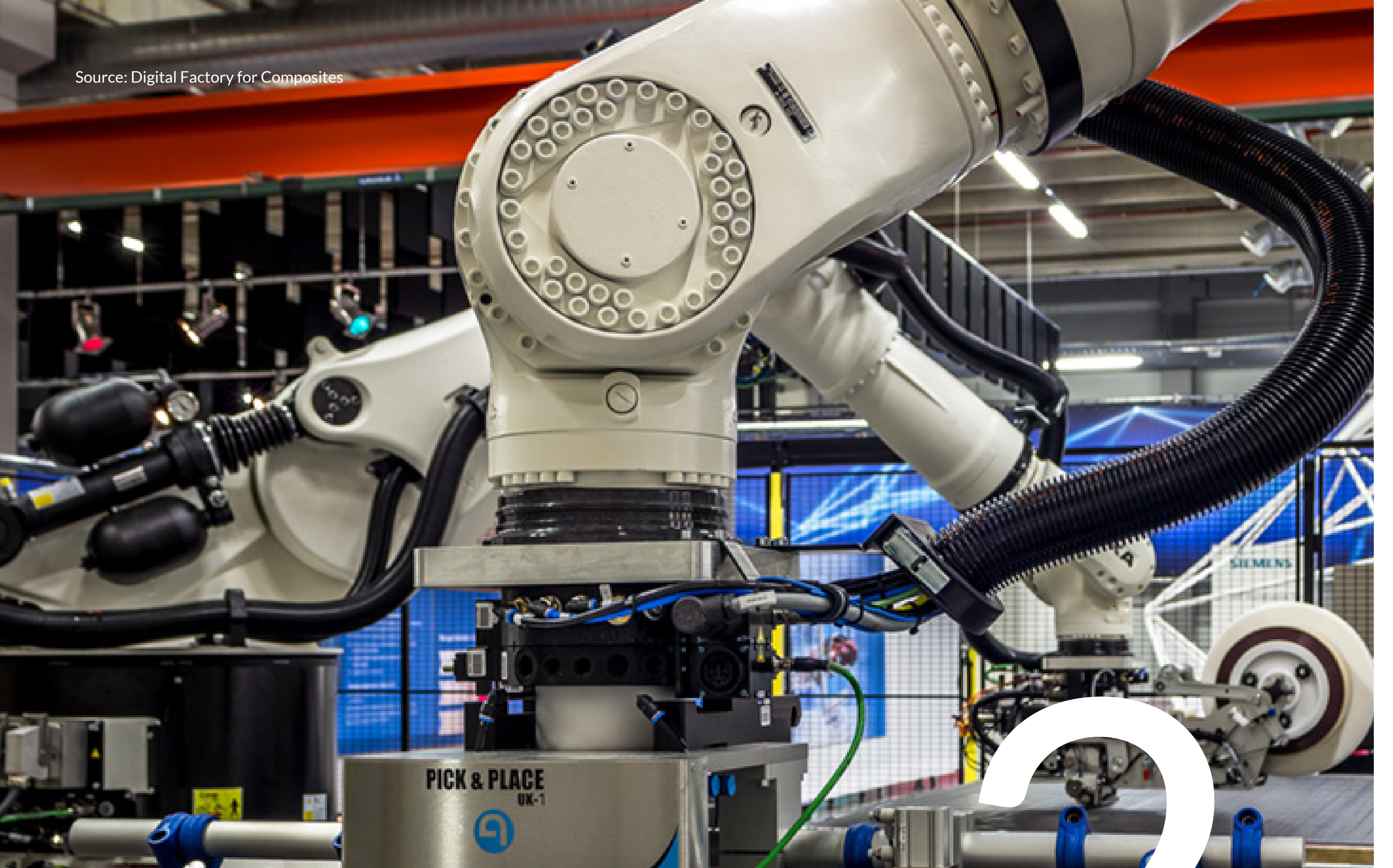
The Dutch composite sector (companies and knowledge institutions) recognises the role it can play in the mission-driven innovation policy of the Dutch government and wants to take the initiative therein. *The Dutch composite sector wants to be the innovative drive behind the development and application of affordable composite technology aimed at the sustainability of society.* The Netherlands are in a strong starting position with an innovative composite ecosystem that is held in high regard internationally. Being able to fulfil the role of innovation engine requires targeted and coordinated additional investments.



FROM AGENDA TO ACTION

The National Cooperation Agenda Composite formulates spearheads and associated action programmes and as such, it forms the basis for an implementation plan that can be worked out as a follow-up. Six national action programmes have been identified on the basis of an extensive consultation of the Dutch composites cluster. These are the building blocks for a socially relevant and economically healthy cluster. In addition, preconditions have been formulated that facilitate the implementation of the action programmes, such as sufficiently skilled staff, export opportunities for Dutch companies, involvement of innovative SMEs and start-ups, knowledge valorisation and the financial instruments; these are key focus areas here.

Chapter 2 of this document first provides an overview of the market for composite and the role of the Netherlands in it. In chapter 3, this is translated into an ambition and spearheads for the next 10 years, after which chapter 4 provides an overview of promising initiatives to shape these spearheads. In chapter 5, this is worked out in the organisation, the collaboration and the necessary investments.



Source: Digital Factory for Composites

2 TECHNOLOGY, MARKET AND THE ROLE OF THE NETHERLANDS

TECHNOLOGY

Composite is a material that consists of multiple components that are combined to develop strength. Composite technology is as old as humanity itself. In ancient Egypt (1500 BC) for example, people made boats, building materials and vases from a combination of straw (fibres) and clay (resin).
By applying this same principle with chemical components, the use of composite has seen major developments and growth since the beginning of the 20th century. The development of plastics (thermosets such as epoxy and polyester or thermoplastics such as polypropylene and polyamide) and glass fibres still forms the basis of many composite applications today. In addition to glass fibres, carbon fibre has become particularly popular in its application. These composite materials are produced on the basis of chemical reactions. In addition, there are thermoplastic composites that are made by heating short fibres and polymers.

Composite technology is complex, not only because it uses compound materials (containing multiple components) but often also because it is used in combination with other materials (hybrid structures) and in many different applications.

Figure 1: main application areas of composite technology in the Netherlands

The many possible combinations of materials and production technologies offer enormous freedom in terms of design, taking maximum advantage of the most important properties of composite materials, viz. lightweight, strength, rigidity, long service life and many other properties, such as allowing through light and radio signals. Many applications are, therefore, specifically designed and produced, certified and tested. The materials have high-quality properties, but are rather expensive. The production techniques are advanced but often still manual, partly because production series are still relatively small. These factors make composite in many cases an expensive technology compared to competing materials such as metal, aluminium, stone, wood and cement. That is why since the beginning of this century, attention has increasingly shifted towards industrialising and scaling up to larger production series. This trend has been set in motion, particularly from the automotive sector.

Lower costs and higher performance of composite technology are the guiding principles. Today, sustainability is added to this mix and this is where new added value of composite technology can be found, both in the production phase and use phase, as well as in the end-of-use/life phase. Through Life Cycle Analysis (LCA), the impact of composite technology can be compared with that of other materials.

The new requirements in the field of sustainability and the continuous pressure to reduce the costs of composite give the composite market new impulses and offer great potential for future growth. Apart from aircraft manufacturing, aerospace and wind energy, the market share of composite is low in many other applications and a lot of growth is still possible. By way of comparison, the global market for composite products totals approximately $ 80 billion and that of steel production approximately $ 1500 billion.

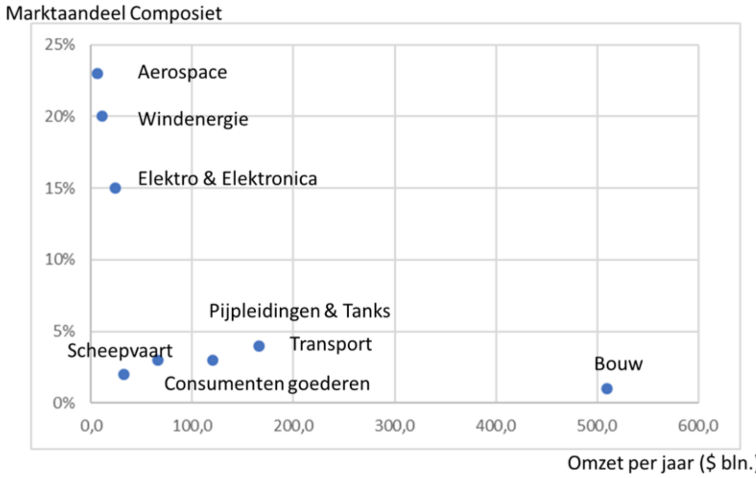


Figure 2: Market share composite compared to other materials for different application areas. Source: Lucintel

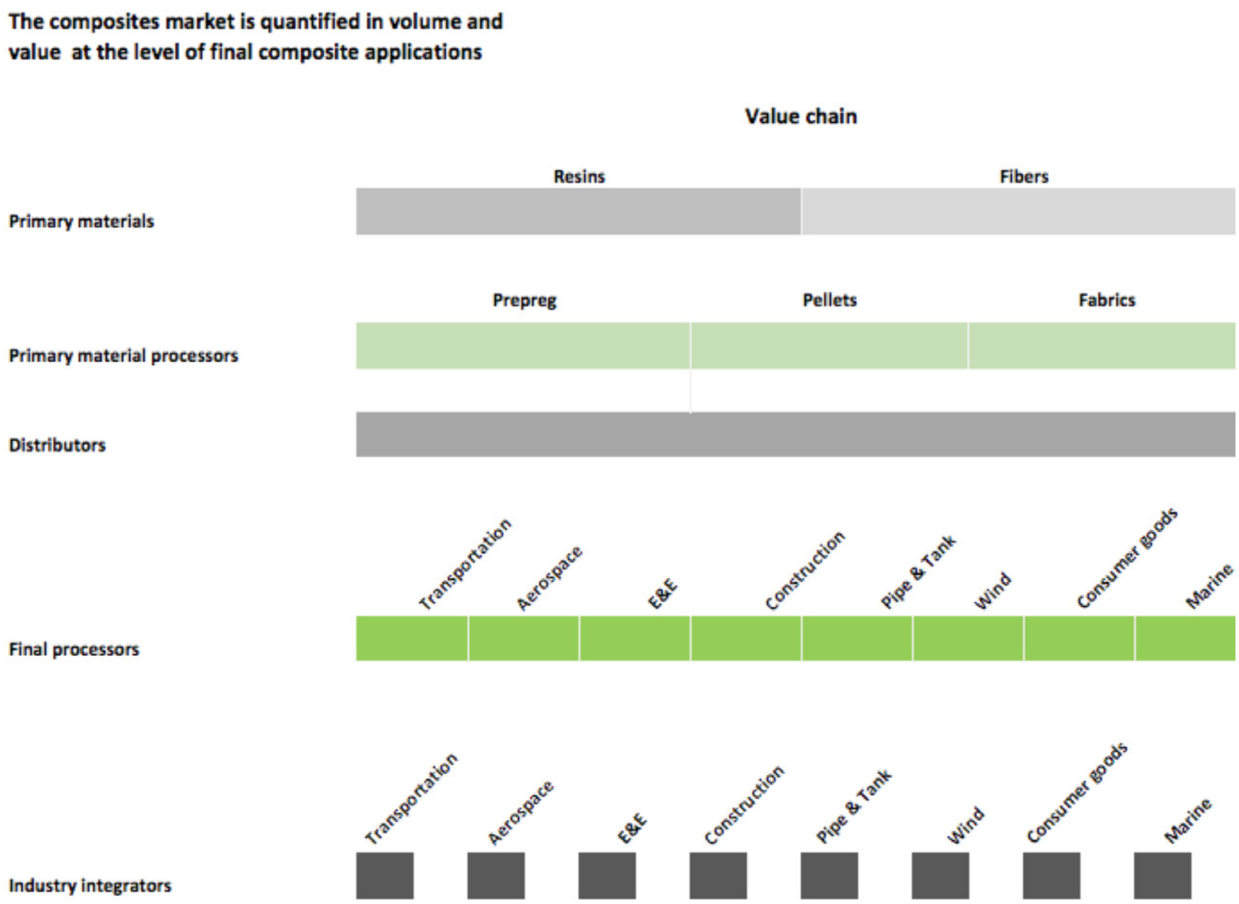


Figure 3: Overview of the value chain of composite materials and market volumes Source: JEC

MARKET DEVELOPMENT

The global composite market is growing by an average of 4 to 5% per year. The largest market growth is concentrated in Asia, North America and Europe. The table below shows the market growth in volumes compared to the market growth in value. This demonstrates that the market is growing steadily in the aforesaid regions, both in terms of volumes and value. The growth of the composites market thus translates into economic return.

2016	Aandeel gewicht	Aandeel waarde
China	29%	26%
Overig Azie	19%	18%
Noord Amerika	26%	29%
Europa	21%	21%
Overig	6%	6%
Totaal	100%	100%

Figure 4: Market share in weight and value of different regions Source: JEC

It is expected that this 4 to 5% of global growth will continue until 2022.

Growth is showing major regional differences. Since the financial crisis of 2008, growth in Europe is concentrated mainly in Germany and Eastern Europe, when measured in volumes.

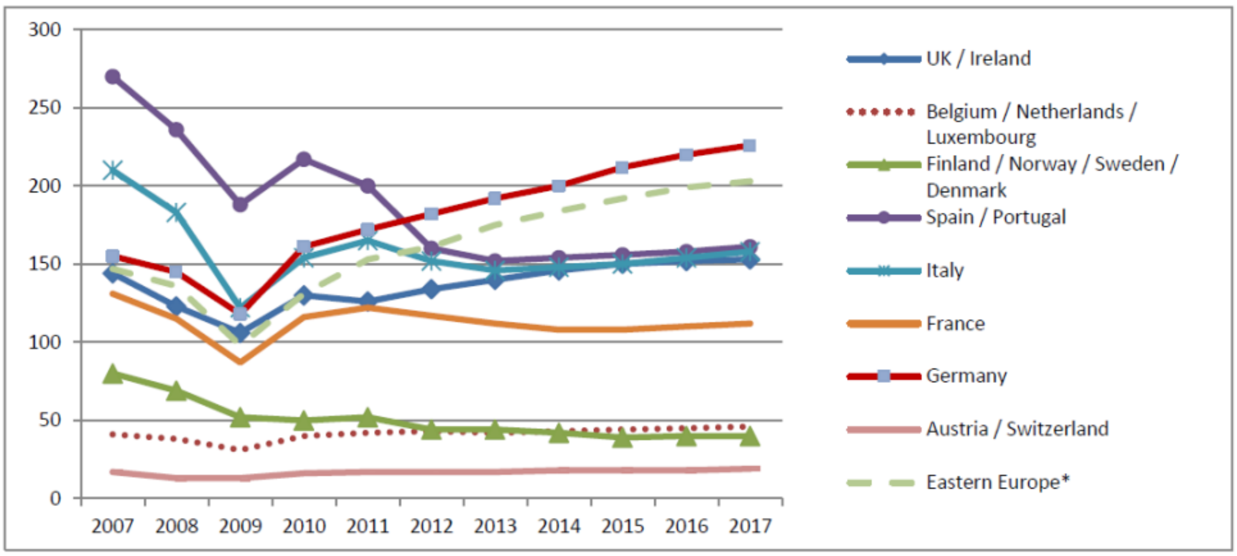


Figure 5: Differences in growth of composite production of countries in Europe. Note: this only concerns glass fibre-reinforced plastic. Source: AVK

Although the Netherlands have a modest market share in the high-volume markets, this is different in the field of more high-value technology applications, such as those of short fibres (thermoplastics) and carbon fibres. Measured by composite production per capita, the Netherlands are among the leaders, together with Germany.

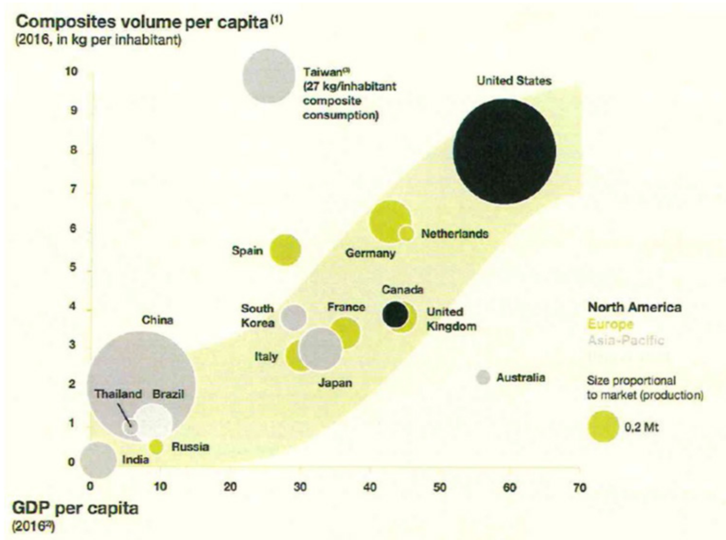


Figure 6: Market share composite per capita

Source: JEC

THE NETHERLANDS

> **The Dutch composite technology sector derives its economic value from a combination of four integrated processes:**
>
> **1. Design & engineering**
> **2. Material development**
> **3. Production technology**
> **4. Application development**

This integral approach plus the collaboration between the business community and knowledge institutions forms the foundation of the Dutch composite sector.

Traditionally, the Dutch composite sector has a strong bond with the knowledge and innovation structure. Important developments in the field of new materials have been initiated and brought to the market through Delft University of Technology and later on, the University of Twente. Examples include Dyneema, Glare and thermoplastic. In addition to fundamental research at the universities of technology, much of the applied research in the Netherlands is carried out by NLR, TPRC and Brightlands Materials Centre (TNO), in field labs such as SAM|XL and DFC and at various Universities of Applied Sciences (Inholland, Saxion, Windesheim and HAN). Despite this strong bond between the business community and knowledge institutions, the Netherlands are lagging behind other European countries in terms of R&D investments and budget. In Germany, substantial investments are made in initiatives such as the Aachen Zentrum für Leichtbau (AZL), Frauenhofer and CFK Stade (Niedersachsen finances Stade Nord with an amount of € 70 million per year). In the United Kingdom, the National Composites Centre in Bristol is one of many initiatives. The NCC is an investment of €25 million, funded largely by public money (local, European and national governments).

The link between knowledge and entrepreneurship is central to this cooperation agenda. On the one hand out of necessity, on the other hand because it gives the Netherlands a competitive edge on the global market. The knowledge intensity of the cluster attracts foreign composite companies. Several internationally renowned companies have offices in the Netherlands, such as Ten Cate/Toray, Tejin Aramid, Sabic, AOC Alliancys, Nippon Electric Glass, GKN/Fokker, Polytec, Suzlon and LM. This is often the result of acquisition by foreign parties. In addition, there are a number of large Dutch players such as DSM, VDL and Damen.

DUTCH COMPOSITE SECTOR

- 200 COMPANIES
- 90% SME S
- 5000 EMPLOYEES
- ANNUAL TURNOVER: € 1 BILLION

The sector is characterised by a large share of suppliers of composite parts. There are few Dutch Original Equipment Manufacturers (OEMs). Most companies are SMEs. Some have grown from start-ups to medium-sized businesses in the past 15 years, often as important suppliers to major foreign OEMs in the automotive, aerospace or shipbuilding industries, but also as suppliers of automation solutions.

Source: Fiberneering

Source: One of the biggest 3D-printers in the world in Delft.
Image by Raymond Rutting / de Volkskrant

Examples include: KVE Composites Group, DTC, Airborne, Vabo Composites, PolyProducts, Eurocarbon, GTM AS, Fibercore. New start-ups are meanwhile finding their way (for example, CurveWorks and CarbonX). Perhaps most striking is the development of 3D composite printing by companies such as Fiberneering, CEAD and Smit Composites. The Netherlands also play a leading role in the combination of composite with other materials, so-called hybrid applications. Delft University of Technology is the father of this technology with the development of first ARALL and thereafter, GLARE. Composite is also ideal for adding functions, such as the integration of (thin-film) solar cells and electroluminescence in, for example, wall panels; this is the area of expertise of companies such as Flexipol and Parthian Technology.

Companies and knowledge institutions in the Netherlands are increasingly focusing on the sustainability value of composite. This means that new technology is developed for the repair, reuse and recycling of composite materials. An important aspect therein is that sustainability and, in particular, circularity are taken into account when designing the application. Companies that focus on the sustainable use of composite materials include SPECTO Aerospace, KVE Composite Repair, PolyProducts, NPSP and Demacq. New possibilities for sustainable composite arise through the use of bio-based materials.

In addition to companies and knowledge institutions, governments too play an important role in the future developments of the Dutch composite sector. At a regional level, these are the provincial authorities and the corresponding regional development companies. In recent years, the following public-private partnership projects have been initiated at a regional level, sometimes resulting in a field lab (in bold): (A description of the field labs is included in Appendix 4.)

INNOVATION CENTRES	
Delft University of Technology	Zuid-Holland
University of Twente	Overijssel
Digital Factory for Composites (DFC)	Zuid-Holland
SAM|XL	Zuid-Holland
Development Centre for Maintenance of Composites (DCMC)	Brabant
Thermoplastic Composites Centre (TPC)	Overijssel
Automated Composites & Metal Manufacturing and Maintenance (ACM3)	Flevoland
Brightlands Material Center (BMC)	Limburg
Smart Production Centre (in aanvraag)	Gelderland
Advanced Hybrid Centre of Competence (AHSCC)	Zuid-Holland
OTHER PUBLIC-PRIVATE PARTNERSHIPS	
World Class Composites Solutions (WCCS)	Noord Nederland
Groot Composiet	Noord-Holland
CompoWorld	Flevoland

Figure 7: Overview of field labs, open innovation centres and other public-private partnerships in the Netherlands

Knowledge institutions and companies have invested € 90 in these innovation centres in the last 5 years.
Many of these PPP projects have led to innovations that companies have been able to put onto the market. There are, nevertheless, also disadvantages to these regional PPP initiatives. Continuity is a problem, working across provincial borders is problematic and coordination is complicated.

INTERNATIONAL PROPOSITION OF THE DUTCH COMPOSITES CLUSTER

Composite technology is an important technology in numerous areas of application and it makes a significant contribution to solving the major social challenges. Increasing demand for strong, lightweight structures with long service lives and low maintenance and the development of materials and applications with very specific properties ensure that the international market continues to grow steadily. This creates a positive perspective on the global composite sector. Other countries in Europe and beyond are fully committed to a strong composite sector by investing heavily in the knowledge infrastructure and high-tech production facilities.

The market for composites offers sufficient opportunities for economic growth and employment.
The Dutch sector distinguishes itself through a number of unique high-tech facilities and excellent knowledge and technology development in specific areas of expertise, which enable the sector to seize these opportunities. In order to capitalise on these growth markets and to allow the cluster qualities to excel, the innovation ecosystem must be strengthened and the Netherlands need to focus on a future-proof sector that seizes opportunities of a social and economic international impact.
The Dutch value proposition consists of high-quality, efficient, affordable and socially relevant technology (development) in three areas:

MATERIALS AND PROCESSES

Historically, the Netherlands are strong in developing new materials, as well as smart production processes. Examples include Dyneema, fibre metal laminates and thermoplastics. The Netherlands are leaders in, particularly, thermoplastic composites in terms of materials, processes and applications.

AUTOMATION AND DIGITISATION OF PRODUCTION TECHNOLOGY

The Netherlands are developing strongly in the field of new composite production technology, particularly in the automation of processes and 3D printing.

SUSTAINABILITY OF COMPOSITE

Internationally, the Netherlands are one of the thought leaders in composite sustainability, for incorporating sustainability in the design, choice of materials and end-of-use/life solutions. For example, the Netherlands are also at the forefront of innovative applications such as composite bridges, particularly so in terms of the advantages that sustainability brings. In addition to products and technology aimed at the sustainability of composite, the Netherlands distinguish themselves in the concentration of knowledge and expertise in the field of composite repair.

CHALLENGES OF THE DUTCH COMPOSITE SECTOR

The Dutch composite sector is working successfully on composite technology and applications. Efforts are aimed at and in many different sectors (the so-called application domains), as described at the beginning of chapter 2.

In order to draw up this agenda, many stakeholders in the Netherlands have been consulted through input sessions, which were organised on the basis of specific themes and aimed at specific sectors.

Except for a number of sector-specific challenges, the various sectors often share similar needs and experience the same challenges when it comes to the development and application of composite technology.

Source: National Agenda meeting at Windesheim University of Applied Sciences

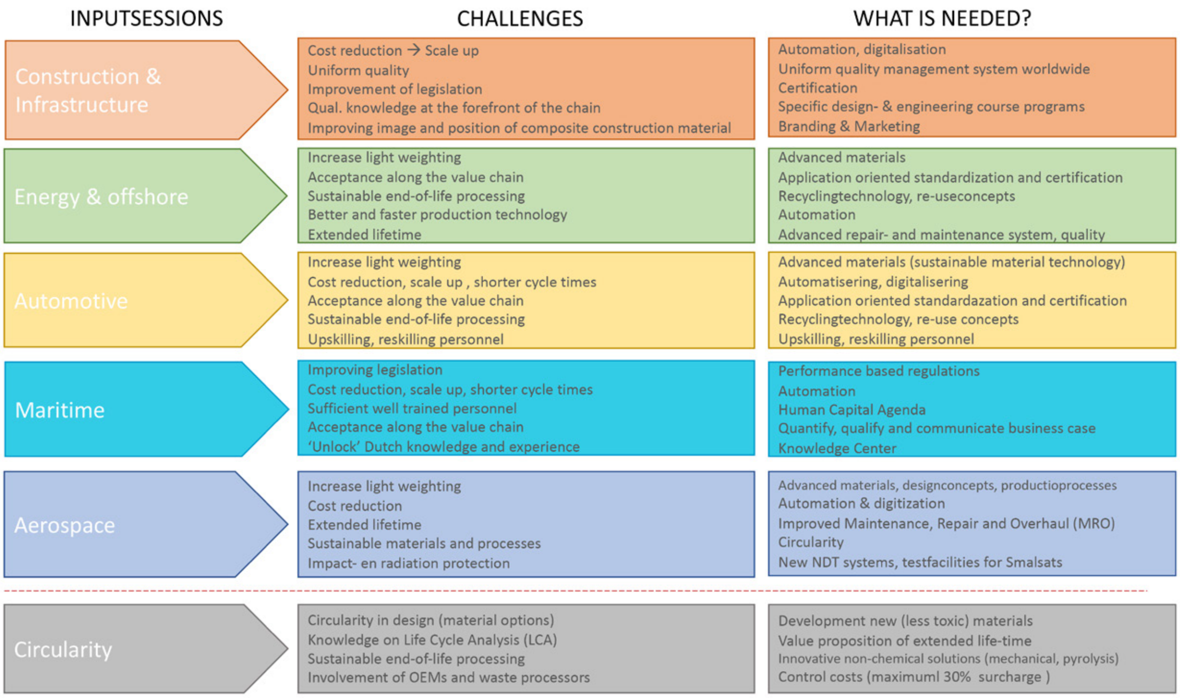


Figure 8: Results of the input sessions

The ambition expressed by the Dutch composite sector for the next 10 years and the three most important spearheads associated with it can be found in chapter 3. In chapter 4, action programmes and improvements to the innovation system are proposed to realise this ambition are subsequently worked out in chapter 5 in the organisation, the collaboration and the necessary investments.

Source: FiberCore Europe

3 AMBITION AND SPEARHEADS

AMBITION

> **The ambition of the Dutch composites cluster is to grow faster than the international average and to double the turnover of the sector from the current € 1 billion to € 2 billion in 2030.**

Within this ambition, the Dutch composites cluster wants to contribute to achieving the sustainability objectives of the climate policy by:

a. using more composite to realise CO2 reductions in the use phase of products;
b. reducing the environmental impact of the production of composites;
c. developing more and higher-quality circular applications.

In which the potential for lowering the environmental costs in the construction & infrastructure, maritime and automotive sectors is relatively the largest. In all cases, the market share of composite in the various sectors will rise, while environmental costs will fall.

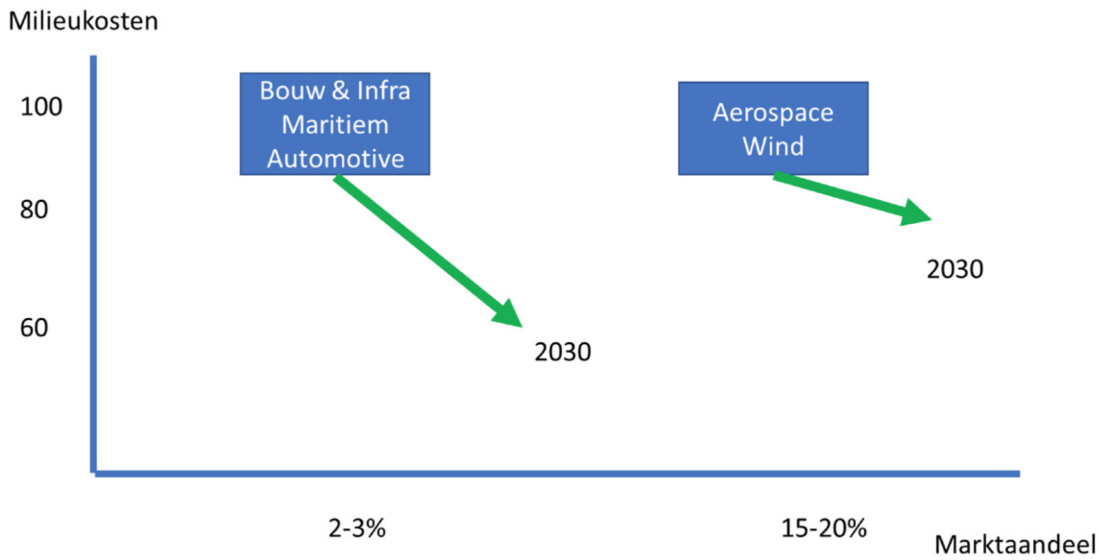
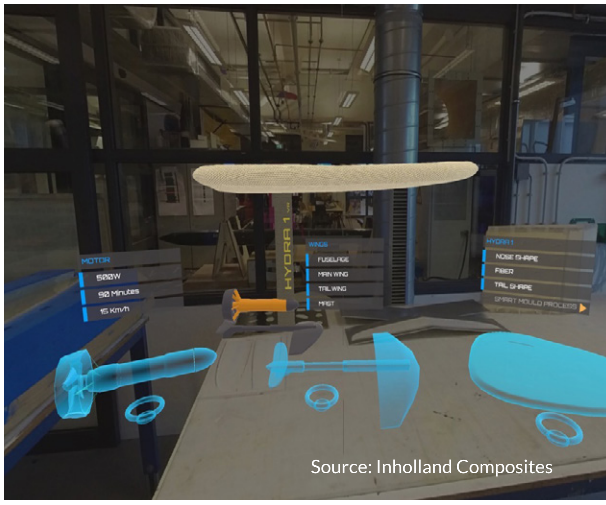


Figure 9: The fall in environmental costs against an increasing market share

TECHNOLOGY SPEARHEADS

In order to realise this ambition, it is necessary to build on what has already been developed in the Netherlands at companies and knowledge institutions. Technology is at the centre of this. On the one hand, the technology strategy will focus on the further replacement of traditional materials of a higher environmental impact while on the other hand, it will result in new products in combination with other technologies. This allows for the current limitations for growth of the composite sector to be removed. These innovations will help Dutch players to make better and more sustainable products, but it will also contribute to the knowledge that the international composites industry needs. As such, knowledge more and more becomes an export product.


Source: Inholland Composites

The Dutch sector has formulated three spearheads knowledge and innovation must be focused on in order to achieve this ambition.

1. RADICAL COST REDUCTION

> **Composite is a complex technology. Materials are relatively expensive, production is often still manual and not industrialised and processing times are often longer compared to other materials. At present, the costs and low production speed are limiting factors in the large-scale application of composite, which also limits the potential impact on sustainability.**

In addition, these factors are a major influence on the competitive position of composite compared to other materials. In order to apply more composite material in the coming years and to be able to introduce new composite applications on the market profitably, considerable improvements are needed. These improvements concern a 40 to 80% reduction in costs compared to the current cost level. This is not feasible with the optimisation of current technologies or the tightening of work processes alone. A radical cost reduction is required, one that is based on improved technology. This is also the only way to overcome the pressure from low-wage countries and to keep the manufacturing industry in the Netherlands.

In order to achieve this, innovations are needed in a number of areas:
- Material development and process development
- Automated production processes
- Digitisation of the manufacturing process

MATERIAL DEVELOPMENT AND PROCESS DEVELOPMENT

Improved or new materials are needed that are more efficient to produce with. This may be because the materials themselves are cheaper but also because of faster processing times, fewer processing steps or materials that are more suitable for more cost-effective or automated production processes, such as thermoplastics. This means that not only the material itself has to be looked at but also the processes needed to manufacture the product. Another possible route is to improve the performance of the material so that less is needed to achieve the same product characteristics. In addition to the composite materials themselves, the materials and processes for assembly or post-processing are also relevant, as that may account for a large part of the costs. The welding of thermoplastics is an example, which makes bonding much faster and more efficient compared to glueing or mechanical bonding. New technologies such as over-moulding, which prevent post-processing, can play an important role in this.

AUTOMATED PRODUCTION PROCESSES

Much of the production of composite is still manual. Automation is needed to reduce the costs, but this is not easy. Composite is fragile, difficult to handle (thermoset composites are still liquid before curing), small defects can have a major impact on the quality and the materials show a relatively high level in variation because it is a compound of fibres and resin. Automation must be able to handle all of this, which is challenging and requires concepts that are different from those that are customary in other sectors.

It is not so much about the one-on-one replacement of manual actions by man but about new processes and materials specially developed for automated processing. That is why we put the emphasis on automated production processes, instead of automating existing production.

In addition, the series are often small in size, whereas customers demand more and more flexibility. This means that the automated processes too must be flexible. Smart mould concepts, which can be quickly adapted, can play a role in this.

3D-printing of composite is a relatively new technology that offers great potential for smaller series in particular. It should be noted that composite is almost always built up in layers and, therefore, by definition comes under additive manufacturing.

DIGITISATION OF THE MANUFACTURING PROCESS

During the production of the composite product, the fibres and the polymer are brought together at a microscopic level; how well this is done determines the quality of the product.
The polymer needs to cure or, in the case of a thermoplastic, the layers of the composite must be welded together. The polymers change during this process and that also determines the quality of the end product. This means that composite production is complex, often combined with strong influences from minor defects and variations in materials and parameters. This often results in a trial-and-error approach, in order to determine the right parameters for production. It also generates a relatively large amount of waste during production, due to the rejection of products.

In order to improve this, a much better understanding is required of what happens during the production process. This requires fundamental knowledge but also better methods to specifically apply existing knowledge. Simulation models that are reliable and efficient to use are vital therein. Historically, there has always been a strong focus on simulation of composite in order to be able to predict product characteristics such as strength, rigidity or crack formation. That is now definitely shifting to simulation of the production process, in order to be able to better predict the production itself but also to be able to include the effects of production (such as residual stresses) in the strength analysis.

More recently, the use of data has come into the picture. Data has always been used during production but now, much more powerful methods become available for analysing much more data. This method is showing a lot of potential to better understand relationships and influences during the production process or to recognise trends prematurely.

2. SUSTAINABILITY

> **Composite generally has a positive impact during the use phase; it has a long service life, is low-maintenance and partly thanks to its lightweight applications, it has a low CO2 footprint. The materials themselves, however, are often still fossil-based and require relatively large amounts of energy to make.**

In order to make composite even more sustainable and competitive, improvement is needed in the following areas:

- The development of reliable bio-based materials.
- The substantiation of a longer service life of composite compared to other materials.
- The development of reuse and recycling technology.
- An ecological impact analysis.
- Chain collaboration.

BIO-BASED MATERIALS

Bio-based materials offer great potential to make composites more sustainable, both in the event of polymers and fibres. The reason they are not used a lot yet is that they are relatively new materials, they often still lag behind in performance compared to conventional materials and they are not always easy to process.
In the area of biopolymers, many new materials are emerging at a rapid pace. In order to make these suitable for composite, research is needed into the impregnation of fibres with these resins and on the bonding between fibres and

resin, among other things. Past research has already been conducted for existing composite systems and new research is needed for new polymers. Behaviour during use must also be researched, for example in relation to properties such as strength, rigidity, fatigue or strength after impact. The processing of these polymers will be different compared to conventional materials. One of the problems that occurs in, for example, degradable bio-polymers is increased sensitivity to moisture.

Organic fibres such as flax, hemp or jute have been available for composite for some time now. The performance is usually less than conventional glass or carbon fibres and the variation in quality is usually higher. Further research is needed to increase performance.

EXTENDING SERVICE LIFE

Composites often have longer service lives than competing materials, thanks to superior chemical resistance (corrosion) and fatigue properties. However, they can also be vulnerable in use. In that case, localised damage can lead to the end of the use phase of the entire product. Improved and more efficient technology is needed for repairing composite in order to extend its service life. This also requires techniques to be able to determine the damage reliably and efficiently and to be able to predict performance after repair.

Another aspect is determining the service life. During use, many phenomena can occur simultaneously, such as mechanical load, crack formation and environmental impact; the effects thereof manifest themselves at a microscopic scale. Since the default properties of composite are often superior and because accurate predictions are still complex, a conservative approach is usually applied, often leading to over-dimensioning. In order to be able to fully use the potential, better and faster methods are needed to accurately predict the service life of a composite product, so that it can also be qualified with that longer service life. New NDT techniques or embedded sensors can provide data that make it possible to predict the service life more reliably or more efficiently.

REUSE AND RECYCLING

Composites are already recycled, both thermoset and thermoplastic composites. This applies to waste during production (ref. article Boeing/ ELG) or at the end of the use phase. Glass fibre thermoset composite of, for example, windmill blades can be shredded and used in new products. Another route is to introduce glass fibre/thermoset recyclate into the cement production process (ref. Eucia article). Carbon fibre thermoset material is usually recycled via pyrolysis, during which the fibres are recovered and can be reused. Thermoplastic composite material can be melted down and used in, for example, injection moulding or compression moulding.
These technologies became available relatively recently and are at the beginning of the innovation curve. They are not used much yet. One of the reasons is that it requires new methods to design and produce products. The performance after recycling is often less and in order to improve this, new technology and knowledge are needed.
In addition to using existing technologies, new and improved technologies are needed to ensure that the efficiency of recycling, as well as the properties after recycling, are of the highest possible level. This requires fundamental research.

ECOLOGICAL IMPACT ANALYSIS

Comparing the environmental impact or circularity of composite with existing materials and technologies (wood, concrete, stone, metal) is often not easy. However, this is necessary to demonstrate the sustainability aspects of composite in order to properly quantify and qualify the business case. In order to properly interpret the competitive position of composite material among other materials and to make well-considered choices, insight into the ecological impact is important.
In order to gain proper insight, more knowledge and experience with the application of methods such as life cycle costing for composite is required.

CHAIN COLLABORATION

New circular chains are needed in order to develop new bio-based materials that are in keeping with new processing and recycling concepts at the different stages of production and use. These new chains must be developed, as part of which organisations, technology and knowledge must be brought together and new knowledge and technology developed.

3. ACCELERATION OF ADOPTION

> **Composite has the special property that, due to the layered structure and the combination of fibres and resin, a lot of the damage, crack formation or imperfections are within the product and thus invisible, making it more complex to predict and, therefore, certify the behaviour of the material. In both existing and new markets, composite is, therefore, regarded as a difficult technology. This limits or delays the adoption.**

In addition, the qualities and technical possibilities of composite are not known enough, as a result of which it is not included in the design and engineering process as a potentially useful material, making steel, concrete or other materials more obvious choices.

These bottlenecks must be tackled and this can be achieved by providing broader ready knowledge of composite, by providing employees with the right knowledge (design expertise), by developing certification codes for composite materials, but above all by smarter technology:

- Certification by simulation
- Sensor technology

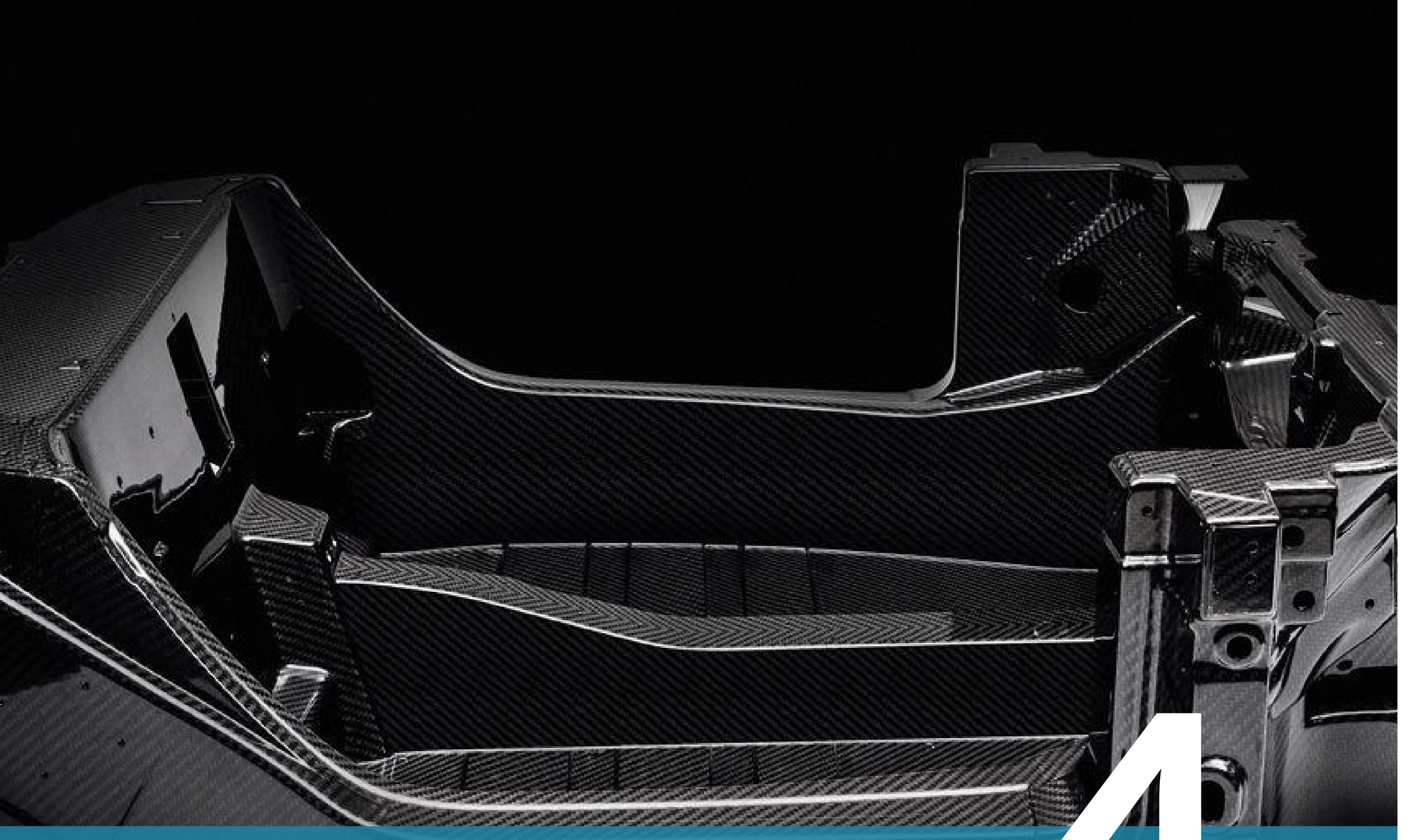
CERTIFICATION BY SIMULATION

The classic method of certification is mainly testing a lot, which does not always lead to more insight. A better method would be to use advanced simulation models that predict behaviour much more accurately. This saves testing, but also provides more accurate insight and can better predict complex combinations of effects than is possible with extrapolation from testing. As such, simulation also creates an acceleration effect on the development process and it reduces costs.

Certification based on simulation has the potential to be much faster and much cheaper. The challenge is to develop reliable models and that requires fundamental knowledge development. In addition, there is a need for a large dataset of physical tests to be able to validate the simulation models.

SENSOR TECHNOLOGY

Sensors make it possible to monitor the behaviour of composites and on the basis of the data obtained, predictions about its behaviour can be made. This can accelerate the adoption of composites and reduce the burden of proof for certification. However, the current sensors are limited; they can be divided into methods that are fast, but which cannot measure within the composite (such as visual cameras, strain gauges or optical fibre sensors) and methods that can measure through the thickness, but which are often slower and cannot be used in the use phase (such as ultrasonic or thermography). There is a need for much better sensors, which can demonstrate the behaviour of composite reliably and quickly and on the basis of which accurate predictions can be made. These technologies must be cost-efficient as well.



4
AGENDA FOR TECHNOLOGY AND INNOVATION

The National Cooperation Agenda for Composite accelerates and increases the development of composite technology and innovation through:

- **the development of technology and innovation at the interface of the application domains and areas of expertise of the Dutch composite sector (materials, process technology and facilities, circularity and certification),**
- **the improvement of the innovation system for composite technology, and**
- **the creation of critical mass at a national level, by bringing together composite technology development under a shared agenda.**

The ultimate objective is, of course, an improved international competitive position for the Netherlands and with that, higher sales and returns for the companies. From there, the KIA can also gain continuity and reduce the relative share of the government.

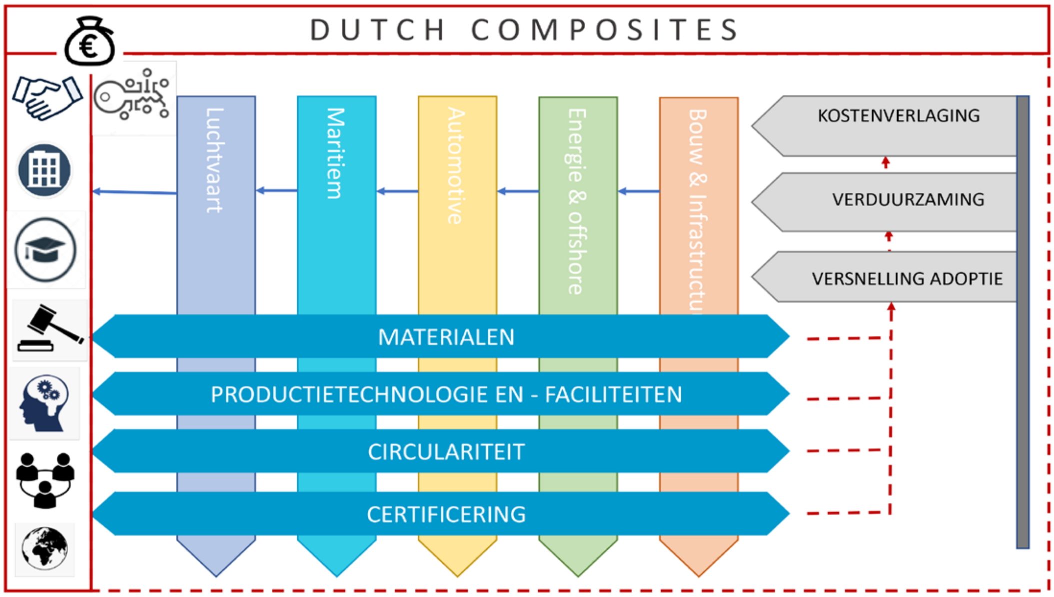


Figure 9: Innovation ecosystem of the Dutch composite sector

4.1. NATIONAL ACTION PROGRAMMES

In order to increase collaboration and critical mass, six national action programmes have been drawn up by consulting companies and knowledge institutes. In these action programmes, the parties work together for innovation. Many parties in this area of expertise and application domains have already found each other, particularly at a regional level and in projects per sector. This already involves extensive investments in public-private partnerships (€ 90 million over the last 5 years). The National Cooperation Agenda for Composite builds on this and transfers existing collaborations into national action programmes. The implementation of the six action programmes requires an investment of €180 million for the next 5 years, i.e. €36 million per year. This equals a doubling of efforts compared to the recent past.

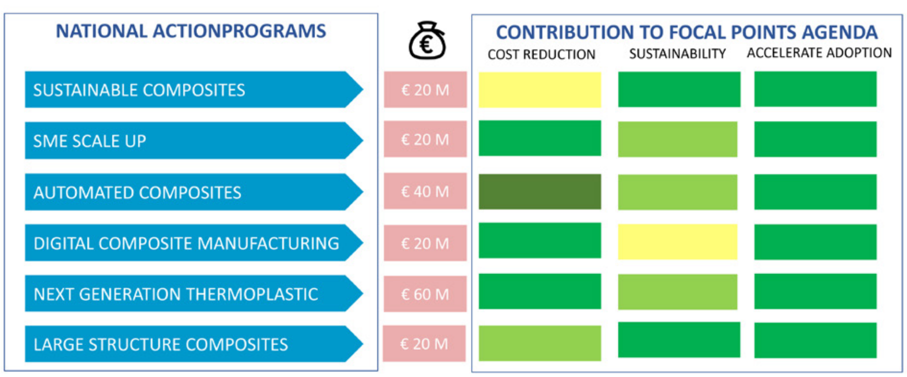


Figure 10: Investments in National Action Programmes and contribution to the spearheads of the agenda.

ACTION PROGRAMME FOR SUSTAINABLE COMPOSITES

Composite as part of the circular economy is not yet a common principle. The Netherlands are working hard in terms of knowledge and technology development in this area. The Netherlands are international leaders in the field of sustainability of composite in all areas. This involves the incorporation of sustainability in the design, development and choice of materials and end-of-use/life solutions; but maintenance and repair of composite also play a major role in extending the service life. In Europe, progress in the Netherlands is closely monitored.
In order to make the role of composite in the area of sustainability even bigger, new concepts must be developed and proven in all areas. This is the way in which we want and can achieve the international leadership position of the Dutch composite sector.

Sustainability
To make composite even more sustainable, improvement is needed in the area of bio-based and low-CO2-emission-produced materials. On the one hand, the innovations focus on the use of natural materials which contain a large degree of circularity (no waste) and on the other, on fibres and resins that can be produced using sustainable energy (heating, pressure). Progress is made in this field through the large knowledge base of materials in the Netherlands.

Extending service life
In this field, work is primarily carried out on new maintenance and repair technology aimed at extending the service life of composite materials. A second activity is to demonstrate the service life by simulating use processes. Here, expertise from aviation (tensile testing) can be used, among other things.
Reuse and recycling
In this field, the challenge is to realise reuse of the highest possible grade. Technological developments focus on the second/third-hand use of, for example, bridge decks and in addition, on the processing of composite strips or flocks with retention of strength. Special attention is paid to thermoplastic composites, as they offer the best possibilities for recovering original raw materials/base materials. Finally, research is carried out into the possibilities for improving hybrid reuse, as can be seen in cement kilns. For example, Saxion develops demonstrators using recycled thermoplastic composites

Ecological impact analysis
In this field, the EcoCalculator is further expanded, improved and tested, in cooperation with other European countries. The aim is to develop a quality mark for the Life Cycle Analysis or the Environmental Cost Index.

In the field of composite sustainability, the market is already showing promising initiatives and leaders. At the same time, we can conclude that the rich composite innovation landscape in the Netherlands offers room for more effort and critical mass for composite sustainability. A national action programme will further boost this and may lead to a ‘National innovation centre for the sustainability of composite’, involving intensive collaboration at both fundamental and applied levels. Internationally, such a centre does not yet exist and the Netherlands can actively distinguish themselves here.

PARTIES
In the Netherlands, various parties are active in the recycling of composite, including many small SMEs such as Composite Structures (bridge sections), Fiby (beams and purlins), Bijl Profielen (composite profiles), Poly Products (structures) and Demacq (grinding and flocculation of thermoset composite). Large companies are also engaging in this, with a number of notable parties: Dutch Railways (recycling of composite train walls), SUEZ (recycling into pavement slabs) and RWE (recycling of wind turbine blades). RWE is currently setting up a pilot plant in the Netherlands for the recycling of turbine blades, also from neighbouring countries.

Natural Power Seed Products (NPSP) are leaders in bio-based composites, with a bio-based material in which two residual streams from water management (softening lime and reed fibre) are combined with bio-resin to form a new robust material. NPSP have been pioneers in bio-based products based on natural fibres for years.

In the field of research, Windesheim is a leader in the recycling of optical fibre composite (which by far accounts for the largest part of the market), in projects which many companies participate in. Inholland Composites works on the repair of composites. In the field lab DCMC (Development Centre for Maintenance of Composites), founded by SPECTO Aerospace, NLR, GKN Fokker and Delft University of Technology, the parties work together to develop a new technology for preservation and repair, with applications in aerospace, maritime and wind energy. TNO is active in this field in the 'Circular Economy and Climate' unit and through the Brightlands Materials Centre.

INNOVATION PARTNERSHIPS

Centre/project	Format	Focus	Parties involved	Scope
Windesheim	Public-private	Recycling/reuse	RWE, EucIA	€600K
DCMC	Public-private	Maintenance	SPECTO Aerospace, NLR, Ministry of Defence, GKN Fokker, REWIN, BOM, DAMEN, Delft University of Technology	€6 million
RWE pilot plant	Private	Recycling/reuse	Windesheim, Bijl	unknown
TPAC	Fieldlab, Public-private partnership	Recycling TPC	TPAC, Saxion, van Werven, Veolia, Comptape, Engel, Byk.	€3 million
Circular composite initiative Zuid-Holland	Public-private partnership in formation	Making composites completely circular within the region: collection, recycling, processing into a new product and application	Innovation Quarter, Delft University of Technology, Municipality of Rotterdam, Municipality of The Hague, Port of Rotterdam Authority.	In formation

ACTION PROGRAMME FOR SME SCALE-UP

Many innovations in the composite sector are initiated by SMEs. There are numerous Dutch SMEs in the composite technology sector successfully entering the (inter)national market. This is often followed by a stagnation in growth, when demand increases and the scale-up of production is the next step. The advantage of composite, viz., the fact that promising innovative products can be developed with relatively little investment, then becomes a disadvantage. An SME is often unable to develop or install the capital-intensive, application-oriented production facilities needed for large-scale production. Many new companies emerge with interesting (and often disruptive) technologies or applications that, like growing SMEs, have difficulty raising sufficient capital to mature or grow into a stable market player.

In order to enable SMEs in the composite sector to grow and to use innovative power, new business concepts are required in combination with flexible production facilities, combined with financial instruments that enable scaling up. The SME Scale-up action programme is intended to support SMEs to scale up and grow into a stable market party and to ensure they anchor in the Netherlands. The Netherlands are already home to many innovation facilities but these can be accessed better and more easily. After production automation has been developed, there is also a need for facilities to produce smaller series, in shared production facilities for example.

The action lines in this programme are

Making R&D facilities more accessible to SMEs
The Netherlands offer substantial R&D facilities for composites. However, these are not always very accessible to SMEs, due to the high costs for use or the high-tech character that is not in keeping with more industrial SMEs. In addition, it is important that SMEs can learn for themselves, instead of the R&D centres doing the work for them. In this line of action, methods are developed to lower the threshold, for example through vouchers, open centres or workshops. The positive initiatives that are already live, such as RAAK projects or field labs will be further expanded.

Facilities for small production series
Start-ups that are not yet able to invest in a full-scale production process or that do not know yet what exactly a commercial production line should look like for a specific series of products, need facilities where they can produce the initial smaller series. These facilities must be flexible in order to be able to quickly switch between production series. In part, existing innovation centres can and already are used for this, whereas a need for more multifunctional production lines may arise in other parts.

Financing to enable scale-up
Substantial financing is often required to enable further scale-up, development, certification and investments in production capacity. These are often long-term and high-risk investments that are not always easy to achieve through conventional financing instruments.

IINNOVATION PARTNERSHIPS

Centre/project	Format	Focus	Parties involved	Scope
CompoHub	Public-private partnership	multifunctional, automated production for scale-up by SMEs	VDL, Wientjes, DTC, VABO, Ebusco, Fokker GKN, Airborne, Cato Composites	t.b.d.
SAM|XL	Joint research centre. Non-profit foundation with membership	Large format composite parts for aircraft, wind turbines, spacecraft and maritime vessels	Delft University of Technology, Fokker GKN, Airborne, Airbus DS, Suzlon, TNO, GTM Advanced Materials and KVE	> €10 million over a period of 5 years

ACTION PROGRAMME FOR AUTOMATED COMPOSITES

In the Netherlands, there are a number of initiatives for the automation of composite; these need to be further strengthened to keep pace with international developments.

This programme addresses two challenges:

The development of new concepts
Since the automation of composites is relatively new, there is also a lot of room and demand for new concepts. The current solutions in the market are mostly based on the mechanisation of existing manual concepts. By choosing a holistic approach in which new materials, processes and automation concepts are developed, much more efficient solutions can be created. This is exactly why intensive collaboration within the chain, as envisaged by this National Agenda, is crucial and can create breakthroughs. Adding mathematics and ICT to the chemical approach that has been followed to date is vital.

The implementation of automation
The second challenge is to scale up and actually implement the automation solutions that are available. This requires substantial investments and working together can make it easier to carry these costs. Chain collaboration between the manufacturing parties, automation providers, material suppliers and end-users are needed to ensure the technology is accepted and certified. Facilities that are up to the task are needed to complete this process efficiently and to accelerate this. In addition, it is necessary to jointly develop and share knowledge in order to achieve a successful implementation.

Automation is an important aspect in Smart Industry, Robotics and other national initiatives. Active collaboration will be sought with this.

PARTNERS

The Netherlands are home to a number of strong niche players for the automation of composite and this sector is experiencing strong growth. Examples include parties such as Airborne, Boikon, Autonational, Van Wees and Eurocarbon (braiding machines). In addition, new technologies emerge such as 3D printing, with start-ups such as CEAD (large scale 3D printing), Fiberneering, HB|3D and Smit Composite, which print the composite themselves. Another new and emerging technique is the 3D printing of moulds, which is much more efficient than traditional milling of plugs and moulds, as this generates a lot of waste.

In addition to suppliers, there are also a number of manufacturing parties that are at the forefront in the adoption of automation. Examples are GKN Aerospace – Fokker (aerospace), Airbus Defence & Space (aerospace), Polytec (automotive), DTC (aerospace), VABO (maritime), VDL (automotive), Plasticon (industry) and Airborne (miscellaneous). At the same time, there are many producers who are yet to make the transition and are threatened by competition from low-wage countries on the one hand and automated competitors on the other.

INNOVATION PARTNERSHIPS

A number of examples of innovation partnerships are listed below. These are explained in more detail in the appendices.

Centre/project	Format	Focus	Parties involved	Scope
ACM^3 (NLR)	Field lab: research and development centre	Cross-sectoral technology development: Development of automated manufacturing processes and the digitisation of these processes. Development of specific production technology, production development.	Vabo, Correlian, Labelbreed, GKN Fokker, PAL-V, AMPYX, OMRON and various international parties.	Initial investment of €3 million, annual turnover of €4.5 million/year.
SAM|XL	Joint research centre. Non-profit foundation with membership	Automated production - improving competitive position - increasing production volumes - creating employment - accelerating innovation	Delft University of Technology, Fokker GKN, Airborne, Airbus Defence & Space Netherlands, Suzlon, TNO, GTM Advanced Materials and KVE	> 10 million over a period of 5 years
SPC Smart Production Centre for Advanced Automotive Applications	Field lab application in process Public-private partnership	The smart and clean production of lightweight components for the automotive industry through automated production processes. - Technology development of materials and processes - Education development and knowledge development - Chain collaboration	23 companies including DSM, Siemens, VDL, EDAG (see appendix for others). Institutions: ACE, IPKW, AutomotiveNL, HAN University of Applied Sciences, Fontys, HvR, BMC, Saxion University of Applied Sciences,	Phase 1: €1-5 million Phase 2: €10-12 million
CFAM Prime	Private partnership	Continuous Fibre Additive Manufacturing	CEAD, and others	€500,000 €800,000
Delft University of Technology	Public	New chair, automation of composites		

ACTION PROGRAMME FOR DIGITAL COMPOSITE MANUFACTURING

The transition to a smart industry is one of the biggest developments the manufacturing industry has gone through during the past century. Thanks to the digitisation and integration of all links in the production chain, products can be made more sustainable, of a better quality, at reduced lead times and cheaper.
Digitisation also offers opportunities to bring the manufacturing industry back to the Netherlands at a large scale.

Simulation software makes building physical prototypes superfluous, thus saving time, costs and waste. New product variants can be designed quickly and digitally and subsequently tested. Digital engineering of production lines helps to optimise material streams and reduce raw material and energy consumption, even before the construction of a physical processing station. The automation of the production process prevents errors and increases production speed. All this leads to a short time-to-market and increased flexibility and quality, important competitive factors in the manufacturing industry. Sensors make it possible to monitor the behaviour of composites and predict its behaviour on the basis of the data. This can accelerate the adoption of composites and reduce the burden of proof for certification.

Since composite is a complex technology in which many processes are still partly black box, digitisation in particular offers great potential in this instance.

The Digital Composite Manufacturing action programme focuses on the following issues:

Development of sensors
There are, of course, many sensors already but composites require specific solutions. Because composites are often layered structures, many of the phenomena take place within the material and are not clearly visible from the outside. In addition, many of the properties are determined at the border between fibre and polymer and at a microscopic scale, which makes it even more difficult to properly measure the condition of composites during the manufacturing process itself, but also during the use phase. This requires new sensor and analysis technology. This makes it possible to much better understand and monitor what happens to the composite.

Development of simulation technology for the production process
Advanced simulation is not yet widely used in the development and optimisation of composite production processes. The phenomena are complex, there are many different materials and processes and the processes are often difficult to monitor because they take place in closed environments (autoclave, press, oven, mould, etc.). In addition, composites are fragile materials that quickly sustain defects and these effects can have a significant impact on performance. The current state of the art is often based on trial and error and on the experience of the process engineers. In order to make the processes more efficient and to shorten lead times, much better simulation techniques are required. This involves both conceptualisation and modelling, as well as the use of machine learning techniques to understand and improve processes faster and more efficiently. This requires fundamental development, but also high TRL development to actually implement the existing technologies.

Development of simulation technology for the use phase
The performances of composite products (for example strength, rigidity) are often only calculated once for certification purposes. How the properties develop and change during their service lives is much more complex to calculate and this often involves conservative approaches. Crack formation, behaviour under impact load, repairs or combined influence of fatigue and chemical degradation are still complex to predict. As a result, the full potential of composite is often left unused and the use phase of a composite product is much shorter than its life phase. A lot can still be gained, particularly in the field of sustainability, by being able to better predict the properties at the end of the first use phase, so that it is easier to determine how products can be used for longer. More predictive models are also required for repaired or reused composite.

Implementation of digitisation technology in composite design and composite production
The sensor and simulation technologies must be brought together so that they can actually be implemented and that we can reap the benefits thereof. This requires collaboration between many parties in the chain and unlocking the knowledge that is present in many composite experts.

For the more generic issues of digitisation, such as handling big data, building digital twins or smarter application of new ICT technology, collaboration will be sought with programmes that already have been or will be set up in the Netherlands, such as Smart Industry or top team ICT.

INNOVATION PARTNERSHIPS

A number of examples of innovation partnerships are listed below. These are explained in more detail in the appendices.

Centre/project	Format	Focus	Parties involved	Scope
Digital Factory for Composites	Field lab, mostly privately funded, automation parties that work together	Working together to make digital factory concepts suitable for composite and to implement these concepts	Airborne, Siemens, TNO, Landscape, knowledge partners	
SPC Smart Production Centre for Advanced Automotive Applications	Field lab application in process Public-private partnership	The smart and clean production of lightweight components for the automotive industry through automated and digitised production processes. - Technology development, digitisation of production process - Education development and knowledge development - Chain collaboration	23 companies including DSM, Siemens, VDL, EDAG (see appendix for others). Institutions: ACE, IPKW, AutomotiveNL, HAN University of Applied Sciences, Fontys, HvR, BMC, Saxion University of Applied Sciences,	Phase 1: €1-5 million Phase 2: €10-12 million

ACTION PROGRAMME FOR NEXT GENERATION THERMOPLASTICS

Thermoplastic composites offer important advantages over conventional materials, such as faster production, recycling and combinations with other production techniques, such as welding and overmoulding and more freedom of choice in materials. The Netherlands have been at the forefront of this for years, both in the development of thermoplastic composite technology and in the application thereof.

The challenge is to capitalise on this lead position and to further improve it in order to achieve large-scale and industrial application of thermoplastic composite technology for large, strength-bearing structures and mass-volume applications.

This action programme is based on the following themes:

Scale-up of thermoplastic composite technology
The first area of attention is to continue to develop and scale up the technology that has been developed to demonstration level in recent years to a higher TRL level and to implement this technology. This requires investments in industrialisation and certification. A textbook example is the technology for load-bearing structures in aircraft manufacturing where a strong Dutch consortium is in an excellent pre-selected international position but which requires large-scale investments to capitalise on this position.

Development and application of recycling technology
Thermoplastics are, by definition, easier to recycle because they can be melted down, in contrast with thermoset composite. The feasibility of these concepts has been demonstrated at lab scale but requires further development in order to reach maturity. This partly concerns technology development for scaling up and efficiency improvement but also chain collaboration to achieve full implementation. The residual waste streams must be developed and embedded in the production of new products. Certification of recycled composite requires further development as well.

Development of new technology, for high-volume applications
The great potential of thermoplastic composite lies in high-volume applications, thanks to the much shorter cycle times of thermoplastic compared to those of thermoset composite. Hence internationally, efforts are mainly aimed at the development of high-volume applications, such as automotive, consumer electronics and sports products. New, faster technologies are needed for this, as well as a better fundamental understanding of thermoplastics. Materials too will have to be developed further or there will be a need for completely new materials.

PARTIES

The Netherlands have a strong ecosystem of material suppliers, producers, technology providers and end-users. GKN Aerospace (Fokker) is a leader in the application of thermoplastic composite in aerospace and the first large-scale, fully automated factory for thermoplastic composite offshore pipelines is located in the Netherlands (Airborne Oil & Gas in IJmuiden). Major players active in the Netherlands in the field of materials, such as Toray-TenCate (leader in high performance thermoplastic composites), DSM (leader in automotive thermoplastic), SABIC (4th largest chemical company in the world with a strong strategic focus on thermoplastic composites) and Nippon Glass Electric (glass fibre supplier with a thermoplastic knowledge centre in the Netherlands).

The Netherlands are also leading in the field of research. With the Thermoplastic Composites Research Centre, the Netherlands are home to the only 100% thermoplastic research centre in the world; this centre is strongly affiliated with the University of Twente, where internationally leading academic research is conducted. Delft University of Technology has been at the forefront for decades and is a breeding ground for thermoplastic composite technology and composite companies. Brightlands Materials Centre (TNO) focuses on the development of materials and applications.

INNOVATION PARTNERSHIPS

A number of examples of innovation partnerships are listed below. These are explained in more detail in the appendices.

Centre/ project	Format	Focus	Parties involved	Scope
Intelligent Thermoplastics	Public-private partnership	Weight reduction, cost reduction		
Digital Composites Manufacturing Line	Largely privately funded	Integral concept of new materials *and* new production technology for high-volume applications, such as consumer electronics, automotive and aerospace	SABIC and Airborne	Large-scale
DSM thermoplastics	Largely private	Automotive applications		Medium-size investments
TPRC	Public-private	Further development of thermoplastic composite technology: process simulations, industry 4.0, predictable properties and long-term behaviour.	Boeing, Collins Aerospace, Spirit Aerosystems, GKN/Fokker, Toray TenCate, Arconic, Sumitomo/Bakelite, University of Twente, Saxion, DTC, KVE, AniForm	€15 million (2009-2018) €25 million (Forecast: 2019-2024)
TPAC	Public-private partnership	Recycling of thermoplastic composites	TPAC, Saxion, van Werven, Veolia, Comptape, Engel, Byk, Tech for Future	Approx. €3 million
TPAC	Public-private partnership	Application of thermoplastic composites in the existing plastic processing industry	TPAC, Saxion, Timmerije, Comptape, Engel, Byk, Pontis, Tech for Future, Promolding, SABIC, NRK	€2.4 million
Brightland Materials Centre	Public-private partnership	Polymer material research, modelling and recycling of thermoplastic composites.	Alligator, Allplast, BMC, CMB, Eurocarbon, Plastica, Thermoforming, Polytec, van Wees, Verbi	€5.5 million
TPY	Public-private partnership, project	Combination of production techniques: high-volume laminate production, welding, overmoulding, end-products.	KVE, Promolding, GTM, Airborne, DFC	1 million in 1st year

ACTION PROGRAMME FOR LARGE STRUCTURE COMPOSITES

application for decades and composite makes it possible to produce increasingly larger blades thanks to the superior properties of fatigue, lightweight and flexibility. Composite is also becoming increasingly popular in maritime applications. In addition to the classic applications in shipbuilding, composite is now also seen as an option for the load-bearing structure of larger vessels, in which the technology for reducing fuel consumption is crucial. The SOLAS regulation (Safety Of Life At Sea) is an important bottleneck that needs to be addressed, particularly so in terms of fire safety. A third sector in which composites are used on a large scale is infrastructure, bridges and locks, but also in and on the external walls of architectural high-rise in particular. The longer service life in particular is an important advantage that has a positive impact on sustainability compared to traditional materials.

Although the sectors are very different, the materials, processes and challenges for these larger structures are comparable; hence they have been brought together in an action programme.

The spearheads of this programme are:

Efficient production processes
The cost pressure when dealing with this kind of large products is always high and there is a strong need for further efficiency increases in order to enable the use of composite. This is possible through smart production processes (for example, building up the product from modular units instead of production by means of one large, expensive mould) and through efficient assembly concepts. Automation can be used as well, but the production of very large structures in lower quantities requires a very different technology than that needed for smaller products in high volume.

Demonstration
Since it concerns large structures, the transfer from concept to demonstration at the actual size is, by definition, a costly process. Far-reaching collaboration between parties in the chain is necessary to enable such developments and special projects are needed to realise a demonstration.

Certification
Certification for composites is always a point that requires attention because it practically always concerns new technology, but in the event of very large structures this is an even bigger issue. Testing the structures is complex and requires large test set-ups. The products are often designed with (very) long service lives in mind, which makes the certification on aspects such as fatigue, material degradation and wear all the more important and complex. In addition, fire safety plays an important role in maritime and infrastructure applications. This requires facilities and possibilities for large-scale testing.

PARTIES

Although the Netherlands no longer have their own wind turbine blade industry, large players are active in the Netherlands, because of the high level of knowledge. Suzlon, one of the largest wind turbine manufacturers in the world, has its worldwide R&D centre in the Netherlands. WMC, an internationally leading test house for wind turbine blades, was recently taken over by LM Windpower (now GE Renewables) and the design office for the blades is also located in the Netherlands. With the rapidly growing offshore wind market in the Netherlands, the industry for installation and maintenance thereof grows with it.

In the maritime sector, Damen focuses on composite with a view to reducing production costs and making shipping more sustainable. Composite is also an important enabling technology for defence applications. There are also many smaller technology players such as VABO composites and Infracore. Composite is already proving a popular application in yacht building, for example by Royal Huisman, Rondal and Damen. A close collaboration has started between NMT (Netherlands Maritime Technology) and CompositesNL, in order to apply composites on a broader basis. The joint ambition is to develop the first fully SOLAS-certified composite vessel in the Netherlands.

The Netherlands are at the forefront of composite bridge construction, with players such as Fibercore and Schaap Composites. Rotterdam is the European capital of composite bridges, with more than 100 bridges already installed. The Netherlands are also at the forefront in terms of regulations and certification. CUR96 was recently published, which is one of the first design codes for composite in the civil sector and serves as a guideline for the Euro Code for composite that is still under development. Composite is also becoming increasingly popular for use in buildings, particularly so because of the enormous freedom of design and robustness of the product. An interesting development is to embed Soliance flexible solar cells in composite wall panels (Flexipol), as a result of which the skin of a building will start to generate energy. And this is no luxury with a view to meeting the challenging climate goals.

INNOVATION PARTNERSHIPS

A number of examples of innovation partnerships are listed below. These are explained in more detail in the appendices.

Centre/ project	Format	Focus	Parties involved	Scope
Testsite Wind	Public-private partnership	Standardisation and certification of new materials in wind through real-life testing.	Suzlon, Parthian, NKC,	Approx. €5 million
QUALIFY	PPP in Interreg	The qualification of hybrid structures to enable lightweight and safe carriage by sea and thus achieve fuel savings and longer service lives, as well as save maintenance costs.	NL: M2I, Delft University of Technology, DAMEN, WMC, NMT EU: Cambridge University, Bureau Veritas, Ghent University, Com&Sens, Parkwind, Lloyd's Register, BAE Systems.	€3.8 million Private: €2.2 million Public: €1.6 million
Offshore Wind Innovation Centre	Public-private partnership between knowledge institutions, SMEs and start-ups	The innovation centre, test facilities and workplaces will enable new products and services that will make the wind industry both financially and energetically more efficient. Improved competitive position of wind energy compared to fossil energy.		
RAMSSES	PPP in Horizon2020	Realisation and demonstration of advanced material solution for large parts of sustainable and efficient vessels	36 international partners, including: Airborne, Damen, Infracore, NMT	€13.5 million Public EU: €10.8 million

4.2. KNOWLEDGE BASE

> **Whereas many other larger countries immediately invest in high-tech development and production facilities (supply-oriented), the Dutch composite sector is working much more demand-oriented and is, therefore, more efficient in terms of its knowledge infrastructure. The Dutch level of knowledge stands in high regard internationally but now, the next step needs to be taken, in particular the incorporation of different disciplines (such as new materials, chemistry, robotics and ICT).**

KNOWLEDGE AGENDAS

This national agenda aims to facilitate the link-up with the knowledge agendas that are important for composite technology and to also give direction to this, by drawing up a knowledge agenda within the six action programmes in consultation with the relevant knowledge agendas and roadmaps of the top sectors HTSM, Chemistry, ICT & Smart Industry and those of the key technologies robotics, advanced materials and nanotechnology.

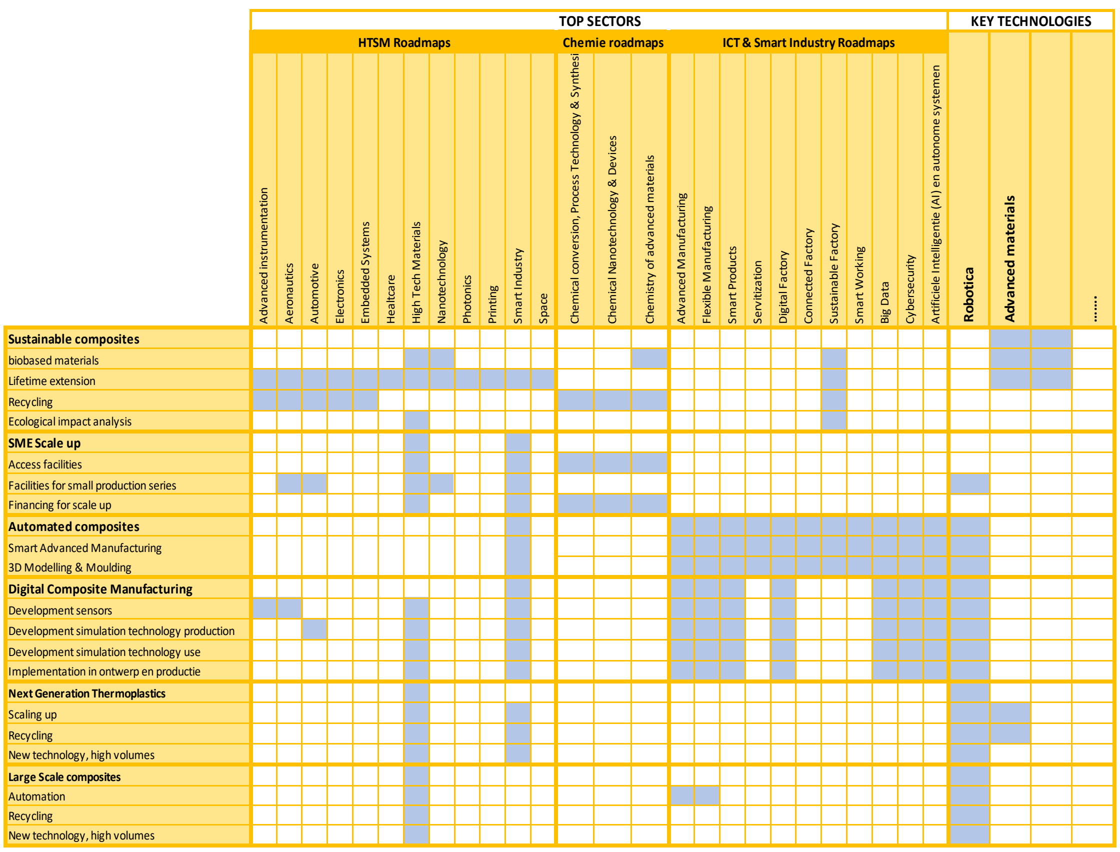


Figure 11: Connection between action programmes and roadmaps of top sectors and key technologies

A strengthening of the collaboration between knowledge institutions, research institutes and the sector is needed in order to make this possible, as well as a connection with the national action programmes set out in 5.1. To this end, the knowledge and research institutions are actively involved in drawing up the knowledge agendas within the action programmes. In addition, the knowledge and research institutions form a part of the public-private partnerships within the action programmes.

The National Science Agenda invests in innovative and socially relevant research via the 25 routes of the National Science Agenda, facilitating knowledge development for scientific breakthroughs and for social assignments. In a large number of the defined routes, composite can play a (major) role, a few relevant routes are: Circular economy and resource efficiency: sustainable circular impact; Energy transition; Materials- Made in Holland; Measuring and detecting: always and everywhere; Smart Industry. The National Science Agenda will be applied to finance the knowledge roadmaps.

Furthermore, knowledge is developed along the lines of the different TRL levels (Technology Readiness Level). This national agenda must serve as a guideline for setting up this knowledge development.

FUNDAMENTAL RESEARCH (TRL 1-3)

The Dutch composites cluster was largely formed through the technical universities. Continuing and strengthening the role of the technical universities is therefore of paramount importance. The Netherlands Organisation for Scientific Research (NWO) offers various possibilities for long-term research programmes through various top sectors. This creates opportunities for trainee fellows and PhD students. Growth in the number of doctoral research is an important basis for the new cooperation model. Companies too will play an important role in the NWO programmes to continue the demand-driven approach.

Composite and composite-related research is becoming increasingly important in Dutch universities. In its current composite research, Delft University of Technology, as the cradle of Dutch composite research, focuses on sustainability, compounds and service life. And whereas the University of Twente and Eindhoven University of Technology focus specifically on thermoplastic composites, the University of Groningen focuses on researching bio-composites. With a total of 80 PhD and Postgraduate positions, the research potential is growing steadily. In these studies (in many cases also in cooperation with the field labs and open innovation centres), efforts are focused on solving the challenges of the sector in combination with the social challenges.

Current and future academic research programmes are:

- Industry 4.0/Process simulations
- Short-term/long-term performance
- Innovative processes
- Next-generation engineering materials
- Extended lifetime (modelling, accelerated characterisation, materials)
- Bio-based composites
- Sustainable composite structures
- Innovative joints and connections
- Prediction of fatigue resistance

The various field labs and open innovation centres offer room to PhD students who can work specifically on composite research related to the spearheads of this agenda.

APPLIED RESEARCH (TRL 4-6)

NLR, BMC (TNO) play an important role at these TRL levels. These research institutes are available for companies to act as R&D partners. This way, high-quality knowledge becomes available for making big strides forward, especially by SMEs. These institutions can deliver pace and added value, particularly in the development of a prototype and in the area of certification requirements. The current TKI scheme is available for this purpose, but should be opened up to companies from sectors other than the top sectors, while consideration should be given to opening it up to companies from other (EU) countries as well. In addition to the research institutes, there is also an important role to play by the Universities of Applied Sciences that carry out specific research, linked up to education and tomorrow's talent. A structural contribution to the implementation of projects (following the example set by CompoWorld) is also needed to promote collaboration at a national level.

VALORISATION (TRL 7-9)

Valorisation of projects currently takes place via EFRO projects or Interreg projects. The disadvantage of these projects is that they are often too heavy for SMEs in terms of administrative requirements and have a limited lead time of 3 years. Another way is the RAAK projects via the various universities of applied sciences. These are easier to access by SMEs. Both instruments must remain available. EU projects such as Horizon2020 also offer opportunities for valorisation but are difficult to access by SMEs.

In order to further promote knowledge valorisation, a positive investment climate in the sector is important. In addition to the existing financial instruments (such as the Innovation Credit), there are also other ways of promoting the investment climate. Parties such as the Regional Development Companies and Novel-T in the eastern part of the Netherlands can play roles therein.

The government will play its part in this as well, by launching the new InvestNL instrument in 2019. InvestNL will start contributing to financing social transition assignments through investments in areas such as energy, sustainability, mobility and food and social domains such as healthcare, safety and education. Furthermore, InvestNL improves access to European funds. A total of € 2.5 billion is available for this.

4.3. THE COMPOSITE WORKFORCE OF TOMORROW

The national challenges of the human capital agenda also apply to the composite sector. Availability of qualified personnel poses a threat to the sector (quality and quantity):

- **first of all because of the gap between the theory of educational programmes combined with intractable practice;**
- **second, cross-sectoral knowledge and skills (material science, chemistry, robotics, ICT) do not easily find their way into the composite sector;**
- **and third, not enough competent staff (of all educational levels) are available.**

As the composite technology sector is growing, the need for well-trained practical and academic staff is increasing. The innovation potential of the future currently finds its way within the education and knowledge institutions. Focus on the talents of tomorrow is vital, while the connection with other horizontal areas such as HTSM, chemistry, ICT and sectors such as aviation and automotive is inevitable. With the rapid innovation of key technologies and innovation programmes in the roadmaps of HTSM, chemistry and ICT, there is a need for integrated educational programmes in which nanotechnology and advanced materials are vital components of education in composite but also robotics, ICT and photonics. In this way, the sector is prepared for tomorrow's value chain. A value chain in which composite production is dominated by smart and automated systems, by composites that light up through the integration of photonics technology, by micro-structures that determine the properties and behaviour of composites but above all, by sustainable and affordable solutions.

A large number of collaborations and field labs in the action programmes link educational programmes with research, innovation and production, to teach everyone the new skills (composite, automation, sustainability, etc.). This applies to both entrepreneurs and employees, as well as to new talented people that still need to be trained.

The composite workforce of tomorrow focuses on the following points:

- Joint educational programmes with various 'inter-sectoral' knowledge institutions, in which multiple disciplines are brought together (ICT, robotics, mechanics, composites).
- Link-up of educational programme with the industrial sector (internship and training places).
- The development of practical training for structural engineers and designers.
- Branding and marketing of the sector for educational purposes to attract more talent for composite-related educational programmes.

4.4. COMPOSITE LEGISLATION

Laws and regulations do not (yet) always allow the use of composite technology for a number of applications, for example the shells of trains and ships. This mainly concerns subjects such as strength and impact resistance, fire safety, noise and vibration, connection techniques, electromagnetic compatibility (EMC) and maintainability.

The current laws and regulations limit the use of composite because it takes longer for new products or applications to be introduced to the market. This increases the costs for a composite innovation.

In order to make composite applicable in many different sectors, adaptation of existing regulations is needed, combined with the introduction of new ones. Representatives of associations such as Netherlands Maritime Technology and Ricardo Rail have started their own initiatives to tackle the regulations, with the aim of accelerating the acceptance of composite and making the application of composite in their sector possible (on a wider scale). CompositesNL, a trade association, is working as part of a working group to improve the legal framework for the use of composites, also on behalf of its members.

The implementation of this national agenda focuses on:

1. The development and implementation of performance-based regulations, codes and standards:
- Pilots to prove the technology (Maritime, Wind Energy, Construction & Infrastructure)
- Knowledge dissemination within the sector
- The government as a launching customer
- Collaboration with certifying bodies
2. Applying (inter)national uniform quality systems

4.5. DUTCH COMPOSITES ABROAD

> **Innovation and internationalisation often go hand in hand. They reinforce each other. On the one hand, innovations provide companies with access to new foreign markets with a positive impulse for economic growth. On the other, companies operating internationally gain access to new knowledge and technologies, which has a positive effect on regional innovation.**

In addition, branches of foreign companies make substantial contributions to the strengthening of our knowledge economy. They account for 34% of all high-profile jobs and 30% of all R&D investments. A strategy that contributes to winning and preserving an advantageous position within the international trade value chain contributes to the creation of employment, transfer of technology and knowledge valorisation. Strong international positioning of the Dutch composite sector is of national importance for imports and exports, direct foreign investments and cross-border partnerships.

To this end, CompositesNL, in collaboration with RVO, has already formulated a value proposition and drawn up an action plan in order to:

- attract foreign investments, following investments of large companies such as Tejin Aramid, Toray, Suzlon and Sabic.

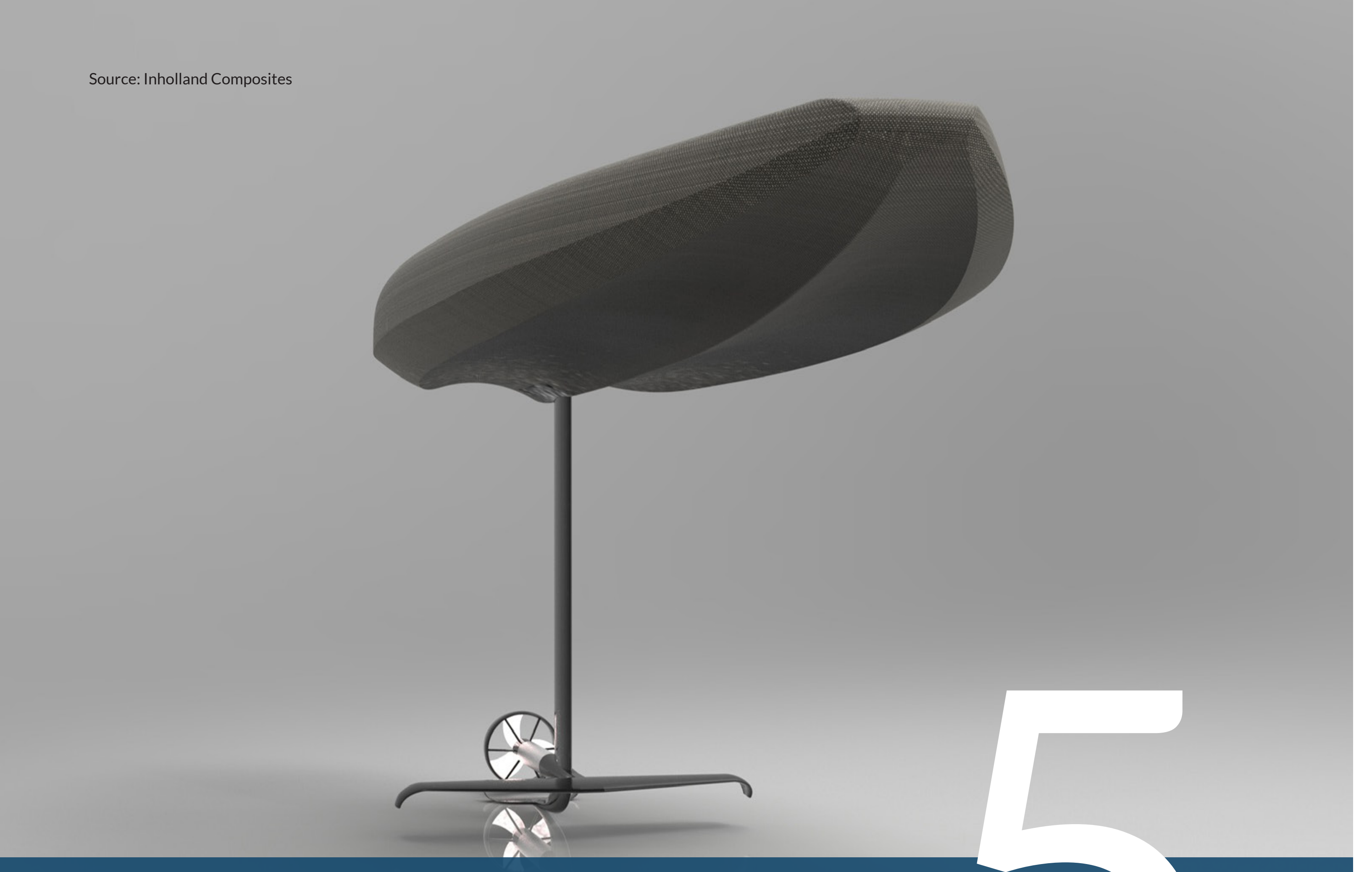
This is important for the innovation impulse of the sector and also leads to improved access to the international market;

- gain improved access to international markets;
- attract international knowledge workers;
- start up cross-border partnerships.

With this international proposition, the Dutch region will jointly and internationally present itself in the coming years, kicking off at the JEC in Paris in March 2019.

In order to set this out in more concrete terms, the internationalisation strategy will be worked out further. International branding and marketing of the composite sector form a part of the strategy.

Source: Inholland Composites



5 ORGANISATION AND INVESTMENTS

5.1. ORGANISATION

In order to develop and market new disruptive technology around the spearheads of this agenda, collaboration across the boundaries of regional initiatives is necessary. The required knowledge and skills for this are divided across the various high-quality initiatives and must be brought together. Not only does this revolve around exchanging knowledge and facilities, but much more so around bringing this knowledge and expertise into the national action programmes in order to work on the challenges of this agenda. The same applies to cross-sectoral collaboration across the boundaries of the application areas, so that the knowledge and expertise from the various application areas become available and is used in the overarching issues of cost reduction, circularity and certification.

DUTCH COMPOSITE PLATFORM (DCP)

The intended national collaboration is given shape through the Dutch Composites Platform, a small flexible organisation that will work out the National Cooperation Agenda for Composite in an implementation plan and supervise the implementation itself. Within the DCP, CompositesNL, the regional development companies and the current top sectors (HTSM and Chemistry in particular) play an important role, especially when drawing up new Knowledge and Innovation Agendas (KIAs) for the mission-driven policy. As part of the efforts, a link-up is sought with other clusters (robotics, photonics, mechatronics) and new areas of application.

The Dutch Composites Platform will use existing research programme structures (Materials NL), field labs and open innovation centres, with regard to technology development through all technology readiness levels (TRL). Other critical policy areas such as Human Capital, internationalisation and laws and regulations are also included in the elaboration of the implementation plan.

The Dutch Composite Platform is positioned at the very heart of the sector and builds strategic partnerships with all relevant adjacent sectors and organisations. As such, the DCP is in the right position to create a single Dutch sector for composites through:

- Coordination of a single Dutch cluster for composites.
- Coordination of the implementation of the national action programmes.
- Monitoring and evaluation of the national action programmes.
- Collaboration and coordination (supra-regional, cross-sectoral, chain collaboration and along the various TRL levels).
- Support from PPP initiators within the national action programmes for strengthening the connection with application areas and social challenges and with other top sectors.
- Communication and awareness.
- Branding & Marketing in collaboration with CompositesNL and other relevant actors such as Holland High Tech.
- Internationalisation, where possible, in collaboration with other networks in the Netherlands and Europe (examples include ROMs NFIA, RVO, the embassy network and High Tech Holland).

In order to implement this agenda in the short term and to work successfully on the spearheads of this agenda, the Dutch Composites Platform will draw up an implementation plan in the coming months (April - June 2019).

The following organisations will play a role in this:

- CompositesNL (on behalf of companies and knowledge institutions).
- Regional Development Companies (ROMs), see Appendix 3.
- Top sectors HTSM and Chemistry, RVO.
- Trade associations such as Netherlands Aerospace Group (NAG), Netherlands Maritime Technology (NMT) and AutomotiveNL.

5.2. BUDGET AND INVESTMENTS

The implementation of this agenda starts with the commitment and initiative of the stakeholders and the willingness to invest in the proposed PPP collaborations. Within this framework, the Dutch composites cluster counts on support from national, regional and international governments, as part of which various financial instruments, both national, regional and European, will be called upon. Examples include facilities such as EFRO (MIT R&D for SME involvement), Interreg and Horizon2020 for cross-border partnerships.

Within the framework of this agenda, an investment amount is planned in the region of € 36 million per year for the technological implementation projects, including € 20 million per year in private investments. This will also be aimed at smart business concepts, for the purchase and use of facilities.

A total investment amount of € 36 million per year is planned for the implementation of the cooperation agenda Composite.

The PPP initiatives, in consultation with the TO2 institutions, will explore the possibilities of programming resources in RegioDeals for intensifying applied research.

For large PPP initiatives, the Dutch Composites Platform wants to play a leading role in the design of a financing facility in collaboration with InvestNL, for the entire chain of research, development and market introduction.

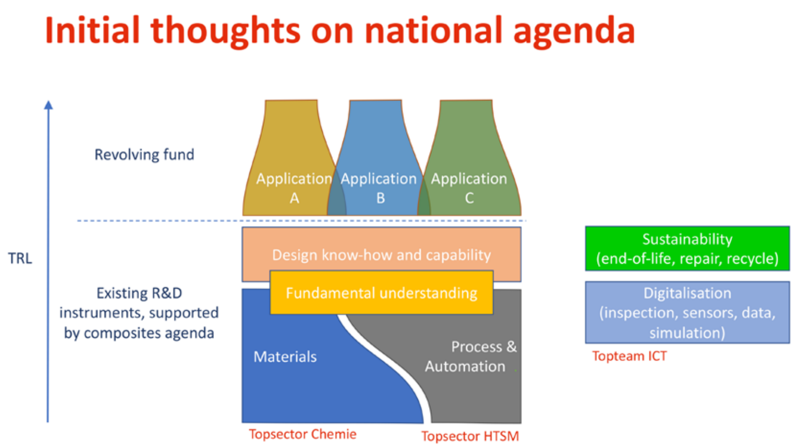


Figure 12: Example of the financing mechanism to be set up

APPENDIX

APPENDIX 1

COMMITMENT TO THE SECTOR

> **In January 2019, nine agenda meetings were held in order to involve as many parties as possible in drawing up the agenda and to thus create a representative picture of the opportunities and challenges in the sector. These opportunities and challenges have been translated into ambitions and spearheads on the basis of which the sector has brought together specific existing and new initiatives in national action programmes that contribute to the realisation of the objectives of this agenda.**

The following parties attended one or more of the meetings within the framework of drawing up the National Cooperation Agenda for Composites in January 2019 and express the intention to be actively involved in the implementation of this agenda. They do this by signing this cooperation agenda in the overview in this appendix.

NAME	ORGANISATION	SIGNATURE
Jaap Ruwaard	Scabro	
Leen Schaap	Schaap ShipCare	
Arnold de Bruijn	Netherlands Maritime Technology (NMT)	
Stef Jaspersen	BNS Industrial	
Tim van Hurck	BNS Industrial	
Charlene van Wingerden	CEAD Group	
Erwin van Maaren	Nedcam	
Geert van der Velde	HMUH	
Marcel Elenbaas	Damen	
Rick Bakker	ADSE	
Jesus Mediavilla Varas	M2I	
Thijs Kok	ADSE	
Arnold Vaandrager	Vabo Composites	
Peter Boer	DTC	
Arjen Korevaar	Polyworx	
Laurent Morèl	Infracore (CompositesNL)	
Sven Korver	Pontis	
Arnt Offringa	GKN Fokker Aerospace	
Maarten Labordus	KVE Composites	
Aldert Verheus	Lightweight Structures B.V.	
Hans Minnee	LM Windpower	
Marco Brinkman	SPECTO Aerospace	
Marcus Kremers	Airborne	
Lucas Janssen	CEAD	

NAME	ORGANISATION	SIGNATURE
Richard Bijland	CEAD	
Marco Brinkman	Specto Aerospace	
Bert Klarus	Innovation Quarter	
Ferrie van Hattum	Saxion Hogeschool	
Rik Voerman	Saxion Hogeschool	
Harald Heerink	TPRC	
Rudy Veul	NLR	
Gerard de Weerd	De Weerd Innovatie Advies B.V.	
Wim Groothuis	PFT Profiles	
Hans Bosch	RVO	
Nico Smit	Smit Composite B.V.	
Farid Talagani	AirbusDS	
Warden Schijve	Sabic	
Joris Wismans	Sabic	
Stefan van Seters	REWIN	
Jos Lobee	Brightlands Materials Center	
Joost van Linnert	Cato Composites	
Harm Alberts	Ten Cate Advanced Thermoplastics	
Michiel Baltussen	DSM	
Wouter Grouve	UT Twente	
Robbert Jan Kooij	OostNL	
Liesbeth Tromp	Royal Haskoning DHV	
Thomas Wegman	AOC Aliancys	
Bert van Haastrecht	M2I	

NAME	ORGANISATION	SIGNATURE
Koert Dingerdis	Hogeschool Inholland	
Erik van Uden	Solico	
Jan Kroon	Fibercore Europe	
Martijn Moonen	Euroresins	
Jaap Ruwaard	Scabro	
Marc Huisman	Brightlands Material Center	
Rien van den Aker	Van Wees	
Paul van den Heuvel	Polyscope	
Sam Sals	Polyscope	
René Kessen	LIOF	
Edze Visscher	Lantor	
Kalong He	Boikon	
Louis Rouland	Velox	
Stefan Voskamp	Eurocarbon	
Evert Jan Temmink	Parthian Technology	
Herbert Bult	Demcon	
Toni Amaddeo	NKC Nederlandse Kunststoffen Chemie	
Sandro Di Noi	Suzlon	
Peter Verschut	HAN Hogeschool	
Ariean Koelewijn	SAMPE	
Ingrid Houthuizen	TU Delft	
Nico Smit	Smit Composites	
Aart Schoonderbeek	Hogeschool Windesheim	
Arnold Koetje	Hogeschool Inholland	

NAME	ORGANISATION	SIGNATURE
Cor Boksem	Twenco	
Kjelt van Rijswijk	SAMXL	
Dhr. Kamminga	M2I	
Alena Belitskaya	European Space Agency	
Frans Cohen	3Acomposites	
Arvid de Lange	AdelPolyester	
Gea Spijkerman	Akzo Nobel	
Ben Drogt	BiinC	
Bram van der Pijl	Bootjessloperij 't Harpje	
Hans te Siepe	Brimos Duurzame Energie	
Bart Thiele	Certion	
Robert Slettenhaar	Demacq Recycling	
Hans Kelderman	Demacq Recycling	
Wim Brink	Fatol	
Jos Lechner	Flexxcon	
Ron Vuur	GroenICT	
Geert-Jan van Woggelum	Groningen Seaports	
Anna Khachaturian	Groningen Seaports	
Jaap van der Woude	Jaap van der Woude	
Derkjan Weeke	Machinefabriek Emmen	
Marie-Louise van de Sande	MLS Management	
Ilse de Vos-van Eekeren	NedTrain	
Rients Oldolphi	Odolphi	
Jasper van Deijnen	Oldolphi	

NAME	ORGANISATION	SIGNATURE
Ron Nuwenhof	OostNL	
Klaas Schuring	RWE	
Huub Ceruwels	Sgs	
Niek van de Griendt	Sphagnum Products	
Harrie	s-pod	
Bert-Jan van der Woude	Suez	
Richard Bergman	TenCate Advanced Composites	
Siep Bultje	Waterschap Zuiderzeeland	
E. Koolmees	Welex	
Eric Roetman	Windesheim	
Margie Topp	Windesheim	
Geert Heideman	Windesheim	
Thomas Camping	Windesheim	
Bastian Coes	Windesheim	
Jaap Ruwaard	Scabro	
Leen Schaap	SchaapShipCare	
Sybren Jansma	LM Wind Power	
Rudmer Heij	NOM	
Rogier Nijssen	Inholland Composites	
Henk Minnema	Pontis Engineering	
Rik Voerman	Saxion	
Philipp Picard	Sabic	

APPENDIX 2

CHALLENGES IN THE DUTCH COMPOSITE SECTOR

The Dutch composite sector is working successfully on composite technology and applications. Efforts are aimed at and in many different sectors (the so-called application domains), as described in chapter 2. In order to draw up this agenda, many stakeholders in the Netherlands have been consulted through input sessions, which were organised on the basis of specific themes and aimed at specific sectors. Except for a number of sector-specific challenges, the various sectors often share similar needs and experience the same challenges when it comes to the development and application of composite technology.


Source: VABO Composites

MARITIME SECTOR

Composite technology is used in relevant maritime applications such as minesweepers, racing boats, advanced yacht structures (e.g. masts), radomes and for commercial maritime applications such as water taxis and crew supply. In all these areas, the Dutch maritime sector is a world player, resulting in economic activities and business opportunities that connect global players such as Hallspars with the Netherlands. New product-market combinations too are being developed in composite, such as the modular water bus, which proves to be competitive with aluminium in terms of both operating costs and initial costs.

Presently, regulations are the biggest challenge in order to apply composite products in the maritime sector on a large scale. Fire safety, in particular, demonstrating that equivalent safety levels can be achieved in comparison with steel, proves to a stumbling block. International organisations such as IMO are making progress, although developments are slow. In 2017, a new guideline was released to make it possible to apply composite elements in commercial vessels. In the next 4 years, this new guideline will be evaluated in various research projects. Damen is involved in this type of European research, together with trade associations such as Netherlands Maritime Technology, NMTF, Airborne Composites and Infracore. The aim of the Dutch consortium is to create a hull section of an 85-metre ship with the aim of giving regulatory authorities an example of how such products can be certified.

The Dutch maritime sector, with Damen Shipyards at the forefront, leads the way internationally in finding solutions to this problem. Strong cross-sectoral cooperation in this area between the maritime and composite sectors is required to connect existing knowledge and to develop new knowledge and expertise, technology and regulatory frameworks that ensure that structures are assessed on the basis of performance (regardless of the materials used). All knowledge for the successful application of composite is present in the Netherlands but not easily accessible. Composite technology in the maritime sector can be the showcase for other Dutch application markets (such as aerospace and automotive) and play a relevant role in the international community for research and legislation, as a result of which the Dutch composite sector is positioned as a Centre of Excellence for legislation and certification (accelerating adoption).
In addition, the cost-benefit factor plays a major role in the maritime sector. Products should be sold not only to the customer but to the entire chain (so trust, quality, sustainability and cost price are also important). Nevertheless, the purchase price often remains decisive. The quantification of quality and sustainability is needed to properly communicate the business case to the stakeholders and to accelerate the adoption of composite.

The maritime sector needs:

- Improvement of laws and regulations > Performance-based regulations
- Cost reduction, scaling up, shorter lead times > Automation
- Sufficiently trained staff > Human Capital
- Quantifying and communicating the business case > Business development
- Unlocking the knowledge and expertise available in the Netherlands > Knowledge centre

AVIATION

The number of people travelling by air is set to continue to grow in the coming decades. Aviation is growing, as a result of which CO_2 emissions will continue to rise if adequate measures are not taken.

In order to produce lighter aircraft, composite technology is used wherever possible. The weight reduction achieved through the use of composite means that fuel consumption is reduced by up to 40%, thus limiting CO_2 emissions. This is not enough to absorb the impact of growth in aviation. In order to generate more impact and make aviation more sustainable, new technologies are needed that allow for a more extensive and large-scale application of composite by tackling the current limitations. For example, composite is currently only economically viable for specific high-quality applications in aviation. In addition, 'heavier' materials such as steel are still required to create material connections. Parties such as GKN Fokker carry out projects to develop new methods for manufacturing aircraft parts from a single composite part, making the 'heavier' material connections unnecessary. Furthermore, the manufacturing process is labour-intensive.
The ever-increasing application of composite in the aircraft industry also makes new demands on the repair and maintenance of aircraft and on the quality standards. Development of new knowledge, technology and guidelines are necessary to ensure acceptance of the application of composite within the chain. Synergy effects can be achieved here through developments and initiatives in this area in the maritime sector.

In order to make growth in aviation more sustainable, efforts are made to:

- Reduce weight
- Reduce costs
- Improve repairs, maintenance and overhaul
- Make materials and processes more sustainable

CONSTRUCTION & INFRASTRUCTURE

Lock gates, bridges, external walls and other structures of composite, you can find them in the Netherlands. The Dutch construction and infrastructure sector is a global leader in this respect. Developments in the surrounding countries are gathering pace but right now, the structural and infrastructural works of composite are nowhere as diverse as they are in the Netherlands. Consequently, the Netherlands are also leaders in terms of laws and regulations for composite in the construction and infrastructure sectors. The high-quality knowledge position of the Netherlands offers many opportunities in Europe. The Dutch products and way of working fit in well with the European level and the new CUR96 guidelines. In order to stay ahead, the Netherlands must continue to deliver quality and be able to scale up. This requires an investment in human capital at the front and makes a uniform quality system indispensable. Individual companies and organisations cannot do this themselves, as this requires a sector-wide approach.

Comparable with other promising sectors, cost reduction is necessary here too in order to achieve scaling up.

In addition to strength and rigidity, properties such as freedom of design and light weight play an important role when it comes to applications for structural or infrastructural purposes. Furthermore, the use of composite provides a number of advantages that cannot be directly attributed to the material itself. Composite allows making adjustments to existing concrete and steel structures, instead of replacing these structures as a whole. This ensures fewer and less lengthy road closures and, therefore, fewer CO2 emissions caused by long traffic jams and diversions.
The use of composite in construction and infrastructure remains limited because there is too little knowledge of the possibilities and properties of composite in the sector. As a result, composite as a material often lacks from the range of materials (e.g. steel and concrete) which a designer/engineer chooses from during in the design process. In addition, composite as a building material has been tarred with a negative image by some less successful projects which received extensive negative media coverage.

The sector needs an improved position for composite as a material of choice in the design process, driven by a focus on specific training courses and overarching awareness activities.
In addition, the possibilities and properties of composite must become more widely known and the added value must be quantified (e.g. for LCA/LCC).

AUTOMOTIVE SECTOR

The Dutch automotive industry mainly covers the beginning of the value chain in the form of material and component suppliers and does not develop passenger cars themselves (OEMs). However, the Netherlands are home to truck and bus manufacturers such as DAF and VDL respectively, who develop systems themselves. Composites, thermosets, in particular, are already used here combined with further development opportunities for composites, both thermosets and thermoplastics. However, more important for developments in the field of composites is the supply to foreign car suppliers.

The demand for sustainable solutions to reduce emissions has triggered a switch to vehicles with other drive systems. All passenger car manufacturers work on electric or hybrid cars or already have models on the market, with a considerable part of the development capacity aimed at this trend. The addition of batteries and hybrid systems only increases the weight of these cars.
In the competitive battle between low-cost traditional drive systems and electric or hybrid vehicles for the lowest consumption figures in Litres or kWh per km, but also for the maximum number of kilometres driven on a tank or battery charge (range), weight reduction is important for all types of drive systems. This results in a reduction in emissions, either directly (combustion engines) or indirectly via the reduced amount of generated energy needed (electric cars). Composites can make an important contribution to this.

The combination of advantageous mechanical properties at a low weight and design options that are much more extensive than those of metals makes composite a suitable material for passenger cars.
The increasing pressure on circularisation leads to an increasing interest in thermoplastics. The developments in the field of separating plastics make this realistic, also with the current processing of end-of-life vehicles. Demand from garage businesses for the correct maintenance of composite body parts is growing. The DMCM can provide support in this, possibly in consultation with organisations such as BOVAG.

A challenge for the suppliers of thermoplastic composite technology is to familiarise the developers in the automotive industry with these materials and automated processing thereof and to build up supply chains to realise cost-efficient applicability on a larger scale.
There are some wonderful opportunities here for the Dutch plastics and composites industry. This requires collaboration, in which knowledge of polymers and thermoplastic processing must be combined with knowledge held by the composite sector. The Netherlands are traditionally strong in collaboration and partnerships. The Dutch Composites Platform wants to facilitate this.

APPENDIX 3

ROLE OF THE REGIONAL DEVELOPMENT COMPANIES (ROMS)

The ROMs play an important role in the implementation of the agenda around the core tasks, ie. investing, internationalising and business development. They have indicated that in line with the Photonics agenda, they can and want to implement this in the following way.

INVESTING:

- The use of expertise to strengthen, structure and manage financing for the Dutch Composites Platform professionally and in the best possible way.
- Introducing expertise into strategic policy-making and road mapping around composite initiatives.
- Advising individual companies operating within this ecosystem on attracting financing and possibly co-invest therein. This involves, among other things, existing portfolio companies from the ROMs, new start-ups and spin-offs from universities, universities of applied sciences and new companies that establish themselves in their region.
- The ROMs (in collaboration with the other ROMs and CompositesNL) will (co-)facilitate the formation of specific funds and possibly manage the money applied from said funds in the form of capital and/or loans.
- The ROMs will develop composite start-ups or composite SMEs into an 'investment-ready' proposition and be soliciting feedback from entrepreneurs about business and investment strategies (scouting, screening and guiding).

INTERNATIONALISATION:

- The deployment of capacity to attract (international) companies and to create and guide new activities in the composite domain (proactive acquisition).
- The Netherlands have a very strong pitch through both industry and knowledge institutions to be able to also recruit internationally to strengthen the composite ecosystem. The ROMs, in collaboration with the cluster, will be eyeing up possibilities and opportunities to identify potentially interesting parties and actively approach them (strategic acquisition), using mainly the NFIA in its approach and, where possible, the existing innovation network.
- Through the key technology of Advanced Materials, the ROMs will be paying attention to the composite theme when organising incoming and outgoing missions to the focus countries selected by the ROMs.

BUSINESS DEVELOPMENT:

- The ROMs will make an accurate description of the current composite ecosystem and monitor the development of that ecosystem.
- The ROMs develop projects (within a European framework or otherwise) that contribute to the innovative strength and competitiveness of the players in the composite ecosystem.
- The ROMs are actively working on strengthening the connection of the composite ecosystem with other relevant (Dutch) ecosystems, such as high tech, energy and automotive.
- The ROMs will actively focus on identifying composite-relevant start-ups or SMEs outside the Netherlands with an interest in developing activities in the Netherlands (scouting, screening and guiding).

APPENDIX 4

FIELD LABS IN THE COMPOSITE SECTOR

This appendix describes the various field labs in the Dutch composite sector together with the partners involved and anticipated investments. These field labs form a basic structure on which to build on for the implementation of the cooperation agenda composite.

DEVELOPMENT CENTRE FOR MAINTENANCE OF COMPOSITES

The ambition of the DCMC is to become an internationally leading and independent authority that initiates and supports innovations in the fields of Maintenance, Repair and Overhaul of composite structures. This is achieved by supervising various national and international innovation projects and the implementation of research and development programmes initiated by DCMC members. In addition to making an important contribution to extending the service lives of composites, the cluster will have a positive effect on the creation of jobs and the consolidation of Woensdrecht as an international maintenance centre for aerospace in Europe.

DESCRIPTION

The DCMC focuses on the development of new Maintenance, Repair and Overhaul products, processes and services for composite structures. Bringing together the knowledge, capacities and infrastructure builds a bridge between fundamental research at institutes and applied technology developed by companies. Projects managed or carried out by the DCMC are assessed on a case-by-case basis and implemented in close collaboration with customers; they have a TRL ranging between 4 and 6/7.

The field lab 'Composites Maintenance and Repair: building the Development Centre for Maintenance of Composites (DCMC)' must become the place where the inspection and repair of composite material are bundled. In the already highly developed physical crystallisation point in Woensdrecht, the visually prominent players in this field come together to shape the DCMC project.

PARTIES INVOLVED

The partners of DCMC are GKN Fokker, NLR, Airborne Services and Delft University of Technology, Fokker Services, SPECTO Services, TiaT Europa, Dutch Terrahertz Inspection Service, Damen Shipyards and REWIN West-Brabant.

INVESTMENTS

The above parties jointly invest more than €10 million in a public-private partnership in 4 years.

SMART ADVANCED MANUFACTURING XL (SAM | XL)

SAM | XL (Smart Advanced Manufacturing XL) is a joint research centre where the technology is developed, demonstrated and the scaling risks are limited for the automated production of large lightweight composite components for aircraft, wind turbine blades, spacecraft and maritime applications. The joint research centre is set up as a non-profit foundation under the auspices of Delft University of Technology and brings together the knowledge bases of Delft University of Technology Aerospace Engineering, Delft University of Technology Robotics Institute, TNO Industry and industrial partners from the various cross-sectoral composite supply chains.

SAM|XL aims to achieve economic growth and create jobs through an improved competitive position of the Dutch composite sector by increasing production volumes and accelerating the innovation process. Its efforts are focused on projects at the various TRL levels:
industrialisation projects, proof-of-concept projects, infrastructure projects and academic projects in combination with education and training activities.

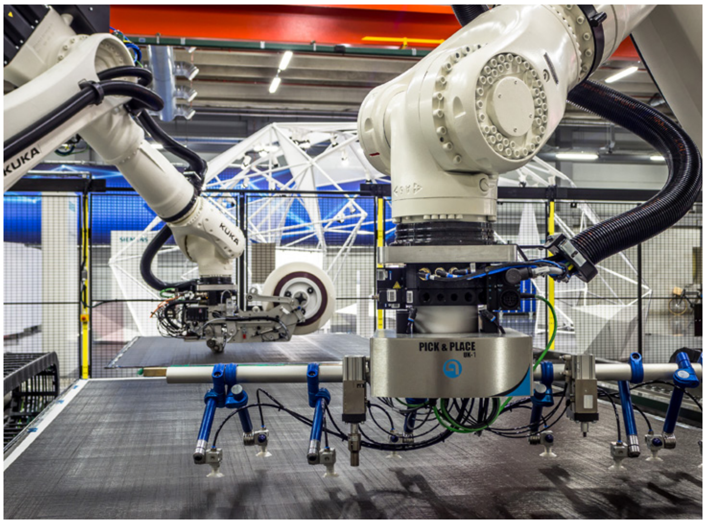
SAM|XL is a research centre in which companies and research institutes work together in the field of automating and robotising the production of lightweight composite structures at the Delft University of Technology Campus. Companies can use the facilities on a project basis together with students, Delft University of Technology and TNO.

PARTNERS INVOLVED
Delft University of Technology, Fokker GKN, Airborne, Airbus Defence & Space Netherlands, Suzlon, TNO, GTM Advanced Materials and KVE.

INVESTMENTS
The investment scope of SAM|XL amounts to more than €10 million over a period of 5 years.

FIELD LAB 'DIGITAL FACTORY FOR COMPOSITES'

The Digital Factory for Composites focuses on open and cross-sectoral innovation in the composite chain. In the DFC, a new technology for automation and digital manufacturing is being developed and demonstrated. DFC has the ambition to reduce the CO_2 footprint by making products lighter as part of a circular production process. It aims to achieve this by developing a pioneering blueprint for composite solutions, produced in an efficient and innovative way, i.e. digitally, sustainably and economically interesting for all parties.



The digital factory focuses on the development of a sustainable and circular method for the production of composites, which can also be applied in other ecosystems and industries. The principles of digital entrepreneurship form the departure point for this.

PARTNERS INVOLVED

Siemens, Airborne, SABIC, KUKA, Delft University of Technology

INVESTMENT

Largely private investment

SMART PRODUCTION CENTRE FOR ADVANCED AUTOMOTIVE APPLICATIONS (SPC)

with an emphasis on the development of composite applications for and especially in collaboration with the business sector, with the aim of scaling these up to full-scale production. (Composite) materials, products and processes are developed as part of an integrated approach and in consultation with the companies and knowledge institutions, which lead to a new Product Market Combination (PMC) for the automotive sector.

The aim is to realise thermoplastic composite products along a digitised and automated production environment in which, in addition to producing (composite) components or assemblies, the quality requirements that this sector sets to both product and the supplier are met as well. Completing the DMP triangle within the chain is important in this respect. In terms of technology, the projects will be realised through clusters. This is supplemented with knowledge for the associated Business Cases and (new) Business Models. Training and education form a part of the test centre. Subject matters such as engineering, design, logistics, ICT, communication and management are united within the test centre. In addition, the SPC acts as a shared facility for the composites manufacturing industry, thereby supporting the SME industry in smarter and cleaner production.

Aspects such as continuous production (24/7), mass production of composites, Internet of Things (IoT) and Big Data are important spearheads of the SPC.

PARTNERS INVOLVED

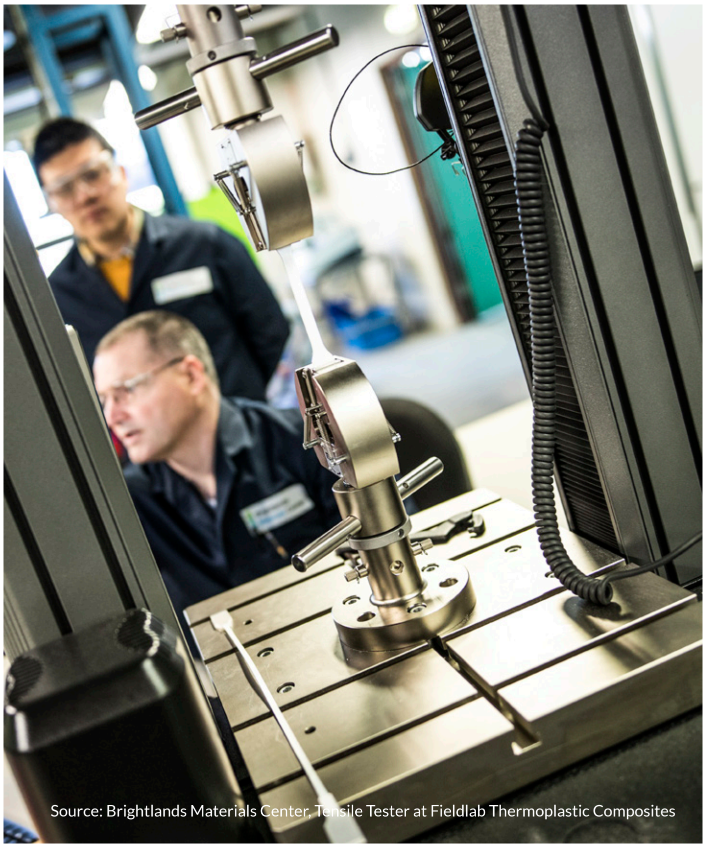
Companies: DSM, Siemens, EDAG, Firestone, Hollander Techniek, Qing, Plantics, Doeko, TM-Induction, Cards Solution, K3D, VDL, VB Airsuspension, Dekra, Donkervoort, Blue Engineering, Intrax, Saker, Ceracarbon, Hencon, Vredestein, Voestalpine, Cato Composites, VDL, DSM, EDAG and many other SMEs (further names to be added)
Institutions: ACE, IPKW, AutomotiveNL, HAN University of Applied Sciences, Fontys, HvR, BMC, Saxion University of Applied Sciences,

INVESTMENT

The investment is made in two phases.
Phase 1: €1-5 million
Phase 2: €10-12 million
As a public-private partnership, financing is sought at institutions such as the universities of applied sciences, local authorities, provincial authorities, the Ministry of Economic Affairs and businesses.

BRIGHTLANDS MATERIALS CENTRE (BMC)

The Brightlands Materials Centre (BMC) is an international research centre for new, sustainable technologies in the field of plastics and their applications. At the Brightlands Chemelot Campus in Geleen, dozens of knowledge institutions and companies in various shared research programmes work on traditional polymers based on raw materials of both petroleum and vegetable origin.



Source: Brightlands Materials Center, Tensile Tester at Fieldlab Thermoplastic Composites

The BMC focuses on reinforced thermoplastic materials for the automotive industry. Because of their properties, such composites have a lot of potential for application in lightweight structures. Their weight is half that of steel and up to a quarter of that of aluminium, which contributes to CO2 reduction at the same time. As part of its research, the BMC focuses on the question of how strength, service life and bond between composites and other materials can be predicted.

The knowledge gained is used to build models on the basis of which BMC, together with the partners, optimises the materials in vehicle components in a cost-efficient manner. When introducing new materials, special attention is paid to the end of the service life. The BMC develops concepts for thermo-mechanical recycling, ensuring that the recycled material is suitable for structural applications. What makes BMC's expertise so special is its modelling competencies in combination with insight into specific polymer materials. Furthermore, the BMC has unique facilities to support experimental research, ranging from clean rooms to 3D printing facilities and from pilot processing lines to access to investors.
Based at the Brightlands Chemelot Campus, the BMC maintains short lines of communication with material suppliers and companies that apply the innovative materials in practice. Moreover, the BMC, with its operational base in the province of Limburg, benefits from easy access to the expertise of educational institutions. For example, Zuyd University of Applied Sciences and the universities of Eindhoven, Maastricht, Twente and Hasselt all contribute to accelerating our research.

PARTNERS INVOLVED
Province of Limburg, TNO

INVESTMENT
Project 'Test Bed for Thermoplastic Composites'. Partners: Alligator, Allplast, BMC, CMB, Eurocarbon, Plastica Thermoforming, Polytec, VanWees, Verbi. Total project volume: approx. €5.5 million.

AUTOMATED COMPOSITES AND METAL MANUFACTURING AND MAINTENANCE (ACM3)

Within the existing Field lab 'Centre for Lightweight Structures' of the Netherlands Aerospace Laboratory NLR, in close cooperation with private-sector companies, SMEs, knowledge institutions, universities (of applied science) and with the support of national and regional authorities, work is carried out on the development of automated manufacturing processes for composite products and the digitisation of these processes. To make these developments possible, the Field Lab is a very modern and well-equipped facility with equipment for processing high-quality composite materials.

Composite products developed within this Field Lab are used in various sectors, such as the aerospace, automotive, maritime, medical and energy sectors (wind energy). However, more and more composite products do not consist exclusively of fibre-reinforced plastics. Often combinations of composite and metal are used. For the manufacturing of these metal parts too, automation, flexibilisation and digitisation of the production process will be playing an increasingly important role.

The field lab for Automated Composites, Metal Manufacturing and Maintenance (ACM3) consists of the following units:
• Automated Composites Manufacturing Technology Centre (ACM-TC): Centre for cross-sectoral technology development
• Automated Composites Manufacturing Pilot Plant (ACM-PP): Centre for specific production technology or product development
• Metal Additive Manufacturing Technology Centre (MAMTEC): Centre for the development of free-form metal additive production technology or product development.

PARTNERS INVOLVED

INVESTMENT

THERMOPLASTIC COMPOSITES RESEARCH CENTRE (TPRC)

The ThermoPlastic composites Research Centre is a research centre that focuses on thermoplastic composites for the aviation and automotive industry and other industrial applications
Thermoplastic composites are new, strong and especially light fuel-saving materials consisting of fibres and thermoplastic synthetics. The material has been used for some time and is growing in popularity in the car and aircraft industries, among others.

Half the weight of the latest aircraft types from Boeing and Airbus already accounts for composite materials, a growing proportion of which are thermoplastic composites. This increase also creates challenges, for example and especially in the area of connections between the different materials, such as between metals and thermoplastic composites. Another challenge is the recycling of thermoplastic composites. Through its research, the TPRC makes an important contribution to this, thereby paving the way for a wider application of thermoplastic composites. By bringing together all the actors in the value chain, we will identify, analyse and effectively overcome the technological barriers that impede the large-scale application of thermoplastic composites. The involvement of the value chain as a whole prevents point solutions and accelerates innovation. The TPRC is known to be a leading authority and is regarded as an excellent knowledge partner with unique know-how on the processing of thermoplastic composites. The TPRC has the disposal of lab with state-of-the-art production and research facilities.

PARTNERS INVOLVED

Boeing, Collins Aerospace, Spirit Aerosystems, GKN/Fokker, Toray TenCate, Victrex, Arconic, Sumitomo/Bakelite, University of Twente, Saxion, DTC, KVE, AniForm, Coriolis, Turkish Aerospace Industries, Daher Aerospace, Web Industries, ATC composites, Dedienne, Rafael

INVESTMENT

The planned investments for the 2020 to 2025 period are €25 million from public and private funds.

THERMOPLASTIC COMPOSITES APPLICATION CENTRE (TPAC)

The TPAC carries out research into the processing and application of lightweight materials. Thermoplastic composites, in particular, offer many possibilities and are, therefore, already applied in a number of sectors. The material is extremely rigid, strong and light and consists of plastic and, for example, glass or carbon fibre.

Composites are often used in expensive products such as aircraft and sports products. They reduce CO2 emissions and can improve and extend overall usability.

The TPAC focuses on reducing the costs of making and processing composites. This will open up lightweight materials and solutions to a larger group of products and people. Or, as Ferrie van Hattum puts it: "Composites for the people!"

Source: Thermoplastic Composites Application Centre (TPAC)

The research centre works together with more than 100 companies and institutions, mostly SMEs. A total of three research areas has been defined in consultation with the business community: Recycling, Production and Automation. In the field of recycling, methods are developed to, for example, process low-grade plastic litter, such as from the plastic soup, into basic applications. In addition, high-quality production waste can be processed into products for the aerospace industry. New methods are developed and tested for production in order to process composite materials cost-effectively. Research is carried out through robots to automate the many processing operations that are common in composite production. This increases the speed and reliability of processes and thus further reduces costs.

PARTNERS INVOLVED

More than 50 industrial and academic partners, including GKN Fokker, TenCate, Pontis, DTC, HAN, TPRC, University of Twente, Saxion, KVE Composites, Eurocarbon, Dutch Composites, Demcon and many others.

DECLARATION

Herewith, with respect to the National Cooperation Agenda for Composites 2019, we declare that:

1. We contributed to the content;
2. We support the strategy and intention;
3. We will continue to cooperate with the further implementation.

TEUN · NOM · TNO innovation for life · Advanced Plastics · EUROCARBON · Airborne
AutomotiveNL · BNS Industrial · BOIKON · BOM · CEAD Composite Additive Manufacturing · Composite Structures
DAMEN · DEMCON · DOPAG · Fatol Kunststoffen · Fontijne Presses · HMVK Composites Consultancy
holland composites · InfraCore company · KVE Composites Group · LANTOR · LIOF · BiinC
POLYSCOPE · Fokker GKN Aerospace · NAG · Schaap Composites · SPC | 3A · Innovation Quarter
Autonational · Windesheim · M2i materials innovation institute · mctechnics · nedcam shaping technology · nlr
Netherlands Maritime Technology · oost nl · FLOWCUT waterjet cutting · Polyworx · Royal HaskoningDHV · sabic
sampe Benelux · SAM XL Smart Advanced Manufacturing · SCABRO · SOLICO · SPECTO Aerospace · SUZLON
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