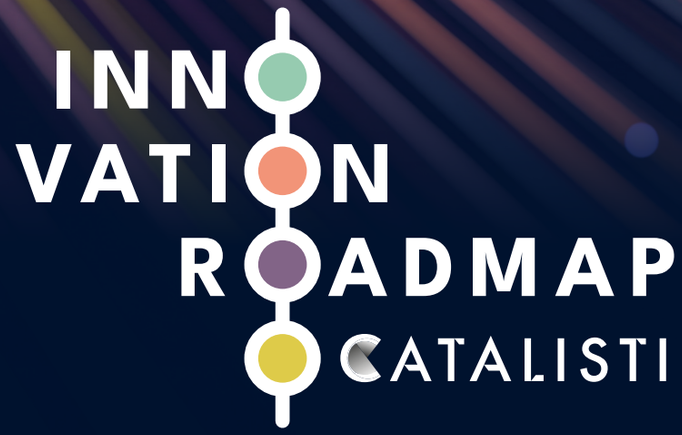
Molecules to markets

Innovation Roadmap
for the chemicals and
plastics industry in Flanders

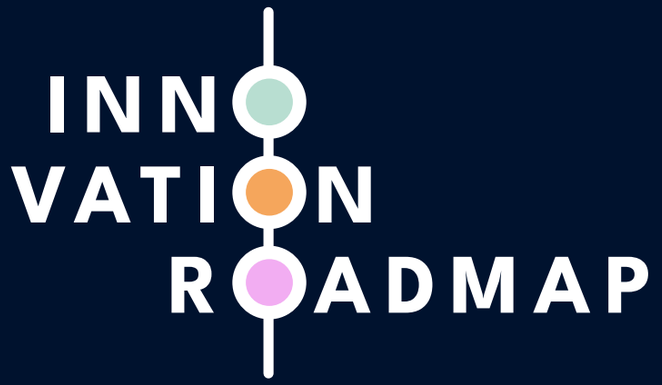


Molecules to markets

Innovation Roadmap
for the chemicals and
plastics industry in Flanders

About this roadmap

Innovation in chemistry and plastics does not happen in isolation. Shaping the future of the sector requires the collective effort and expertise of companies, researchers, policymakers and other ecosystem partners.



From the outset, the roadmap approached innovation from three perspectives: a context perspective, identifying the drivers that shape the sector; a cluster perspective, defining the levers through which Catalisti creates additional leverage for its ecosystem; and a technical perspective, translating ambition into concrete innovation programmes.

A first draft of this Innovation Roadmap was developed by Catalisti in close dialogue with the Board of Directors, Innovation Committee, VLAIO and essenscia, and grounded in analysis of recent authoritative reports. This first draft, published in November 2025, formed the basis for an extensive consultation of the ecosystem in three steps. An online questionnaire (November–December 2025) tested all three perspectives with companies, research institutes, policymakers and other key stakeholders. A series of in-depth expert interviews (January–February 2026) explored Catalisti's role as a cluster within the innovation ecosystem and sharpened the cluster perspective. Finally, a dedicated workshop day (24 March 2026) brought experts together to refine the technical perspective into seven innovation programmes, each with its own tracks and action plans. Each step fed directly into the next iteration of the roadmap.

The result reflects the collective insights of more than 130 participants from over 70 organisations and serves as a shared framework to guide Catalisti's innovation efforts towards a more competitive, sustainable and resilient chemicals and plastics sector.

2

Acknowledgements

We would like to thank all the individuals and organisations who contributed to this roadmap. The development of this Innovation Roadmap was a truly collective effort. It reflects the ambitions, expertise and perspectives of a broad community of companies, researchers, policymakers and innovation actors who share a commitment to strengthening the competitiveness, sustainability and resilience of the chemicals and plastics industry in Flanders.

Throughout the roadmap process, Catalisti's board of directors, Innovation Committee and operational team provided input and feedback through several review rounds. Their involvement helped shape the direction, ambition and priorities set out in this document.

The roadmap was also developed in close collaboration with essenscia, the Belgian federation for chemistry and life sciences. Its insights into the economic and industrial context of the sector helped sharpen the roadmap and its strategic priorities.

The voices featured throughout this publication are equally important. Through their quotes, industry leaders, researchers, innovators and policymakers offer their own views on the opportunities and challenges shaping our ecosystem today.

A special word of appreciation goes to all participants who contributed through questionnaires, in-depth interviews and technical workshops. Their expertise and willingness to engage in open dialogue helped identify priority innovation domains, refine Catalisti's role as innovation cluster and ensure that this roadmap is firmly rooted in the needs and ambitions of the broader ecosystem.

Catalisti also gratefully acknowledges the continued support of VLAIO, the Flemish Agency for Innovation & Entrepreneurship, and of the Flemish Government. As one of Flanders' innovation clusters, our work and the development of this roadmap are made possible through VLAIO's support.

— **Tine Schaerlaekens & Peter Roose**
Catalisti



Contributors to the Innovation Roadmap

We are grateful to the following people, whose time, expertise and insights helped shape this roadmap.

Alexandre Beirão, Devan Chemicals
An De Schryver, POM Oost-Vlaanderen
An Hardy, IUMAT
An Vermeulen, Pack4Food
Andre Barros, Procter & Gamble
Ann Aerts, University of Antwerp
Ann Dierckx, essenscia
Annabelle Bertin, Covestro
Annie Renders, VLAIO
Aurelie Bellemans, Vrije Universiteit Brussel
Azd Zayoud, Ghent University
Barbara Sowa, CAPTURE
Barbara Veranneman, essenscia
Bart Adams, INEOS Styrolution
Bart Forier, Kemin
Bart Ghysels, ENGIE Laborelec
Bart Hommez, Ghent University
Bart Mantels, VITO
Bart van Duffel, KU Leuven
Benjamin Vandeputte, Sirris
Bert De Mot, Solvakem
Bert Lagrain, KU Leuven
Bert Metten, Ajinomoto
Bert Pluymers, KU Leuven
Bert Sels, KU Leuven
Carlo Lammers, Atlas Copco
Christian Steuwe, KU Leuven
Christophe Cuigniez, Alpha
Corien Struijk, VLAIO
Daan Van Havere, Agfa
Danny Verboekend, Zeopore
Dave Van den Plas, Soudal
Denis Turmel, Chevron Phillips Chemical
Dirk Bontinck, Allnex
Dirk Dompas, INEOS Inovyn
Dominique Durt, DEME
Dominique Gemoets, Pryme
Dries Maes, Flemish Government
Dries Vandamme, Hasselt University
Eduardo Morais, University of Antwerp
Elien Lemmens, KU Leuven
Elisabeth Delbeke, Ghent University
Elke Theeuwes, University of Antwerp
Eric Van Nevel, ANRIC
Erik Moerman, Indaver
Erik Van Praet, Borouge International
Eva Daels, Umicore
Evelien Uitterhaegen, Bio Base Europe Pilot Plant
Frank Hoogendijk, Found Advisory
Frederick Loeckx, Flux50
Frederik Balcaen, The Venturi Tribe
Geert Boogaerts, essenscia
Geert Deroover, ChemStream
Geert Maesmans, Cargill
Geert Reyniers, Worley
Geert Van Der Vorst, Johnson & Johnson
Gert Vanmarcke, Vrije Universiteit Brussel
Gill Scheltjens, D-CRBN
Guy Buytaert, Arteco
Guy Marin, Ghent University
Guy Verrue, European Floorcoverings Association
Heleen De Wever, VITO
Ignace Lemahieu, Ghent University
Ilyesse Bihi, Vrije Universiteit Brussel
Isabel De Schrijver, Centexbel
Isabel Vermeulen, BlueChem
Ivan Pelgrims, Evonik Antwerpen
Jan Heijl, Covestro
Jan Vaes, von Karman Institute for Fluid Dynamics
Jan Venneman, Agfa
Jan Willems, Carpenter
Jasper Smets, Chevron Phillips Chemical
Jasper Van Noyen, Soudal
Jeroen Bets, Johnson & Johnson
Jeroen Geens, VITO
Joeri Denayer, Vrije Universiteit Brussel
John Metselaar, independent
Joke Nelissen, Agfa
Jonas Van Damme, Sioen
Joost Brancart, Vrije Universiteit Brussel
Joost Matthijssen, Thomas More
José Núñez Ares, Minitab
José Vanheule, Proviron Functional Chemicals
Julien Cousin-Saint-Remi, Atlas Copco
Karel De Winter, independent
Karen Aerts, Aquatreat
Karl Vrancken, Indaver

Karolien Vanbroekhoven, VITO ●
Keikhosro (Kei) Karimi, Vrije Universiteit Brussel
Kevin Poelmans, Agoria
Kevin Van Geem, Ghent University ●
Koen Van Aken, Creaflow
Koenraad Debackere, KU Leuven ●
Kris Van de Voorde, imec ●
Kristof De Wispelaere, BASF Antwerpen
Kristof Moonen, Eastman ●
Kristof Proost, IP-FAB
Kristof Verbeeck, ArcelorMittal
Kurt De Weirdt, Flanders Make ●
Lies Bonami, Huntsman
Liesbet Boogaerts, Carboganic
Liesbeth Stockman, Port of Antwerp-Bruges
Liesbeth Vandaele, Unilin
Lieve De Doncker, Hasselt University ●
Lieven Deketele, Procter & Gamble ●
Linsey Garcia-Gonzalez, VITO ●
Lode Deprez, Flint Group Digital Xeikon
Luc Wallican, Orac
Ludwig Goris, independent ●
Luk Umans, OVAM
Marion Bechtold, KU Leuven
Marjon Willekens, D-CRBN ●
Mark Andries, VLAIO ●
Mark Saeys, Ghent University
Martijn Helsen, POM Limburg
Matthew Porters, Triple Helix
Metin Bulut, VITO
Michiel Verswyvel, INEOS Styrolution
Miguel Knockaert, Orac
Moreno Geerts, BASF Antwerpen ●
Nico Kimpe, Vanheede
Nina Ackermans, Borouge International ●
Nivedita Yadav, Vrije Universiteit Brussel
Patrick De Schryver, Kingspan
Patrick Plehiers, independent ●
Peter Ragaert, Pack4Food
Peter Roose, Eastman ●
Peter Wauteraerts, Johnson & Johnson ●
Philippe Gendebien, Fost Plus
Pieter Struelens, Oleon
Rob Ameloot, KU Leuven
Robert Malina, Hasselt University
Robin Matton, Eastman
Roel Bosschaerts, Port of Antwerp-Bruges ●
Ronnie Belmans, KU Leuven
Ronny Vercauteren, Cargill ●
Sabine Van Miert, Thomas More ●
Sam Wuyts, Johnson & Johnson ●
Sandra Wauters, BASF Antwerpen
Sergey Sergeyev, University of Antwerp
Siegfried Mercelis, University of Antwerp
Stefaan De Wildeman, B4Plastics
Stefan Tielen, Exolon Group ●
Steven Peleman, Triple Helix
Steven Van Passel, University of Antwerp ●
Steven Vandeleene, BASF Antwerpen
Stijn Boeren, Avecom
Stijn Van de Vyver, Eastman
Stijn Van Lierde, ExxonMobil
Stijn Verbert, BASF Antwerpen ●
Thierry Lambert, Euralpack
Thomas Cardinaels, VITO ●
Thomas Vermeulen, Voxdale
Tim Devlamynck, Indaver ●
Tom Breugelmans, University of Antwerp
Tom Bruggeman, VLAIO ●
Tom Haerinck, Buildwise ●
Tom Houthoofdt, Orac
Tom Renders, INEOS Phenol and Nitriles
Tom Van Gerven, KU Leuven
Twan Bearda, Entras
Vera Meynen, University of Antwerp
Walter Vermeiren, TotalEnergies
Wim Six, Deceuninck
Wim Soetaert, Bio Base Europe Pilot Plant ●
Wouter Marchal, Hasselt University
Wouter Van Gaens, Flint Group Digital Xeikon
Yves Boonen, Plinius Labs

● Member of the Board of Directors
● Member of the Innovation Committee
● Member of the Extended Team

About Catalisti

Catalisti is the innovation cluster for the chemicals and plastics industry in Flanders, bringing together industrial companies, universities and research institutes, and government to stimulate collaboration and accelerate innovation.

USP

Combining a broad sector coverage, company-driven governance, neutral brokerage role, ability to build collaboration and long-term innovation roadmap

BENEFITS

Transforming individual company needs and opportunities into collaborative, fundable initiatives with economic & environmental impact

MISSION

Accelerating innovation towards a competitive, sustainable and resilient chemicals and plastics industry in Flanders

2012

The Flemish government recognises Flanders Innovation Hub for Sustainable Chemistry (FISCH) as a competence pool. FISCH aims to strengthen and accelerate innovation in sustainable chemistry.

2014

FISCH and Flanders' Plastic Vision (FPV), the Flemish competence pool for the plastics and rubber processing industry, are joining forces.

2017

FISCH becomes spearhead cluster Catalisti. The spearhead cluster takes up the thread of the past competence pools FISCH and FPV. At the start of Catalisti, more than a hundred companies, sector federation essenscia Flanders, all five Flemish universities and the relevant research institutes joined Catalisti.

2019

Catalisti becomes the coordinator of Moonshot Flanders, the industry innovation programme to accelerate the transformation of the Flemish industry towards Climate neutrality.

2020

BlueChem, the first incubator for sustainable chemistry in Belgium opens its doors. Catalisti is a partner of BlueChem, a member of the BlueChem governance and is located at the BlueChem premises.

The Catalisti team



— **Tine Schaerlaekens**
Managing Director



— **Bert Boekaerts**
Innovation Broker



— **Ania Coen**
Innovation Broker



— **Aron Deneyer**
Innovation Broker



— **Mathias Jacobs**
Innovation Broker



— **Stef Koelewijn**
Innovation Broker



— **Martijn Roosen**
Innovation Broker



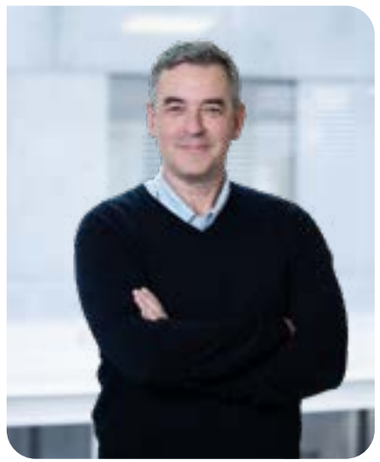
— **Dieter Ruijten**
Innovation Broker



— **Laurie Braeckmans**
Business Developer



— **Lesley Neys**
Management Assistant



— **Floris Van Cauwelaert**
Communications Manager



— **Michiel Wouters**
Communications Officer

Table of contents

11 **1. Forewords**

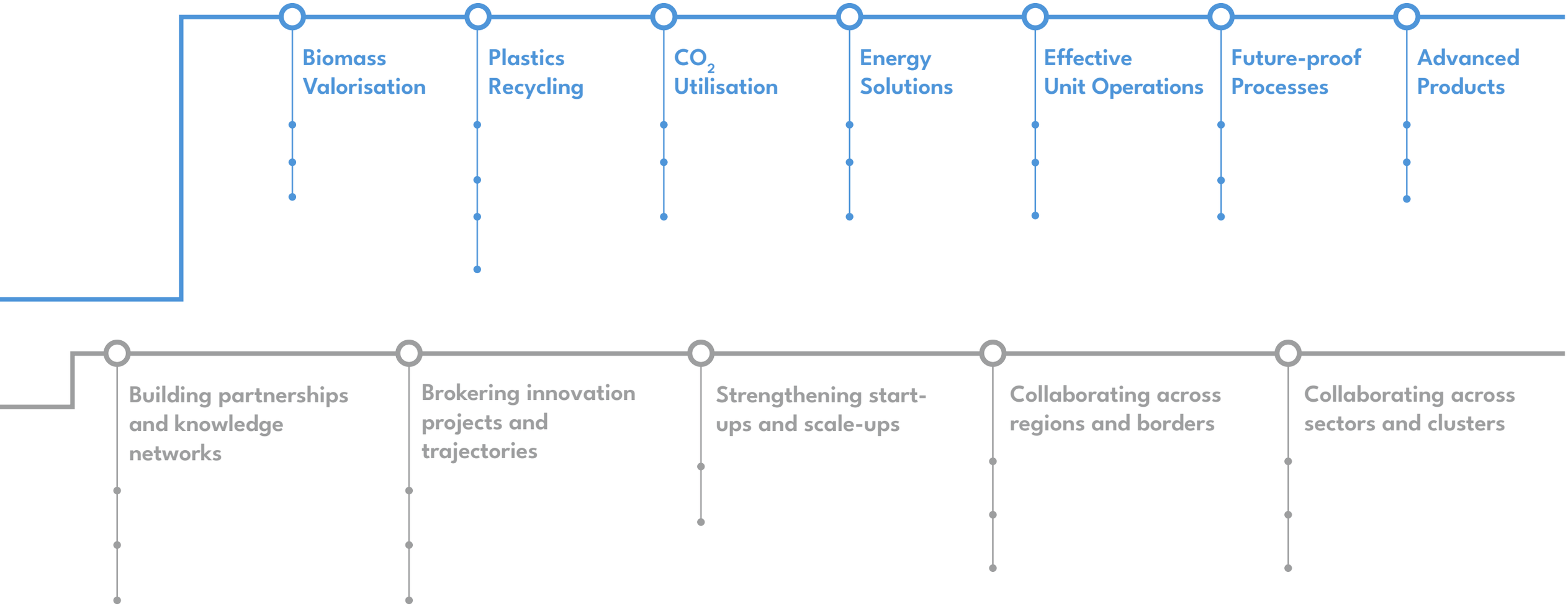
17 **2. Chemicals and plastics industry at a tipping point**

23 **3. Four drivers, one mission**

43 **4. Seven programmes, one value chain**

123 **5. Five roles, one innovation cluster**

163 **6. From roadmap to action**


Biomass Valorisation
Plastics Recycling
CO_2 Utilisation
Energy Solutions
Effective Unit Operations
Future-proof Processes
Advanced Products
Building partnerships and knowledge networks
Brokering innovation projects and trajectories
Strengthening start-ups and scale-ups
Collaborating across regions and borders
Collaborating across sectors and clusters



We invest together, Peter Roose

Flanders has built one of the densest chemical clusters in Europe. Pipelines run under our fields, reactors line the ports and whole value chains sit a few kilometres apart. That density is our greatest asset. It is also why the task ahead is so demanding. We are asking this cluster to change almost everything about how it works – the energy it uses, the carbon it emits and increasingly reuses, the raw materials it starts from – while the plants keep running, customers keep ordering and competitors elsewhere keep moving.

Anyone who has sat in a strategic meeting lately knows how hard the choices are. Protect today's business or build tomorrow's? Scale what already works or keep exploring? Stay here or go where conditions seem better? The honest answer is usually "both", which is exactly why it is hard. We should not pretend we have a magic formula. But we do know what the answer is not: waiting.

Innovation is often discussed in the language of subsidies: funding to secure, programmes to apply for, calls to meet. That is not how the companies and knowledge institutions in this cluster behave. Every innovation is an investment, first and foremost. Companies bring people, plants and budgets to the table. Universities and research centres put in their best minds. The Flemish government, through VLAIO, puts in public resources because it believes in the long-term benefits for the region. Nobody does this alone. We invest together. Not only in projects: in a network that brings partners together, connects our sector with others and gives start-ups a place in the value chain. A risk shared across a network is a very different animal from a risk carried by one company.

Nor do we start from scratch. This roadmap builds on more than a decade of joint research and development. Its themes, the seven detailed technical programmes you will find in the roadmap, are not new ambitions. They are the next stage of a research agenda this sector has pursued and refined for over ten years. What's new is the clarity of the direction, the scale of what we are prepared to put behind it, and the discipline to judge every idea on whether it will create value in the market.

That investment in innovation is carried by many people, and they deserve a word of thanks. Our partners, who kept backing the network when stepping back would have been the easy choice. The people in the plants and the labs who go beyond their job description: the researcher who keeps a pilot running after a project formally ends, the engineer who makes time for a workshop when there is little time to spare, the plant manager who makes room for a trial run in a schedule that is already full.

The time for debate is behind us. The roadmap gives purpose to our common goals. Some innovations will bring value rapidly, some will take more time. That is fine, as long as we learn quickly and keep moving forward.

This roadmap is not Catalisti's to execute. It is ours. If you are a partner, put your people and your plants behind it. If you are a researcher, bring your best ideas. If you are still on the fence, get in touch with Catalisti. The cluster we want in ten years will be built by the people in this network, one project at a time – starting today.

— **Peter Roose**
Chairman of Catalisti



Flanders' chemistry future, Matthias Diependaele

Our industry is under pressure. High energy prices, geopolitical tensions and ever fiercer international competition confront our companies with major challenges. Recent reports of substantial job losses in sectors that were for years regarded as strong growth engines of our economy make it clear once again that economic strengths can never be taken for granted. Every single day, we have to make sure that companies want to research, innovate, produce and invest here.

For Flanders, the conclusion is clear: retreating now and scaling back our ambitions in the field of innovation would be exactly the wrong response. It is precisely in economically difficult times that we must keep investing, in a targeted way, in the foundations of our prosperity.

Chemistry and plastics are one such foundation. Flanders has a strong industrial and logistics ecosystem, internationally renowned knowledge institutions and companies that develop and apply new technology here every day. That combination makes Flanders an excellent region in which to innovate – and to invest. But we will only hold on to that position if we keep looking ahead.

That is why I strongly believe in the model we have built in Flanders. Not an innovation policy that dictates from above where companies should be tomorrow, but a partnership in which companies, educational and knowledge institutions and government join forces. Industry brings in its challenges and market knowledge, our researchers their scientific expertise, and government creates the framework and supports innovation where it is of strategic importance to our economy and society.

This Innovation Roadmap sets out shared innovation priorities for the coming years, starting from the concrete challenges facing the sector – from changing market demand and productivity to circularity and climate neutrality.

That same philosophy underpins Moonshot Flanders. Through it, Flanders is making a long-term investment in technological breakthroughs that can help our energy-intensive industry achieve the climate transition in a realistic manner and within an economically viable context. For me, climate policy and industrial policy are therefore not opposites. The challenge is precisely to use the transition to anchor new technology, economic activity and investment in Flanders.

Because ultimately, innovation policy is about much more than technology. It is about jobs, productivity and prosperity. About the question of where tomorrow's factories, research centres and investments will end up – and Flanders must be ambitious in that respect. We have the knowledge, the companies, the people and the ecosystem to be among the international frontrunners.

This roadmap shows that our chemistry and plastics sector shares that ambition. As the Government of Flanders, we want to be a reliable partner in this. Not only when the economy is doing well, but above all when the choices become harder.

— **Matthias Diependaele**
Minister-President of the Government of Flanders
Flemish Minister for Economy, Innovation and Industry



Cluster policy: the next decade, Mark Andries

Ten years of spearhead cluster policy offer a good moment to look back, but above all to look forward. When Flanders introduced its cluster policy, the starting point was clear: strong companies, knowledge institutions and other actors do not automatically form a strong innovation ecosystem. Knowledge, investment and entrepreneurial ambition need to connect. Cluster policy was created to unlock economic potential through active and sustainable collaboration, with companies firmly in the driving seat. Research, development and innovation are not goals in themselves, but instruments to strengthen the competitiveness of Flemish companies and create economic value.

A decade of experience has confirmed the value of that approach, while the context has changed considerably. The renewed Flemish cluster policy builds on the original principles, but sharpens expectations: a more business-driven and mission-oriented approach, greater impact on societal and economic challenges and productivity, more attention to start-ups, scale-ups and pioneers, a stronger role for clusters as neutral facilitators, and increased international and European leverage.

This connects cluster policy to broader Flemish transition policies. Klimaatsprong provides the overarching context for the transition towards a low-carbon and competitive industry, a necessary but challenging transition for the energy-intensive chemical industry. Moonshot Flanders, coordinated by Catalisti, supports breakthrough technologies contributing to climate neutrality. The Catalisti roadmap helps translate these long-term ambitions into innovation priorities and trajectories that the chemicals and plastics industry can act upon.

For VLAIO, this explains why a spearhead cluster needs a company-driven roadmap. It is not a catalogue of technologies or projects, but a tool for making choices: where can innovation make a meaningful difference, where does Flanders have strengths to build on, and where can collaboration unlock opportunities that individual actors cannot realise alone? The roadmap should provide focus, enable progress and impact to be monitored, and evolve with technologies, markets and value chains.

Catalisti is therefore more than a gateway to collaborative R&D projects. As a neutral facilitator, it brings together companies, knowledge institutions and other actors, articulates innovation needs, strengthens valorisation and connects companies with the broader innovation ecosystem. This role is increasingly important as innovation requires interaction across value chains.

Ultimately, cluster policy is about turning collaboration and innovation into lasting economic and societal impact. Projects are important building blocks, but their value lies in contributing to longer-term trajectories that strengthen companies and value chains, accelerate productivity and valorisation, support industrial transitions and anchor sustainable economic activity in Flanders.

This roadmap opens a new decade for Catalisti. It provides a shared direction while leaving room to adapt to technological, economic and societal change. As Catalisti enters its second decade, I congratulate the cluster, its members and partners on what has been achieved so far and wish them every success in turning this roadmap into action and tangible impact for companies, the sector and Flanders.

— **Mark Andries**
Administra-



Turning innovation into industrial strength, Barbara Veranneman

Every industrial breakthrough starts with an idea: a molecule, material, process or technology that does something new, better, cleaner or more efficiently. At its best, innovation creates new products and processes, strengthens value chains and leads to investment in production capacity and high-quality jobs. It anchors both knowledge and industrial activity.

That link has rarely been more important. The chemical and life sciences industry faces high energy and production costs, geopolitical tensions and fierce global competition. At the same time, it is undergoing an unprecedented transition towards climate neutrality and circularity, while digitalisation and artificial intelligence are reshaping how we research, design and produce.

In this rapidly changing world, our capacity to innovate is one of our greatest assets. But scientific and technological excellence alone will not secure our future competitiveness. We must become equally strong at translating research and new ideas into innovation that creates economic and societal value, thereby reinforcing our industrial leadership.

Flanders has strong assets: world-class universities and research centres, a highly integrated chemicals and plastics cluster, skilled people, strong logistics, cross-border connections with major European production sites, and leading companies operating at the heart of international value chains.

Just as importantly, we have built an innovation ecosystem that connects scientific expertise, entrepreneurship and industrial know-how. Catalisti plays a key role in this ecosystem, bringing companies, start-ups and knowledge partners together around strategic innovation projects.

We must nurture this unique ecosystem. Continued and reinforced support for innovation is not a luxury, even when public budgets are under pressure. It is a strategic investment in the technologies and industrial activities on which our future prosperity depends.

But supporting innovation alone is no longer enough. Our greatest challenge is to ensure that innovative products, processes and technologies developed here can also be scaled up and industrialised, both in Flanders and across the global value chains in which our industry operates. Industrial and innovation policies must therefore go hand in hand.

Flanders should be the natural choice in Europe for investment in the chemical industry. But companies will only invest if the boundary conditions are right: competitive energy and production costs, a supportive fiscal framework, access to talent, infrastructure and capital, faster and more predictable permitting, strong markets for innovative products, and coherent regulation that supports innovation rather than slowing it down.

The materials, molecules, processes and technologies developed by the chemical and life sciences industry enable transformation across the economy: from construction and mobility to energy, healthcare, food and advanced manufacturing. Progress increasingly depends on collaboration across companies, sectors, value chains and borders.

This is why the Catalisti Innovation Roadmap matters. It provides a shared direction for collaboration around the challenges and opportunities ahead. The objective is clear: accelerate innovation by strengthening the triple helix collaboration between companies, knowledge centres and government, and create the enabling conditions to move promising technologies faster towards industrial application.

Because ultimately, the true value of innovation lies in its impact: new solutions for society, new investments in our industry and a stronger position for Flanders as a leading industrial and innovation region in Europe.

— **Barbara Veranneman**
Managing Director essenscia
Belgian federation for the chemical and life sciences industry





Chemicals and plastics industry at a tipping point

As the backbone of many industrial value chains, the chemicals and plastics industry plays a pivotal role in the Flemish economy. The sector enables the production of virtually all modern goods and ranks among Flanders' most strategic industrial sectors.

Key figures from essenscia, as shown in Figure 1, demonstrate the scale and economic importance of the sector. In 2025, the chemical, plastics and life sciences industry generated approximately 50.1 billion EUR in turnover, accounted for 28% of Flemish exports, and provided employment for 64155 people directly, while supporting around 2.5 times as many indirect jobs. Within the sector, basic chemicals and plastics processing are the largest employers, representing 33.8% and 22.0% of total sector employment, respectively.

The sector is also a clear frontrunner in innovation. In 2024, companies active in chemistry, plastics and life sciences invested 3.3 billion EUR in R&D, accounting for more than half of all industrial R&D expenditure in Flanders. In the same year, the sector generated 16.7 billion EUR in added value, equivalent to 33.5% of the total added value of the Flemish manufacturing industry.

INSIGHTS FROM OUR MEMBERSHIP

The composition and evolution of Catalisti's membership provide additional insights into the sector's innovation dynamics. Over the past nine years, the number of members has almost doubled to over 170, reflecting a strong commitment to collaboration and innovation across the ecosystem. While approximately one-third of the members are in the province of Antwerp, the membership base is geographically distributed across Flanders and Brussels. It is also balanced in terms of company size, with large companies accounting for around half of all members, medium-sized enterprises for 15%, small enterprises for 25%, and micro-enterprises for 10%.

Catalisti's membership further illustrates the international character of the Flemish chemicals and plastics sector. Deeply embedded in global value chains, the ecosystem combines local entrepreneurs, Belgian companies with international activities, and foreign multinationals with operations in Flanders. Among Catalisti members, 18% are Belgian domestic companies, 32% are Belgian multinationals, and 50% are foreign multinational enterprises.

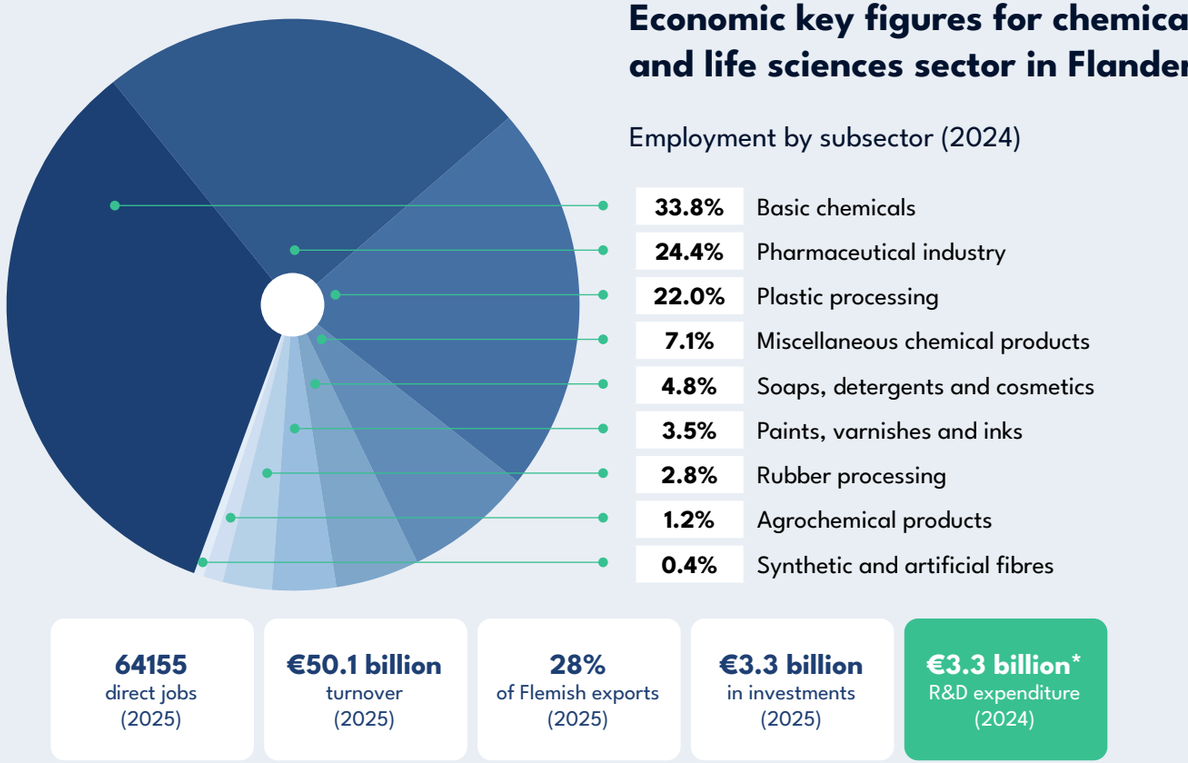


Figure 1: Key economic figures for chemical, plastics and life sciences sector in Flanders (essenscia, 2024-2025).

The challenges for the European chemicals and plastics industry

The European chemical industry is facing a period of profound structural pressure. While it remains a major economic pillar, generating 635 billion EUR in turnover and providing 1.2 million direct jobs, its global competitive position is gradually eroding. Europe's share of the global chemical market has fallen to 13%, while China now accounts for 46% of global chemical sales. At the same time, the industry is experiencing significant capacity reductions. Announced plant closures between 2022 and 2025 amount to several million tonnes of production capacity, particularly in Germany (8.8 Mt), the Netherlands (7.2 Mt), the United Kingdom (4.5 Mt), France (3.9 Mt), and Belgium (2.3 Mt). The investment outlook is equally concerning: confirmed capital investments in the European chemical industry declined from 7.6 billion EUR in 2022 to just 1.5 billion EUR in 2025.[1]

The underlying pressures remain substantial. European gas prices continue to be several times higher than those in the United States, while the sector faces weak demand, growing import pressure, and persistently low production utilisation rates. In 2025, EU chemical capacity utilisation stood at only 74%, remaining below historical averages for the third consecutive year.[2]

These challenges are also clearly visible in Belgium (see Table 1). After losing 1145 jobs in 2024, the Belgian chemicals, plastics and life sciences sector shed a further 1590 jobs in 2025. Exports declined by nearly 5% in 2025 and by 23% over the past three years, while turnover remained broadly stable at around 75 billion EUR, implying a significant decline in real terms. New large-scale investment announcements have largely disappeared, with Belgium's share of European chemical investments falling from 15% during the period 2016-2019 to just 0.8% since 2023.[3]

Yet despite these headwinds, the sector remains strategically important and technologically strong. It still accounts for approximately one-third of Belgian exports and invests around 7 billion EUR annually in research and development.[4] The current challenges should therefore not be interpreted as a loss of relevance, but rather as evidence that the industry is undergoing a profound transformation in how future growth and competitiveness will be created.

Historically, growth in the chemical industry was largely driven by volume expansion, particularly in commodity chemicals. Today, this model is increasingly constrained by high energy costs, global competition, geopolitical uncertainty, regulatory requirements, and the imperative to defossilise. The key question is therefore not whether the sector can grow, but how future growth will be created.

According to Deloitte, the future competitiveness of the European chemical industry will depend less on increasing production volumes and more on creating value through innovation, circularity, low-carbon solutions, and resilient value chains. Europe's competitive advantage is expected to reside increasingly in technology-intensive and sustainability-driven activities, supported by its industrial infrastructure, research capabilities, and innovation ecosystem. In this context, sustainability is evolving from a regulatory obligation into a source of competitive differentiation and long-term value creation. The most promising growth opportunities are expected to emerge at the intersection of technological leadership, circular business models, and resource resilience, driving demand for new materials, circular feedstocks, low-carbon production processes, and advanced end-of-life solutions.[5]

		Average yearly growth rate 2015-2023	Evolution 2023-2024	Evolution 2024-2025
Employment	97427 direct jobs	+1.5%	**-1.1%**	**-1.6%**
Export	1/3 Belgian export	+5.1%	**-3.6%**	**-4.6%**
Investments	4.1 billion EUR	+9.4%	**-1.8%**	+9.0%
Innovation	1096 patents	+4.8%	+8.5%	**-4.6%**
R&D expenditure	7.0 billion EUR	+7.5%	+7.9%	+2.6%
Turnover	75.4 billion EUR	+2.1%	**-0.5%**	+0.7%

Table 1: Economic key figures for chemical and life sciences sector in Belgium (essenscia, 2025)

[1] Erwin Douma et al., "European Chemical Closures and Investments Radar 2022-2025," January 28, 2026, https://cefic.org/resources/european-chemical-closures-investments-radar-2022-2025/. Report prepared by Roland Berger on behalf of Cefic.

[2] Moncef Hadhri, "Cefic Facts and Figures 2025," Data set, December 2, 2025, https://cefic.org/resources/data-files-xls-2024-cefic-facts-and-figures/.

[3,4] essenscia, "Belgische chemie en farma op kantelpunt: minder jobs, export krimpt en investeringen blijven uit," April 22, 2026, https://www.essenscia.be/belgische-chemie-en-farma-op-kantelpunt-minder-jobs-export-krimpt-en-investeringen-blijven-uit/.

[5] Deloitte, "Future of the European Chemical Industry: A Positive Outlook," July 25, 2025, https://www.deloitte.com/global/en/industries/energy-chemicals/perspectives/future-of-the-european-chemical-industry-a-positive-outlook.html.

Building on the strengths of Flanders

INFRASTRUCTURE AND INTEGRATED PRODUCTION

Flanders benefits from a world-class industrial infrastructure that has evolved over decades around one of the most integrated chemicals and plastics ecosystems in the world. At the heart of this ecosystem lies the Port of Antwerp-Bruges, home to Europe's largest integrated chemical cluster and the second-largest globally. The close proximity of production sites, logistics providers, storage terminals, utilities and service companies creates powerful economies of scale and enables highly efficient material, energy and knowledge flows. As part of the Antwerp-Rotterdam-Rhine-Ruhr (ARRA) region, Flanders is embedded in Europe's strongest industrial mega-cluster, providing direct access to major markets, suppliers and industrial value chains.

An extensive network of pipelines, multimodal transport infrastructure, storage facilities and utility networks further reinforces the competitiveness of the Flemish chemicals and plastics industry. The high degree of integration across the value chain, from feedstock supply and basic chemicals production to advanced materials and plastics processing, creates an attractive environment for both established companies and emerging industrial activities. This unique concentration of industrial assets provides a strong foundation for innovation, circular value chains and the transition towards a climate-neutral chemicals and plastics industry.

TECHNOLOGICAL COMPETENCE

Beyond its industrial infrastructure, Flanders has developed a strong technological competence base in chemistry. This is reflected in a clear patent specialisation, a substantial R&D expenditure, a broad industrial employment base, and the presence of advanced research, testing and scale-up infrastructure.

Belgium holds a remarkably strong patent position in chemistry, life sciences and biotechnology. According to essenscia, Belgium ranked among the global top ten with 1096 European Patent Office (EPO) patent applications in these domains in 2025 (see Figure 2). Moreover, 43% of all Belgian patent applications are concentrated in chemistry and life sciences, the highest sectoral share worldwide, underlining the country's strong specialisation in these technologies.[6]

This technological strength is matched by significant private-sector investment in innovation. In 2024, companies in the chemical and life sciences sector invested 3.3 billion EUR in R&D, while the region hosts numerous lead plants, technology centres, and R&D facilities operated by major international companies.

Flanders' innovation capacity is further reinforced by a dense network of research, testing, and scale-up facilities. In addition to its five universities and research organisations such as VITO, imec, and Centexbel, the region hosts specialised infrastructure such as the Bio Base Europe Pilot Plant, which supports the development and scaling of bio-based products and processes from laboratory to industrial scale.

Finally, Flanders benefits from a strong start-up and entrepreneurship ecosystem. Initiatives such as BlueChem and NextGen Demo support the demonstration, scaling, and commercialisation of sustainable chemistry technologies, helping to bridge the gap between research, entrepreneurship, and industrial deployment.

SCIENTIFIC COMPETENCE

Complementing these industrial and technological strengths, Flanders also possesses a world-class research ecosystem in sustainable chemistry and plastics. On the one hand, Flanders hosts a number of research groups that belong to the world's leading research groups in their respective domains. On the other hand, the research landscape in Flanders spans the diverse topics of the Catalisti innovation roadmap, ranging from circular feedstock and climate technologies to digitalisation, automation, polymer science, and product design. Moreover, there is a strong complementarity between the more fundamental and strategic research conducted at the universities and the more application-oriented research carried out by other research organisations.

The participation of Catalisti research groups in Horizon Europe projects related to the innovation roadmap provides a valuable indicator of the region's scientific strength in sustainable chemistry and plastics. A mapping of this participation reveals a strong presence of Catalisti research partners, accounting for 31% of all Flemish participations and 11% of all European participations in the Catalisti domain. This highlights the smart specialisation of Flanders and the Catalisti ecosystem in sustainable chemistry and plastics, while also demonstrating their ability to successfully compete for and secure European research funding.

[6] essenscia, "België Bij Europese Koplopers Voor Innovatie in Chemie En Life Sciences," April 8, 2026, https://www.essenscia.be/belgie-bevestigt-voortrekkersrol-in-chemie-en-life-sciences-met-sterke-patentcijfers/.

Patent position Belgium

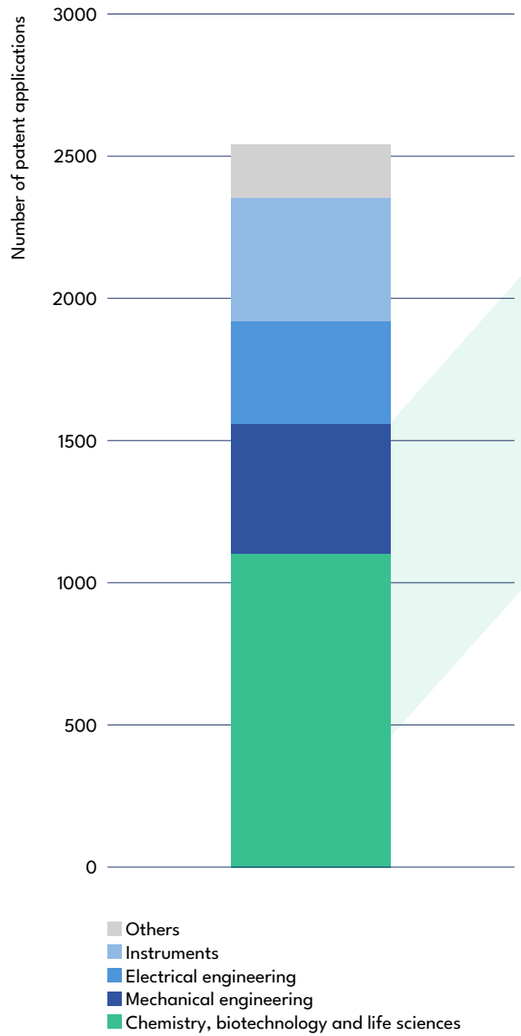
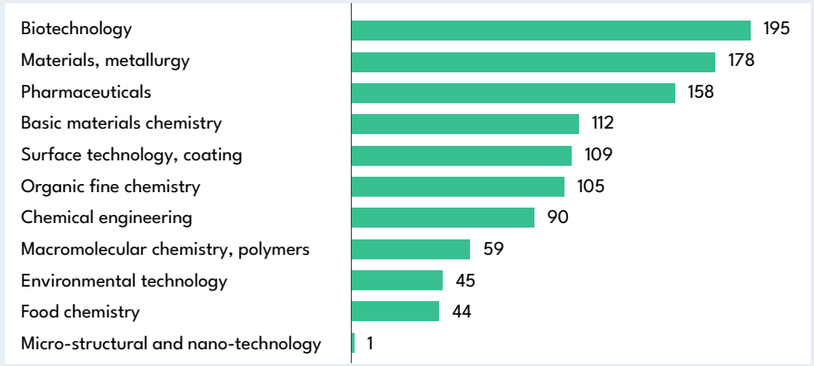
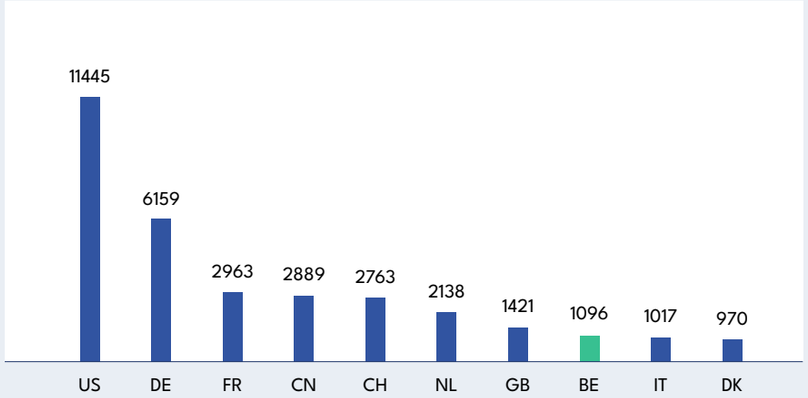


Figure 2: Overview of the 1096 Belgian patent applications in chemistry, life sciences and biotechnology, including their share of total patent applications (43%), distribution across technological subdomains, and international comparison (EPO, 2025).



Breakdown of the 1096 Belgian patent applications in chemistry, life sciences and biotechnology, across sub-technologies.



Patent applications in chemistry, life sciences and biotechnology: comparison of the leading applicant countries across the EU-27, the United Kingdom, Switzerland, China and the United States.

Market shares, export rates, employment, utilisation of capacity, etc.

Energy costs, global competition, regulatory pressure, etc.

Traditional growth models challenged, defossilisation, circularity, digitalisation, etc.

Challenging times

Strengths of Flanders

Scientific competence: sustainable chemistry & plastic research as strength

Technological competence: patent leadership & high R&D investments

World-class infrastructure and integrated production clusters

Help build the chemical industry of the future

These challenging times, in which the chemical sector finds itself at a tipping point, offer a clear strategic position for the cluster organisation. Catalisti will help build the chemicals and plastics industry of the future, by supporting its companies capturing this new growth agenda. It will connect industrial needs with innovation capacity, accelerate collaboration across value chains, and support the development of circular, low-carbon, and high-value chemical solutions. In doing so, the cluster will help ensure that the transition of the chemical industry is not only a response to pressure, but also a pathway to renewed competitiveness and long-term growth. What gives me confidence is what I experience every day when working with our members: a remarkable level of motivation, engagement and perseverance, whether in projects, governance meetings or other collaborations. It makes me truly believe that the only way is forward. We must keep moving, keep progressing and turn ambition into action. I am convinced that innovation, combined with strong collaboration across our ecosystem, will make things happen.

— **Tine Schaerlaekens**
Managing Director





Four drivers, one mission

Four drivers reflect the most decisive innovation forces shaping the sector today. Together, they steer the sector towards a competitive, sustainable and resilient chemicals and plastics industry in Flanders, Catalisti's overarching mission.

Innovation starts with **responding to changing demands from markets and consumers**, without a clear market pull, technologies do not scale. The business case decides whether an investment is worth making. That business case only holds if the sector keeps **boosting productivity growth**, so that new solutions raise efficiency and competitiveness – with digitalisation and automation as the main accelerators. **Moving towards a circular economy** then changes the material logic behind both: how we source, use and recover materials, and how design, production and end-of-life choices connect. **Transitioning towards climate neutrality**, finally, sets the long-term horizon: it anchors all innovation in societal value and secures the sector's licence to operate.

Together, these four interconnected drivers create a shared language for companies, researchers and policymakers. They prompt every innovator to ask: which driver does a given project address, and how does it contribute to the overarching mission of reaching a competitive, sustainable and resilient chemicals and plastics industry in Flanders?

In addition, regulation is a major horizontal boundary condition for the framework of innovation. It strongly influences the drivers behind innovation. Regulation can have the power to stimulate innovation, but rapidly changing priorities, complexity and incoherence between different policy levels can also paralyse innovation investments.

Responding to changing consumer and market demands

Developing innovative products for the markets of tomorrow will require collaboration across the value chain involving downstream users from the first design ideas until the launch of the product or service. Moreover, the rapidly changing market requires innovation to deliver new solutions efficiently and with the shortest possible time to market. Anticipating market demand and building strong business cases to capture value are the key drivers of Catalisti's innovation efforts.

Significant opportunities lie in further diversification into emerging market segments, particularly those with high growth and strong added value. As new value chains take shape, the ability to explore and quickly identify unmet needs and translate them into targeted solutions will be critical to sustaining growth. The positive outlook of Deloitte identified six attractive market segments for future growth of the EU Chemical Industry: advanced polymer materials, advanced materials, high-performance resins, knowledge chemicals, surfactant-related building blocks and advanced intermediates (see figure 3).[7]

Across industries such as personal and healthcare, construction, and mobility, brand owners and consumers increasingly demand high-performance, circular, and safe materials. They seek trusted solutions with enhanced properties, which necessitates not only precise product engineering but also the development of business models that deliver clear and measurable value.

A strong business case is central to every innovation decision, guiding investments in new molecules, processes and products. Financial planning provides essential insight into the economic feasibility of each stage of the innovation journey, while early identification of financial risks enables continuous refinement of assumptions and exploration of more favourable scenarios. Furthermore, economic considerations help define the optimal balance between technical performance and commercial viability, ensuring that innovation and collaboration efforts remain focused and impactful.

[7] Deloitte, "Future of the European Chemical Industry: A Positive Outlook," July 25, 2025, https://www.deloitte.com/global/en/industries/energy-chemicals/perspectives/future-of-the-european-chemical-industry-a-positive-outlook.html.

AMBITION

Catalisti is committed to prioritising innovation initiatives that are underpinned by solid business cases, demonstrating clear value creation and strong potential in the markets of tomorrow.

Six promising segments

- Advanced polymer materials
- Advanced materials
- High performance resins
- Knowledge chemicals
- Surfactant-related building blocks
- Advanced intermediates

Figure 3: Deloitte identified six key segments in which the European chemical industry can leverage its particular strengths and can capitalise on the continuing trend towards sustainability and regionalisation (Deloitte, 2026).

Safe and Sustainable by Design

Innovation goes beyond developing molecules, processes and products that solely have the right properties, functionality, and economic viability. Safety, sustainability and circularity must be considered from the start. Growing awareness of the impact of operations and products and continuously advancing insights have pushed the industry to reconsider, adjust, and ameliorate products and processes towards safe, sustainable and circular alternatives. The industry is increasingly adopting a Safe and Sustainable by Design (SSbD) approach, an iterative process guiding the development and market introduction of new chemicals, materials, products, processes, and services that are safe and deliver environmental, societal, and/or economic value through their applications.[8] SSbD is a framework that integrates a holistic set of safety and sustainability dimensions along the innovation process, from initial concept up to product launch. By embedding SSbD principles, companies can gain a competitive advantage while reducing regulatory, liability, and reputational risks. Figures 4 and 5 provide a visual representation of the SSbD framework.

One of the applications of SSbD is the identification of alternatives for hazardous chemicals. By reducing the numbers and volumes of hazardous chemicals, SSbD contributes to safer working conditions, safer use for consumers, and less environmental contamination or long-term effects (persistence and bioaccumulation).

[8] Cefic, "Safe and Sustainable-by-Design: a guidance to unleash the transformative power of innovation," March 2024, https://cefic.org/resources/safe-and-sustainable-by-design-a-guidance-to-unleash-the-transformative-power-of-innovation/.

AMBITION

Whenever new molecules, processes and products are developed, the Catalisti innovation approach will be guided by the SSbD principles.

A hierarchical approach

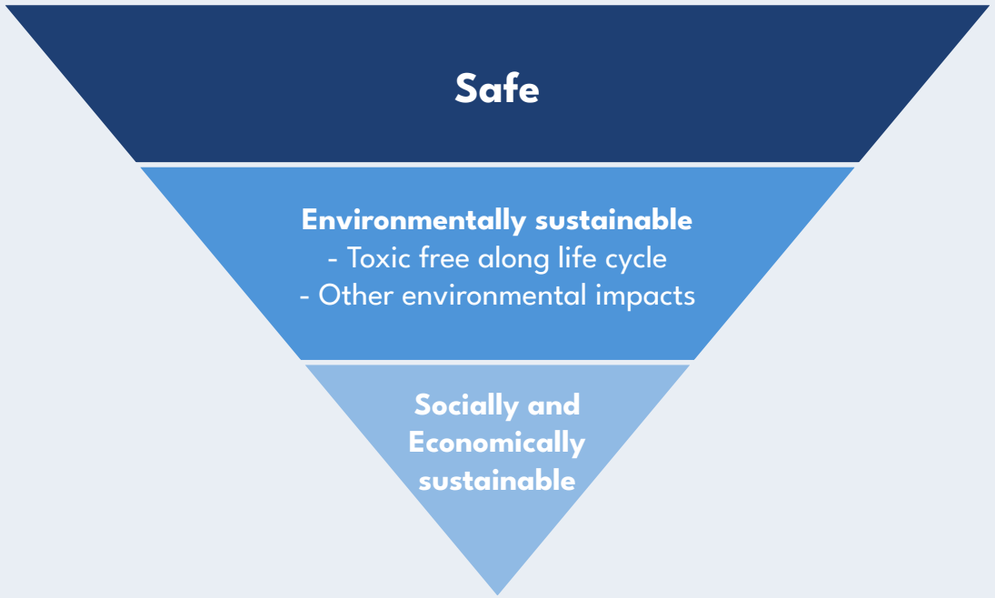


Figure 4: The hierarchical SSbD approach prioritises safety as a prerequisite for sustainability. Environmental, social and economic aspects are assessed only when minimum safety requirements are met, ensuring that sustainability gains do not come at the expense of human or environmental safety (JRC EU, 2022).

A holistic approach

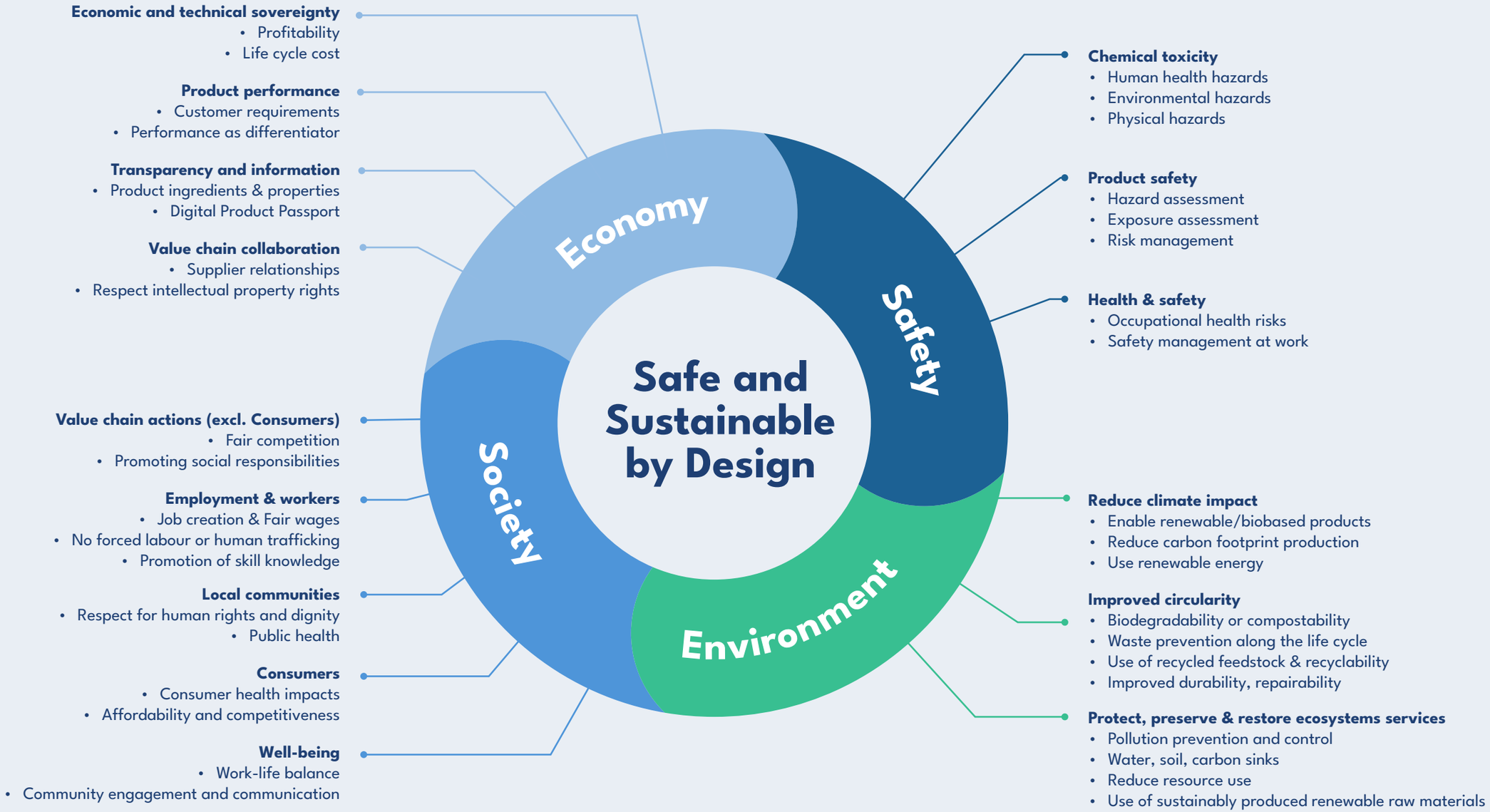


Figure 5: A comprehensive non-exhaustive list of safety and sustainability dimensions to assess and design sustainable chemicals, materials, products and processes (Cefic, 2024).

Collaborative innovation across the entire value chain is key to the markets of tomorrow, Ann Dierckx

The markets of tomorrow will not be shaped by a single company or technology. In my conversations with companies across our sector, I see time and again just how important collaboration throughout the value chain has become. This is not new: companies have always worked together with suppliers, customers and knowledge institutions. The major difference today is both the speed and the complexity. Market expectations, technology and regulation are evolving at an ever-faster pace. At the same time, innovation is becoming more complex: companies need to consider more requirements and trade-offs from the outset, while the time available to develop a market-ready solution is becoming shorter in an era in which artificial intelligence is rapidly gaining ground.

Whether we are talking about materials for construction and mobility, components for high-tech applications or consumer products, the market expects more than a technologically advanced product. Performance, safety, sustainability and circularity need to go hand in hand with concrete market needs.

To keep pace with these developments, I see particular value in closer collaboration from the outset. When companies and knowledge partners share their expertise and make choices together from the start, they can assess more quickly whether an idea is technically and commercially viable. This brings bottlenecks to light earlier, allows risks to be shared and enables an innovation to develop step by step into a solution that finds its way to the market.

Especially in the early stages of innovation, the Safe and Sustainable by Design (SSbD) framework can provide useful guidance. It helps partners embed safety and sustainability considerations in processes, products and applications from the outset of their development or improvement. In this way, it provides a shared framework for identifying potential trade-offs early and discussing them openly, while leaving room for different innovation pathways.

This is where I see clear added value of Catalisti. They help create an ecosystem in which companies and knowledge partners can find each other more easily, share expertise and build new connections across the entire value chain. For me, this is essential to get collaboration moving more quickly and to develop innovation ideas further together.

For essenscia, I see our role primarily as that of a bridge-builder. Together with Catalisti and the chemistry incubator BlueChem, we bring companies, knowledge partners and innovators together, helping new ecosystems to emerge and grow. This allows market needs and expectations to be connected more quickly with technological expertise and entrepreneurship, and translated into innovation with both economic and societal impact.



— **Ann Dierckx**
Director Innovation and Circular Economy, essenscia

Boosting productivity growth

Productivity measures how efficiently capital, labour and raw materials are converted into products and services. While the Flemish industry has long been a textbook example of rising productivity, this growth is currently slowing.

Reversing this negative trend is pivotal to strengthen the industry's competitiveness, drive economic growth, and safeguard future Flemish prosperity.[9] To do so, combining higher employment rate with higher (labour) productivity is key. Despite Flanders' high R&D intensity, productivity growth is not keeping pace. Reasons for this "productivity paradox" include a lack of valorisation, a disconnect between R&D and the market, and a lack of alignment with existing or potential value chains in Flanders.

VARIO, the Flemish Advisory Council for Innovation and Entrepreneurship, listed specific recommendations to reverse this trend.[10] One recommendation emphasises the leverage of cross-cutting innovation policy such as high-quality education and a flexible labour market. This requires attracting top talent, deliver strong education in the region, and strengthening the Flemish and European position in knowledge excellence. Another recommendation emphasises R&D&I as key driver for achieving long-term productivity growth. The importance of education and innovation for productivity growth is further illustrated in Figure 6.

The EU Action Plan for the chemical industry makes the following recommendations when focusing on the potential of innovation to increase productivity[11]:

- Innovate for products with higher added value through smart specialisation;
- Innovate for products and processes that increase resources and energy efficiency, while reducing dependence on fossil resources;
- Close the innovation and valorisation gap by funding demonstration and scale-up projects;
- Innovate faster and smarter by accelerating the digital economy, especially via start-ups and pioneers.

AMBITION

Catalisti is committed to derisking of the valorisation gap with pilot and demonstration as indispensable part of innovation trajectories. Innovation choices are made where molecules and products with high added value are developed in a resource and energy-efficient way.

[9] Flemish Government, "Vlaamse productiviteits- en competitiviteitsagenda. Visie en acties 2025," February 2025, https://www.vlaanderen.be/publicaties/vlaamse-productiviteits-en-competitiviteitsagenda-visie-en-acties-2025.

[10] VARIO, "Advies 37: Naar een hogere productiviteitsgroei," November 6, 2024, https://www.vario.be/nl/adviezen-rapporten/vario-advies-37-naar-een-hogere-productiviteitsgroei.

[11] European Commission, "A European Chemicals Industry Action Plan (COM/2025/530 final)," July 8, 2025, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex:52025DC0530.

Key factors in labour productivity growth

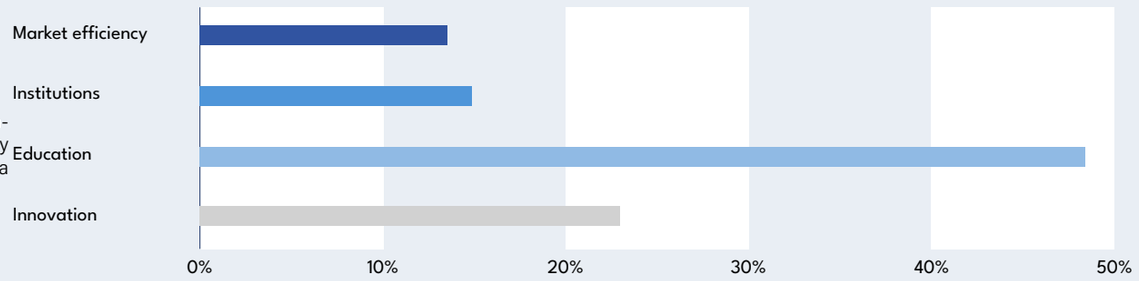


Figure 6: A dominance analysis by Baarsma and D'Orey Neves, as presented in VARIO Recommendation 37, covering 24 countries over the period 2015-2020, found education to be the factor most strongly associated with productivity growth, followed by innovation. This result highlights the crucial role of high-quality education and innovation in driving labour productivity (Baarsma & D'Orey Neves, 2024; VARIO, 2024).

Digitalisation and automation

Digitalisation and automation connect the chemicals and plastics industry's need for higher productivity with its ambitions for innovation and sustainability. Digital tools help companies put their data to work. In research, this can speed up innovation. In production, it can help operators adjust processes to use fewer resources. The aim is not automation for its own sake, but better ways of working, which will be essential to keep our industry competitive.

These benefits depend on good data. Well-managed data gives companies a reliable basis for improving their operations. When systems can exchange information, data becomes useful beyond the equipment that generated it. Achieving this starts with treating data as a valuable resource and organising how it is collected and used. Connecting systems through shared formats makes that information easier to use across the organisation. Modernising legacy IT helps put this approach into practice.

With reliable data that can be shared across systems, companies can use AI and machine learning to identify emerging process deviations and anticipate maintenance needs. Digital twins allow engineers to explore process behaviour before making changes in a plant, while advanced process control and automation translate insights into operational improvements. In R&D, computational chemistry complements these capabilities through atom-level simulations and predictive modelling that can accelerate innovation. Their value, however, depends on the quality and relevance of the underlying data, as well as on the ability of engineers and operators to use the results.

Physical AI extends this connection between insight and action. It combines AI with sensors, equipment and robotics so that systems can perceive their physical environment, reason about it and act within it. Deloitte's Physical AI Dossier identifies potential applications relevant to chemical production, including adaptive quality and process control and the coordination of material movements of hazardous materials.[12] These applications could help prevent defects and reduce delays where isolated automation leaves gaps between process steps.

Turning these opportunities into everyday practice takes more than technology. Companies need a clear business case to justify the investment. Uncertainty about the return can make it difficult to commit. Employees also need the skills to use digital technologies, and the organisation must be ready to change how work is done. Developing these skills and bringing operational and digital teams together helps make that change possible. Figure 7 shows these financial and organisational challenges, including those related to people and skills, alongside the technological barriers.

Catalisti's role is to help companies turn these shared barriers into collaborative innovation opportunities by connecting industrial needs with research expertise, digital technology providers and automation partners. The emphasis is on projects, demonstrators and innovation trajectories that help companies improve operational performance, reliability and resource efficiency, including Physical AI where its value and safety can be demonstrated. In this way, digitalisation and automation can develop from individual applications into cross-cutting enablers of circular feedstocks, electrified processes, advanced unit operations and next-generation materials.

[12] Deloitte, "The Physical AI Dossier", 2026, https://www.deloitte.com/content/dam/assets-shared/docs/about/ai-dossier/physical-ai-dossier.pdf?icid=lnc_download-the-full-dossier.

AMBITION

Catalisti's ambition is to make innovation faster and operations more efficient while strengthening the competitiveness, resilience and future readiness of the Flemish chemicals and plastics industry. This means combining short term gains with the foundations for longer-term transformation: reliable and relevant data, models that engineers and operators can use, and demonstrators that show how digital technologies create value under real industrial conditions.

Challenges of implementing digital technologies in the chemical sector

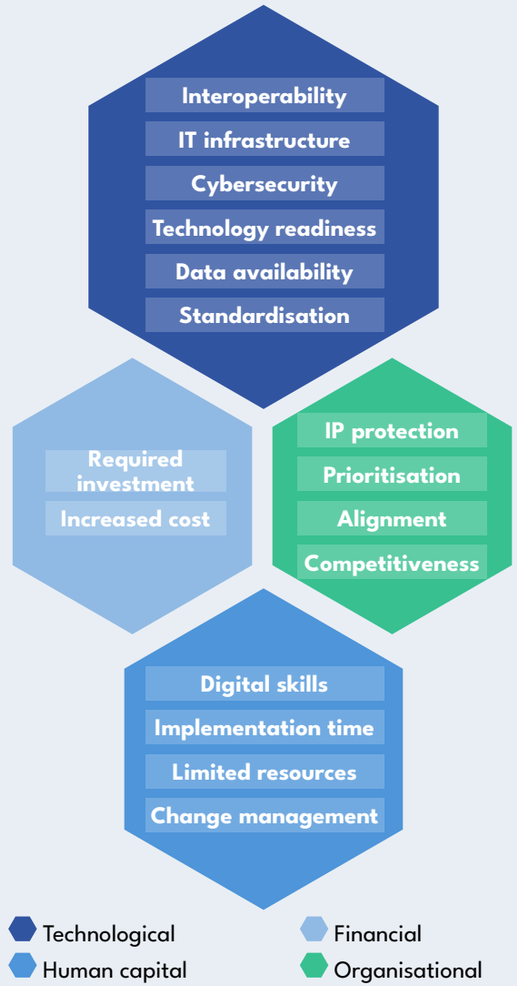


Figure 7: An overview of the technological, financial, human capital, and organisational challenges that need to be overcome to further drive and accelerate implementation of digital technologies in the chemical sector (Cefic & Arthur D. Little, 2023).



Small data, big plants, Mathias Jacobs

A plant can generate millions of measurements without giving a model millions of informative examples. That distinction helps explain why promising applications do not automatically lead to widespread industrial adoption, and why many companies remain at the pilot stage even as AI's role in industrial operations grows. Chemical and plastics plants may combine equipment of different generations with heterogeneous control systems and uneven sensor coverage. Their processes can produce large volumes of high-frequency data, but much of it may describe stable operation under similar conditions. This limits the variety of operating conditions represented in the data. Quality and completeness can also vary, while dedicated experiments to generate new data can be costly. The challenge is therefore not simply to collect more data, but to obtain sufficiently varied, reliable and relevant data from which models can learn and create value.

Meeting this data challenge takes more than collecting measurements or developing better models. It also requires the right organisational conditions to put them to use. This broader perspective emerged from DIGICHEM, through which Catalisti mapped the sector's digitalisation needs in 2018. One of its key lessons was that technology alone is not enough: successful digitalisation requires a clear strategy, the right skills and expertise. DIGICHEM also highlighted the importance of demonstrators and successful industrial use cases to inspire companies and help them take the next step. Since then, we have put these lessons into practice. Through DAP2CHEM (2020–2023), Procter & Gamble, Johnson & Johnson and Ajinomoto Bio-Pharma Services worked with imec-IDLab, KU Leuven and Flanders Make to use real-time data in production. Their work included vision-based anomaly detection on a high-speed line and hybrid models that combined thermodynamics with machine learning to control a continuous process. In 2026, we took the next step with EL4CHEM. Together with the same research groups, Johnson & Johnson, Procter & Gamble, Eastman and Indaver are developing models that need less data. The project aims to make models transferable from lab to pilot scale and improve predictive quality control and process monitoring in production. In both cases, the models are being developed for use by engineers and operators, not just data scientists.

For me, the strategic lesson is to start with the industrial problem, not the technology. We need solutions that work beyond a single pilot and that the people running the plant can use with confidence in their daily work. By focusing on practical applicability and lasting improvements in production, we can make digitalisation and automation, including AI, valuable tools for industry. This transition is complex and requires a multidisciplinary approach, so no company in Flanders can make it alone. Over the next decade, Catalisti will continue to bring companies together around shared challenges, so that each project contributes to knowledge and solutions the wider industry can build on.

— **Mathias Jacobs**
Innovation broker, Catalisti



Moving towards a circular economy

The chemicals and plastics industry in Flanders is already highly resource-efficient, thanks to the high level of integration of its production sites, one of its major strengths. Especially the petrochemical, basic inorganic, and polymer subsectors are closely interconnected in highly integrated industrial clusters. In addition, side and waste streams are transferred and (re)used both within and across companies. Further strengthening this industrial symbiosis can continue to achieve gains in efficiency, productivity, and cost savings.

The most significant transformation that still needs to take place is the transition to a circular economy, which is needed to further decouple economic growth from resource consumption and to address climate change. This will require systemic approaches and collaboration across all value chains. The chemicals and plastics industry can reduce its reliance on virgin fossil raw materials by turning to alternative carbon sources such as waste, biomass, and CO_2. This approach enables us to close material loops, reduce waste and optimise resource efficiency, which ultimately supports a competitive, sustainable and resilient industry.

In a key report from Cefic, a realistic scenario for 2050 foresees that the total amount of feedstock consumed by the chemical industry will increase by 15% compared to 2019 (see Figure 8).[13] However, the composition of this feedstock is expected to change dramatically. Fossil-based feedstocks, which currently dominate, are predicted to decline to roughly 35% of total feedstock use, while alternative carbon sources such as biomass, captured CO_2, and recycled materials will become increasingly important.

[13] Cefic, "The Carbon Managers: Modelling possible pathways for the EU chemical sector's transition towards climate-neutrality and circularity with iC2050," May 23, 2025, https://cefic.org/resources/the-carbon-managers-ic-2050/.

AMBITION

Catalisti has the ambition to reduce reliance on virgin fossil raw materials by developing a viable route to value creation and value capture from alternative carbon sources such as plastics, biomass, and CO_2. Catalisti will also further strengthen industrial symbiosis by making connections as well as transferring and (re)using side and waste streams.

Future feedstock mix

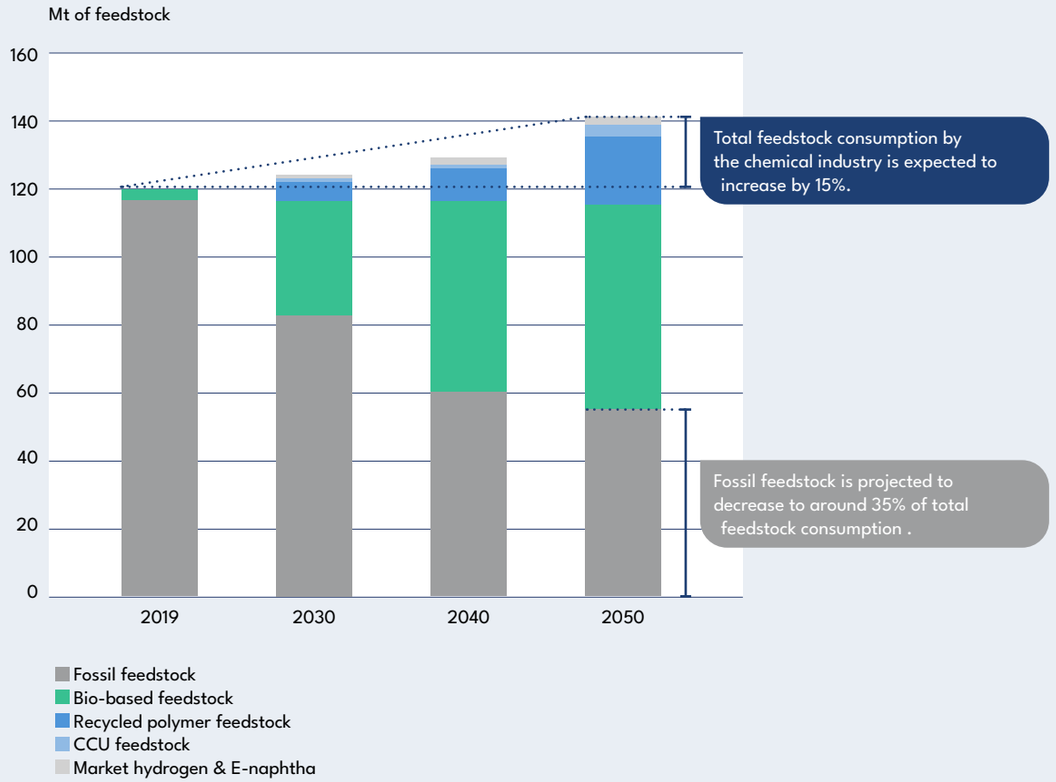


Figure 8: Projected evolution of the feedstock mix between 2019 and 2050 (Cefic, 2025).

Now it has to scale, Liesbeth Stockman

Flanders hosts one of the world's most integrated chemicals and plastics clusters. For decades, this integration has been a major strength. Companies exchange intermediates, share infrastructure, optimise logistics and create value through close collaboration along interconnected value chains. The Port of Antwerp-Bruges is a clear example of how industrial symbiosis can drive efficiency, competitiveness and resilience.

Yet the next transformation goes beyond improving efficiency within existing systems. To maintain competitiveness while delivering on climate and resource objectives, the chemicals and plastics sector must progressively reduce its dependence on virgin fossil resources and transition towards circular carbon sources such as recycled materials, biomass and captured CO_2.

For the Port of Antwerp-Bruges, circularity is not only an environmental ambition aimed at reducing carbon emissions. It is equally a strategic necessity for securing the long-term future of Europe's largest integrated chemical cluster. The unique strength of the Antwerp ecosystem lies in its ability to integrate circular feedstocks into existing value chains and industrial infrastructure. When circular carbon enters the cluster, it does not serve a single production process. Through the cracker and the interconnected chemical network, it can contribute to the circularity of a broad range of products, from basic chemicals and polymers to high-value speciality chemicals.

The challenge today is no longer whether the technologies exist. Across Europe, innovative companies have demonstrated technologies capable of converting waste streams, biomass and captured carbon into valuable feedstocks for the chemical industry. The critical question is whether these first-of-a-kind projects can successfully scale from pilot and demonstration facilities to full industrial deployment.

Experience shows that this transition remains challenging. Circular investments at industrial scale often face a combination of financial, regulatory and market barriers. Investors require confidence in long-term feedstock availability, stable demand for circular products and a predictable investment environment. At the same time, Europe's chemical industry is navigating a period of reduced competitiveness, which affects investment appetite, willingness to enter into long-term offtake agreements and the capacity to support the deployment of new technologies.
In this context, a supportive framework becomes increasingly important. Clear and fit-for-purpose regulation, efficient permitting procedures, demand-side measures and targeted de-risking mechanisms can significantly improve the investment case for circular projects. Without these enabling conditions, promising innovations may struggle to move beyond demonstration scale, despite their technological maturity and strategic importance.

This is where collaboration across the ecosystem becomes essential. Ports, industry, investors, policymakers and innovation organisations each have a role to play in reducing risk and accelerating deployment. The Port of Antwerp-Bruges contributes by providing space for scale-up through initiatives such as NextGen District, by connecting circular newcomers with industrial value chains, by facilitating access to infrastructure and logistics, and by working with partners to address barriers related to regulation, finance and market creation.

If successful, the chemical cluster of 2040 and 2050 will remain a leading industrial hub. The difference will be that an increasing share of its carbon feedstock will originate from circular sources, creating a more competitive, sustainable and resilient, and strategically autonomous chemicals and plastics industry for Europe.

— **Liesbeth Stockman**
Programme Manager Sustainable Transition Industry, Port of Ant-



A closer look at plastics

Plastics Europe has developed a roadmap outlining an ambitious pathway to both net zero emissions and circularity for the plastics industry.[14] In terms of circularity, the report projects a gradual substitution of virgin fossil-based plastics by "circular" plastics, which could reach 25% by 2030 and 65% by 2050 (see Figure 9). The report also sets out a potential pathway to reduce greenhouse gas emissions (GHG) from the overall plastics system by 28% by 2030 and to achieve net zero emissions by 2050.

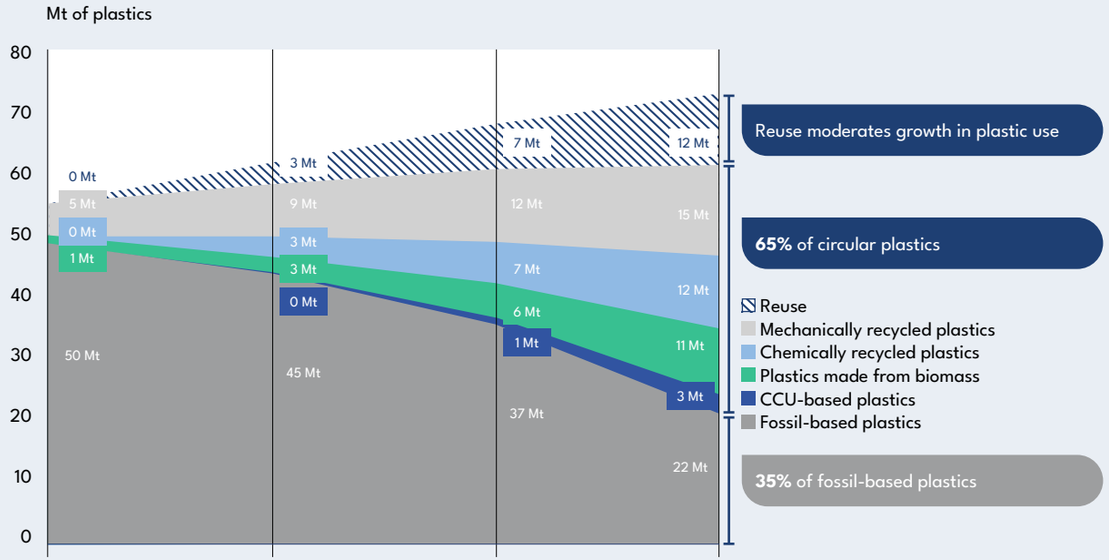
At the Flemish level, the WEWIS department of the Flemish government, together with OVAM and VLAIO, commissioned Deloitte to develop a roadmap for plastic recycling in Flanders.[15] The report's "circular scenario" puts forward an ambitious "20–50 by 2050" target. This means that by 2050, 20% of polymer production and 50% of plastic conversion in Flanders are based on recycled materials. These ambitions are further reinforced by a growing regulatory push to increase the use of recycled materials, e.g. by the Packaging and Packaging Waste Regulation (PPWR) and the End-of-Life Vehicles (ELV) Regulation. The report indicates that achieving the 20-50 target will require substantial efforts, including increasing collection rates of plastic waste to around 800 kt (compared to around 120 kt in 2022) and importing up to 2.7 Mt of plastic waste. Hence, significant investments will be needed to develop sufficient recycling capacity in the region.

Furthermore, the report highlights that every link in the plastics value chain plays a critical role in the transition to a circular economy and that plastic production, conversion, and waste recycling are closely interconnected. Depending on the polymer type and targeted application, different recycling routes will need to complement each other to reduce dependence on virgin fossil resources and improve the overall environmental performance of plastics. To make these pathways technically and economically viable, continued advances in logistics, pre-treatment and sorting are essential to provide high-quality recycled feedstocks at sufficient scale. Ultimately, achieving circularity will require close collaboration between all actors in the value chain, from waste management companies and recyclers to polymer producers, converters and end users.

[14] The plastics transition. Our industry's roadmap for plastics in Europe to be a circular and have net-zero emissions by 2050. Plastics Europe, October 2023.

[15] Roadmap kunststofrecyclage. Eindrapport 2025. Study commissioned by Departement Werk, Economie, Wetenschap, Innovatie en Sociale Economie (WEWIS) in Flanders, June 2025. Study conducted by Deloitte Belgium.

A closer look at plastics



2021	2030	2040	2050	
57 Mt	60 Mt	62 Mt	65 Mt	Converter's use (in Mt)
12%	25%	40%	65%	% of circular plastics compared to total converter's use

Figure 9: With the support of policymakers and increased collaboration with value chain partners, circular plastics will be able to grow and gradually replace fossil-based plastics (Plastics Europe, 2023).

Transitioning towards climate neutrality

The transition to a climate neutral chemicals and plastics industry will play a vital role in cutting greenhouse gas emissions (GHG) and tackling climate change. Beyond its own footprint, the sector provides technologies and materials that empower other sectors to reach net zero. A shift will be made towards more low-carbon energy sources and fossil-free feedstocks. Together, low-carbon energy solutions and fossil-free feedstocks will enable most of the industry's GHG emissions to be reduced. Carbon capture will address the remaining hard-to-abate emissions.

An analysis of technological pathways for the Flemish industrial landscape indicates that energy-intensive industries could reduce greenhouse gas emissions by 86-90% by 2050 compared with 2005 levels (see Figure 10).[16] Achieving this ambition will require the rapid deployment of four complementary transition pathways: biomass, circularity, electrification and hydrogen, and carbon capture, utilisation and storage (CCUS).

While alternative carbon feedstocks such as biomass and plastic waste can reduce reliance on fossil resources, carbon capture remains indispensable in all scenarios. Electrification of industrial heat and processes will be critical, as total energy demand is expected to remain high. Significant investments will also be needed in infrastructure for hydrogen, CO_2 transport and storage, and electricity networks, alongside continued R&D and technology scale-up.

The 2025 update confirms the continued relevance of all four pathways.[17] Electrification is gaining importance but remains dependent on electricity costs and availability. CCS and CCU, including blue hydrogen production, are expected to play a major role in the short term. Circular plastics, particularly chemical recycling, remain a priority, while green hydrogen and biomass face challenges related to cost, availability and scalability. Overall, the studies point to accelerated investments in CCS, industrial electrification and circular plastics value chains as key priorities towards 2030.

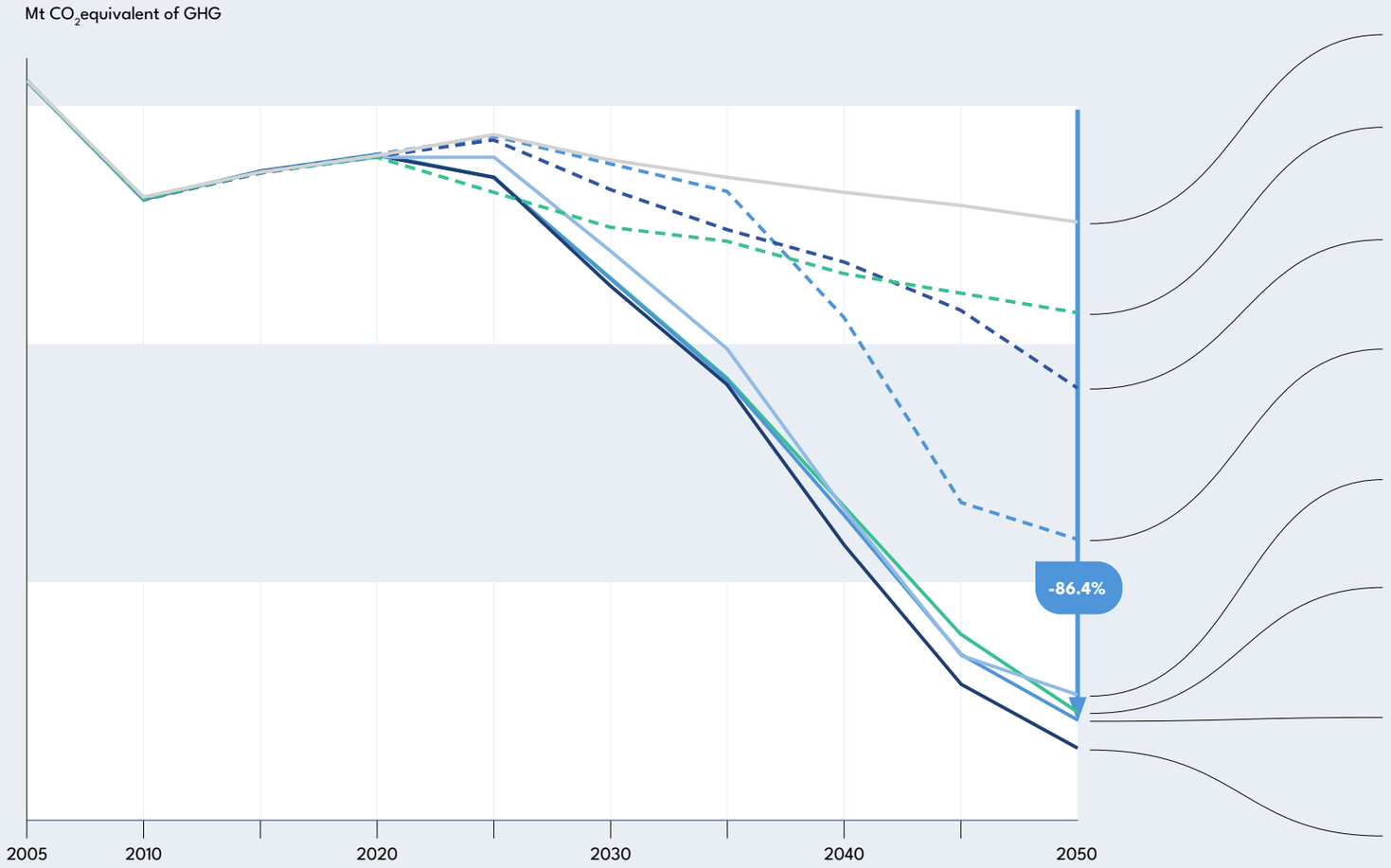
AMBITION

Catalisti is committed to integrating technologies for low-carbon energy and fossil-free feedstocks with the ambition to reduce greenhouse gas emissions by 90% by 2050.

[16] Flanders Innovation & Entrepreneurship (VLAIO), "Contextanalyse en roadmapstudie: Naar een koolstofcirculaire en CO_2-arme Vlaamse industrie," November 2020. https://www.vlaanderen.be/publicaties/naar-een-koolstofcirculaire-en-co2-arme-vlaamse-industrie. Study conducted by Deloitte Belgium in collaboration with VUB-IES, Climact and AMS.

[17] Eindrapport – Update contextanalyse en roadmapstudie: Naar een koolstofcirculaire, CO_2-arme en competitieve Vlaamse basisindustrie. Study commissioned by Agentschap Innoveren & Ondernemen (VLAIO), 30 June 2025. Study conducted by Deloitte Belgium in collaboration with VUB-IES.

Significant reductions demand a combination of transition paths



Business as usual
A reference scenario in the roadmap study, exploring how emissions could evolve without fundamental changes to the current industrial system.

Maximum focus on circularity
A scenario that maximises the role of circularity, particularly through mechanical and chemical recycling of plastic waste. Carbon is kept in circulation and reused as a feedstock, reducing the need for virgin fossil resources and lowering emissions across industrial value chains.

Maximum focus on biomass
A scenario that maximises the use of sustainable biomass as an alternative feedstock and energy source. By replacing fossil carbon with renewable biological resources, biomass can reduce emissions and, when combined with carbon capture, could even contribute to negative emissions.

Maximum focus on electrification
A scenario with maximum deployment of electrification and hydrogen-based technologies. Industrial heat and production processes increasingly rely on climate-neutral electricity, while hydrogen provides an alternative feedstock and energy carrier for processes that are difficult to electrify directly.

Maximum focus on CCUS
A scenario that maximises the capture of CO_2 from industrial processes for storage or reuse. CCUS addresses emissions that cannot easily be avoided through other technologies and therefore acts as an important pathway towards deep industrial emission reductions.

Mixed scenario
The central exploration scenario which combines biomass, circularity, electrification and hydrogen, and carbon capture rather than relying predominantly on one solution. It illustrates how these complementary pathways could jointly deliver substantial emission reductions while preserving existing industrial value chains.

Varied scenario 1 (greater focus on electrification)
A variation on the mixed scenario that places greater emphasis on electrification. More industrial processes switch to electricity and electricity-derived hydrogen, reducing reliance on fossil energy and shifting a larger part of the transition towards climate-neutral power.

Varied scenario 2 (greater focus on CO_2 capture)
A variation on the mixed scenario in which a greater share of emission reductions is achieved through CO_2 capture. It combines the different transition pathways while placing greater emphasis on capturing and storing or reusing remaining industrial CO_2 emissions.

Figure 10: Analysis of eight technological transition pathways for Flemish industry and their projected GHG emissions (Deloitte, 2020).

Moonshot Flanders, breakthroughs for a climate-neutral industry

Accelerating the transformation of Flemish industry towards climate neutrality

FLANDERS INDUSTRY INNOVATION
MOONSHOT



Flanders is one of the most industrialised regions in Europe, home to the world's second-largest chemical cluster, a high-performing steel industry and a major refining hub. These basic industries are the backbone of the Flemish economy – and a significant source of CO_2 emissions. That makes them part of the problem, but above all part of the solution: as producers of the materials and building blocks used in almost every downstream sector, they can cut their own emissions and, at the same time, deliver the solutions other sectors need. Unlocking this double positive requires more than incremental improvement. It requires breakthrough innovation – and that is exactly what Moonshot Flanders aims to accomplish.

Launched by the Flemish Government in 2019 and coordinated by Catalisti, Moonshot Flanders is a long-term, industry-driven innovation programme with one sole ambition: accelerating the transformation of our Flemish industry towards climate neutrality. The vision is clear: Flemish research must deliver the breakthrough technologies that allow our industry to become carbon-circular and climate-neutral while remaining competitive. Breakthrough innovation is one piece of a four-piece puzzle, alongside financing, infrastructure and regulation. Moonshot Flanders focuses on the innovation piece.

The strategy rests on four research paths that mirror the transition routes identified in the Flemish roadmap study for a carbon-circular, low-CO_2 basic industry: bio-based chemistry, circularity of carbon in materials, electrification and radical process transformation, and energy innovation.[18] With 15 to 20 million EUR in annual funding over a twenty-year horizon, the programme supports innovation projects ranging from early-stage strategic basic research to later-stage pilot and demonstration projects, carried out by Flemish research institutes, in close collaboration with industry. Projects are selected in a two-stage process steered by industry, on their fit with the Moonshot ambition, scientific excellence and valorisation potential. Moonshot Flanders is highly selective by default: it pushes excellent research to go further and turns it into actionable industrial innovation.

The 2025 update of the Flemish roadmap study, commissioned by VLAIO, confirms both the relevance and the urgency of this approach.[19] European climate targets have tightened considerably since 2020, while the competitiveness of the Flemish basic industry is under pressure from high energy costs and global overcapacity. Deep emission cuts will only be possible through large-scale process and energy innovations that reach maturity after 2030. The study therefore explicitly recommends accelerating Moonshot Flanders with a view to valorisation. That is exactly where the programme is heading: Later-Stage Innovation projects now scale promising results up to pilot and demonstration level, building the bridge from the lab to the plant.

The results are tangible. Since 2019, Moonshot Flanders has invested over 137 million EUR in 69 projects, involving 243 companies and 15 research institutes. Five pilot and demonstration facilities have been realised and eight more are under development – from lignin biorefineries and plasma-based CO_2 conversion to chemical recycling of plastics and solar hydrogen panels. Spin-offs such as D-CRBN, Purtiso and Solhyd are bringing Moonshot technologies to market. Together, and based on conservative estimates, the technologies developed so far have the potential to reduce CO_2 emissions from Flemish industry by 5.6 Mt.

Moonshot Flanders is where science meets the real economy. By connecting research institutes, industry leaders, clusters and government in one network, it uses climate neutrality as an engine to strengthen Flanders' position as an industrial frontrunner in Europe – and beyond.

[18] Flanders Innovation & Entrepreneurship (VLAIO), "Contextanalyse en roadmapstudie: Naar een koolstofcirculaire en CO_2-arme Vlaamse industrie," November 2020. https://www.vlaanderen.be/publicaties/naar-een-koolstofcirculaire-en-co2-arme-vlaamse-industrie. Study conducted by Deloitte Belgium in collaboration with VUB-IES, Climact and AMS.

[19] Eindrapport – Update contextanalyse en roadmapstudie: Naar een koolstofcirculaire, CO_2-arme en competitieve Vlaamse basisindustrie. Study commissioned by Agentschap Innoveren & Ondernemen (VLAIO), 30 June 2025. Study conducted by Deloitte Belgium in collaboration with VUB-IES.

Building bridges for climate-neutral industries, Bert Boekaerts

From the onset Moonshot Flanders was a high-reaching and audacious programme. Its purpose is to build bridges between two worlds that are hard to connect: breakthrough climate research in research institutes, and the industrial reality of companies that must turn that innovation into a product, process or plant with a credible business case. Bringing those two worlds together is far from evident. It is precisely what makes the programme unique – and what makes it demanding.

Flanders has excellent scientists which are leaders in their research fields. Moonshot Flanders challenges them to look ahead and to conceive how their creative ideas and hypotheses could be valorised by industry within relatively short timeframes. Will the technology be technically and economically viable in an industrial setting? Does it have a realistic and reasonable energy cost and how large is the CO_2 emission reduction potential? Because of Moonshot's ambitious targets, these are not questions for later. It is why they are built into the programme itself: project applications are subjected to an early assessment of energy costs and CO_2 emissions, and research proposals are evaluated on their valorisation potential as much as on their scientific quality. This does not make the research less excellent. It makes it more relevant.

Research results only become industrial breakthroughs when companies invest in them. With a growing number of pilot and demonstration facilities, Moonshot Flanders has built up a project portfolio worthy of industrial interest. We call on the 243 companies actively involved, to keep engaging with our programme and to keep evaluating what Moonshot Flanders has to offer. Even in these demanding times we challenge them to collaborate and invest in unique and promising carbon-circular and climate-neutral technologies to stay competitive.

While formidable, these challenges are Moonshot's strength and ambition. Accelerating innovation means closing the distance between lab and plant – from both sides. That is what Moonshot Flanders is for and what Moonshot Flanders is doing.

— **Bert Boekaerts**
Innovation broker, Catalisti



Catalisti coordinates Moonshot Flanders

Catalisti plays the central coordinating role in the organisation and implementation of Moonshot Flanders, in cooperation with Flux50 and VLAIO. Guided by its own innovation agenda set by the energy-intensive industries (chemistry, petrochemistry and steel), Moonshot Flanders supports the development of breakthrough technologies for climate-friendly processes and products through collaboration between companies and research institutes. While Moonshot Flanders has a separate governance structure and distinct funding rules, its operational team and daily operations are integrated within the Catalisti organisation.

moonshotflanders.be

THE MOONSHOT FLANDERS TEAM



— **Tine Schaerlaekens**
Managing Director



— **Bert Boekaerts**
Innovation Broker



— **Dieter Ruijten**
Innovation Broker



— **Mathias Jacobs**
Innovation Broker



— **Michiel Wouters**
Communications Officer

Our mission: competitiveness, sustainability and resilience

The four drivers contribute in different but complementary ways to Catalisti's mission of strengthening the competitiveness, sustainability and resilience of the chemicals and plastics industry in Flanders. Rather than pursuing these objectives separately, Catalisti seeks innovation opportunities that reinforce them simultaneously. Where trade-offs arise, Catalisti takes an integrated perspective, supporting innovations that create a positive impact on one or more objectives without undermining the others. The following sections clarify how the four drivers contribute to each dimension of Catalisti's mission across different time horizons.

Competitiveness

To strengthen competitiveness, Catalisti focuses on two key drivers: responding to changing market and consumer demands and boosting productivity. Significant potential lies in identifying emerging market opportunities and translating them into new molecules, processes and value-added products. Through its innovation activities, Catalisti helps companies explore new markets and applications with high added value. This can create value in different ways over time. In the short term, companies can increase profitability by positioning existing products in new applications. In the medium term, new products and value chains can generate additional growth opportunities. Catalisti also supports innovation that improves productivity through the smarter use of data, digitalisation and automation. These technologies can deliver efficiency gains in time, resources and operational performance in the short term, while simultaneously building the foundations for broader industrial transformation in the longer term. By connecting chemical and digital expertise, Catalisti helps companies translate productivity gains into improved competitiveness.

Sustainability

To strengthen sustainability, Catalisti focuses on three key drivers: market demands, circularity and climate neutrality. By embedding Safe and Sustainable by Design (SSbD) principles from the earliest stages of innovation, Catalisti supports the development of new molecules, processes and products that are safer and more sustainable. These innovations can deliver tangible results in the short and medium term. At the same time, Catalisti stimulates the transition towards a circular and climate-neutral economy by connecting partners, supporting innovation projects and accelerating the development of new value chains. While many of these innovations have already been initiated, their implementation horizon extends much further, towards 2030 and even 2050. Through continued collaborative innovation, Catalisti aims to strengthen and accelerate this transition in the years ahead, helping to realise the required transformation and achieve the roadmap's sustainability ambitions.

Resilience

To strengthen resilience, Catalisti draws on all four innovation drivers. Some drivers can deliver tangible benefits in the short term, while others contribute to a longer-term transformation whose full impact will only become visible over time. By helping companies identify and respond to emerging market needs, Catalisti supports diversification into new applications, value chains and growing markets. At the same time, Catalisti strengthens the sector's resilience by accelerating the transition towards circular feedstocks and supporting innovation that improves productivity. More efficient use of feedstocks, energy and other resources can reduce dependencies and improve the sector's ability to respond to economic, geopolitical and supply-chain challenges. In parallel, alternative feedstocks and circular value chains can decrease reliance on external resources and regions, which is becoming increasingly important in the current geopolitical context. Together, these innovation pathways help build a more resilient chemicals and plastics industry for the future.

From drivers to mission

FOUR DRIVERS

1. **Responding to changing consumer and market demands**
2. **Boosting productivity growth**
3. **Moving towards a circular economy**
4. **Transitioning towards climate neutrality**



ONE MISSION

Competitiveness

- **Shorter term:** existing products positioned in new applications, and efficiency gains from data, digitalisation and automation
- **Longer term:** new products and value chains that generate additional growth

Sustainability

- **Shorter term:** safer and more sustainable molecules, processes and products, guided by SSbD principles
- **Longer term:** a carbon-circular and climate-neutral economy, built on new value chains

Resilience

- **Shorter term:** diversification into new applications, value chains and growing markets; fewer dependencies through more efficient use of feedstocks, energy and other resources
- **Longer term:** circular and alternative feedstocks that decrease reliance on external resources and regions

41



Seven programmes, one value chain

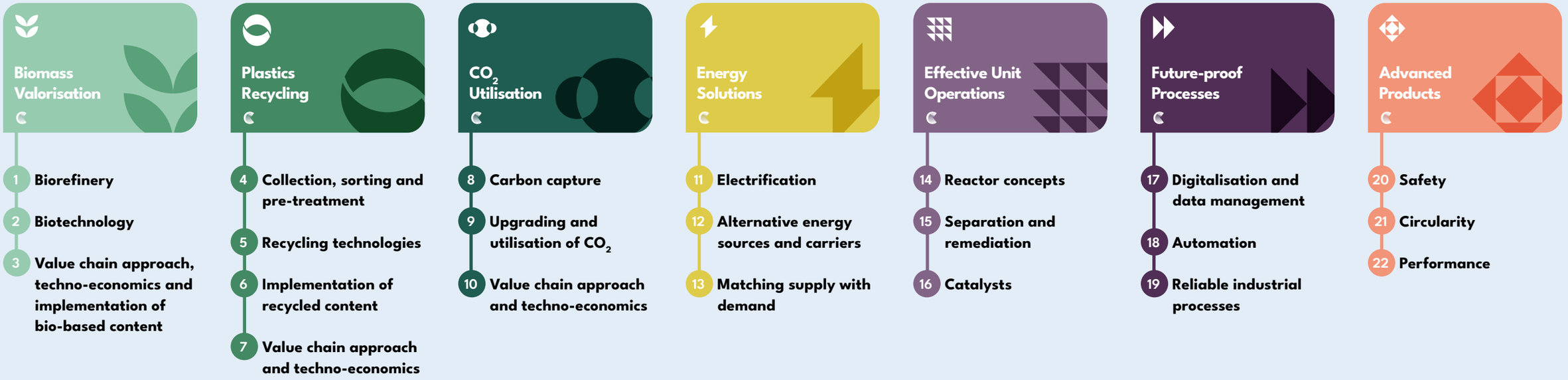
The innovation roadmap is built around seven programmes, one value chain, translating ambitions into well-defined actions across the entire chemical value chain. This involves processes consisting of multiple unit operations, from feedstocks and energy resources to valuable products. This programme structure enables Catalisti to respond to current needs while remaining open to future challenges.

Circular Feedstocks focuses on bringing alternative (carbon-based) inputs – **Biomass Valorisation**, **Plastics Recycling** and **CO_2 Utilisation** - into value chains, reducing fossil dependency and enabling circular flows, while opening up new performance and differentiation opportunities. **Energy Solutions** addresses the reality that our sector is both energy-intensive and cost-sensitive, by exploring electrification, alternative energy carriers and smarter ways to match energy demand with supply. **Effective Unit Operations** takes a look at the core infrastructure of the industry, seeking step-change gains in conversion, separation and purification, which often unlock both cost and environmental benefits. **Future-proof Processes** responds to the need for safe, resilient and digitally enabled production, integrating advanced digital tools, automation and process innovation. Finally, **Advanced Products** ensures that what emerges from this value chain is safety, circularity and performance, aligned with regulatory expectations and customer needs.

Together, these programmes form a coherent framework. These interconnected programmes will help us to gauge the rapid changing world, clarify the challenges we face, and commit to a long-term process of adaptation and leadership. By naming these seven programmes, the roadmap mirrors how companies practically think about their business. The innovation roadmap looks at technical opportunities along the value chain as a whole an asks: how can we offer technical solutions to transform (process) resources (input) as efficiently as possible into valuable molecules and products (output)? Together, they provide a coherent structure for the 22 tracks and help stakeholders position their own innovation activities within shared, forward-looking action plans.



7 Programmes, 22 tracks



The seven programmes translate the four drivers, described in chapter 3, into concrete ambitions, innovation needs and actions. Each programme contributes, directly or indirectly and in varying degrees, to changing consumer and market demands, boosting productivity growth, moving towards a circular economy and transitioning towards climate neutrality. Together, the programmes provide a structured framework that links innovation drivers with specific innovation needs and collaborative actions.

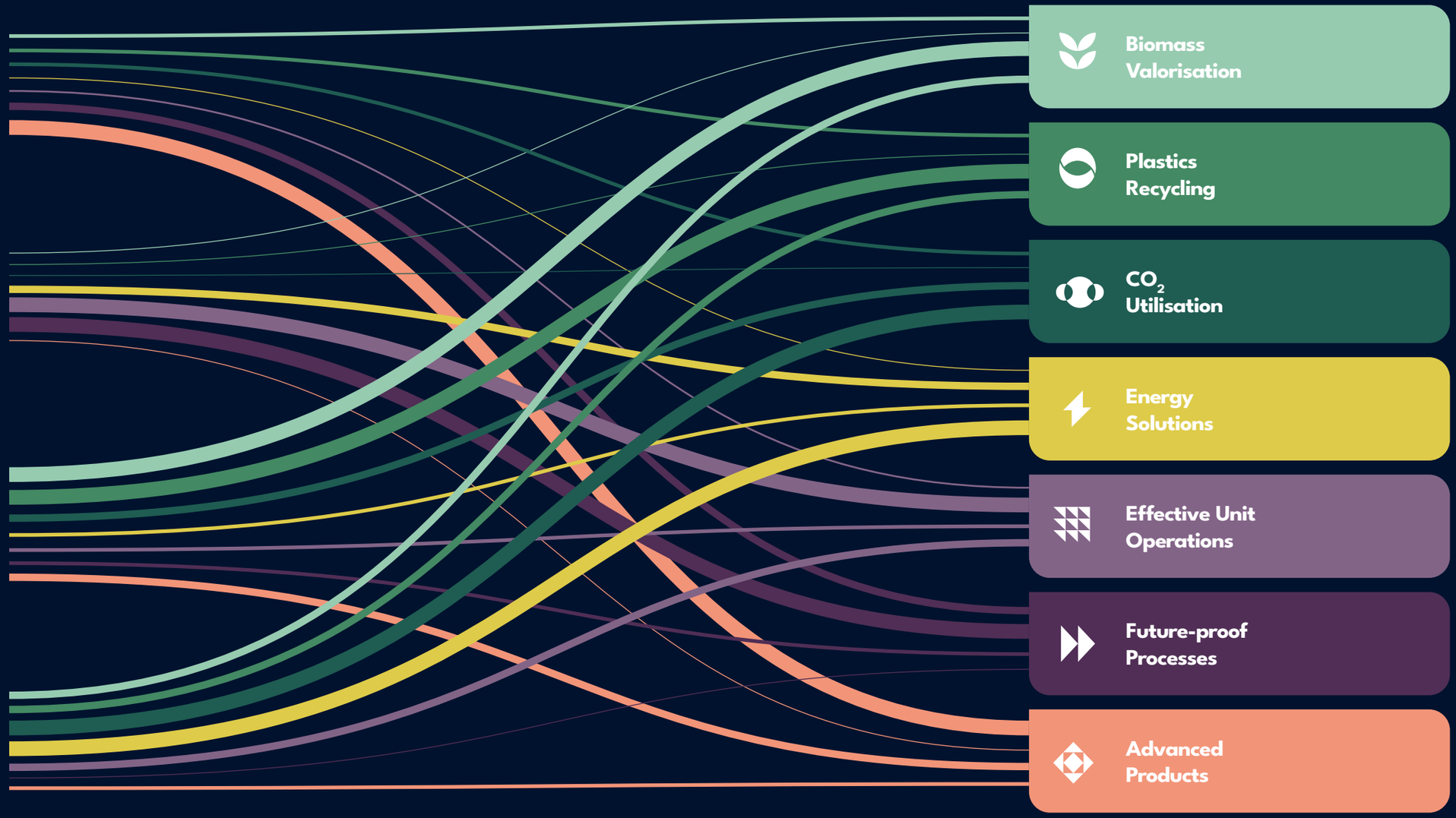
The strongest and most direct linkages reflect the principal purpose of each programme. Biomass Valorisation and Plastics Recycling are central to moving towards a circular economy, while CO_2 Utilisation and Energy Solutions contribute most directly to the transition towards climate neutrality. Effective Unit Operations and Future-proof Processes primarily support productivity growth, whereas Advanced Products responds most directly to changing market and consumer demands.

These principal linkages do not imply that a programme contributes to only one driver. On the contrary, each programme comprises multiple innovation needs and actions that can simultaneously contribute to several drivers. The matrix below therefore highlights the primary contributions of each programme, while recognising that many additional interactions and synergies exist throughout the roadmap.

From drivers to programmes

FOUR DRIVERS

1. Responding to changing consumer and market demands
2. Boosting productivity growth
3. Moving towards a circular economy
4. Transitioning towards climate neutrality



SEVEN PROGRAMMES

- Biomass Valorisation
- Plastics Recycling
- CO_2 Utilisation
- Energy Solutions
- Effective Unit Operations
- Future-proof Processes
- Advanced Products

Biomass Valorisation



1. **Biorefinery**
2. **Biotechnology**
3. **Value chain approach, techno-economics and implementation of bio-based content**

Biomass Valorisation

This programme focuses on reducing our reliance on fossil resources by deploying biorefineries and fermentative processes on an industrial scale for the efficient conversion of biomass into valuable chemicals, biopolymers, and biofuels. This requires innovation efforts across the entire biomass value chain, with emphasis on cascade approaches, full utilisation of all biomass fractions, and continuous and intensified processes. Robust (bio)catalytic processes are needed that can handle variations in feedstock quality while consistently delivering high-quality products. Innovation should enable the demonstration of bio-based processes that are cost-competitive with traditional chemocatalytic approaches, ultimately leading to a higher overall bio-based content in chemicals, materials, and fuels.

CATALISTI CONTACTS



— **Dieter Ruijten**
Innovation Broker



— **Aron Deneyer**
Innovation Broker



© Cargill

Project portfolio

1 Biorefinery

- **BIORESAL** – Bio-based resins from aldehydes and lignin
- **BIOVERTOL** – Towards the sustainable synthesis of branched-chain higher alcohols from bio-based feedstock using catalytic processes
- **DELICARE** – Depolymerisation of hydrolysis lignin for conversion to acrylic resins
- **GAME** – Unravel metabolite production by Porphyra
- **SPICY** – Sugar based chemicals and polymers through innovative chemocatalysis and engineered yeast
- **UPLIFT** – Upcycling lignin biorefinery waste through thermal conversions

2 Biotechnology

- **AppliSurf** – Screening the application potential of a yeast-based biosurfactant portfolio
- **CAPRA** – Upgrading steel mill off gas to caproic acid and derivatives using anaerobic technology
- **CO2PERATE** – All renewable CCU based on formic acid integrated in an industrial microgrid
- **ENZYMARES** – Enzyme prediction toolbox
- **ENZYMASE** – Enzymes for added sustainability and efficiency
- **LipaMetics** – Lipase-catalysed solvent-free esterification of fatty acids with lower alcohols
- **ODORETION** – Towards sustainable solutions for better malodour elimination

3 Value chain approach, techno-economics and implementation of bio-based content

- **ATOL** – Advanced tailored oligosaccharides
- **BAFTA** – Bio-aromatics feedstock and technology assessment
- **BARDI** – Bio-based aromatic diols
- **BIOLOOP** – Decision support model for biomass logistics optimisation
- **BioPol4Motive** – Bio-based polyols for flexible polyurethane foams in automotive applications
- **BioSAPs** – Bio-based and biodegradable superabsorbing polymers
- **CropExplore4Farmers** – Mapping arable crops withing the Flemish bioeconomy
- **Encaps2Control** – Controlled release, uptake and enhanced (bio-)availability by encapsulation
- **FResCo** – Fouling restraining coatings for marine and terrestrial applications
- **PolyFlam** – Polyol based flame retardants and lubricants
- **PROMETHEUS** – Assessment of microbial protein sources for food and feed
- **PROMIS** – Sustainable production of bio-based multi-reactive isocyanates
- **SUPERNATURE** – Sustainable polyurethane alternatives without hazardous isocyanates
- **SweetEst** – Use of sugar in feed additives, surfactant in personal care and gelling in industrial products
- **VITAL** – Vegan chitosan tailoring for diverse applications

LipaMetics

The development of enzymatic esterification technology illustrates how long-term collaborative innovation can progressively increase technology readiness and pave the way for industrial implementation. The journey started with the Catalisti-supported LipaMetics project, which brought together Oleon, VITO, Nutrition Sciences and Gova to develop a continuous, solvent-free route for producing esters from fatty acids and alcohols using enzymatic catalysis. By replacing conventional high-temperature esterification with a biocatalytic process operating under much milder conditions, the project demonstrated the potential to significantly reduce waste generation, energy consumption and downstream purification requirements.
Rather than ending with a successful proof of concept, Oleon and VITO continued to build on these results through the European INCITE-project. The technology was further developed and validated at increasing scale, allowing key technical challenges to be addressed and reducing the risks associated with industrial deployment. This stepwise progression from laboratory research to pilot-scale validation and industrial demonstration steadily increased the technology readiness level and strengthened the business case for commercial implementation.
The opening of Oleon's enzymatic esterification plant in Oelegem in 2023 marked the culmination of this innovation trajectory. With a production capacity of 3,000 tonnes per year, the facility demonstrates how sustained collaboration across multiple projects can transform an emerging biocatalytic concept into an industrial production technology. The case highlights the importance of long-term innovation pathways that combine research, pilot validation and demonstration activities to accelerate industrial uptake of sustainable process technologies.



Oleon's enzymatic esterification plant in Oelegem. © Oleon

Did you know?

Crop Explore4 Farmers

The intercluster project CropExplore4Farmers delivered an online tool that helps farmers and companies identify and compare crops with potential for the Flemish bioeconomy. The platform combines information on cultivation characteristics, yields, biomass composition and application opportunities, enabling users to evaluate alternative crops and biomass streams based on their specific needs. By making knowledge on hundreds of crops readily accessible, the tool supports crop diversification, stimulates the use of sustainable bio-based feedstocks and helps connect agricultural production with new value chains in food, feed and industrial applications.

cef.ilvo.be



1 Biorefinery

INNOVATION NEEDS

Biorefineries are a key component of the circular bioeconomy, as they enable the conversion of renewable biomass derived from various sources (e.g. lignocellulosic residues, algae, fat and oil waste, or food waste) into value-added products such as chemicals, biofuels, and bioplastics. Globally, biomass currently provides about 10–15% of primary energy input, yet only a small fraction (<5%) is converted into high-value chemicals, materials, and biofuels. To increase this share, robust and efficient biorefineries are needed that can cope with the heterogeneous nature of biomass feedstocks and integrate efficient pre-processing and fractionation technologies to valorise valuable biomass fractions.

One of the key technical challenges is the heterogeneous nature of biomass streams. In contrast to fossil feedstocks, biomass composition can vary significantly more depending on their origin, seasonality, moisture content, ash content, and biological degradation. Such variability poses challenges to stable process operation, catalyst lifetime, and consistent product quality. Therefore, Catalisti will stimulate research into improved feedstock characterisation, sorting, and mild pre-treatment technologies to enhance process robustness while minimising energy consumption and chemical use. Since extensive feedstock pre-treatment should be minimised to reduce both cost and environmental impact, biorefinery schemes should be robust, flexible and capable of delivering consistent product specifications over extended periods, despite variability in feedstock composition and impurity levels. In all cases, full valorisation of the biomass input should be pursued, for example through a cascading approach. Before using catalysts, as discussed in the next paragraph, a biorefinery should maximise fractionation through physical and physicochemical processes. These include water treatment, gravity-based separation, sieving, and temperature-based treatments such as steam explosion. Wet fractionation can also be preceded by dry fractionation to further improve component separation.

The core of a biorefinery scheme is often a stable and highly active catalyst that selectively converts biomass into useful fractions. Future catalyst systems should combine high selectivity with long-term stability and resistance to deactivation caused by impurities present in biomass (e.g. O-, N- and S-containing compounds). As some deactivation will be inevitable, effective catalyst regeneration strategies should be developed. Moreover, an improved mechanistic understanding of biomass conversion pathways should be targeted to steer selective depolymerisation, deoxygenation, and upgrading reactions towards desired products while minimising side-product formation. Depolymerisation should not always be the preferred approach, as high-molecular-weight fractions can be valuable in particular cases. In addition, to enable high-volume production of biofuels and chemicals, continuous processes should be favoured over batch processes.

> “Unlocking the value of biomass side streams through integrated biorefineries is key to competitive and sustainable bio-based chemicals”
>
> — Ronny Vercauteren, Senior advisor, Cargill

Efficient downstream separation technologies should be in place to isolate and purify the obtained fractions, providing intermediates for further upgrading into chemicals, materials, and biofuels. Compared to fossil-based streams, biomass conversion mixtures are often significantly more diluted and chemically complex, making downstream separation more energy-intensive. Catalisti will accelerate research efforts into novel separation technologies such as membranes, adsorption systems, reactive separations, and hybrid separation trains that can potentially reduce energy consumption compared to conventional distillation-based approaches. This should lead to overcoming remaining technical challenges related to fouling resistance, solvent compatibility, stability under harsh operating conditions, and the selective separation of O-rich molecules.

Both “drop-in” and novel bio-based products will be targeted, leveraging the unique functional groups and molecular structures of bio-derived compounds to create high-performance alternatives to fossil-based products. When designing such biorefinery schemes, Catalisti will stimulate research that focuses on the integration of renewable energy sources and explores synergies between bio-based production and emerging e-fuel or biofuel platforms to optimise carbon and energy efficiency.

Within a 10-year horizon, Catalisti aims to support the development and deployment of demonstration-scale biorefineries in Flanders that maximise the valorisation of all biomass fractions. These biorefineries should combine energy and carbon efficiency with robustness to process variable renewable feedstocks at an industrial scale, contributing to a more circular and sustainable chemical industry.

1 Biorefinery

Upgrading of biomass, and specifically side streams from the agri-food value chain, has the potential to become an important source of differentiation for the chemical-related industry in the near future. The inherent complexity and variability of biomass streams opens the opportunity for a radical change in process philosophy and the redesign of robust, industrially viable biorefineries with higher degrees of strategic (European) autonomy.

The development of a biorefinery network, with associated logistics for side streams, will have to be rolled out at the Flemish level and connected at the European level. Emphasis should be placed on minimising transport and energy costs while maximising the valorisation of all biomass fractions.

Our experience with our existing, fully integrated biorefineries that fractionate plant-based materials into ingredients for food, cosmetics, chemicals and animal nutrition has shown that it will be important to move beyond refined biomass streams (e.g. pure cellulose, glucose or refined oils) towards economically viable fractionation technologies for more heterogeneous plant feedstocks and side streams. Moreover, it will be important to investigate whether different waste streams can be converted into higher-value products without intensive fractionation. Together with new generations of robust and selective catalysts, this will be key to improving the competitiveness of sustainable bio-based chemicals.

— **Ronny Vercauteren**
Senior advisor, Cargill



ACTIONS

Increasing robustness of current biorefineries by (i) designing feedstock-agnostic processes while ensuring consistent product quality, (ii) improving feedstock characterisation and sorting, and (iii) developing mild feedstock pre-treatment technologies.

Maximising full biomass valorisation into products by (i) converting all biomass fractions into chemicals, fuels and materials, and (ii) implementing cascaded valorisation approaches across the sector.

Advancing biomass conversion process performance by (i) developing robust and stable catalysts resistant to impurities, (ii) improving mechanistic understanding to steer selective biomass upgrading and continuous processing, and (iii) developing high-performing continuous processes.

Improving downstream separation of the complex bio-derived fractions into desired intermediates by (i) developing novel membrane, adsorption, and reactive separation technologies, and (ii) improving fouling resistance, solvent compatibility and energy efficiency.

AMBITION

Developing and deploying demonstration-scale biorefineries in Flanders that maximise the valorisation of all biomass fractions; These biorefineries should be energy and carbon efficient, and sufficiently robust to process variable feedstocks.

LEGEND

Indication of the timing

- Short term
- Mid term
- Long term

Impact of innovation and/or collaboration

- Minor
- Medium
- Major



2 Biotechnology

INNOVATION NEEDS

Industrial biotechnology for the chemical sector encompasses the use of whole-cell systems (bacteria, yeasts, fungi) and isolated enzymes (biocatalysis) to transform bio-based, waste-derived, or alternative feedstocks into molecules and products. The field integrates genetic engineering, metabolic engineering, and synthetic biology to design optimised microorganisms and tailored enzymes that enable highly selective, efficient, and sustainable production routes.

Over the coming decade, Catalisti aims to accelerate the deployment of highly productive biocatalytic processes that are cost-competitive with conventional chemocatalytic pathways. To realise this ambition, major innovation efforts are required to develop high-performance bioprocesses that span large-volume compounds (e.g. organic acids, alcohols, or platform molecules) and high-value, low-volume speciality chemicals. Process intensification is a key objective, with continuous and modular bioprocessing offering advantages in productivity, stability, and energy efficiency over traditional batch operations.

A major technical barrier for industrial biotechnology is the scale-up from laboratory to industrial scale. Microbial strains and enzymes that perform well under laboratory conditions often show reduced productivity, inhibition effects due to impurities or the product itself, or instability at larger scales due to gradients in O_2 transfer, nutrient availability, pH, and temperature. To overcome these hurdles and enable industrial deployment, Catalisti will foster innovation that supports stable long-term operation in continuous systems while preventing contamination and genetic drift. In this context, more robust strains and adaptive metabolic pathways should be developed. Better predictive models linking strain design, metabolic pathways, and reactor performance are also needed to accelerate industrial implementation.

> “Successful biotech scale-up requires robustness and integrated process development”
>
> — Stijn Boeren, Director & Owner, Avecom

Hybrid catalytic routes that combine chemo- and biocatalysis are gaining attention as a flexible means of producing complex molecules more sustainably by leveraging the selectivity of biocatalysts alongside the efficiency and scalability of chemical processes. At the core of these innovations is the design of robust and reliable biocatalysts that demonstrate high tolerance to feedstock impurities and compositional variability. Early-stage integration of biocatalyst design with process and reactor engineering is essential to maximise overall performance and economic viability.

Cutting-edge tools such as high-throughput strain engineering, automated enzyme evolution platforms, and data-driven design workflows can enable the rapid development and selection of superior biocatalysts with reproducible long-term performance. Also, the search for novel biocatalysts originating from microorganism that have salt rich, high temperature, high acid/alkaline, high-pressure environments, is a high priority to find adapted enzymes that fall outside the current strain/enzyme databanks.

Downstream processing (DSP) remains a major bottleneck. For dilute aqueous fermentation streams in particular, product purification can represent a dominant share of the overall process cost and energy demand. Therefore, Catalisti will stimulate research into selective, low-energy recovery technologies and integrated process concepts. Intensified and integrated separations should be implemented through technologies such as in situ product recovery, membrane filtration, adsorption-based recovery using green solvents, and continuous chromatography systems. High-gravity fermentation, flocculation-assisted clarification, and continuous DSP integration are further avenues to improve process economics and material efficiency.

Finally, digitalisation and smart control are pivotal for industrial-scale reliability. The introduction of real-time monitoring via sensors and spectroscopy, combined with digital twins for predictive control and optimisation, can significantly improve process stability, productivity, and resource efficiency. Together, these innovations will enable a new generation of bio-based production platforms that can offer competitive alternatives to fossil-based industrial chemistry while enhancing circularity and sustainability.

2 Biotechnology

The real challenge in industrial biotechnology is not demonstrating that a strain or enzyme works in the laboratory, but ensuring that the entire process remains productive, stable and economically viable at industrial scale. Variable feedstocks, inhibition effects, gas-transfer limitations and energy-intensive downstream processing can all become decisive bottlenecks during scale-up.

Our experience with converting heterogeneous industrial side streams and gases - such as CO_2 and agricultural co-products - into microbial proteins and biodegradable polymers shows that biological performance, reactor design, process control and product recovery must be developed as one integrated system. Flexible fermentation platforms, pilot facilities and molecular diagnostic tools can help identify and address scale-up risks at an earlier stage.

However, technology alone is not enough. Close collaboration between biotechnology developers, process engineers and industrial value-chain partners is essential to validate solutions under realistic conditions and translate promising biocatalytic routes into robust, cost-competitive production processes.

— **Stijn Boeren**
Director & Owner, Avecom



ACTIONS

Improving industrial competitiveness of fermentation processes by (i) intensifying biocatalytic routes to increase yield and titres, (ii) transitioning from batch to continuous processes, and (iii) integrating separation technologies.

Improving robustness and industrial deployment by (i) developing robust microbial strains, (ii) preventing inhibition and genetic drift in continuous systems and (iii) creating predictive models linking strain design, metabolic pathways, and reactor performance.

Advancing hybrid catalytic production approaches by (i) combining chemo- and biocatalysis for sustainable production of complex molecules, and (ii) integrating biocatalyst, process and reactor design to maximise performance and economic viability.

Advancing DSP, process monitoring and control by (i) implementing intensified continuous DSP concepts, and (ii) applying real-time monitoring, digital twins and smart process control.

AMBITION

Accelerating the deployment of highly productive biocatalytic processes that achieve cost competitiveness with conventional chemocatalytic pathways.

LEGEND

Indication of the timing
- Short term
- Mid term
- Long term

Impact of innovation and/or collaboration
- Minor
- Medium
- Major



3 Value chain approach, techno-economics and implementation of bio-based content

INNOVATION NEEDS

Within the next 10 years, Catalisti wants to achieve cost-competitive production of bio-based chemicals, materials, and fuels compared to fossil-derived alternatives, thereby increasing the bio-based content of end products. This requires both technological innovation and systemic value chain alignment. The focus is on generating and capturing value through efficient biomass conversion, equitable value distribution among feedstock suppliers, technology developers, and end users, and effective alignment between supply and market demand. High and consistent quality, functionality, and performance specifications are essential to ensure that bio-based products can be integrated into existing industrial applications.

Innovation efforts should apply cascading approaches that fully valorise biomass streams, focusing first on the highest-value fractions before using remaining components for lower-value applications such as fuels or energy recovery. The required industrial transformation should be gradual to avoid resistance to change, thereby balancing the retrofitting of existing sites with strategic greenfield biorefinery investments and enabling a phased and cost-effective transition. Currently, there is a gap between the existing biomass conversion technologies and end applications. For this reason, Catalisti will support the development of decision-support frameworks that link biomass feedstocks, biorefinery schemes, and end-use applications and help identify the most efficient valorisation routes.

> “Successful biomass valorisation depends on the synchronised development of technology, financial viability and the entire value chain”
>
> — Yves Boonen, CEO, Plinius Labs

Developing chemicals and materials that offer unique bio-based performance or safety advantages, such as novel molecular structures or improved degradability, can create a premium over fossil alternatives, thereby boosting the business case for partly or fully bio-based materials, chemicals, and fuels.

Finally, collaboration and long-term vision are essential. Catalisti will play a connecting role by bringing together industrial players, technology developers, and research institutes to accelerate innovation and implementation across the bio-based ecosystem. Sharing proven investment models and infrastructure approaches across the sector will de-risk deployment. A strategic roadmap linking industrial decarbonisation needs with innovation opportunities across biotechnology and biorefineries will guide coordinated actions between partners and programmes. This integrated approach will enable Flanders to establish cost-effective, sustainable and resilient bio-based value chains.



Biocon facility for the production of bio-aromatics from wood and agricultural residues, developed as part of the Moonshot Flanders project PILLAR, located at KU Leuven’s TRANSfarm. © KU Leuven, Rob Stevens

Secondary agricultural streams are among the most available, yet still underutilised, biomass resources in Flanders. Our work on converting these streams into multifunctional components for cosmetics and food applications has shown us that technical feasibility is only one part of the challenge. To reach industrial markets, bio-based products must combine consistent quality and performance with cost competitiveness, while their bio-based and biodegradable properties must deliver sufficient market value.

Our experience also shows that moving from validated technology to the first commercial production facility remains a major hurdle. This requires better alignment between biomass suppliers, technology developers, processors and end users. Equally, it calls for a more unified European capital market and investors willing to take a longer-term, less risk-averse view on the bio-economy. Technology, business case, value chain and financing must therefore progress in parallel to maximise biomass valorisation and increase the bio-based content of chemicals and materials.

— **Yves Boonen**
CEO, Plinius Labs



3 Value chain approach, techno-economics and implementation of bio-based content

ACTIONS

Making bio-based products cost competitive with fossil-based alternatives by (i) improving efficient biomass conversion technologies, and (ii) ensuring consistent product quality and performance.

Maximising the value of biomass streams by applying cascade use of biomass, prioritising high-value products before biofuels or energy recovery.

Improving the connection between biomass feedstocks, biorefineries and end markets by (i) developing decision-support tools linking feedstocks, biorefineries and applications, (ii) identifying the most efficient valorisation routes, and (iii) matching supply with market demand across the value chain.

Strengthening collaboration across the bio-based ecosystem by (i) connecting industry, technology developers, and research institutes, and (ii) sharing investment models and infrastructure approaches.

LEGEND

Indication of the timing
- Short term
- Mid term
- Long term

Impact of innovation and/or collaboration
- Minor
- Medium
- Major

AMBITION

Enabling cost competitive production of bio-based chemicals, materials and fuels compared to fossil-derived alternatives, leading to an overall increase of the bio-based content in the end products.

Plastics Recycling



4 **Collection, sorting & pre-treatment**

5 **Recycling technologies**

6 **Implementation of recycled content**

7 **Value chain approach and techno-economics**

Plastics Recycling

This programme focuses on the circularity of plastics. Over the next decade, systemic innovation efforts across the entire value chain, from collection and sorting to recycling technologies, market uptake, and improved economic structures are required. Catalisti's objective is to position Flanders at the forefront of plastics recycling by supporting collaborative innovation projects. Innovation should focus not only on the technical level, but also on aligning companies across the value chain around shared objectives such as quality, scale, and cost competitiveness.

CATALISTI CONTACTS



— **Martijn Roosen**
Innovation Broker



— **Stef Koelewijn**
Innovation Broker



Indaver's Plastics2Chemicals (P2C) recycling plant in Antwerp. © Indaver

Project portfolio

4 Collection, sorting & pre-treatment

- **HG4PPFlex** – Holy Grail 4 polypropylene flexibles

5 Recycling technologies

- **DISSOLV** – Dissolution recycling, rejuvenation and reuse of post-consumer PVC waste in vinyl applications
- **MATTER** – Mechanical and thermochemical recycling of mixed plastic waste
- **P2PC** – Plastics to precious chemicals
- **PolyAl Circular** – Closing the loop in carton packaging recycling
- **RECYCOAT** – Recycling of coated materials
- **Remove2Reclaim** – Recycling of plastics and titanium dioxide for plastic additive removal
- **TRUCE** – True recycling upscaling of flexible packaging
- **WATCH** – Plastic waste to chemicals
- **WIN-CE** – Catalytic solutions for end-of-life wind turbine blades in a circular economy

6 Implementation of recycled content

- **In2OrFoam** – Innovations in foaming of recycled polymers
- **PoCoPadd** – Post-consumer PVC boosted with additives

7 Value chain approach and techno-economics

- **Map4Plastics** – Mapping of non-circular EoL plastics and identification of strategies to close circularity gaps
- **Multi2Recycle** – 'Design for recycling' guidelines for multilayer plastic food packaging
- **PROFIT** – Plastic recuperation and valorisation fit for use
- **PVCircular** – PVC fibreglass side stream valorisation and development of circular products

DISSOLV and TRUCE

The DISSOLV and TRUCE cases demonstrate how collaborative innovation can accelerate the transition from research to industrial impact. By connecting partners across value chains, Catalisti projects help validate new technologies, reduce scale-up risks and create the foundations for successful market deployment and long-term economic value.

DISSOLV

INEOS Inovyn's investment in next-generation PVC recycling pilot plants in Jemeppe-sur-Sambre, just across the regional border in Wallonia, demonstrates how collaborative innovation can accelerate the transition towards industrial-scale circular plastics. The pilot infrastructure forms part of Project Circle, INEOS Inovyn's strategic initiative to make complex PVC waste fully recyclable. The investment builds on decades of experience in PVC recycling and on knowledge generated through collaborative innovation projects, including the Catalisti-supported DISSOLV consortium.

DISSOLV brought together partners from across regions and throughout the value chain, including Beaulieu, Sioen, Empire Carpets, ExxonMobil, Centexbel and INEOS Inovyn, to develop recycling solutions for complex PVC waste streams that are difficult or impossible to recycle mechanically. By combining expertise in materials, recycling, testing and product development, the consortium demonstrated advanced dissolution recycling technology capable of separating textile fibres, removing legacy additives and producing high-quality rejuvenated PVC suitable for demanding applications. The project successfully demonstrated pilot-scale recycling and achieved closed-loop recycling for plastisol-based products, enabling flooring-to-flooring, carpets-to-carpets and tarpaulins-to-tarpaulins recycling routes.

TRUCE

The TRUCE project demonstrates how collaborative innovation can accelerate the transition towards fully recyclable flexible packaging solutions. As an intercluster initiative of Catalisti and Flanders Food, TRUCE brought together partners from the entire packaging value chain, including Borouge International, Amcor, Bostik, Eastman, Puratos and Ghent University, to address one of the key challenges in flexible food packaging: replacing complex multilayer structures with recyclable alternatives while maintaining the performance required for food preservation. Through the project, the consortium developed innovative packaging concepts based on mono-polyethylene structures containing more than 95% polyethylene, enabling fully recyclable flexible packaging without compromising functionality.

A key strength of the project was the involvement of industrial partners across the complete value chain, allowing innovations to be tested and validated under realistic industrial conditions. By combining expertise in polymer development, packaging design, adhesives, food production and recycling, the consortium successfully demonstrated that recyclable mono-material packaging can meet demanding requirements for flexible food applications. Several packaging solutions developed within TRUCE have subsequently been commercialised, translating project results into tangible industrial impact and market adoption.

Did you know?

Map4 Plastics

The intercluster project Map4Plastics is creating a knowledge platform that helps companies identify unrecycled plastic waste streams, understand the barriers that prevent their circular use and evaluate potential pathways towards higher-value recycling. By combining quantitative data, material flow analysis, technology assessments and stakeholder insights, the project maps where plastic losses occur and which recycling, reuse or design-for-circularity strategies offer the greatest potential. The resulting insights support companies in identifying promising feedstocks, evaluating investment opportunities and accelerating the development of new circular plastics value chains.



4 Collection, sorting & pre-treatment

INNOVATION NEEDS

Effective recycling depends critically on collection rates, identification of the polymer type and the presence of impurities, (advanced) sorting, and pre-treatment, including removal of other polymers, impurities, and contaminants, such as (legacy) additives and non-intentionally added substances (NIAS). These are key steps for producing high-quality secondary materials and/or chemicals. Indeed, today, significant volumes of valuable polymers are either not separately collected, with around 49% of waste being collected in mixed streams, or are lost during sorting, with an average of 62% of collected plastics across EU member states being lost to inefficiencies at these early stages. Minimising these losses is critical for increasing the availability of plastics for recycling processes and maximising diversion from incineration and landfill.

Therefore, within a 10-year horizon, Catalisti aims to significantly reduce polymer losses across the entire upstream value chain, including collection, sorting, and pre-treatment, while improving the quality of recovered materials in line with the requirements of the most suitable recycling technologies.

A first strategic priority is to maximise sorting at source, with targeted separate collection where feasible to improve quality and reduce variability. Collection rates must be increased through strengthened Extended Producer Responsibility (EPR) systems, ensuring that funding mechanisms support the collection and processing of all relevant plastic streams. Harmonised sorting rules and product design standards will further improve overall recycling efficiency. At the same time, further feedstock differentiation should be guided by modelling and route-specific recycler requirements, so that additional sorting is introduced only where the circular value gained outweighs the added cost and complexity. Catalisti will contribute by stimulating collaborative and translational research that assesses which EPR and/or sorting systems are best suited to specific plastic products.

> "Collection, sorting and pre-treatment are the foundation of high-value plastic recycling"
>
> — Philippe Gendebien, Business Innovation Manager, Fost Plus

At the same time, sorting efficiencies must also increase, supported by more granular separation enabled by advanced sorting technologies. In parallel, pre-treatment processes should minimise material losses by valorising all plastic-containing streams and by developing advanced treatment steps that generate higher-quality feedstocks for recycling. Implementing advanced sorting technologies is a key priority. This includes the industrial-scale adoption of AI-based systems as well as approaches based on tracers or digital watermarking. Successful implementation requires coordination across the value chain, from converters and brand owners to waste management companies and recyclers. Catalisti will play a convening role by bringing these stakeholders together to identify best practices, build alignment, and assess economic feasibility.

Pre-treatment processes must be optimised and tailored to specific recycling pathways. Mechanical recycling requires clean, homogeneous streams. Dissolution recycling has the potential to offer greater robustness than mechanical recycling for certain contaminated polymer streams. However, a high target-polymer content generally still improves yield and economics. Other polymers and contaminants may be removed if they remain insoluble, but additional separation and purification steps add cost. In contrast, thermochemical processes such as pyrolysis can be more sensitive to chemical impurities, such as chlorine- or oxygen-containing compounds. Pre-treatment should therefore be designed to maximise output quality and yield and aligned on the following recycling technology. Reducing material losses during these steps is essential. A deeper understanding of polymer behaviour during advanced pre-treatment processes, such as washing and solvent-based contaminant removal, will support improved material quality and higher recovery rates. Catalisti will play a key role by stimulating both basic research and value chain collaboration to optimise these processes.

4 Collection, sorting & pre-treatment

Today, most plastics are manufactured from fossil feedstocks. The challenge ahead is to reverse that feedstock and increasingly use recycled carbon as the basis for new materials. Advanced chemical recycling can play an important role by breaking plastics down into their base elements, enabling the production of new plastics with qualities comparable to virgin materials. Our experience also highlights the importance of complementary solutions that combine smart sorting with advanced pre-treatment and recycling technologies, including delamination, deinking, decontamination and dissolution.

The potential for the packaging industry cannot be overstated. Never before have the ambitions for recycled content been so high. However, the legislative framework has yet to provide the clarity and consistency needed to support investment across recycling technologies. As long as recycling rates are not calculated consistently across technologies - at the input of the recycling process as is the case for mechanical recycling - the large-scale investments needed to build the recycling sector of tomorrow will remain difficult to unlock. Advancing circular plastics therefore requires progress in collection, sorting, recycling technologies and policy frameworks alike.

— **Philippe Gendebien**
Business Innovation Manager,
Fost Plus



ACTIONS

Adopting advanced sorting technologies at industrial level (e.g. AI-based systems, tracers or digital watermarking) by implementation at scale and engagement across the entire value chain.

Increasing collection rates by (i) studying the fate of plastic products, (ii) studying effective Extended Producer Responsibility (EPR) schemes to enable the financing of collection, sorting and recycling across all plastic streams and (iii) bringing stakeholders together to harmonise sorting rules and product design.

Optimising pre-treatment processes by tailoring them to recycling technologies to maximise input quality and reduce recycling costs.

AMBITION

Minimising polymer losses across the entire upstream value chain, while improving the quality of the recovered materials in line with the requirements of the most suitable recycling technologies.

LEGEND

Indication of the timing
- Short term
- Mid term
- Long term

Impact of innovation and/or collaboration
- Minor
- Medium
- Major



5 Recycling technologies

INNOVATION NEEDS

Effective recycling depends on reliable and robust processes in which polymers are either physically reprocessed without changing their chemical structure or chemically processed in ways that alter the polymer structure. When impurities are present, recycling technologies should be able to handle and, preferably, even valorise them. Downstream processing (DSP), involving the recovery, concentration, and purification of target molecules, should also be taken into account, especially for (thermo) chemical recycling, where output products must be purified before they can be used again as a feedstock.

Today, different recycling technologies exist, each with specific strengths and limitations depending on the type and quality of the input streams. Mechanical recycling remains the most established and energy-efficient pathway but can be sensitive to contamination, degradation, or the presence of incompatible polymers. More advanced recycling technologies, such as solvolysis or pyrolysis, may be able to process more complex or contaminated waste streams, but many still require further technological development, improved process efficiency, and demonstration at larger scale. In addition, impurities present in the feedstock, such as additives, metals, or other contaminants, can significantly affect process performance and product quality. Developing recycling technologies that can better tolerate, remove, or even valorise such impurities is therefore an important challenge.

Hence, in the next decade, Catalisti aims to support the development and deployment of next-generation recycling technologies that move beyond downcycling towards value retention and performance preservation, aiming to maximally preserve the quantity and quality of polymers in the economy.

> “Enabling higher recycled-content levels in demanding applications without compromising quality, performance or compliance”
>
> — Wim Six, R&D Project Manager, Deceuninck

In mechanical recycling, this includes approaches that maintain or enhance polymer properties through additives, chain extenders, and compatibilisers, enabling recycled polymers to meet the requirements of higher-value applications. This would enable the processing of a broader range of polymer types and more complex waste streams while maintaining material performance.

Catalisti will support innovation aimed at improving the robustness and performance of mechanical recycling technologies. This includes work on stabilisation strategies, compatibilisation of mixed polymer streams, and advanced additive systems that enable materials to retain their functional properties over multiple processing cycles. In parallel, Catalisti will bring together partners across the value chain to support implementation at industrial scale.

At the same time, complementary recycling pathways must be further developed to address contaminated or complex waste streams that cannot be efficiently processed through mechanical recycling. Physical recycling technologies, e.g. dissolution or delamination, thermochemical recycling, and chemical recycling technologies offer opportunities to process such fractions, including those containing legacy additives, metals, or non-intentionally added substances (NIAS). Catalisti will stimulate both basic research into lower-TRL technologies and collaboration to accelerate the industrial adoption of more mature solutions.

DSP is equally important. Efficient separation, purification, and upgrading of recovered molecules or polymers are critical for producing high-quality outputs suitable for industrial applications. Catalisti will support research into more selective and energy-efficient purification methods, improved separation strategies, and catalytic upgrading approaches, while facilitating collaboration to address key bottlenecks.

Access to pilot infrastructure remains a major hurdle. Therefore, Catalisti will stimulate the development of shared pilot and demonstrator facilities in which emerging recycling and DSP technologies can be validated and scaled up. Such infrastructure will reduce technological risk and scale-up risk and, hence, will mobilise capital for investments.

5 Recycling technologies

Circularity is at the core of the innovation strategy of Deceuninck. Through our recycling operations in Diksmuide, one of Europe's largest PVC recycling facilities, end-of-life window frames and other rigid PVC waste streams are transformed into high-quality raw materials that can be used in new products. This enables us to continuously increase the use of recycled content while maintaining the quality, durability and performance standards required in the construction sector. Today, significant volumes of post-consumer PVC are already reintroduced into new applications, demonstrating that circularity can create both environmental and economic value. Nevertheless, further increasing recycled-content levels in demanding applications remains a considerable technological and economic challenge. Improving recyclate quality, dealing with legacy additives, understanding long-term material performance, and ensuring compliance with evolving regulations all require additional innovation efforts.

This requires more than internal innovation alone. Many of the remaining challenges can only be addressed through collaboration across the value chain, bringing together recyclers, raw material suppliers, technology providers, product manufacturers and research organisations. Catalisti plays a valuable role in creating these connections and translating shared industry challenges into collaborative innovation projects. These collaborative projects are essential to further close the PVC loop and maximise the value of post-consumer window frames and other PVC waste streams in high-performance applications.

— **Wim Six**
R&D Project Manager,
Deceuninck



ACTIONS

Developing next-generation mechanical recycling by (i) shifting from downcycling to value retention, and (ii) preserving or enhancing polymer performance through, e.g. additives, chain extenders, and compatibilisers.

Developing/optimising physical/(thermo)chemical recycling options for waste fractions unsuitable for mechanical recycling (e.g. due to legacy additives, metals, and mixed polymers).

Improving downstream processing by selective and energy-efficient purification methods, improved separation strategies, and catalytic upgrading approaches.

Improving test infrastructure by building centralised pilot and testing facilities to validate technologies and accelerate scale-up.

AMBITION

Developing and deploying next-generation recycling technologies that move beyond downcycling towards value retention and performance preservation, aiming to maximally preserve the quantity and quality of polymers in our economy.

LEGEND

Indication of the timing
- Short term
- Mid term
- Long term

Impact of innovation and/or collaboration
- Minor
- Medium
- Major



6 Implementation of recycled content

INNOVATION NEEDS

Increasing the use of recycled plastics in new products is a crucial step towards achieving a circular plastics economy. However, the successful implementation of recycled content requires recycled materials to meet strict quality, performance, and functionality specifications for their intended applications. The presence of impurities, degradation during processing, and variability in feedstock composition can affect the mechanical, thermal, and aesthetic properties of products containing recycled polymers, thereby limiting the confidence of manufacturers and brand owners when using recycled materials, even when recycling technologies are available. Ensuring that recycled materials consistently meet the required specifications is thus essential for their broader adoption in industrial applications.

Therefore, within a 10-year horizon, Catalisti aims to support the wider implementation of recycled content by improving the quality, consistency, and functionality of recycled materials so that they can increasingly replace virgin polymers in a broad range of applications, in line with relevant legislative targets.

For instance, the EU Packaging and Packaging Waste Regulation (PPWR) introduces mandatory recycled-content requirements for plastic packaging, between 10% and 35% by 2030, increasing up to 65% by 2040, depending on the polymer and whether the application is contact-sensitive. In the automotive sector, the new End-of-Life Vehicle (ELV) Regulation, published in July 2026, requires 15% recycled plastic in new vehicles six years after entry into force and 25% after ten years, with 20% of it coming from ELV plastics.

> “Higher recycled content only creates impact when materials retain the quality, functionality and value required by customers”
>
> — Stefan Tielen, Head of Business Development, Exolon Group

A key focus area is the development of strategies to control and stabilise material properties. This includes the use of additives, compatibilisers, and formulation approaches that enable recycled polymers to meet application-specific requirements. Catalisti will stimulate research into how material properties evolve over multiple recycling cycles and how formulations can be optimised.

Ensuring compliance with regulatory and safety requirements is also essential. This requires improved analytical methods and monitoring tools to detect and control potentially harmful substances, such as legacy additives or non-intentionally added substances (NIAS). Catalisti will support collaborative research to improve characterisation, traceability, and safety assessment methods.

In addition, Catalisti will bring together actors across the value chain to identify application opportunities for recycled materials and to develop practical implementation strategies. By facilitating collaboration and knowledge exchange, Catalisti aims to accelerate the uptake of recycled plastics in high-value applications.



6 Implementation of recycled content

Increasing regulatory requirements in sectors such as construction and automotive are an important driver for the transition towards higher recycled content in plastics, and our company is anticipating these developments. However, incorporating more recycled content is only meaningful if materials continue to meet the quality, performance and specifications required by customers.

Our experience shows that closing the loop is not simply about increasing recycling volumes. It requires recovering and reusing valuable materials in ways that avoid unnecessary downcycling, preserve material value and functionality, and keep resources in the value chain for as long as possible. Achieving this at industrial scale requires continued innovation in materials, processing technologies and quality assurance.

Catalisti and its innovation projects can help bridge the remaining innovation gap by developing the technologies and knowledge needed to make higher recycled content both technically and economically feasible. Continued collaboration across the value chain will be essential to accelerate this transition.

— **Stefan Tielen**
Head of Business Development,
Exolon Group



ACTIONS

Maintaining material performance and quality by (i) ensuring recycled content meets required product specifications and (ii) preventing degradation and preserving functional properties with additives, compatibilisers and formulation approaches.

Ensuring compliance with regulatory and safety requirement by (i) improving analytical methods and (ii) developing monitoring tools to detect and control potentially harmful substances (legacy additives or non-intentionally added substances).

Identifying application opportunities for recycled materials and developing practical implementation by bringing actors together across the value chain.

AMBITION

Supporting the wider implementation of recycled content by improving quality, consistency, and functionality of recycled materials to increasingly substitute virgin polymers in a broad range of applications in line with legislative targets.

LEGEND

Indication of the timing
- Short term
- Mid term
- Long term

Impact of innovation and/or collaboration
- Minor
- Medium
- Major



7 Value chain approach and techno-economics

INNOVATION NEEDS

Achieving large-scale circularity for plastics requires not only technological innovation but also a coordinated approach across the entire value chain. Even when collection, sorting, pre-treatment, recycling, and DSP technologies are available and perform well from a technological perspective, circular solutions may fail to scale if economic incentives are not aligned or if supply and demand for recycled materials remain disconnected. Ensuring that value is generated and fairly distributed across the plastics value chain, from waste collection and sorting to recycling, material production, and end-use applications, is essential.

Against this background, within the next decade, Catalisti aims to support development of economically viable and well-coordinated circular value chains for plastics. This includes improving the alignment among plastic waste availability, recycling technologies, and end-use applications, while ensuring that recycled materials can compete with virgin alternatives in terms of cost, quality, and performance. In the longer term, the objective should be for mature recycling pathways to become economically competitive with virgin materials at scale and on their own commercial merits.

An important aspect is to improve the techno-economic understanding of recycling pathways. Catalisti will stimulate research that evaluates economic feasibility and identifies mechanisms for improving competitiveness, such as eco-modulation within EPR systems, logistics optimisation, and demand-side measures, including recycled-content targets and green public procurement. Studies on economies of scale and logistics will also be supported.

> “Industrial-scale deployment requires viable circular value chains, not just innovative recycling technologies”
>
> — Erik Moerman,
> Director Sales and Development,
> Indaver Plastics2Chemicals



Another key priority is to structure innovation efforts and support evidence-based decision-making. Catalisti will stimulate the development of decision-support frameworks that link waste streams, recycling technologies, and applications, while facilitating test panels in which companies can validate techno-economic feasibility under real-world conditions.

Finally, rethinking business models and value creation is essential. Catalisti will encourage the redesign of cost structures, revenue streams, and pricing mechanisms, as well as the implementation of risk-sharing approaches among stakeholders. New collaboration models among industry, research institutes, and end users will be fostered to accelerate the transition towards a competitive circular plastics economy.

7 Value chain approach and techno-economics

The transition towards a circular plastics economy is reaching a new phase, where technologies such as chemical recycling are moving beyond demonstration and into industrial deployment. Our experience, including a recent 105 million euro investment in a chemical recycling facility with the capacity to process 25000 tonnes of plastic waste annually, demonstrates that innovation can successfully progress from project-based development to industrial-scale implementation.

At the same time, technological feasibility alone is not sufficient to establish a viable circular value chain. The availability and quality of suitable feedstocks, collection and pre-treatment costs, process efficiency, scale and market demand for circular feedstocks all determine whether recycling solutions can become economically sustainable in practice.

Our work in Catalisti projects such as P2PC, WATCH, MATTER and PolyAl Circular has highlighted the importance of connecting technology development with the wider industrial ecosystem. These collaborations have helped build the knowledge, expertise and partnerships needed to address challenges across the entire value chain rather than focusing on individual technologies in isolation.

Innovation is therefore not only about developing more advanced recycling processes, but also about understanding the conditions required for successful deployment at scale. This requires evaluating the economics of complete value chains and identifying where collaboration between industry, research institutes, infrastructure providers and policymakers can accelerate market uptake. Only through such integrated approaches can circular technologies deliver both environmental and economic value at industrial scale.



— **Erik Moerman**
Director Sales and Development,
Indaver Plastics2Chemicals

ACTIONS

Improving the techno-economic understanding of recycling pathways by (i) evaluating economic feasibility and (ii) identifying mechanisms to improve competitiveness (eco-modulation within EPR, scale-logistics, and demand-side measures).

Structuring innovation and decision-making by (i) developing decision-support frameworks that link waste streams, recycling technologies and applications and (ii) establishing test panels where companies validate feasibility.

Rethinking business models and value creation by (i) redesigning cost structures, revenue stream, and pricing mechanisms, (ii) implementing risk-sharing approaches, and (iii) fostering new collaboration models.

AMBITION

Supporting the development of economically viable and well-coordinated circular value chains for plastics. This includes improving the alignment between plastic waste availability, recycling technologies, and end-use applications, while ensuring that recycled materials can compete with virgin alternatives in terms of cost, quality and performance.

LEGEND

Indication of the timing
- Short term
- Mid term
- Long term

Impact of innovation and collaboration
- Minor
- Medium
- Major

CO_2 Utilisation



8 **Carbon capture**

9 **Upgrading and utilisation of CO_2**

10 **Value chain approach and techno-economics**

CO_2 Utilisation

This programme focuses on the development of an integrated carbon value chain, seeking to transform industrial CO_2 streams into valuable carbon feedstocks for chemicals, materials and selected fuels. This requires moving efficiently from CO_2 capture and purification to transport, upgrading, utilisation and market deployment, while ensuring that each step is aligned with the requirements of the next. This innovation programme reimagines CO_2 not only as an emission to be reduced, but as a potential raw material for a more carbon-circular industry. New capture and conversion concepts can enable more efficient, selective and cost-effective use of industrial CO_2 streams under realistic operating conditions. At the same time, integration with energy and hydrogen supply, existing infrastructure, product specifications and end-market demand is essential to create technically feasible and economically viable CO_2 value chains.

CATALISTI CONTACTS



— **Mathias Jacobs**
Innovation Broker



— **Bert Boekaerts**
Innovation Broker



© BASF

Project portfolio

8 Carbon capture

- **ACCTS** – Carbon capture, transport and storage in the chemical cluster of the port of Antwerp
- **CARBOOST** – Advanced mineral carbonation techniques in steel slag for durable and thermal-efficient products

9 Upgrading and utilisation of CO_2

- **BluePlasma** – Circular CO2 conversion by means of atmospheric plasma
- **CAPRA** – Upgrading steel mill off gas to caproic acid and derivatives using anaerobic technology
- **CO2PERATE** – All renewable CCU based on Formic Acid integrated in an industrial Microgrid
- **GASTLY** – Green anaerobic syngas transformation for low-carbon yield

10 Value chain approach and techno-economics

- **MAP-IT CCU** – Mapping and evaluation of CCU technologies

BluePlasma and GASTLY

Reducing industrial CO_2 emissions requires not only breakthrough technologies but also the ability to scale them towards industrial implementation. BluePlasma illustrates how collaborative innovation can accelerate this journey. The project brought together D-CRBN's plasma-based CO_2 conversion technology with the expertise and industrial perspective of partners including ArcelorMittal, ENGIE, BASF, the University of Antwerp and VITO. Through this collaboration, a pilot-scale installation was successfully developed and deployed, demonstrating the potential to convert CO_2 into valuable products while reducing emissions by up to 1000 tonnes annually.

Beyond validating the technology at pilot scale, BluePlasma helped de-risk further development through complementary research activities and strengthened the connections between technology developers, industrial end users and research institutes. The project demonstrated both the technical feasibility and the industrial relevance of plasma-based CO_2 conversion, creating a strong foundation for further scale-up.



D-CRBN's pilot plant for plasma-based CO_2 conversion at ArcelorMittal in Ghent. © ArcelorMittal Blegium

The impact of BluePlasma extended well beyond the project itself. Building on the knowledge, partnerships and results generated, the follow-up project GASTLY was launched to develop new CO_2-based value chains and explore additional industrial applications. At the same time, the project created substantial leverage for further investment. D-CRBN secured a 2.5 million EUR grant from the European Innovation Council to continue scaling the technology towards demonstration level, followed by 17.5 million EUR in Series A funding in 2026. This progression from collaborative research and pilot validation to European support, private investment and industrial deployment demonstrates how innovations can evolve from promising concepts into technologies with significant environmental and economic impact.

Did you know?

Map-it CCU

The intercluster project Map-it CCU delivered an online decision support tool that helps companies identify and compare suitable carbon capture technologies based on their specific process conditions. Combined with technology information sheets, environmental assessments and a cost calculator, the platform enables companies to evaluate CCUS options and build informed decarbonisation strategies.

emis.vito.be/nl/tools/mapitccu/map-it-ccu-tool



8 Carbon capture

INNOVATION NEEDS

The development of a CO_2 value chain starts with effective capture. Capture determines the volume, purity, pressure, and impurity profile of available CO_2 streams, and these parameters strongly affect transport, purification, and downstream conversion.

Within a 10-year horizon, Catalisti aims to support economically viable CO_2 capture solutions in Flanders, mainly for industrial point sources. Large emitters can provide concentrated streams and economies of scale, while smaller emitters need modular, compact, and cost-effective capture units. Direct air capture remains a complementary longer-term option, as energy demand and cost limit short-term deployment.

Innovation should focus on reducing the energy penalty, cost, and footprint of capture. Promising routes include advanced solvent systems with lower regeneration energy, solid sorbents with high cyclic stability, membrane-based separations, calcium looping, cryogenic separation for specific streams, and hybrid capture systems combining multiple separation principles. For industrial implementation, these technologies must tolerate real flue gas conditions, including O_2, water, SO_x, NO_x, particulates, and trace contaminants that can degrade solvents, poison sorbents, or reduce membrane lifetime.



Construction of the first CO_2 pipeline in the Port of Antwerp, as part of Antwerp@C. © Fluxys

> “Carbon neutrality requires integrated carbon ecosystems”
>
> — Sandra Wauters, Manager Net Zero Transition, Policy, Advocacy & Compliance Reporting, BASF Antwerpen

Process integration is equally important. Capture units should be integrated with available waste heat, steam networks, electrified utilities, or flexible renewable electricity supply. Modular and intensified designs can enable deployment across a wider range of industrial sites, while digital monitoring and predictive maintenance can improve uptime and solvent and sorbent management. Flexible operation will become increasingly relevant as capture units interact with variable energy prices, intermittent renewable electricity, and dynamic CO_2 demand from utilisation plants.

Consistent CO_2 quality is a key prerequisite for downstream use. Different conversion routes require different specifications: catalytic hydrogenation requires tight control of catalyst poisons, electrochemical conversion is sensitive to electrolyte and membrane degradation, and transport networks require limits on water, O_2, and corrosive impurities. Therefore, innovation should address purification, compression, liquefaction, quality monitoring, and standardisation of CO_2 specifications across the value chain.

Infrastructure remains a critical enabler. Decisions are needed on when CO_2 should be purified and converted on-site, when it should be transported to shared hubs, and when storage should be used as a balancing option. Flemish initiatives, such as Antwerp@C, illustrate the strategic importance of shared CO_2 infrastructure, including export routes for offshore storage and possible reuse. Such infrastructure can reduce individual investment risks and create the backbone for a future CO_2 economy.

8 Carbon capture

Achieving net zero in the chemical industry will require a broad portfolio of technologies, each contributing to the decarbonisation of products and processes. Carbon Capture, Utilisation and Storage (CCUS) is an essential complement to energy efficiency, renewable energy and electrification, enabling the capture of emissions while supporting circularity and the continued production of low-carbon materials.

Our work on CO_2 capture, purification and catalyst technologies, combined with our involvement in initiatives advancing both CO_2 capture and permanent storage, illustrates the important role CCUS can play in reducing emissions while creating value from carbon streams. The key challenge is to move beyond individual technologies and establish integrated carbon value chains, recognising that successful CO_2 conversion depends as much on the availability of renewable energy, hydrogen and supporting infrastructure as on technological innovation.

To unlock the full potential of CCUS, feedstock and energy supply, transport infrastructure, conversion technologies and storage solutions must be connected into a coherent ecosystem. Only through such holistic approaches can the transition towards a competitive net zero chemical industry be accelerated.

— **Sandra Wauters**
Manager Net Zero Transition, Policy, Advocacy & Compliance Reporting, BASF Antwerpen



ACTIONS

Supporting advanced CO_2 capture technologies that are improving solvents, sorbents, membranes, cryogenic and hybrid systems to reduce energy demand, cost and footprint.

Developing modular, cost-effective CO_2 capture solutions for smaller emitters and integrating them with industrial energy systems (e.g. waste heat) to reduce operational costs and energy penalties.

Exploring direct air capture as a complementary option by monitoring technology progress and identifying use cases where high energy demand and cost can be justified.

Facilitating shared CO_2 infrastructure by connecting relevant stakeholders, supporting matchmaking, and helping advance pipelines, terminals, hubs, liquefaction, compression, export routes, and testing fields that reduce individual investment risk and enable large-scale deployment.

AMBITION

Developing economically viable CO_2 capture solutions, primarily for industrial point sources, with scalable approaches for large emitters and modular, compact and cost-effective capture units for smaller emitters, while considering direct air capture as a complementary longer-term option.

LEGEND

Indication of the timing
- Short term
- Mid term
- Long term

Impact of innovation and/or collaboration
- Minor
- Medium
- Major



9 Upgrading and utilisation of CO_2

INNOVATION NEEDS

Captured CO_2 can be transformed into chemicals, materials, and fuels, positioning Flanders as a frontrunner in carbon circularity. Given the local industrial context, the greatest opportunities are expected for chemicals and materials, where CO_2 can replace fossil-based carbon in existing value chains or enable new products with improved sustainability profiles. E-fuels can play a role in selected hard-to-electrify applications, but their high demand for renewable electricity and green H_2 means that prioritisation is essential.

Several conversion pathways should be developed in parallel. Thermocatalytic routes such as reverse water-gas shift, methanol synthesis, methane synthesis, and CO_2 hydrogenation towards intermediates can provide links to existing chemical platforms. Electrochemical CO_2 reduction can enable the direct production of molecules such as carbon monoxide, formate, ethylene, or alcohols, provided that selectivity, current density, membrane stability, and energy efficiency are improved. Mineralisation and carbonation routes can bind CO_2 into inorganic materials or construction products. CO_2 can also be used in polymers and organic carbonates, for example through incorporation into polycarbonates, polyurethanes, or cyclic carbonates. Biocatalytic and microbial routes may offer selective pathways under mild conditions, but require further development to improve productivity, robustness, and downstream processing (DSP).

The key technical bottleneck is the thermodynamic stability of CO_2. Conversion usually requires substantial energy input, often in the form of green H_2, renewable electricity, or highly active catalysts. Therefore, innovation must focus on improving overall carbon and energy efficiency rather than merely achieving conversion. Important research priorities include stable and selective catalysts, non-critical catalyst materials, robust electrodes and membranes, improved reactor design, intensified heat and mass transfer, and integrated separation of products from unreacted CO_2, H_2, water, and electrolyte streams.

> “A successful CO_2 technology must deliver a product that industry can use, afford and rely on”
>
> — Gill Scheltjens, CEO & Co-Founder, D-CRBN

The ability to process impure CO_2 streams could become a competitive advantage. Real industrial CO_2 streams may contain impurities that affect catalyst lifetime, membrane performance, or product quality. Developing catalysts, sorbents, membranes, and electrochemical systems that tolerate realistic impurity levels would reduce purification costs and improve the business case. This should be combined with operando analysis under realistic conditions, accelerated catalyst testing, and digital modelling to better understand degradation mechanisms in industrial settings.

Plant-level integration is essential. CO_2 utilisation should not be developed as an isolated conversion step but as part of an integrated process involving capture, purification, compression, H_2 or electricity supply, product separation, recycling of unconverted gases, and heat integration. Synergies with existing chemical assets in Flanders can reduce scale-up risk, especially where CO_2-derived syngas, methanol, or other intermediates can enter existing production chains.

Within the next decade, Catalisti aims to support development and demonstration of CO_2 conversion technologies that move beyond proof of concept towards industrially relevant operation. Priority should be given to technologies that combine high carbon efficiency, high selectivity, long catalyst or membrane lifetime, tolerance to realistic feed compositions, and credible integration with Flemish industrial infrastructure. Support for technologies above TRL 6, including access to pilot and demonstration facilities, will be crucial to bridge the gap between innovation and commercial deployment.

9 Upgrading and utilisation of CO_2

Developing plasma technology to convert CO_2 into CO has shown us that scale-up is as much about reliable operation and industrial integration as it is about conversion performance. Commercial deployment requires a complete process that delivers the product quality and availability customers need.

Our experience is that the cost and carbon footprint of the usable product delivered to the customer are ultimately the decisive measures of success. These depend not only on conversion performance, but also on electricity consumption, feedstock preparation and separation. These requirements must therefore be assessed together under realistic operating conditions.

Flanders has the chemical industry and research expertise to turn CO_2 into a valuable industrial feedstock. To realise this potential, technology developers, engineering partners and customers need to work together as early as possible, defining product specifications, integration requirements and a credible route to commercial uptake. Shared demonstration facilities, committed industrial partners and access to competitive low-carbon electricity can help bridge the gap between promising technology and an investable industrial project.

— **Gill Scheltjens**
CEO & Co-Founder, D-CRBN



ACTIONS

Developing next-generation catalysts, membranes, electrodes and integrated reactor systems that improve stability, selectivity, conversion efficiency and tolerance to realistic industrial CO_2 streams, while reducing purification costs, energy use and reliance on critical raw materials.

Prioritising strategic CO_2-derived products and selecting high-potential conversion pathways by evaluating industrial relevance, product value, carbon efficiency, scalability, and electricity-usage demand across a range of technological routes.

Scaling mature CCU technologies beyond lab proof-of-concept by supporting pilot and demonstration projects above TRL 6 that prove long-term operation, realistic feed tolerance and industrial integration.

Advancing plant-level integration of CCU systems by linking capture, purification, compression, hydrogen or electricity supply, product separation, recycling and heat integration with existing Flemish chemical assets.

AMBITION

Demonstrating CO_2 conversion technologies beyond proof-of-concept towards industrially relevant operation, focusing on high carbon efficiency, high selectivity, long catalyst or membrane lifetime, realistic feed tolerance and credible integration with industrial infrastructure.

LEGEND

Indication of the timing
- Short term
- Mid term
- Long term

Impact of innovation and/or collaboration
- Minor
- Medium
- Major



10 Value chain approach and techno-economics

INNOVATION NEEDS

A successful CO_2 economy depends on value creation across the entire chain, from capture to end markets. The optimal route depends on CO_2 source quality, transport options, energy availability, H_2 cost, product value, regulatory recognition, and market demand. CO_2 should therefore be assessed not only as an emission to be avoided, but also as a potential carbon feedstock for chemicals, materials, and selected fuels.

Techno-economic and life-cycle assessments (TEA; LCA) should be embedded early in project development to compare value-chain options and avoid shifting emissions or costs elsewhere. Key factors include capture and purification costs, compression and transport requirements, electricity and H_2 availability, conversion efficiency, downstream processing (DSP), product specifications, and certification needs. TEAs and LCAs should help identify which CO_2 sources, conversion technologies, and end-use markets offer the strongest industrial business case.

Market formation remains a key challenge, as CO_2-derived products often face higher costs than fossil-based alternatives, especially when renewable electricity or green H_2 is required. Demand-side measures such as green procurement, carbon-footprint labelling, product standards, contracts for difference, renewable-carbon targets, and certification schemes can help create lead markets and improve investor confidence.

> “There is no single best destination for captured CO_2. The most viable pathway will depend on technology, infrastructure, economics and market demand”
>
> — Kristof Verbeeck, Business Developer, ArcelorMittal

Within a 10-year horizon, Catalisti aims to support competitive CO_2 value chains in Flanders through access to demonstration facilities and value-chain collaboration. This should help align CO_2 emitters, technology providers, infrastructure operators, and end users around technically feasible and economically viable carbon-utilisation pathways.



10 Value chain approach and techno-economics

A viable CO_2 economy depends on creating value across the entire chain, from the source of CO_2 to the market for the final product. Our experience has taught us that a technically promising conversion route is only meaningful if the full chain can work at industrial scale. The most promising route will depend on the quality of the CO_2 stream, available infrastructure, energy and hydrogen costs, and demand for lower-carbon products.

Carbon storage can provide an important option in the shorter term, particularly where utilisation pathways are not yet technically or economically viable. From our perspective, storage and utilisation should not be treated as competing answers: they address different needs and may become viable on different timelines. At the same time, we need to develop routes that use captured CO_2 as a carbon feedstock for chemicals, materials and selected fuels. Techno-economic and life-cycle assessments should guide these choices from the outset, helping to identify solutions that deliver genuine emissions reductions without shifting costs or impacts elsewhere.

Bringing emitters, technology developers, infrastructure providers and end users together will be essential to turn promising pathways into viable industrial value chains. We have learned that no single company can make this transition work alone: infrastructure, technology and demand need to develop together.

— **Kristof Verbeeck**
Business Developer, ArcelorMittal



ACTIONS

Creating a central CCU knowledge base by supporting companies with shared techno-economic insights, CO_2 source mapping, technology benchmarking and investment decision support.

Aligning value chain actors by connecting emitters, technology providers, infrastructure operators, hydrogen or electricity suppliers, converters and end users around feasible business cases.

Providing science-based policy input by ensuring policymakers receive accurate industry-backed information on CCU potential, CO_2 specifications, certification and regulatory bottlenecks.

Establishing competitive integrated CO_2 value chains in Flanders by combining capture, infrastructure, conversion, market deployment and supportive regulation into scalable industrial carbon-circular systems.

AMBITION

Enabling competitive CO_2 value chains through access to demonstration facilities and value-chain collaboration, aligning CO_2 emitters, technology providers, infrastructure operators and end users around technically feasible and economically viable carbon-utilisation pathways.

LEGEND

Indication of the timing
- Short term
- Mid term
- Long term

Impact of innovation and/or collaboration
- Minor
- Medium
- Major

Energy Solutions



11 **Electrification**

12 **Alternative energy sources and carriers**

13 **Matching supply with demand**

Energy Solutions

This programme focuses on transforming the fossil-fuelled chemicals and plastics industry into an electrified, renewable-energy powered sector. Chemical processes can be electrified through e-boilers, heat pumps, and novel heating technologies, requiring both retrofitting existing plants and developing new reactor concepts. In parallel, electro-, plasma-, and photo(electro) chemistry and other non-conventional and hybrid technologies offer novel ways to efficiently supply reaction energy and enable unique product selectivities. To match intermittent renewable energy supply with continuous chemical processes, dynamic operation becomes essential. Energy carriers such as hydrogen, ammonia, and methanol can serve both as chemical feedstocks and as renewable energy vectors. Together, these technologies can reduce fossil dependence and improve process efficiency when carefully integrated.

CATALISTI CONTACTS



— **Dieter Ruijten**
Innovation Broker



— **Mathias Jacobs**
Innovation Broker



© ArcelorMittal Belgium

Project portfolio

11 Electrification

- **SHERPA** – Sorption enhanced hydrogen production via ammonia decomposition

12 Alternative energy sources and carriers

- **BluePlasma** – Circular CO_2 conversion by means of atmospheric plasma
- **FUNY** – Enabling advanced functionalisation of powder particles
- **GASTLY** – Green anaerobic syngas transformation for low-carbon yield
- **MMICAS** – Multiphase processing with microfluidics, cavitation and acoustic streaming
- **PLASMASOL** – Atmospheric plasma as green solution for enhanced adhesion and functionalisation

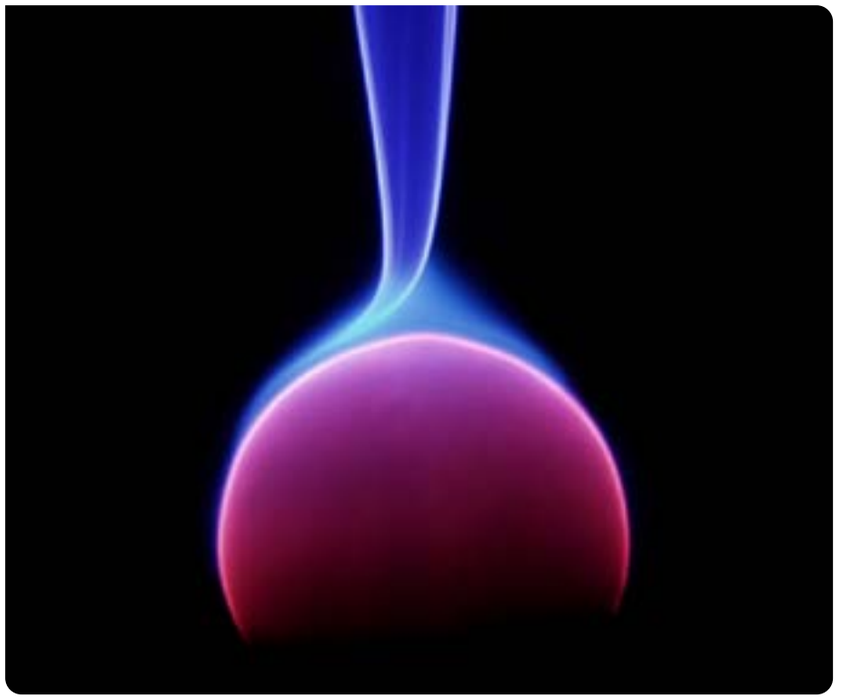
13 Matching demand with supply

- **CO2PERATE** – All renewable CCU based on formic acid integrated in an industrial microgrid
- **CSP+** - Enhanced PV integrated concentrator solar power system

FUNY

The FUNY project demonstrates how innovative process technologies can contribute to more energy-efficient and sustainable industrial production. The project brought together MPG, PROCEPT, industrial end users - Eastman, Johnson & Johnson and Soudal -, and research institutes - Ghent University, University of Antwerp, KU Leuven and VITO - to develop a novel plasma-fluid bed reactor technology for the functionalisation of powder particles. By combining atmospheric plasma technology with advanced coating reactor technology in a single integrated process, the consortium explored an alternative to conventional wet coating methods that rely on solvents, energy-intensive drying steps and chemical additives.

The integrated technology offers several advantages. The process operates without solvents, generates less waste and reduces the energy requirements associated with solvent evaporation and downstream processing. In addition, it functions at ambient temperature, making it suitable for heat-sensitive materials while further lowering energy consumption. Beyond these sustainability benefits, the approach also improves coating homogeneity and creates opportunities to introduce entirely new functionalities to powder particles. The project illustrates how process innovation can simultaneously improve product performance, reduce environmental impact and contribute to the transition towards more energy-efficient industrial production.



Did you know?

Moonshot Flanders

Moonshot Flanders addresses the energy challenge of Flemish industry from two complementary angles. The Energy Innovation research path focuses directly on energy technologies and systems, while Electrification & Radical Process Transformation targets CO_2 reduction through fundamentally new and electrified production processes. Although energy is not the primary focus of this second path, many of its solutions can significantly change how, when and in what form energy is used in industry. Together, the two research paths account for 43 of the programme's 69 projects.

Through strategic basic research at Flemish universities and research institutes, these projects prepare tomorrow's breakthroughs: high-temperature heat pumps, electrified steam cracking, green hydrogen and algorithms that match flexible processes with renewable energy supply. Companies follow the research from the front row in Industrial Advisory Boards and help steer it towards industrial relevance.

moonshotflanders.be



11 Electrification

INNOVATION NEEDS

The electrification of the chemical industry is a cornerstone of the transition towards a competitive, low-carbon, and future-proof industrial cluster. Given the sector's high energy intensity and reliance on fossil-based heat, electrification must go beyond simple substitution and instead enable flexible, process-integrated solutions that align with variable renewable energy supply. Therefore, developing a flexible and hybrid production environment is a priority, enabling chemical plants to dynamically respond to changes in electricity availability, pricing, and grid conditions without compromising productivity or product quality.

A key innovation pathway lies in the deployment of flexible and hybrid systems. This includes dual configurations combining electric and gas-fired boilers or hybrid reactor systems, allowing operators to switch between energy sources in real time. Such flexibility is essential for managing intermittency while maintaining continuous industrial operations. Retrofitting existing chemical plants with electrified components will be necessary in the short to medium term, requiring modular and scalable solutions that can be integrated without major disruptions. At the same time, it is important to design new plants that are fully optimised for electrification, avoiding the constraints of existing infrastructure. Demand-side flexibility will also play a critical role, with innovations enabling load shifting, temporary shutdowns, or adaptive production scheduling in response to energy system conditions.

In parallel, the electrification of high-temperature processes represents one of the most significant technical challenges and opportunities. There is a need for advanced electric boilers and industrial heat pumps capable of delivering reliable and efficient heat at scale. To address the intermittency of renewable electricity, high-temperature heat storage solutions must be developed and integrated, allowing energy to be stored and used when needed. Alternative heat vectors, beyond traditional steam, can further enhance system efficiency and flexibility.

Breakthrough innovations are required for processes operating above 500 °C, where conventional electrification technologies are not yet fully viable. These include the development of non-conventional heating methods, such as ohmic (Joule) heating, induction, and shockwave technologies, which enable rapid, uniform, and volumetric heating with improved energy efficiency. The electrification of core chemical processes, such as steam cracking, will be critical. Advancing electrified cracking technologies and alternative reactor designs will enable the production of key chemical building blocks with significantly reduced emissions.

> "Competitive electrification depends on intelligent control and system-wide integration"
>
> — Twan Bearda, Senior Advisor, Entras

Against this background, within the next decade, Catalisti aims to support the development of flexible and hybrid electrification technologies that enable low-carbon and energy-efficient chemical production. These technologies should allow chemical plants to respond dynamically to the availability of renewable electricity while maintaining productivity and competitiveness. This includes electrified high-temperature processes, alternative heating technologies, thermal energy storage, and electrified reactor concepts with lower emissions and improved process efficiency.

11 Electrification

Electrification of chemical processes is essential for industrial decarbonisation, but hardware alone is not enough. As energy-intensive assets switch to electricity, they face volatile power markets and grid constraints that have a direct impact on competitiveness.

Our experience shows that cost-efficient electrification requires the optimum use of flexibility opportunities while taking into account the process requirements. Before over-investing in additional storage or infrastructure, chemical sites can leverage their inherent thermal buffers and process dynamics as smart flexibility options. By modelling across multiple energy vectors and assets, low electricity prices can be captured while ensuring that electrified processes maintain operational stability. To scale electrification successfully across Flanders, the focus must shift towards intelligent control, system-wide integration, and sound business cases in order to keep the chemicals sector competitive and resilient.

— **Twan Bearda**
Senior Advisor, Entras



ACTIONS

Demonstrating electrified chemical production by (i) deploying dual electric and fossil-fuelled boilers or reactors, (ii) retrofitting of existing plants for electrification to reduce CAPEX costs, and (iii) designing new plants and reactor types fully optimised for electrified production.

Increasing flexible production by (i) enabling load shifting and adaptive scheduling, (ii) integrating systems that can respond dynamically to electricity prices, and (iii) ensuring productivity and product quality under flexible operations.

Electrifying high-temperature (> 500 °C) heat processes by (i) developing advanced electric boilers, industrial heat pumps, and non-conventional heating technologies (ii) integrating heat and cooling storage solutions to manage renewable intermittency, and (iii) exploring alternative heat vectors beyond traditional steam.

AMBITION

Developing low-carbon, energy-efficient and cost-competitive electrified processes for chemical production that can operate dynamically while ensuring productivity and product quality.

LEGEND

Indication of the timing

- Short term
- Mid term
- Long term

Impact of innovation and/or collaboration

- Minor
- Medium
- Major



12 Alternative energy sources and carriers

INNOVATION NEEDS

The use of alternative energy inputs to drive chemical reactions offers novel, energy-efficient synthesis routes beyond conventional heat-driven reactions, such as thermocatalysis.

Pathways based on electrochemistry, plasma processes, photocatalysis, photo-electrochemistry (i.e. direct coupling of light and electricity) and other non-conventional technologies can provide energy- and atom-efficient routes for producing bulk and fine chemicals. Further advances are needed to develop stable, high-performance catalysts that can operate efficiently under industrial conditions. In electrochemistry in particular, stable and cost-competitive membranes are highly sought after. In addition, process intensification is needed across these technologies, with a focus on achieving higher yields (including conversion and selectivity) and lower energy consumption. Moreover, electrochemical and photochemical processes are often limited by low product concentrations and challenging separations. Therefore, integrated downstream and separation concepts are needed, including membrane reactors, reactive separations, and electro-driven separation technologies.

For electrochemistry, this includes the design of smart electrochemical cells that minimise heat losses. Whereas current efforts are mainly focused on the reduction reaction at the cathode, new concepts should make optimal use of both cathodic and anodic reactions, which are currently often limited to O_2 evolution, thereby improving overall system efficiency. Plasma technologies, in particular, offer opportunities to activate molecules under milder conditions and enable novel reaction pathways. To accelerate deployment, it is essential to establish pilot-scale facilities in which these technologies can be tested and validated under realistic industrial conditions. Further reducing the energy demand of plasma technologies will remain an important attention point.

> “Yesterday’s know-how enables tomorrow’s technologies”
>
> — Daan Van Havere, Senior Scientist, Agfa

Photocatalysis currently shows strongest potential in niche applications, but emerging reactor and catalyst innovations may expand its industrial relevance in the medium to long term. This requires the identification of suitable use cases in which light-driven processes can be competitive. In addition, efficient photocatalysts, scalable reactor concepts, and effective product separation techniques need to be developed particularly for O_2 management. Overall, the key challenge for these alternative processes lies in maximising energy efficiency while ensuring industrial scalability and integration into existing value chains.

In addition to their role as important chemical feedstocks, energy-rich molecules such as H_2 and its carriers, e.g. NH_3, methanol, and liquid organic hydrogen carriers (LOHC), have gained attention as media for the storage and transport of energy from renewable-rich regions. Although initial hype around these molecules has somewhat subsided, they can still play a complementary role as energy carriers. Focus should be on their strategic use for specific applications. Where possible, electrification has an efficiency advantage over energy carriers such as H_2. However, molecules such as H_2, NH_3, methanol, and related derivatives can play multiple roles as energy storage media, transport vectors, fuels, and key feedstocks for the chemical industry. For energy applications, a clear strategy is needed for the import and integration of “green electrons”, either in the form of renewable electricity or embedded within these carriers. Innovation is needed to improve the round-trip efficiency from electricity to carrier and back, ensuring that energy losses during conversion, storage, and reuse are minimised. Alternative pathways that explore the direct use of NH_3 as a fuel hold potential, but they face the challenge of NO_x formation, which tends to occur when nitrogen-containing molecules are combusted or converted at elevated temperatures in the presence of O_2. In parallel, significant investments are required in infrastructure, safety frameworks, and value chain development to support the large-scale logistics of these carriers, from production and transport to storage and industrial use.

Hence, over the coming decade, Catalisti aims to support development and scale-up of energy-efficient alternative conversion technologies and sustainable energy carriers for chemical production and energy storage. This includes electrochemical, plasma, photocatalytic, and other non-conventional technologies with improved efficiency, selectivity, and industrial robustness, as well as efficient value chains for H_2, NH_3, methanol, and related carriers with minimised energy losses and strong industrial integration.

12 Alternative energy sources and carriers

Products and markets may evolve over time, but the deep scientific and industrial expertise required to develop high-tech materials remains a lasting asset. Knowledge built over decades in areas such as advanced materials, polymers, dispersions, coating technologies and manufacturing can be applied to entirely new challenges.

Our experience shows that capabilities developed for complex products such as photographic and medical films can provide the foundation for emerging applications, including advanced materials and components that enable green hydrogen production and other next-generation technologies.

A distinctive strength of the technology landscape across Flanders and Europe lies in its concentration of companies and research institutes with deep technical roots and specialist know-how. As challenges in energy, sustainability and raw-material use grow more complex, bringing these capabilities together becomes increasingly important. Only by connecting established strengths and complementary expertise can we unlock their full potential and accelerate the development of tomorrow's technologies.

— **Daan Van Havere**
Senior scientist, Agfa



ACTIONS

Advancing of electro, plasma- and photo(electro)chemistry processes by (i) developing stable high-performance catalysts and cost-competitive membranes, and (ii) improving process intensification, integrated separation approaches, yields and energy efficiency through smart reactor and cell design.

Scaling of alternative conversion technologies by (i) establishing pilot-scale testing facilities, (ii) developing scalable reactor concepts and integrated product separation technologies, and (iii) identifying competitive industrial use cases.

Enabling hydrogen and its carriers (ammonia and methanol) as a renewable energy carrier and chemical feedstock by improving round-trip energy and cost efficiency.

Supporting large-scale integration of hydrogen carriers by (i) developing infrastructure for production, transport, and storage, and (ii) developing a long-term strategy for the import and integration of renewable energy through green electrons and/or energy-rich molecules.

AMBITION

Scaling of energy-efficient alternative conversion technologies, such as, electro-, plasma-, and photo(electro)chemical processes with improved efficiency, selectivity, and industrial robustness and deploying low-carbon hydrogen and its carriers as a cost-competitive energy carrier and chemical feedstock.

LEGEND

Indication of the timing
- Short term
- Mid term
- Long term

Impact of innovation and/or collaboration
- Minor
- Medium
- Major



13 Matching supply with demand

INNOVATION NEEDS

Although this track is important for the chemical industry, it primarily concerns activities outside Catalisti's domain. Therefore, innovation and change will mainly be driven by the energy sector, with Flux50 as its spearhead cluster in Flanders. For this track, collaboration across cluster and sector boundaries, e.g. intercluster collaboration with Flux50, is necessary.

A pressing challenge is aligning variable energy demand with often intermittent and geographically dispersed renewable energy supply. This requires a systemic approach that integrates energy generation, storage, grids, and industrial processes into a coherent system. Sufficient and reliable access to renewable energy is a key prerequisite, supported by accelerated deployment of solar, wind, and other renewable sources. The strategic deployment of nuclear energy may contribute by providing baseload stability and supporting grid-scale decarbonisation.

Energy storage plays a central role in aligning supply and demand profiles. At the process level, thermal storage, both short- and long-term, including high-temperature heat storage, can buffer fluctuations in heat demand and allow plants to operate more flexibly with intermittent power sources. Cooling storage should also be investigated. Innovation in the advanced control systems for heat and cold storage should help optimise overall energy use and reduce peak loads. At the grid and plant scale, electricity storage, e.g. via batteries or supercapacitors, should enable better matching of energy demand and supply.

Furthermore, grids and infrastructure are critical enablers of the required flexibility. Grid expansion and congestion management, together with load balancing and smart energy systems, are needed to integrate large shares of variable renewables and meet the sector's high power demand. The development of DC grids should improve transmission efficiency, while cross-border electricity interconnections allow regions with a surplus of renewable generation to supply energy-intensive industries elsewhere. Strategically, targeted deployment of nuclear technology can strengthen baseload reliability and reduce the need for fossil-based backup, thereby supporting the transition of energy-intensive chemicals and plastics production to low-carbon electricity.

> "Matching industrial energy demand with renewable supply requires an integrated energy system, not industrial flexibility alone"
>
> — Bart Adams, Energy & GHG Management EMEA, INEOS Styrolution

Enabling conditions will be essential to support the transition to a flexible and low-carbon energy system. Long-term strategic alignment, efficient infrastructure development, and supportive innovation frameworks can help accelerate the deployment of renewable energy, storage technologies, smart grids, and integrated industrial energy systems. Together, these elements can strengthen the ability of the chemicals and plastics industry to match energy demand and supply effectively in a decarbonised future.

Within the next decade, Catalisti, together with Flux50, aims to support the development of flexible and integrated energy systems that enable the chemicals and plastics industry to efficiently match variable renewable energy supply with industrial energy demand. This includes innovations in thermal and electrical energy storage, smart energy management systems, grid integration, and flexible industrial processes that improve energy efficiency, reduce peak loads, and strengthen reliable integration of low-carbon energy sources into industrial operations.

13 Matching supply with demand

Chemical production has historically been designed around stable, continuous operation, and most high capex-processes are only truly economically viable when operated at high load. While specific processes can provide flexibility, e.g. electro-intensive processes such as electrolysis, this is not a core activity across the industry, nor should flexibility alone be expected to resolve the mismatch between intermittent supply and industrial demand.

Our experience is that matching variable renewable energy supply with the continuous demand of energy-intensive chemical processes requires a system-level approach in which mainly the supply-side takes responsibility to resolve variability-related challenges. Electrification of heat production by means of hybrid systems (combined fossil/electricity) at chemical cluster level constitutes an interesting opportunity for strongly industrialised regions.

Therefore, a more integrated approach is needed, connecting renewable generation, grids, storage and industrial demand to provide reliable and competitive low-carbon energy. Flexibility and storage should be developed where they create value for the overall energy system, while stable low-carbon generation, including SMRs, can provide an important complementary source of supply of heat and power. Our experience shows that this transition requires coordinated action and appropriate investment models involving the energy sector, industry and policymakers.

— **Bart Adams**
Energy & GHG Management EMEA,
INEOS Styrolution



ACTIONS

Increasing energy flexibility by (i) developing dynamic chemical production processes, (ii) cooling and heat storage, and (iii) advancing electricity storage and smart control systems.

Strengthening energy infrastructure and grid flexibility by (i) expanding grids and congestion management, (ii) developing DC grids and cross-border interconnections, and (iii) improving load balancing.

Matching energy demand with low-carbon energy supply by (i) accelerating deployment of renewables, (ii) integrating energy generation, storage, grids and industrial processes, and (iii) strategically deploying nuclear energy.

AMBITION

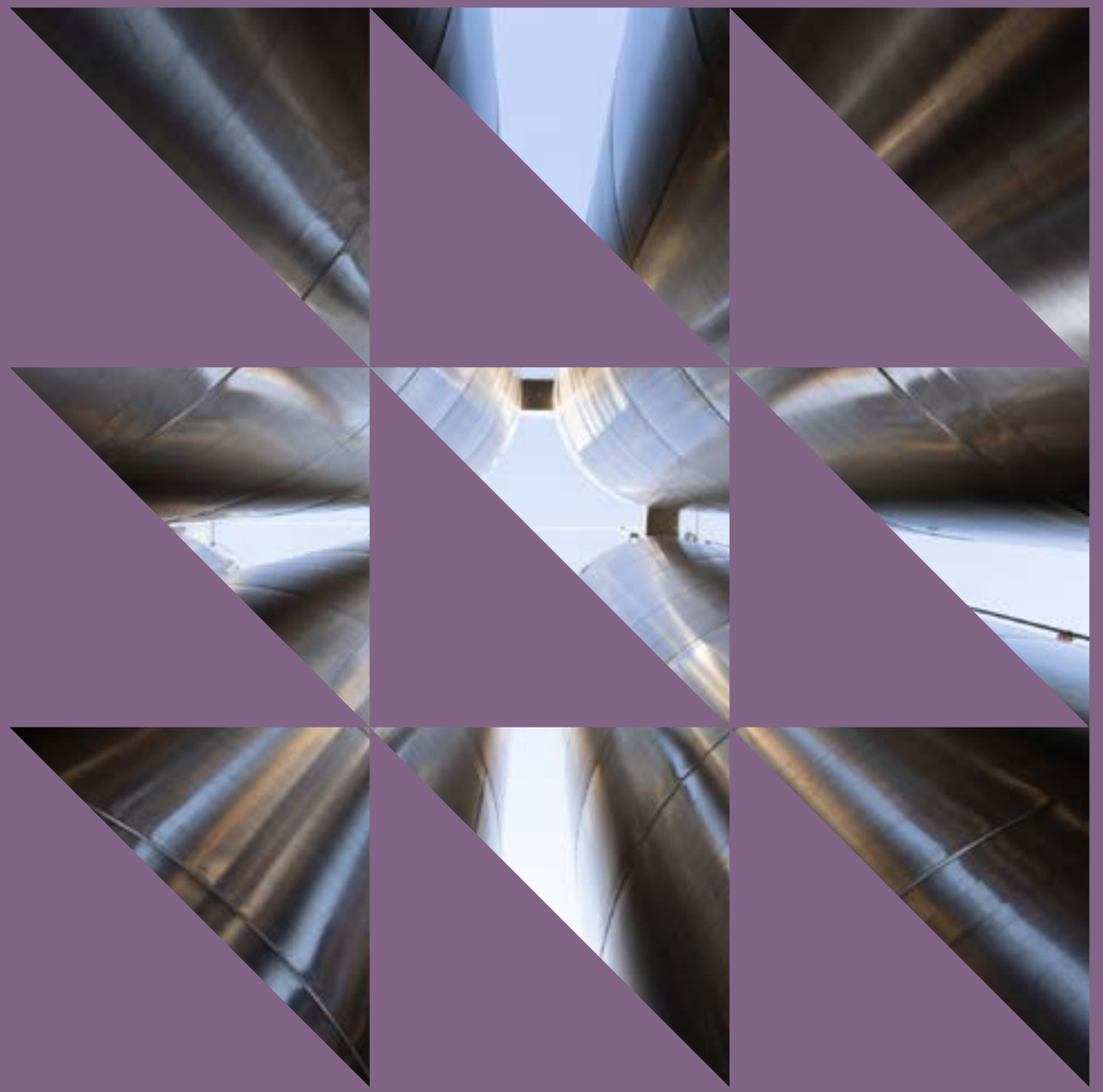
Supporting flexible and integrated energy systems that enable the chemicals and plastics industry to efficiently match variable renewable energy supply with industrial energy demand.

LEGEND

Indication of the timing
- Short term
- Mid term
- Long term

Impact of innovation and/or collaboration
- Minor
- Medium
- Major

Effective Unit Operations



14 **Reactor concepts**

15 **Separation and remediation**

16 **Catalysts**

Effective Unit Operations

This programme focuses on the core of the chemicals and plastics industry, seeking step-change gains in conversion, separation and purification, which often unlock both economic and environmental benefits. Our industry wants to move efficiently from molecule A to B or C, which often requires a train of unit operations. This innovation programme reimagines traditional process steps by introducing novel reactor and separation concepts and by using more sustainable inputs. New concepts can enable more efficient, better controlled, and often less energy-intensive reactions compared to conventional processes. At the same time, the use of alternative feedstocks (e.g. bio-based) and solvents (e.g. water-based chemistry), supports safer and more environmentally friendly operations. Catalysts are an indispensable part of the reactor set-up that enable reactions to proceed faster, more selectively, and with lower energy input.

CATALISTI CONTACTS



— **Bert Boekaerts**
Innovation Broker



— **Dieter Ruijten**
Innovation Broker



© Indaver

Project portfolio

14 Reactor concepts

- **ATOM** – Towards an industrial platform for flow chemistry in Flanders
- **BluePlasma** – Circular CO_2 conversion by means of atmospheric plasma
- **FUNY** – Enabling advanced functionalisation of powder particles
- **GASTLY** – Green anaerobic syngas transformation for low-carbon yield
- **MMICAS** – Multiphase processing with microfluidics, cavitation and acoustic streaming
- **PIF** – Particles in flow
- **PLASMASOL** – Atmospheric plasma as green solution for enhanced adhesion and functionalisation
- **SHERPA –** Sorption enhanced hydrogen production via ammonia decomposition

15 Separation and remediation

- **BlueFabric** – Pushing the limits of high-performance IPC membranes
- **EASiCHEM** – Efficient affinity separations for chemical applications
- **FF-PFAS** – Fast forward on PFAS removal, gathering, observing, neutralising
- **RESCO** – Reduction of emissions and sustainable solvents in polyurethane coating
- **SENSOR** – Sensor platform for on-line monitoring
- **SuMEMS** – Sustainable membrane solutions for solvent-rich wastewater treatment

16 Catalysts

- **CO2PERATE** – All renewable CCU based on formic acid integrated in an industrial microgrid
- **ENZYMARES** – Enzyme prediction toolbox
- **ENZYMASE** – Enzymes for added sustainability and efficiency
- **SPICY** – Sugar based chemicals and polymers through innovative chemocatalysis and engineered yeast

BlueFabric

The transition towards a circular water economy requires advanced wastewater treatment technologies that combine high performance with cost-effective deployment. BlueFabric demonstrates how collaborative innovation can strengthen an entire Flemish value chain while advancing a technology with significant industrial and environmental potential. The project brings together three specialised SMEs, each contributing a critical element of the membrane manufacturing process: Luxilon Industries develops the monofilament yarns, VdS Weaving converts these into three-dimensional spacer fabrics, and Blue Foot Membranes transforms these intermediate materials into high-performance IPC® membranes for industrial wastewater treatment.

By combining expertise across the complete value chain, the consortium is working to push the limits of current membrane technology. The project focuses on developing thinner IPC® membranes that maintain the robustness and unique operational characteristics of existing designs while improving performance and process economics. Supported by the complementary expertise of KU Leuven and Centexbel, BlueFabric illustrates how close collaboration between SMEs and research institutes can address complex innovation challenges that would be difficult to tackle individually.



Beyond the technical objectives, BlueFabric highlights the strength of the Flemish innovation ecosystem. The project connects specialised companies that collectively cover the full development trajectory from advanced materials and textile engineering to membrane fabrication and industrial application. By reinforcing this unique regional value chain and preparing the technology for broader deployment, BlueFabric demonstrates how collaborative innovation can accelerate the development of sustainable industrial solutions while creating new opportunities for growth, competitiveness and international impact.

Did you know?

ENZYMARES

The intercluster project ENZYMARES developed an open-source enzyme discovery toolbox that combines curated biological data, computational modelling and AI-based prediction tools to accelerate the identification of novel enzymes for industrial applications. The platform helps researchers and companies identify enzymes with specific functionalities and performance characteristics, reducing the need for extensive experimental screening and trial-and-error testing. By enabling faster and more targeted enzyme discovery, the ENZYMARES toolbox helps translate biodiversity and biological data into practical biocatalytic solutions for different sectors ranging from chemicals to food, feed and pharmaceuticals.

ugent.be/marine/en/partnerships/enzymares



14 Reactor concepts

INNOVATION NEEDS

The search for (new) improved reactor concepts is driven by the drawbacks and limitations of the most common systems currently employed. Some of these are related to physicochemical phenomena occurring inside the reactors, while others are linked to the industry's transition in energy and feedstock inputs, from natural gas heating to electrical heating, and general sustainability goals, e.g. minimising solvent use.

Although heavily studied at a fundamental level and generally understood from an engineering perspective, heat and mass transfer limitations often remain technically challenging to solve in current reactor systems. Many chemical reactions are strongly exothermic or endothermic in nature, leading to problems such as hot spots, inefficient or insufficient heat removal, and internal temperature gradients. Furthermore, mass transfer limitations can significantly lower reaction rates and selectivity. For example, in CCU processes for CO_2 conversion, gas-liquid transfer is especially challenging. These phenomena matter especially when scaling up from the lab to pilot, demonstration, and commercial scale. Suboptimal reactor hydrodynamics, poor mixing at scale, and non-ideal flow can hinder or prevent implementation of new chemical processes.

To tackle some of these drawbacks, several process intensification methods offer promising alternatives. These include, for example, photochemistry, mechanochemistry, electrochemistry, plasma chemistry, and magnetic-field-enhanced heating. They can reduce solvent use, avoid reliance on natural gas heating, and often offer more flexible operating modes. Furthermore, local rather than full-system heating can significantly lower the total energy requirement, which is especially important for Flemish and European chemical companies. Fast on/off switching is particularly interesting when using (renewable) electricity as the primary energy input, as this increases process flexibility in response to amongst others wind and solar energy availability.

> "Advanced reactor technologies unlock sustainable production, but industrial impact depends on successful scale-up"
>
> — Bert Metten, Technology Development Manager, Ajinomoto Omnichem



Reactor operating mode and flexibility extend beyond energy use and affect other process parameters and their control, including steady-state operation and fluctuating conditions. While batch reactors are multipurpose, continuous reactions are often preferred due to lower OPEX.

Hence, over the coming decade, Catalisti aims to support the development and deployment of improved next-generation reactor concepts that enable chemical processes to convert alternative feedstocks with lower total environmental footprints and greater energy efficiency. These improved designs should have lower CAPEX and OPEX than the current state of the art through smart process intensification.

14 Reactor concepts

Next-generation reactor concepts that combine process intensification with the electrification of chemical processing have the potential to significantly improve the efficiency and sustainability of chemical manufacturing. Our experience with continuous flow technologies, including advanced reactor platforms for flow chemistry and photochemistry, demonstrates how enhanced heat and mass transfer can contribute to higher selectivity, improved scalability and lower energy consumption.

The key challenge is not proving these concepts at laboratory scale, but translating their performance reliably to pilot and commercial production environments without compromising process robustness or efficiency. Addressing this challenge requires close collaboration between industrial end users, technology developers and research institutes to accelerate the transfer of fundamental reactor knowledge into industrial practice.

By combining technological innovation with pilot-scale validation, digital process monitoring and scalable reactor platforms, the chemical sector can develop more flexible, energy-efficient and cost-effective production processes for the future.

— **Bert Metten**
Technology Development Manager,
Ajinomoto Omnichem



ACTIONS

Accelerating implementation of new processes, via robust multi-scale integrated reactor modelling, by (i) avoiding heat transfer limitations and (ii) solving non-optimal reactor hydrodynamics, poor mixing at scale and non-ideal flow.

Bringing (i) new reactor technologies (electrification, magnetic field enhanced heating, etc.) and (ii) process intensification methods (flow chemistry, photochemistry, mechanochemistry, electrochemistry, plasma chemistry, etc.) from lab-scale and proof-of-concept to pilot scale and commercialisation.

Improving flexibility of reactions by (i) fast on-and-off systems synchronising with available renewable energy input and (ii) selection of optimal operating mode (batch, flow, continuous).

AMBITION

Improved next-generation reactor concepts converting alternative feedstocks with lower total environmental footprints and in a more energy efficient way. These improved reactor designs should have lower CAPEX and OPEX than the current state-of-the-art due to smart intensified reactions.

LEGEND

Indication of the timing
- Short term
- Mid term
- Long term

Impact of innovation and/or collaboration
- Minor
- Medium
- Major



15 Separation and remediation

INNOVATION NEEDS

Separation and remediation techniques are processes used to purify solid, liquid, and gaseous streams and to remove contaminants from soil, water and air by exploiting differences in physical and/or chemical properties. Examples include distillation and membrane separations for product purification and adsorbents and membranes for wastewater and air treatment. These techniques can also enable the recovery of valuable components from side and waste streams of the chemical industry, thereby supporting circular and atom-efficient use of resources, e.g. water, N-based streams, P-based streams, halogens, critical raw materials, and metals.

Historically, innovation in separation has mainly focused on distillation and extraction technologies that have been developed over 70-80 years, specifically for the oil and gas industry. Although these are high-performing techniques with high separation selectivity, they also suffer from drawbacks such as high energy consumption and the fact that they have been optimised to handle contaminants and impurities that are inherently present in these fossil-based feedstocks, which are relatively constant in composition.

Existing chemical processes often utilise end products from preceding processes (ethylene, propylene, methanol, phenol, etc.), where purification takes place at the end of that preceding process. With circular and bio-based feedstocks as the inputs of tomorrow, this is not the case and these inputs are by definition complex and variable, which render the reaction step and subsequent purification steps more difficult. Therefore, more advanced, reliable and robust separation processes are needed in the context of the pre-treatment of circular and bio-based feedstocks.

Newer separation technologies are emerging, such as membrane separations, which have the potential to operate more energy-efficiently. Nevertheless, several research challenges remain before they can become the new industrial benchmark. First, their operating windows are still limited by the stability of membrane materials, which restricts their use under extreme conditions, e.g. temperature, pH, solvents, etc. Stability and fouling concerns are also particularly relevant when processing alternative feedstocks (bio-based, recycled and CO_2), which are heterogeneous mixtures containing different heteroatoms, metals, moisture, and other impurities. For gas separations and membrane-based carbon capture technologies specifically for example, there is often still a trade-off between membrane permeability and separation selectivity.

In this context, a better fundamental understanding of newer separation technologies such as membranes and sorbents supported by digital models, would be a major enabler, similar to how Aspen and other software tools support the design of distillation or extraction steps in industry. New processes and chemical reactions based on alternative feedstocks should also be coupled from the start with downstream processing (DSP) and upstream pre-treatment. In practice, it may be better not to optimise a chemical reaction or process towards 100% conversion, but to focus instead on synergies with DSP that improve overall economics and efficiency.

> "High-quality circular products start with effective separation and remediation"
>
> — Kristof Moonen, Chief scientist Amines, Eastman

For both adsorbents and membranes, the separation cycles should minimise additional waste generation and material losses, while the environmental impact of the materials and co-components themselves should also be taken into consideration, leading to better LCA outcomes than current industrial separation technologies. This also extends to the origin and chemical composition of these materials, as access to critical raw materials through closed mass and atom balances is of strategic importance for Flemish and European companies.

For contaminant remediation specifically, environmental trade-offs often occur in industry, as removing pollutants may generate secondary waste and require additional chemicals and/or energy, also known as the remediation paradox. This applies especially to demanding separations where pollutants are present at very low concentrations. This remains a technical challenge, as detecting contaminants at such low levels is not always feasible, despite regulatory pressure. Whenever possible, R&D projects should prioritise avoiding pollution and waste generation during conversion processes rather than relying on remediation afterwards.

Within a 10-year horizon, Catalisti aims to support research into energy-efficient separation and remediation processes that perform 10-20% better than current processes, with very high selectivity and robustness to handle diverse feedstocks, including biomass, recycled content, and CO_2. The materials used should be abundant and have low environmental impact. This should help making downstream operations in circular processes economically viable and ensure a business case for the overall process.

15 Separation and remediation

Improved separation and remediation are vital to resource-efficient, circular chemical processes. As feedstocks diversify and recycled streams become a larger part of the raw material mix, maintaining product quality while managing variable compositions and contaminants becomes increasingly challenging.

This creates opportunities for more selective, energy-efficient and adaptable separation technologies, with remediation integrated into process design from the outset. The objective is not only to remove unwanted components, but also to recover value, reduce waste and avoid shifting environmental impacts elsewhere in the system.

Our experience shows that progress depends on a combination of sound process engineering, relevant-scale testing and close collaboration between technology developers, chemical producers and research institutes. Over the past decade, collaborative innovation projects coordinated by Catalisti have enabled us to engage in projects with industrial and academic partners that we might otherwise not have pursued, or even been aware of. By combining practical trials with shared expertise, we can evaluate energy use, recovery efficiencies, product quality and safety under realistic conditions, build confidence in scale-up and strengthen the competitiveness and resilience of a more circular chemical industry.

— **Kristof Moonen**
Chief scientist Amines, Eastman



ACTIONS

Employing smarter combinations of existing technologies to reduce (i) energy consumption (ii) environmental footprint and (iii) OPEX.

Understanding in a more fundamental way, supported by digital models, of newer separation technologies such as (i) membranes and (ii) adsorbents to accelerate their industrial implementation.

Improving operating window of membranes by (i) better stability of the materials and (ii) reducing fouling when processing heterogeneous (alternative) mixtures containing impurities.

Co-developing of new alternative reactions with downstream processing and upstream pre-treatment steps for better overall (i) economics and (ii) efficiency.

Minimising environmental footprint of both separation and remediation techniques by (i) reducing waste generation, (ii) closing mass balances and (iii) using (recycled) abundantly available materials.

AMBITION

Energy-efficient (10-20% better than today) separation and remediation processes with very high selectivity and robustness that can handle diversified feedstock (biomass, recycled content and CO_2); The separation materials used should as much as possible be based on (recycled) abundantly available materials with low environmental impact. This should enable downstream processing of circular processes to become economically viable to ensure a valid business case for those processes in their entirety.

LEGEND

Indication of the timing
- Short term
- Mid term
- Long term

Impact of innovation and/or collaboration
- Minor
- Medium
- Major



16 Catalysts

INNOVATION NEEDS

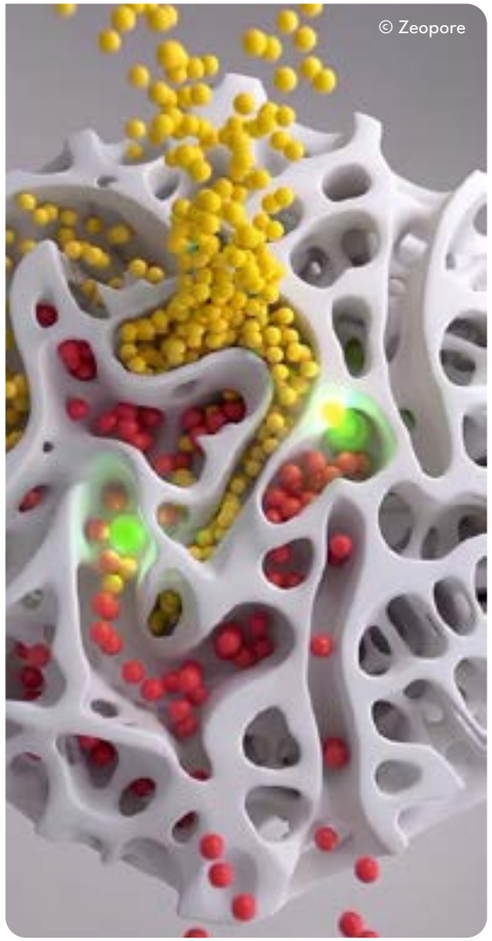
Today, most reaction conversions in the chemicals and plastics industry rely on catalysts to accelerate reaction rates and steer selectivity towards the desired product(s). However, these catalysts are mostly designed for processes based on fossil-based resources with well-known compositions and impurity profiles. This means that their use is not readily transferable to future processes using alternative resources with different chemical compositions and more variable, unpredictable impurities and additives. As a result, improved catalysts designs will be needed for these new conversions, bringing with them also significant future research challenges.

Traditional catalyst development is time-consuming and largely empirical, typically taking 10–20 years from discovery to industrial deployment. Catalyst research spans a vast materials space and still relies on trial-and-error experimentation, with limited predictive models. The gap between theory, e.g. DFT modelling, and realistic reaction environments, e.g. surrounding solvent molecules and impurities, makes predictive design challenging. In addition, characterising catalysts under reaction conditions and identifying the catalytically active site during reaction, rather than before or after, remain difficult. These hurdles must be overcome to accelerate catalyst development through mechanistic insights and faster predictive models.

> “Strategic innovation creates value when performance and manufacturability are both de-risked”
>
> — Danny Verboekend, Chief Scientific Officer, Zeopore

Another important technical challenge is catalyst scale-up and shaping. Catalysts that work in the lab may fail at industrial scale due to challenges in synthesis reproducibility. These include precise control of (nano)particle size, uniform distribution on supports, and batch-to-batch reproducibility; even minor differences can significantly affect performance. Catalyst shaping should be integrated with broader process design to for instance minimise pressure drops and improve control over mass and energy supply in the reactor.

Therefore, within the next decade, Catalisti aims to support research into novel, economically viable, and robust catalysts that perform well in future chemical processes. They should be able to handle alternative feedstocks, including biomass, recycled content, and CO_2, and associated variable impurities, ensuring stability and long lifetimes. Furthermore, when possible, they should be based on environmentally benign, abundantly available materials and recycled resources, supporting a stable local supply chain with limited environmental impact.



16 Catalysts

Circular refining offers a significant challenge: producing high-quality sustainable fuels and chemicals while minimising the formation of undesired by-products. Improving feedstock-specific conversion pathways, such as reverse water-gas shift and Fischer-Tropsch processes, therefore remains a key priority. At the same time, innovation and collaboration in the refining industry is fundamentally about derisking.

Our experience with highly porous zeolite materials for upgrading circular streams through hydrocracking and hydro-isomerisation demonstrates that superior process performance can deliver higher yields of valuable products while reducing by-product formation. However, new technologies only create impact when both their performance and manufacturability have been proven at industrially relevant scale. Demonstrating catalyst performance under realistic conditions and de-risking production before commercial deployment are therefore essential steps towards adoption.

Ultimately, we believe the greatest short-term impact is achieved when strategic innovation can leverage existing technologies and infrastructure while delivering measurable performance improvements.

— **Danny Verboekend**
Chief Scientific Officer, Zeopore



ACTIONS

Accelerating catalyst development for alternative feedstock conversion based on actual mechanistic insights and faster predictive models by (i) active site characterisation under reaction conditions and (ii) closing the gap between theory (DFT modelling) and realistic reaction environments (impurities, surrounding solvent molecules, etc.).

Controlling, in a more reliable and better way, catalyst synthesis scale-up and catalyst shaping by (i) precise control of particle size, (ii) uniform distribution on supports and (iii) batch-to-batch reproducibility to avoid reactor pressure drops and optimise reactor mass and energy supply.

Securing warranty of supply for and avoiding environmental burdens of catalyst synthesis by (i) recycling strategies, (ii) replacing precious metals and (iii) avoiding critical raw materials leading to greener and safer catalysts.

AMBITION

Economically viable and robust catalysts to handle alternative feedstocks (recycled content, biomass and CO_2) and their impurities, ensuring stability and long lifetimes; These catalysts should be based on environmentally benign and abundantly available materials as well as recycled resources, ensuring a stable (local) supply chain with limited environmental impact.

LEGEND

Indication of the timing
- Short term
- Mid term
- Long term

Impact of innovation and/or collaboration
- Minor
- Medium
- Major

Future-proof Processes

17 **Digitalisation and data management**

18 **Automation**

19 **Reliable industrial processes**



Future-proof Processes

This programme focuses on the development of chemicals and plastics processes that are digitally enabled, increasingly automated and highly reliable. This requires moving from fragmented data and isolated tools to integrated systems that improve process control, reduce downtime, optimise resources, increase safety and accelerate innovation. This innovation programme focuses on digitalisation, automation and reliability as enablers for a more competitive, sustainable and resilient industry. By connecting data, control, automation and safety into one coherent industrial system, future-proof processes can become more efficient, better monitored and more robust under real-world operating conditions.

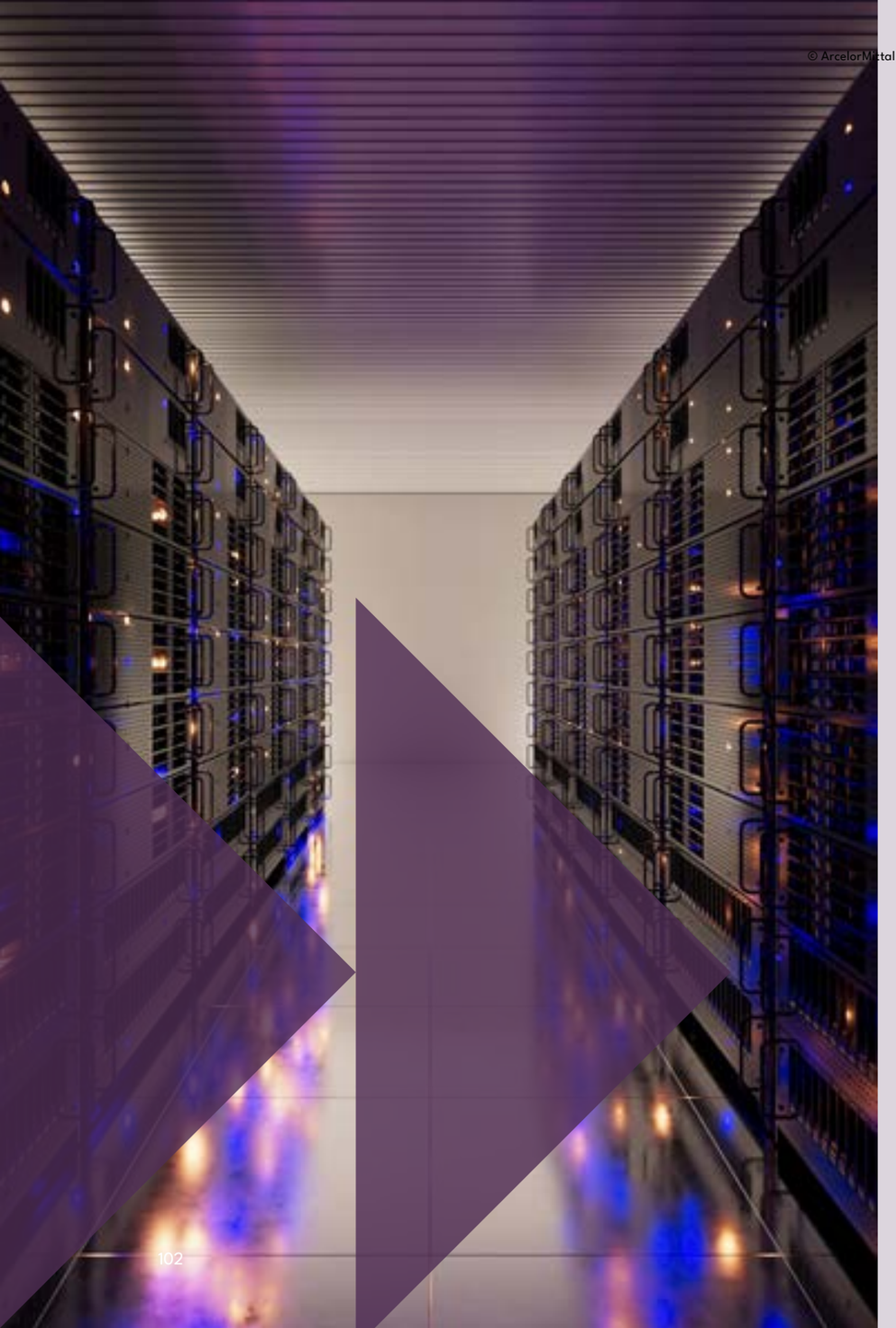
CATALISTI CONTACTS



— **Mathias Jacobs**
Innovation Broker



— **Aron Deneyer**
Innovation Broker


© ArcelorMittal Belgium

Project portfolio

17 Digitalisation and data management

- **DAP2CHEM** – AI for improved process development and manufacturing excellence
- **DIGICHEM** – Innovation plan Industry 4.0: route to a digitised chemical sector in Flanders
- **EL4CHEM** – Efficient learning for chemical applications
- **ENZYMARES** – Enzyme prediction toolbox
- **SENSOR** – Sensor platform for on-line monitoring

18 Automation

19 Reliable industrial processes

- **FUNCTIONARY-I** – Functional safety in the process industry: towards a science-based approach
- **FUNCTIONARY-II** – Functional safety in the process industry: towards an industry-wide paradigm shift
- **Opleiden 4.0** – Living lab industry 4.0: Education 4.0

DAP2CHEM and EL4CHEM

DAP2CHEM demonstrates how digital technologies can create immediate value in industrial production while laying the foundation for more agile and resource-efficient process development. The project brought together Johnson & Johnson, Procter & Gamble, Ajinomoto, Cronos, KU Leuven, Flanders Make and imec, combining capabilities in artificial intelligence, digital twins, advanced modelling and process engineering to enable real-time data utilisation for process optimisation, faster development cycles and improved product quality.

A flagship use case focused on a solvent-switch operation in batch equipment at Johnson & Johnson, where a digital twin was developed and validated under industrial conditions. The results highlighted the transformative potential of data-driven process engineering. The digital-twin approach reduced solvent consumption by 30%, shortened process times by 40% and lowered operational costs by 30%, resulting in an estimated annual return on investment of approximately 2 million EUR for the process under study.

Beyond these direct gains, DAP2CHEM established a scalable methodology that can be applied across a wide range of production processes. By connecting expertise from partners across the innovation ecosystem, the project demonstrated how artificial intelligence, advanced modelling and digital twins can help companies optimise operations, reduce resource use and accelerate innovation. Building on these foundations, the follow-up project EL4CHEM is further advancing the development and industrial application of digital technologies for the process industry. Together, these projects illustrate how collaborative innovation can translate data-driven technologies into tangible economic, operational and sustainability benefits at industrial scale.

Did you know?

FUNCTIONARY

The FUNCTIONARY initiative is developing guiding principles and a Functional Safety Guide that rethink how functional safety is approached in the chemical process industry. By combining process safety, cybersecurity, reliability and life cycle economics, the project aims to help companies design safer, more resilient and more cost-effective production systems.



The FUNCTIONARY consortium at its eighth consortium meeting on 25 September 2026 at the Geel-site of Johnson & Johnson.

Project partners FUNCTIONARY-I: University of Antwerp, Ghent University, KU Leuven
Project partners FUNCTIONARY-II: BASF, Covestro, Envalior, essenscia, Evonik, Johnson & Johnson, Nero



17 Digitalisation and data management

INNOVATION NEEDS

Digitalisation and data management focus on making industrial data more structured, accessible, and usable across the chemical sand plastics industry. This includes data generated by production assets, sensors, laboratories, quality systems, maintenance activities, and R&D workflows. When properly connected and interpreted, such data can support better process control, faster product development, improved traceability, predictive maintenance, quality assurance, energy optimisation, and collaboration across the value chain. Digital tools such as AI, machine learning, computational chemistry, process models, and digital twins are therefore not objectives in themselves, but enablers for turning fragmented industrial information into actionable insights.

A key challenge is unlocking the value of existing data. Companies often possess large volumes of process, laboratory, maintenance, quality, and energy data, but such datasets are often fragmented across systems, sites, and departments. Innovation should therefore focus on data architecture, interoperability, data quality, semantic modelling, and secure data pipelines that make industrial data usable and reliable.

Advanced analytics can create value in both production and R&D. Soft sensors and hybrid models can estimate difficult-to-measure variables such as composition, viscosity, fouling, catalyst activity, or product quality. Digital twins can support energy optimisation, yield improvement, operator training, HAZOP preparation, debottlenecking, and scale-up from lab to pilot and industrial scale.

> “Turning data into actionable process intelligence”
>
> — Jeroen Bets, Pilot Plant Systems and Data Lead, Johnson & Johnson Innovative Medicine



Data governance and trusted data sharing are essential. Companies need clarity on ownership, access rights, cybersecurity, confidentiality, and liability when sharing operational or value-chain data.

Within 10 years, Catalisti aims to support the development and implementation of practical, scalable, and trusted digital solutions for the Flemish chemicals and plastics industry. Through best-practice sharing, matchmaking, expertise mapping, demonstrators, and training, Catalisti will help companies move from fragmented data and isolated digital pilots to scalable, data-driven implementation.

17 Digitalisation and data management

The real value of industrial digitalisation emerges when data and models contribute to better process decisions in real time. Our experience shows that the challenge is rarely a lack of data, but rather making the right laboratory, process and equipment data available in a reliable and interpretable form. Historical data become truly valuable when combined with the knowledge of the people who understand the process.

Process Analytical Technology and soft sensors turn data into actionable process insights. They reveal process and quality attributes that are difficult to measure directly, detect deviations earlier, and support timely, well-informed decisions. Automated data analysis is an important next step, not to replace process expertise, but to continuously highlight what requires attention and help experts arrive at the right insights faster.

Integrating these technologies, models, and digital twins into existing process control and production systems translates insights into operational actions more quickly and consistently. We have learned that a successful application can only be deployed more widely when integration, maintainability, and reusability are considered from the outset. Standardisation, cybersecurity, and scalability are not later optimisations, but essential design requirements that make each subsequent implementation faster and more reliable.

— **Jeroen Bets**
Pilot Plant Systems and Data Lead,
Johnson & Johnson Innovative Medicine



ACTIONS

Strengthening ecosystem knowledge sharing by organising best-practice exchange, expertise mapping and matchmaking between chemical companies, technology providers, research institutes and data specialists.

Deploying advanced analytics in production and R&D by developing soft sensors, hybrid models, AI and machine-learning tools to estimate difficult-to-measure variables such as composition, viscosity, fouling, catalyst activity and product quality.

Developing practical digital twins and process models by using them for energy optimisation, yield improvement, debottlenecking, operator training, HAZOP preparation and scale-up from lab to pilot and industrial scale.

AMBITION

Facilitating the transition from fragmented industrial data towards structured and trusted data foundations that enable scalable digital implementation, while helping companies turn existing process and lab data into actionable insights through best-practice sharing, matchmaking, expertise mapping, demonstrators and training.

LEGEND

Indication of the timing
- Short term
- Mid term
- Long term

Impact of innovation and/or collaboration
- Minor
- Medium
- Major



18 Automation

INNOVATION NEEDS

Automation in the chemical industry is more than introducing individual technologies or isolated automated tasks. It involves the gradual integration of reliable control systems, data-driven intelligence, and safe physical execution across chemical operations. Existing technologies such as PLC, SCADA, and distributed control systems are increasingly combined with advanced process control, AI, connected sensors, robotics, functional safety systems, and OT cybersecurity. Together, these elements enable closer monitoring, earlier detection of deviations, more consistent operations, and stronger operator support.

In production environments, automation can improve accuracy, safety, and responsiveness. It can support automated dosing, reduce manual exposure during sampling or inspection, stabilise process control, and enable predictive maintenance. Robotics and automated handling systems can take over repetitive or hazardous tasks, while decision-support tools help operators intervene before problems escalate. The goal is not simply to replace manual work, but to make operations more reliable, transparent, and resilient.

However, automation at chemical sites faces important constraints. Many plants rely on legacy equipment, heterogeneous control systems, and long asset lifetimes. Sensor coverage is often incomplete, data quality can vary, and interfaces are not always standardised. Because chemical sites are safety-critical environments, cybersecurity and functional safety must be integrated from the start, especially as operational technology becomes more connected.

> “Faster innovation requires integrated learning cycles, not isolated automation steps”
>
> — Lieven Deketele, Director of Open Innovation, Procter & Gamble

Digital shadows and digital twins can help reduce implementation risks. They allow companies to test control strategies, assess abnormal scenarios, train operators, and optimise processes before changes are made in the physical plant. This can build confidence when moving from monitoring to predictive control, semi-autonomous workflows, or selected autonomous operations.

Automation should extend beyond production. It can strengthen R&D, quality control, logistics, utilities, maintenance, and infrastructure by improving repeatability, traceability, planning, and resource efficiency. This broader view matters because competitiveness depends on the whole-ecosystem performance.

Catalisti will support this transition by connecting chemical companies, research institutes, system integrators, automation suppliers, robotics experts, data specialists, and cybersecurity partners. Through collaborative projects, demonstrators, and validation environments, Catalisti can help translate automation technologies into safe, scalable, and sector-specific solutions.

Within 10 years, Catalisti aims to support a more automated, competitive, and resilient chemical industry in Flanders. Full automation will not always be feasible or desirable, and human expertise remains essential in complex and safety-critical situations. The ambition is to help companies gradually move from data capture and visualisation to trusted operator guidance, predictive control, and selected autonomous operations, strengthening productivity, safety, and competitiveness while reinforcing human expertise.

18 Automation

The real opportunity of automation lies not in automating individual tasks, but in connecting experimentation, process understanding and scale-up into a faster learning cycle. We see significant potential in combining high-throughput experimentation and robotics with real-time monitoring, advanced modelling and simulation. These technologies can help generate knowledge faster in the laboratory, identify scale-up challenges earlier and accelerate the journey from an idea to robust industrial production.

At the same time, automation has the potential to improve the efficiency with which energy, water and materials are used throughout product and process development. However, realising this potential requires more than technological advances alone. No single company can develop all the capabilities needed to make this transition on its own.

Collaboration between industry, technology providers, start-ups and research institutes is essential to combine expertise across experimentation, digitalisation, modelling and manufacturing. Through our involvement in collaborative innovation projects, we have seen how innovation ecosystems such as Catalisti can play an important role in connecting these capabilities and translating emerging technologies into scalable industrial solutions that accelerate innovation while strengthening both competitiveness and sustainability.

— **Lieven Deketele**
Director of Open Innovation,
Procter & Gamble



ACTIONS

Strengthening collaboration with automation integrators by connecting chemical companies, system integrators, automation suppliers, cybersecurity experts and research institutes, while aligning on IP and licensing models.

Enabling smart process and asset control by developing predictive process control, digital assistants, virtual sensors, autonomous sampling, automated dosing, robotic inspection and predictive maintenance tools.

Using digital twins and digital shadows to reduce automation risk by simulating control logic, testing abnormal scenarios, training operators and validating automation concepts before plant implementation.

Developing selected autonomous or semi-autonomous operations by implementing automation where technically feasible, safe and economically justified, while keeping human expertise central in complex decision-making.

AMBITION

Enabling a more automated, competitive and resilient chemical industry, where automation strengthens human expertise rather than replacing it, and companies move stepwise from data capture and visualisation towards trusted decision support, predictive control and selected autonomous operations.

LEGEND

Indication of the timing
- Short term
- Mid term
- Long term

Impact of innovation and/or collaboration
- Minor
- Medium
- Major



19 Reliable Industrial processes

INNOVATION NEEDS

Reliable industrial processes are designed to operate safely, consistently, and efficiently under real-world conditions. They require the integration of process safety, functional safety, cybersecurity, asset integrity, maintenance, workforce training, and continuous process innovation into one coherent industrial system. As chemical installations become more digital, connected, automated, and flexible, reliability is no longer merely an operational topic, but a strategic enabler of competitiveness, resilience, and safety.

Within a 10-year horizon, Catalisti aims to support the development of a world-class process industry system in Flanders, in which industrial installations are safer, more robust, better monitored, and increasingly capable of semi-autonomous or autonomous operation where technically feasible and safe. This transition should strengthen rather than replace human expertise by combining operator know-how with advanced monitoring, predictive analytics, decision support, and automated intervention for selected tasks.

A key challenge is the fragmentation of safety and reliability domains. Process safety, functional safety, occupational safety, cybersecurity, maintenance, and production optimisation are often managed separately, although their interdependencies are growing. More holistic risk-management frameworks are therefore needed, integrating safety-by-design, security-by-design, and reliability-by-design from the earliest stages of process development, plant modification, and digital implementation.

> “Safe and reliable processes require technology, industrial expertise and skills to advance together”
>
> — Ivan Pelgrims, Managing Director, Evonik Antwerpen & President of essenscia’s Process Academy

A second major bottleneck is ageing infrastructure. Many chemical installations were not designed for digitalisation, automation, circular feedstocks, electrification, or flexible operation. Future-proof processes therefore require structured strategies for infrastructure modernisation, sensor integration, asset health monitoring, predictive maintenance, and compatibility with modern control systems. Reliability also depends on understanding degradation mechanisms such as fouling, corrosion, catalyst deactivation, membrane degradation, solvent degradation, impurity build-up, and thermal cycling.

Finally, workforce skills, training, and collaboration across companies are essential. As industrial systems become more complex, companies need multidisciplinary expertise that combines process engineering, automation, data science, cybersecurity, and safety management. Catalisti will act as a neutral platform to identify shared bottlenecks, map expertise, stimulate pre-competitive demonstrators, and share best practices across industry, research institutes, system integrators, automation suppliers, and safety experts, enabling safer, smarter, and more resilient chemicals and plastics production in Flanders.



Safety, reliability and productivity are fundamental to our industry's licence to operate, and the transition towards more sustainable production is putting all three to the test. Electrification, new feedstocks and increasingly connected plants introduce new hazards and failure modes that industry must learn to manage. A process that is greener but less reliable is not a step forward.

Our experience shows that addressing these challenges requires collaboration as much as technological innovation. Through initiatives such as the essenscia Process Academy, companies, research institutes and public authorities can bring together complementary expertise in a neutral setting. The FUNCTIONARY trajectory demonstrates the value of this approach by connecting industrial and academic expertise to advance the safety and reliability of future chemical processes, including the integration of electrified processes.

But reliable processes ultimately depend on people as well as technology. Our involvement in initiatives such as SkillsUpp shows how technical competencies and process knowledge can be made more structured and measurable, helping to strengthen technical capabilities and safety in industrial operations.

Research only creates lasting value when its insights reach industrial practice. Combining the expertise of research institutes with the practical knowledge available within industry can turn research on reliable processes into real-world impact. The next step is to ensure that these insights also find their way into training, curricula and dialogue with policymakers, so that the next generation of engineers can build on what we learn today.

— **Ivan Pelgrims**
Managing Director, Evonik Antwerpen &
President of essenscia's Process Academy



19 Reliable Industrial processes

ACTIONS

Embedding safety-by-design, security-by-design and reliability-by-design by considering safety, cyber risks and asset integrity from the earliest stages of process development, plant modification and digital implementation.

Improving asset-health monitoring and predictive maintenance by applying sensors, analytics and degradation models to detect fouling, corrosion, catalyst deactivation, membrane degradation, solvent degradation, impurity build-up and thermal cycling.

Developing immersive and practical workforce training tools by using digital twins, simulators and cross-company learning to prepare operators and engineers for abnormal scenarios, automation and complex system interactions.

AMBITION

Creating safer, more robust and better monitored industrial installations, increasingly capable of semi-autonomous or autonomous operation where technically and safely feasible, by combining operator know-how with advanced monitoring, predictive analytics, decision support and automated intervention for selected tasks.

LEGEND

Indication of the timing
- Short term
- Mid term
- Long term

Impact of innovation and/or collaboration
- Minor
- Medium
- Major

Advanced Products

20 Safety

21 Circularity

22 Performance



Advanced Products

This programme focuses on advanced chemical substances, materials and products with tailored functionalities for high-performance applications. Their design must integrate functionality and technical performance with safety, environmental sustainability and circularity from the outset. Guided by the Safe and Sustainable by Design (SSbD) principles across the full life cycle and value chain, this programme organises its innovation priorities around three interdependent design tracks: safety, circularity and performance. Each has a distinct technological focus, but design choices in one can create benefits, constraints or trade-offs in the others.

The three tracks structure the programme's innovation priorities but do not represent the full scope of SSbD. Environmental sustainability is integrated across all three, while other sustainability challenges are addressed more explicitly in other Catalisti programmes. Economic viability and societal and regulatory acceptance are vital drivers for implementation, not separate design tracks.

A key innovation priority across and beyond this programme is systematic adoption of SSbD principles in industrial innovation. Its common language and structured assessment approach support transparent decision-making by combining safety and sustainability assessments, including risk assessment (RA) and life cycle assessment (LCA), and harmonising input data, assumptions and scenarios where possible. Applied from the earliest design stages, SSbD helps stakeholders compare options, identify interactions and make trade-offs explicit before design choices become difficult to reverse. This requires new competencies and decision-making practices, embedded in education, training and company routines.

CATALISTI CONTACTS



— **Stef Koelewijn**
Innovation Broker



— **Martijn Roosen**
Innovation Broker



Project portfolio

20 Safety

- **BARDI** – Bio-based aromatic diols
- **D4SMD** – Design for sustainable medical devices
- **FResCo** – Fouling restraining coatings for marine and terrestrial applications
- **PolyFlam** – Polyol-based flame retardants and lubricants
- **PROMIS** – Sustainable production of bio-based multi-reactive isocyanates
- **SUPERNATURE** – Sustainable polyurethane alternatives without hazardous isocyanates

21 Circularity

- **BioSAPs** – Bio-based and biodegradable superabsorbing polymers
- **HG4PPFlex** – Holy Grail 4 polypropylene flexibles
- **In2OrFoam** – Innovations in foaming of recycled polymers
- **NaPoly** – Design rules for the homogeneous dispersion of nanoparticles
- **PoCoPadd** – Post-consumer PVC boosted with additives
- **RECYCOAT** – Recycling of coated materials
- **TRUCE** – True recycling upscaling of flexible packaging
- **Tune2Bio** – Tuning the biodegradability of (bio)polymers

22 Performance

- **AppliSurf** – Screening the application potential of a yeast-based biosurfactant portfolio
- **ATOL –** Advanced tailored oligosaccharides
- **BioPol4Motive** – Bio-based polyols for flexible polyurethane foams in automotive applications
- **BIORESAL** – Bio-based resins from aldehydes and lignin
- **BIOVERTOL** – Towards the sustainable synthesis of branched-chain higher alcohols from bio-based feedstock using catalytic processes
- **BlueFabric** – Pushing the limits of high-performance IPC® membranes
- **CSP+** - Enhanced PV integrated concentrator solar power system
- **DELICARE** – Depolymerisation of hydrolysis lignin for conversion to acrylic resins
- **Encaps2Control** – Controlled release, uptake and enhanced (bio-)availability by encapsulation
- **FUNY** – Enabling advanced functionalisation of powder particles
- **GAME** – Unravel metabolite production by Porphyra
- **HybridMoulds** – Hybrid injection development for short-run production
- **ODORETION** – Towards sustainable solutions for better malodour elimination
- **P2PC** – Plastics to precious chemicals
- **PlasmaSol** – Atmospheric plasma as green solution for enhanced adhesion and functionalisation
- **SweetEst** – Use of sugar in feed additives, surfactant in personal care and gelling in industrial products
- **VITAL** - Vegan chitosan tailoring for diverse applications

BARDI, BIORESAL, DELICARE, PROMIS and SUPERNATURE

Lignin, a major component of wood and agricultural residues, is increasingly recognised as a renewable source of aromatic building blocks for the chemical industry. Through a long trajectory of Catalisti projects, including BARDI, BIORESAL, DELICARE, PROMIS and SUPERNATURE, Flemish companies, universities and research institutes are developing new lignin-derived molecules for applications ranging from polyurethanes, polycarbonates and epoxy resins to coatings, adhesives, insulation materials and other high-performance materials.

These projects explore how bio-based aromatic building blocks can not only replace fossil-derived alternatives, but also create opportunities for improved safety, sustainability and functionality. The projects integrate SSbD principles, ensuring that safety, sustainability, circularity and performance are considered from the earliest stages of molecular, material and product design.

Over the past years, this research portfolio has evolved from strategic basic research and molecule discovery towards pilot-scale production and industrial application testing. Flanders now benefits from dedicated pilot infrastructure such as the Biocon facility at KU Leuven and the LignoValue platform at VITO, bridging the gap between laboratory innovation and industrial deployment. This combination of collaborative innovation projects, pilot infrastructure and industrial engagement is creating the foundations for new value chains based on renewable carbon. It demonstrates how lignin can be transformed from an underutilised side stream into a source of high-value functional molecules.



PILLAR II unit for dissolution and extraction of lignin, part of VITO's LignoValue Platform.



20 Safety

INNOVATION NEEDS

Safety as a design dimension (safe by design) focuses on developing and evaluating chemical substances, materials, and products to reduce risks to human health and the environment throughout the full life cycle and value chain while maintaining the required functionality and performance. This means moving beyond development driven primarily by technical performance. Improvements can result from hazard reduction, exposure reduction, safer material and product design, or substituting substances of concern with alternatives that better balance functional performance, safety, environmental sustainability, circularity, economic viability and societal acceptance. This requires a deeper understanding of the relationship between molecular structure, properties, functionality and performance.

One challenge is that chemical safety is dynamic and multidimensional. Hazard refers to inherent properties of a substance or material, such as toxicity, flammability, and reactivity. Risk results from the combination of hazard and exposure, while safe use also depends on appropriate conditions of use and risk-management measures throughout the life cycle. These aspects are regulated through frameworks such as EU REACH and EU Classification, Labelling, and Packaging (CLP) and, for medical devices, the European Union Medical Device Regulation (EU MDR).

> “Fit-for-purpose performance creates room for safer and more circular materials”
>
> — Stefaan De Wildeman, CEO, B4Plastics

Another challenge is the limited availability of robust tools, data, and methodologies for assessing and comparing chemical risks early in development and substantiating related claims. Uncertainty and data gaps hinder transparent benchmarking of alternatives and evaluation of trade-offs. The objective is to improve safety without significant adverse impacts in other relevant dimensions. This is particularly important when functionalities such as flame-retardant or barrier properties require fundamentally different chemistries or material architectures.
A stronger data and knowledge base is needed for data-driven safety assessment. Priorities include improving data availability and quality, making uncertainty explicit and generating relevant evidence early in innovation. A shared, well-governed knowledge base could support research, education and training in toxicity prediction and substitution. Catalisti will support R&D aimed at substituting substances of concern, while digital tools, such as software, models and data platforms, supported by regulatory instruments such as digital product passports, can enable earlier screening, better documentation, and more credible communication.

Within the next decade, Catalisti aims to embed safety systematically in innovation trajectories and value-chain collaboration. It will support the substitution of substances of concern with safer alternatives, while also advancing hazard reduction, exposure reduction and safer product design. These approaches must safeguard circularity, functionality, environmental sustainability and overall system performance, thereby accelerating the transition towards safer chemical substances, materials and products.

20 Safety

Safety, circularity and performance are closely interconnected considerations in the development of new biomaterials. While performance is traditionally a primary consideration in material development, our experience is that this can lead to a tendency towards 'over-performance', with material properties being maximised even when they exceed the actual requirements of the application. Do we really need a car dashboard to remain fully colourfast and last for up to 200 years, or should we be designing for fit-for-purpose performance rather than performance beyond what the application actually requires? What if we could reconsider some of these requirements and gain significantly more circularity in return? The opportunity becomes even more significant when we also make the connection to safety. Not safety in the narrow sense, but genuine safety that looks beyond a single human life and considers the implications of the materials we develop and use across generations. What is the value of fantastic-looking, over-performing products if they are linear, resource-depleting or potentially harmful rather than circular and safe by design?

By questioning established specifications and aligning material performance more closely with actual needs, we can rethink the way materials are designed and accelerate the transition towards a fundamentally safer and more circular material world.

— **Stefaan De Wildeman**
CEO, B4Plastics



ACTIONS

Strengthening the data and knowledge base for data-driven safety assessment, toxicity prediction and substitution through (i) improving data quality and availability, (ii) explicit treatment of uncertainty, and (iii) early evidence generation.

Developing a deeper understanding of structure-property-functionality-performance relationships to enable the substitution of substances of concern with safer alternatives.

Developing digital tools and leverage digital product passports to enable (i) earlier screening, (ii) better documentation, and (iii) more credible communication.

AMBITION

Accelerate the transition towards safer substances, materials and products by systematic embedding of safety thinking in innovation trajectories while safeguarding circularity, functionality, environmental sustainability and overall system performance.

LEGEND

Indication of the timing
- Short term
- Mid term
- Long term

Impact of innovation and/or collaboration
- Minor
- Medium
- Major



21 Circularity

INNOVATION NEEDS

Circularity as a design dimension (circular by design) integrates circularity into product design to optimise resource use and minimise waste without compromising quality, safety or performance over an extended lifetime. The appropriate strategy depends on the application and value chain, for example food, automotive or textiles, and may include lifetime extension, dedicated collection, advanced sorting or improved recyclability. Each option must be evaluated against functionality, chemical safety, processing requirements and regulatory compliance because improvements in one dimension can constrain another. In plastics, circular design must address polymer matrices and functional additives, including the recovery and retention of critical raw materials, and can create stable outlets for recycled material streams. Biodegradable solutions are relevant where collection is technically difficult or environmental leakage is likely.

A central challenge is that circular design can conflict with current performance requirements. Multi-material products (e.g. multi-material multilayer plastic packaging; polymer matrices with embedded functional additives) are widely used because their constituent materials provide key properties such as mechanical strength, barrier performance, durability, flexibility, adhesion, and surface functionality. Catalisti will promote simpler material architectures wherever the required product performance can be maintained (e.g. mono-material multilayer plastic packaging). Where simplification is not technically feasible in the short term, it will support circular solutions that enable the controlled separation, recovery or recycling of the constituent materials.

> “Designing for recycling means designing for both performance and separation”
>
> — Kristof Proost, Founder & CEO, IP-FAB

A high-impact innovation priority is improving polymer recyclability. Design for high-quality mechanical recycling should remain preferred wherever technically, economically and environmentally feasible, including through mono-material products that deliver the required functionality with fewer material types and additives and more recycling-compatible coatings or surface treatments. Where multi-material products remain unavoidable, debondable designs, including adapted adhesive chemistries, can enable controlled separation at end of life. Depolymerisation, dissolution recycling and delamination are needed for streams that mechanical recycling or controlled separation cannot address effectively.

Another high-impact innovation priority is understanding and managing recycled materials over multiple recycling cycles. As recycled content enters new products, cumulative effects on degradation products, input variability, mechanical properties, additives and regulatory compliance remain insufficiently understood. Managing legacy additives and contaminants, for example through deinking or deodorisation, is essential to maintain quality and compliance across multiple high-value loops. Decision-support tools can help companies choose among reuse, mono-material design, advanced recycling, debondable multi-material designs and biodegradability according to the application.

Reuse and repair, including approaches such as self-healing polymers, should also be considered because they can preserve more product value than recycling. However, industrial-scale reuse and repair are often constrained by reverse logistics, cleaning requirements, fragmented collection systems and cost. System-level analysis is therefore needed to identify the product streams for which reuse or repair can create tangible environmental and economic value.

Within the next decade, Catalisti aims to support the transition towards circular substances, materials and products by enabling reuse, repair and high-quality recycling wherever technically, economically and environmentally feasible, while safeguarding safety, functionality, environmental sustainability and overall system performance. Biodegradable solutions are pursued for applications where they provide a clear environmental benefit and where reuse, repair or recycling are not realistic options.

21 Circularity

Circularity starts with product design. Designing for recycling means considering from the outset not only how materials perform during use, but also how they can be separated and recovered at end of life. Triggered debonding illustrates this challenge particularly well: strongly bonded polymer surfaces need to provide reliable adhesion throughout a product's lifetime while allowing controlled separation when that product reaches its end of life.

Our experience with solar panel debonding has demonstrated both the technical complexity of achieving this balance and the opportunities it creates. Transferring these insights to other polymer applications, such as multilayer films, could enable new approaches to design for recycling and high-quality material recovery.

Turning this potential into economically viable products will require close collaboration between material producers, converters and recyclers. By considering performance during use and separation at end of life as part of the same design challenge, we can develop materials that perform when needed while enabling more effective recovery afterwards.

— **Kristof Proost**
Founder & CEO, IP-FAB



ACTIONS

Developing decision-support tools to identify the most appropriate circular design and end-of-life strategies based on the application requirements and value-chain conditions.

Improving understanding and management of recycled materials over multiple recycling cycles including the effects on degradation products, input variability, additives, mechanical properties and regulatory compliance.

Designing mono-material products that deliver the required functionality while minimising material types, additive complexity, and incompatibilities with high-quality recycling.

Developing circular multi-material products and advanced end-of-life technologies that enable the controlled separation, recovery, and recycling of constituent materials where mono-material designs are not technically feasible.

Pursuing biodegradable solutions where collection is technically difficult or environmental leakage is likely, provided they offer a clear environmental benefit and reuse, repair or recycling are not realistic options.

AMBITION

Accelerate the transition towards circular substances, materials and products by enabling reuse, repair and high-quality recycling wherever technically, economically and environmentally feasible, while safeguarding safety, functionality, environmental sustainability and overall system performance. Biodegradable solutions are pursued for applications where they provide a clear environmental benefit and where reuse, repair or recycling are not realistic options.

LEGEND

Indication of the timing
- Short term
- Mid term
- Long term

Impact of innovation and/or collaboration
- Minor
- Medium
- Major



22 Performance

INNOVATION NEEDS

Performance as a design dimension (performance by design) uses structure-property relationships at molecular, material and product levels to build the required functionality into substances, materials and products from the outset. Technical performance remains essential for market adoption but must be optimised together with safety, circularity and environmental sustainability. Requirements should therefore be defined and evaluated across the full life cycle and value chain, alongside economic viability and regulatory robustness. Performance by design extends beyond individual application specifications to optimise product and system performance under these combined design requirements.

A central bottleneck is the limited availability of accessible, high-quality data and interoperable digital infrastructure. Valuable data on formulations, processing, molecular properties and product performance are often fragmented, non-standardised or inaccessible across organisational boundaries because of IP and competition concerns. Consequently, predictive models cannot yet reliably connect molecular design and processing conditions with product performance. AI and other digital tools can accelerate materials discovery and formulation optimisation only with representative training data, robust validation and effective data-integration. Without these foundations, development remains overly dependent on trial and error, and performance requirements are often defined too late in the value chain.

> “Data-driven R&D as enabler to combine high technical performance with safety, sustainability and circularity”
>
> — Jasper Van Noyen, R&D Director Sealants and Adhesives, Soudal

Performance by design therefore requires stronger value-chain co-design. Chemical companies, material producers, converters, recyclers, brand owners, and OEMs need to align requirements earlier in innovation. Clear agreements on IP, data sharing, roles, and value capture are essential for trust, especially in early, low-TRL phases. Catalisti will facilitate this collaboration by convening the relevant partners and supporting alignment throughout the process.

The most immediate high-impact innovation priority is the deployment of validated digital tools. Digital twins of molecules, materials, formulations and processes can support virtual testing and optimisation before physical validation, reducing development time and allowing companies to explore a broader design space. Over time, connected digital models could integrate molecular design, processing conditions, application performance and end-of-life behaviour across the full life cycle. Their value depends on data being generated early, curated consistently, validated robustly and shared under clear conditions across the value chain. Catalisti will act as a neutral platform connecting industrial needs, research expertise and digital capabilities, supporting advanced digital strategies in larger companies and providing more targeted tools or demonstrators for smaller players.

Another high-impact innovation direction is to enhance performance by achieving more with less. Advanced products should deliver equal or superior functionality with lower material input, fewer additives, and simpler formulations. This combination can improve material efficiency while preserving material value and facilitating high-quality recycling.

Within the next decade, Catalisti aims to support the design of substances, materials and products that deliver the required functionality with greater material efficiency and shorter development cycles. Validated digital tools, high-quality data and value-chain collaboration will enable performance to be defined and optimised earlier across the full life cycle, while accounting for safety, circularity and environmental sustainability.

Our experience shows that maintaining competitiveness in the speciality chemicals sector increasingly depends on our ability to combine high technical performance with safety, sustainability and circularity. For developers of sealants, adhesives, foams and other formulation-based products, this means moving beyond the traditional optimisation of individual product characteristics and considering the full product life cycle from the earliest stages of innovation.

Decisions on raw materials, performance, durability, recyclability and end-of-life can no longer be addressed independently. They need to be evaluated together, balancing technical requirements, developing safer chemistries, anticipating substitution of substances of concern and enabling the growing demand for more circular material solutions. Achieving this requires close collaborative R&D across the value chain and across scientific disciplines.

At the same time, digitalisation is becoming an increasingly important enabler of innovation. Data-driven R&D, modelling and advanced digital tools can complement our strong formulation and application know-how, support more informed decision-making and identify the optimal balance between performance, safety and sustainability. Our experience is that digitalisation should not be seen as a separate objective, but as a means to develop differentiated solutions that remain relevant in increasingly demanding global markets.

— **Jasper Van Noyen**
R&D Director Sealants and Adhesives, Soudal



22 Performance

ACTIONS

Strengthening value-chain co-design by (i) aligning performance requirements early in innovation and (ii) establishing trusted mechanisms for IP management, data sharing and value capture across the value chain.

Deploying validated digital tools to accelerate R&D in material development and testing across the value chain by (i) enabling virtual design, testing and optimising before physical validation and (ii) supporting the generation, validation and sharing of high-quality data under clear conditions across the value chain.

Improving resource efficiency by delivering equal or superior functionality with lower material input, fewer additives, simpler formulations and enhanced recyclability.

AMBITION

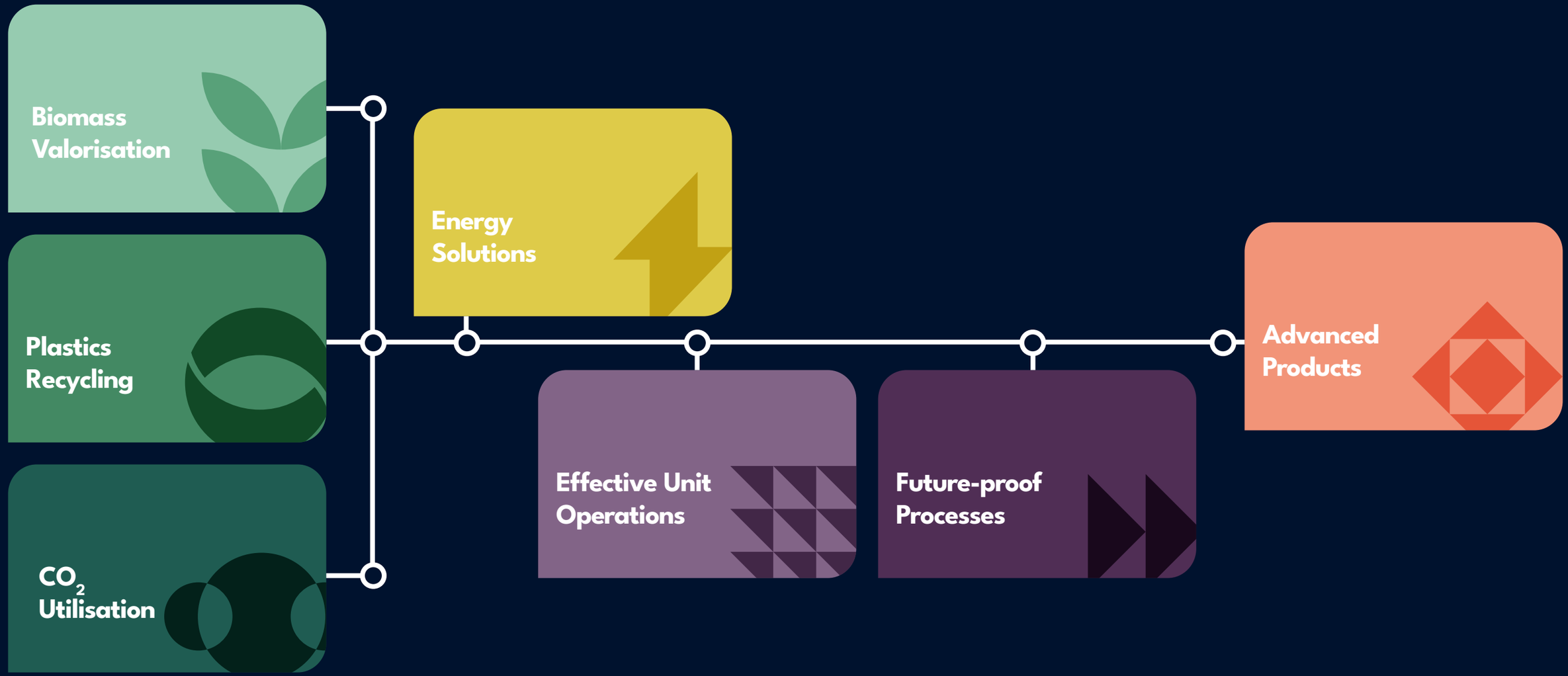
Accelerate the transition towards high-performing substances, materials and products by enabling functionality to be designed, predicted and optimised from the outset through data-driven innovation, digital tools and value-chain collaboration, while safeguarding safety, circularity, environmental sustainability and overall system performance.

LEGEND

Indication of the timing
- Short term
- Mid term
- Long term

Impact of innovation and/or collaboration
- Minor
- Medium
- Major

The value chain



121



Five roles, one innovation cluster

Catalisti focuses on five interconnected roles to stimulate collaboration and accelerate innovation.

First, Catalisti **builds partnerships and knowledge networks** by gathering and sharing relevant intelligence, mapping expertise and infrastructure, and bringing together the right stakeholders around emerging needs and opportunities.

Second, **brokering innovation projects and trajectories** remains at the heart of Catalisti's activities. As a neutral facilitator, Catalisti connects complementary partners and helps transform company needs and shared roadmap priorities into innovation projects with strong potential for industrial impact.

Third, Catalisti **strengthens start-ups and scale-ups** by connecting them with established companies, research institutes, collaborative projects, infrastructure and relevant funding and support mechanisms.

Fourth, Catalisti **collaborates across regions and borders**, linking the Flemish ecosystem to European networks, strategic partners, innovation projects and European funding opportunities.

Finally, Catalisti actively **collaborates across sectors and clusters** to identify opportunities at the intersection of value chains, align shared innovation priorities and translate them into intercluster roadmaps and collaborative projects.

Together, these five roles enable Catalisti to leverage knowledge, partnerships and funding across the innovation landscape. Through this integrated approach, Catalisti helps translate innovation opportunities into long-term innovation trajectories, spanning strategic basic and translational research, collaborative mid-TRL projects, and the pathway towards pilot, demonstration, scale-up and industrial deployment.

5 Roles, 14 pillars

PARTNERSHIPS & KNOWLEDGE NETWORKS

1 **Ecosystem intelligence and mapping**

Building and activating an innovation-driven knowledge network

2 **Strategic intelligence and knowledge sharing**

Enabling members to stay informed and respond faster to new opportunities

3 **Roadmap-driven ecosystem collaboration**

Bringing the ecosystem together, guided by the innovation roadmap

INNOVATION PROJECTS & TRAJECTORIES

4 **Collaborative project brokerage**

Brokering company-driven collaborative innovation projects

5 **Basic & translational research**

Feeding basic research and translating research results to the broader sector

6 **Innovation trajectory support**

Supporting company-driven projects from R&D to pilot and demonstration

START-UP & SCALE-UP SUPPORT

7 **Project brokerage & funding**

Helping start-ups with access to innovation projects and funding opportunities

8 **Ecosystem connectivity**

Connecting start-ups with the broader innovation ecosystem

COLLABORATION ACROSS REGIONS AND BORDERS

9 **European partnerships and network development**

Enabling cross-border matchmaking and project development

10 **European funding access and project development support**

Increasing participation of Flemish companies in EU projects

11 **EU innovation initiatives**

Creating value for the entire industry

COLLABORATION ACROSS SECTORS AND CLUSTERS

12 **Cross-sector alignment**

Structurally engaging with other spearhead clusters and innovation platforms

13 **Intercluster roadmaps**

Defining common innovation priorities where sectoral roadmaps intersect

14 **Intercluster project brokerage**

Proactively initiating and shaping intercluster innovation projects

Insights from our members: expectations and priorities

Results of the member satisfaction and wider stakeholder consultation conducted between November 2025 and January 2026.

As a first step towards this Innovation Roadmap, Catalisti invited its members in the autumn of 2025 to complete an online questionnaire. One in three members took part, with 85 responses from companies, universities and research institutes, federations and public bodies. Alongside the innovation drivers and priorities that shape this roadmap, the questionnaire also measured how satisfied members are with Catalisti.

Building partnerships and knowledge networks

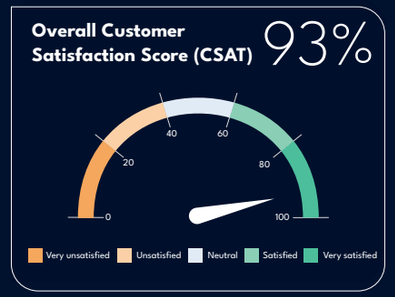
Strengths

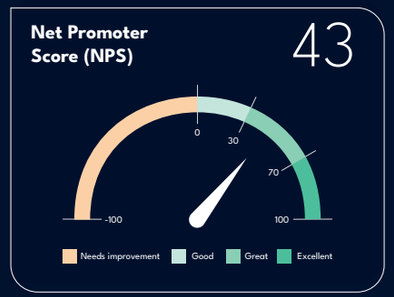
- Strong visibility within the Flemish ecosystem
- Networking events and opportunities to stimulate the collaboration between different actors
- Personal contact with the account manager and the facilitation of one-to-one connections

Areas for improvement

- Broader communication of ongoing and upcoming projects
- Information dissemination about subsidies, trends, policy developments, etc.
- More pro-active matchmaking and networking around specific technical themes and value chains

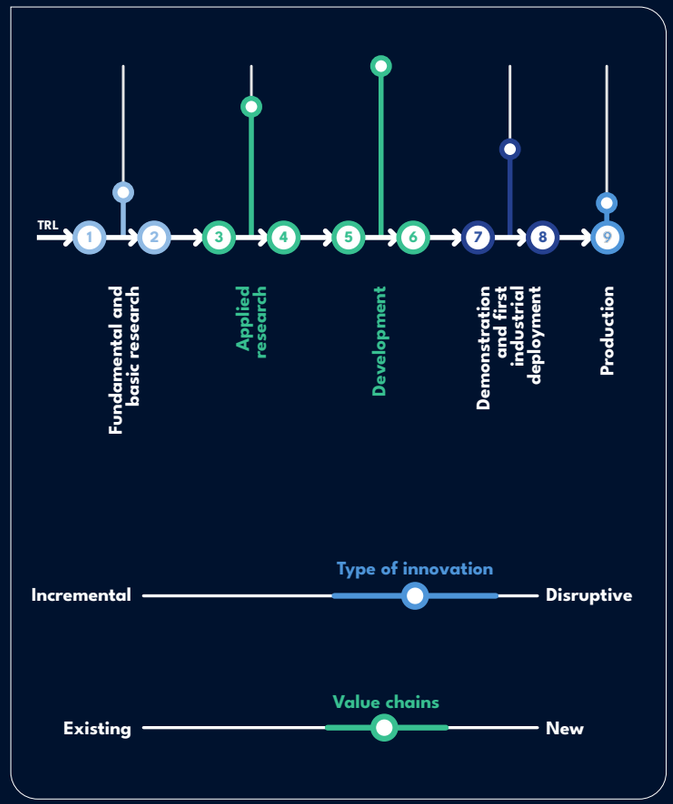
Overall satisfaction stands at 93%, and no respondent scored Catalisti below 4 on a scale of 7. The Net Promoter Score comes to 43: over half of the respondents would strongly recommend Catalisti. Members particularly value Catalisti's visibility in the Flemish ecosystem, its networking events and the personal contact with their account manager. Their suggestions for improvement — more project communication, theme-based sessions and proactive partner matching — have fed directly into this roadmap.





Brokering innovation projects and trajectories

Catalisti concentrates its efforts on collaborative innovation at TRL 3 - 6, while strengthening the pathway towards pilot, demonstration and industrial deployment through targeted support. Catalisti weights its efforts towards disruption and new value chains, while overall maintaining a balance between incremental improvements and disruptive innovation.



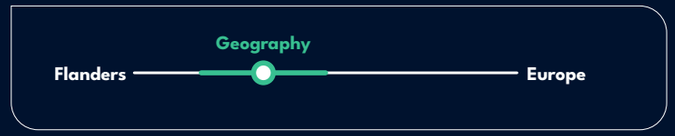
Strengthening start-ups and scale-ups

Start-ups and scale-ups are a vital part of the ecosystem. Support is primarily needed to facilitate R&D collaboration projects and to connect start-ups with universities and research institutes, and larger companies.



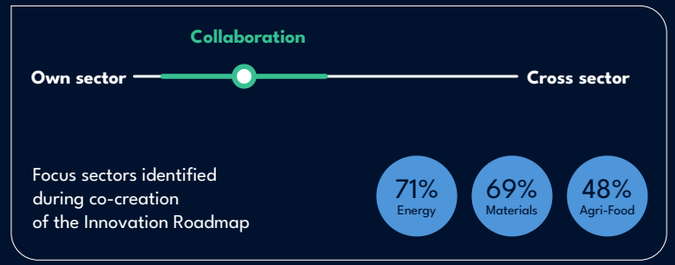
Collaborating across regions and borders

Support in European projects is primarily needed for information and knowledge sharing, networking, and partnership building.



Collaborating across sectors and clusters

Mostly focus on the chemicals and plastics sector, but where relevant go cross-sectoral.



127

Building partnerships and knowledge networks

1. **Ecosystem intelligence and mapping**
2. **Strategic intelligence and knowledge sharing**
3. **Roadmap-driven ecosystem collaboration**

AMBITION

Catalisti builds an active and future-oriented innovation ecosystem in which companies and knowledge partners can easily connect, share knowledge and expertise, and collaborate on innovation. All members are well informed and have clear insight into available infrastructure, expertise across companies of all sizes and research institutes, as well as relevant trends and developments.

Unlocking the full potential of the ecosystem by connecting knowledge, expertise, infrastructure and people across organisational boundaries

Catalisti goes beyond simply sharing information with its members and ecosystem partners. It actively builds and strengthens knowledge networks across the entire innovation value chain. Through thematic brainstorming sessions, workshops, working groups, and networking events, Catalisti stimulates knowledge exchange, identifies emerging innovation needs, and helps shape future innovation priorities.

By connecting the right partners and fostering strong collaborations, Catalisti brings together complementary knowledge, expertise, and capabilities. In doing so, it unlocks value that far exceeds what individual organisations can achieve on their own, creating a stronger and more innovative ecosystem for all participants.

— **Ania Coen**
Innovation broker, Catalisti



Building partnerships and knowledge networks

Catalisti fosters a well-connected and informed innovation ecosystem in which collaboration between companies, research institutes, industry federations, incubators, and public authorities becomes the norm. Members have clearly expressed the need for better insight into industry innovation challenges, as well as greater visibility of the expertise, research capabilities, and infrastructure available across universities and research institutes.

To address these needs, Catalisti takes a proactive role in gathering, sharing, and interpreting strategic intelligence. This includes information on emerging start-ups and scale-ups, regional and international funding opportunities, technological breakthroughs in key domains, and relevant regulatory and policy developments. By providing timely and targeted insights, Catalisti enables members to identify emerging opportunities and respond more effectively to a rapidly evolving innovation landscape.

Drawing on its unique ecosystem-wide perspective, Catalisti not only shares relevant knowledge but also actively connects companies, researchers, expertise, infrastructure, and innovation opportunities. By bringing together the right partners at the right time, Catalisti strengthens collaboration, accelerates innovation, and maximises the collective impact of the ecosystem.

CATALISTI CONTACTS



— **Aron Deneyer**
Innovation Broker



— **Ania Coen**
Innovation Broker

1

Ecosystem intelligence and mapping

Catalisti builds and maintains a clear, up-to-date overview of the innovation ecosystem, providing a strong foundation for collaboration and accelerating project development. This includes mapping available pilot and demonstration infrastructure, expertise across the ecosystem, and emerging innovation needs. By making this intelligence visible and easily accessible through a dedicated knowledge platform, Catalisti enables its members to quickly identify relevant capabilities, connect with potential partners, and explore new opportunities for collaboration. This pillar provides the foundation for effective innovation support, stronger project generation, and a more connected and responsive innovation ecosystem.

- Maintaining a clear and up-to-date overview of (pilot) infrastructure, expertise and emerging innovation needs
- Making this intelligence visible and accessible through a knowledge platform

2

Strategic intelligence and knowledge sharing

Catalisti shares relevant and timely insights on technological breakthroughs in strategic themes, emerging Flemish and European funding opportunities and evolving policy developments. Through targeted communication and knowledge sharing, Catalisti helps members stay informed, anticipate change, and respond quickly to new opportunities. By equipping members with the right intelligence at the right time, Catalisti strengthens their ability to initiate, join, and shape innovation trajectories with greater confidence, relevance, and impact.

- Sharing relevant and timely information on technical breakthroughs on strategic themes
- Informing on new Flemish and European subsidy instruments, calls and policy trends

3

Roadmap-driven ecosystem collaboration

Catalisti brings the innovation ecosystem together through targeted networking events, thematic working groups, focused brainstorming sessions, and innovative interaction formats that stimulate collaboration around strategic themes and value chains. Guided by its innovation roadmap, Catalisti connects the right stakeholders, facilitates the development of strong partnerships, and drives collective innovation efforts towards shared priorities. By continuously updating the roadmap based on ecosystem feedback and emerging signals, Catalisti ensures that members' needs remain at the centre of its activities and that innovation efforts remain relevant, focused, and action-oriented.

- Organising targeted networking, thematic working groups and focused brainstorms around concrete themes and value chains
- Updating the roadmap regularly based on ecosystem feedback and signals







131

Brokering innovation projects and trajectories

4 **Company-driven collaborative project brokerage**

5 **Sector-wide strategic basic and translational research**

6 **Company-driven innovation trajectory support**

AMBITION

Catalisti is the preferred innovation partner for collaborative innovation projects in Flanders in the chemicals and plastics sector. All supported projects fit into an innovation trajectory with the highest chances of effectively leading to valorisation.

Helping promising ideas travel further

The most rewarding part of being an innovation broker is seeing the moment when companies realise that a challenge they face is not theirs alone. What begins as a conversation about a specific technical need can reveal a shared opportunity and bring together partners with complementary expertise, resources, infrastructure and ambitions.

Our role is to help turn that first connection into a credible innovation project and, ultimately, a longer-term trajectory. That means asking the right questions, building trust between partners and keeping the business case and route towards valorisation in sight from the start. A strong project is not simply a well-written proposal. It is a consortium that understands what it wants to achieve together, why each partner is needed and what the next step should be once the project ends.

Personally, I find it especially satisfying when an initial idea continues to grow beyond the project itself, through follow-up research, pilot validation, a new partnership or industrial implementation. That is when you see that brokerage is not only about launching projects, but about helping promising ideas travel further.



Brokering innovation projects and trajectories

Facilitating collaborative innovation projects lies at the heart of Catalisti's activities. Acting as a neutral broker, Catalisti brings together companies, research institutes, and other stakeholders to build strong partnerships and address the complex challenges that often arise in collaborative innovation. This role creates the greatest value at the mid-TRLs, where research institutes and industry meet, companies collaborate, and promising ideas are translated into tangible innovation opportunities. Rather than operating in isolation, individual projects form part of a broader portfolio that contributes to long-term innovation trajectories within the cluster.

Catalisti therefore continues to place a strong focus on mid-TRL innovation, where collaboration has already demonstrated its long-term value for the ecosystem. At the same time, Catalisti recognises that a healthy innovation pipeline requires continuous investment across the entire TRL spectrum. At the lower TRLs, disruptive research conducted by research institutes, with active involvement from industry, provides the foundation for future breakthroughs. At the higher TRLs, companies often face significant technical, financial, and operational challenges when scaling innovations towards pilot, demonstration, and industrial deployment. To help bridge this gap, Catalisti increases its support for pilot and demonstration projects and advocates for stronger support mechanisms that accelerate scaling and first industrial deployment.

To strengthen the long-term competitiveness, sustainability, and resilience of the industry, Catalisti actively supports both disruptive and incremental innovation. Disruptive innovations can create entirely new markets, value chains, and business opportunities, while helping companies differentiate themselves and generate additional value. At the same time, incremental innovations remain equally important, as they can deliver significant improvements in productivity, efficiency, and sustainability in the shorter term. By fostering a balanced innovation portfolio, Catalisti enables its members to capture immediate benefits while building the foundations for long-term transformation and growth.

CATALISTI CONTACTS



— **Stef Koelewijn**
Innovation Broker



— **Aron Deneyer**
Innovation Broker

4

Company-driven collaborative project brokerage

Facilitating collaborative innovation projects remains at the heart of Catalisti's activities. Guided by the action plans of the seven programmes and their underlying tracks within the innovation roadmap, Catalisti continuously identifies new ideas, challenges, and innovation opportunities. By bringing companies together and complementing their expertise with research institutes, Catalisti creates strong consortia capable of addressing ambitious innovation goals.

From the earliest stages of project development, Catalisti focuses not only on technological excellence and partner complementarities, but also on the business case and economic rationale underpinning each initiative. This ensures that projects are well positioned to deliver future valorisation and impact. Catalisti actively supports the development of project concepts into high-quality proposals and guides consortia throughout the entire process, from the initial idea through to approval by VLAIO. As a recognised Flemish spearhead cluster, Catalisti can leverage dedicated VLAIO funding to support collaborative innovation projects via earmarked funds.

Throughout project execution, Catalisti continues to act as a neutral facilitator, fostering effective collaboration among partners and serving as a trusted interface between the consortium and VLAIO. Catalisti also supports the drafting and negotiation of the collaboration agreement between consortium partners, an important step in establishing a clear framework for the project collaboration.

Beyond project approval and execution, Catalisti monitors the long-term impact of its innovation portfolio. By tracking the results achieved in the years following project completion, Catalisti gains valuable insights into economic, technological, and societal impact, helping to strengthen future innovation initiatives and maximise value creation for the ecosystem and Flanders.

Supporting and guiding project development up to a full proposal, with attention to the business case from the start

Acting as neutral liaison during project execution and monitor the realised impact afterwards

What makes a collaborative innovation project work? Koenraad Debackere

Science and its applications have progressed through a balanced mix of competition, collaboration, and sharing. This balancing act brings together two fundamentally different perspectives on agency and transaction costs. One approach focuses on the structural importance and the design of contracts. Contracts are agreements in writing between two or more parties which are perceived as legally binding, focusing on technical content, formal and structured organisation, milestones, intellectual property, deliveries, costs and timelines. They are considered an effective and efficient governance mechanism. The other approach focuses on relational processes and stresses the importance of trust as a psychological state comprising the intention to accept vulnerability based on positive expectations of the intentions or the behaviour of others. Both dimensions are core to successful collaborative innovation projects.

The interaction between the trust dynamics of contracting, of the collaborating parties and of the content and application of the contracts, determines collaborative innovation project performance. Trust and contracts co-evolve. Trust dynamics are positively influenced when contract application is flexible, while they are negatively influenced when contract application is rigid and overly formal.[20] Flexibility allows for joint sensemaking on unexpected scientific and technological challenges. Both performance monitoring and behaviour monitoring must be in place for this co-evolution to occur. Flexibility is also valuable during processes of collaborative technology transfer and business model experimentation in new venture creation processes.[21]

> "He who receives an idea from me, receives instruction without lessening mine; as he who lights his taper at mine, receives light without darkening me"
>
> — Thomas Jefferson, 1813

The interaction of relational trust and contractual governance, accompanied by joint monitoring processes, must be embedded in a culture conducive to successful collaborative project work, bridging the institutions involved, and bridging the academic and business sectors. Gambi and Debackere (2025, 2026)[22, 23] have shown that a balanced synthesis of hierarchical culture, market culture, adhocracy culture, and clan culture (using the Competing Values Framework) underpins successful collaborative project work between academia and industry. The interplay of culture, contract governance and relational trust are the building blocks of successful collaborative project work. The co-evolution of the building blocks benefits both knowledge providers and knowledge users. As Grimpe and Kaiser have shown (2010)[24], the innovation performance of organisations is optimal when internal and external knowledge acquisition are in an equilibrium state, supporting a make "and" buy strategy rather than a make "or" buy strategy. Collaborative project work offers companies the ideal instrument to optimise this internal/external knowledge balance. Not only do companies benefit from this balance, but also the research organisations with which they interact benefit from the cognitive spillovers occurring during collaborations. They develop a deeper insight into the "problem of problem choice" that fuels the development of novel research agendas.

When Catalisti helps build this relational trust and contractual governance, it makes a strong contribution to the innovation ecosystem in Flanders.



— **Koenraad Debackere**
Executive director,
KU Leuven R&D

[20] Faems, D., Janssens, M., Madhok, A. & B. Van Looy. 2008. Towards an integrative perspective on alliance Governance. Academy of Management Journal, 51, 6: 1053-1078.

[21] Andries, P., Debackere, K. & B. Van Looy. 2013. Simultaneous experimentation as a learning strategy. Strategic Entrepreneurship Journal, 7, 4: 288-310.

[22] Gambi, L. & K. Debackere. 2025. The importance of an inclusive technology transfer office culture in linking university and industry. CERN IdeaSquare Journal of Experimental Innovation, 9:1: 23-35.

[23] Gambi, L. & K. Debackere. 2026. Organizational culture in technology transfer offices: from exploratory insights to extended evidence across LERU member universities. CERN IdeaSquare Journal of Experimental Innovation, 10, 3: in print.

[24] Grimpe, C. & U. Kaiser. 2010. Balancing internal and external knowledge acquisition. Journal of Management Studies, 47, 8: 1483-1509.

5

Sector-wide strategic basic and translational research

Catalisti strengthens the innovation pipeline by supporting strategic basic research and facilitating the translation of research outcomes into opportunities for the wider sector. Through industrial advisory boards and user committees, Catalisti actively involves companies in shaping research directions and aligning them with industrial needs. As with company-driven collaborative innovation projects, Catalisti can leverage dedicated VLAIO funding to support these initiatives. In this way, strategic basic research and translational research become part of broader innovation trajectories that generate impact across the entire ecosystem.

By connecting industry and research institutes around strategic challenges, Catalisti helps generate the scientific knowledge, technological insights, and breakthrough concepts that form the foundation for future industrial innovation. This early-stage research expands the industry's long-term innovation potential and creates the knowledge base on which future collaborative and individual innovation projects can build.

At the same time, Catalisti helps translate research results into opportunities for the broader ecosystem. Through knowledge dissemination, thematic collaboration, and the active exchange of insights and expertise, research outcomes reach a wider audience and can be further explored, validated, and adopted by companies.

Supporting new strategic basic research and the collective translation of existing research results

Involving companies as members of an industrial advisory board, creating the foundation for follow-up industrial projects

Early-stage research with industry in the loop, Steven Van Passel

For us as a university, Technology Readiness Levels are a shared language. The real issue is how low-TRL research can renew our chemicals and plastics industry facing climate neutrality, circularity, resource efficiency and global competition. These challenges cannot be met through incremental innovation alone. Many of the technologies the industry will need do not exist yet, and companies rarely develop that kind of knowledge on their own: most new scientific insight originates in universities and public research institutes. A sustainable transition therefore needs scientific underpinning and, most likely, more radical innovation. Low and high TRLs are not competing priorities: each is necessary, and neither is sufficient on its own.

Companies should therefore be involved from the beginning. Their knowledge of industrial conditions, value chains, regulation and scale-up barriers helps identify where breakthroughs could create real value. This does not mean letting companies define the research agenda; it means exploring together, early enough to prevent promising results from becoming stranded between laboratory and application.

Research must nevertheless remain ambitious and excellent, and look beyond today's questions. Universities start from curiosity-driven inquiry, long time horizons and high-risk ideas, using industrial dialogue to sharpen rather than narrow their questions. A balanced portfolio should combine projects addressing clear industrial needs with disruptive pathways whose relevance may only emerge over time. The returns on such research often take a decade or more to materialise. That patience is the price of genuine breakthroughs.

The university's distinctive contribution goes beyond technical expertise. We combine independent, interdisciplinary research with the freedom to challenge assumptions, develop enabling knowledge, train researchers and retain expertise over the long term. By linking chemistry and materials science with engineering, data science, economics and sustainability assessment, we examine not only whether a technology works, but whether it can become environmentally, economically and socially viable. And the researchers we train, many of whom later move into industry, remain one of the most effective channels through which knowledge reaches companies.

More early-stage results will be valorised only if the transition from discovery to application is organised deliberately. Researchers need incentives, time and professional support; companies need accessible entry points and confidence to engage while outcomes remain uncertain; and promising projects need continuous funding, shared infrastructure and teams spanning scientific, entrepreneurial and industrial expertise. Success ultimately requires universities and companies to share risk, exchange knowledge earlier and remain engaged beyond a single project. Catalisti helps us create the space in which this can happen.



— **Steven Van Passel**
Vice-rector Valorisation and Sustainability - Professor Environmental Economics, University of Antwerp

6

Company-driven innovation trajectory support

Catalisti identifies and leverages complementary funding and support beyond its dedicated funding instruments to address specific needs across the innovation value chain. Acting as a broker and facilitator, Catalisti helps companies and consortia navigate the innovation landscape by matching the most suitable instruments to their ambitions and supporting pathways that move innovations from early-stage research through pilot and demonstration activities towards industrial deployment and, where relevant, investment support.

For individual company projects, Catalisti primarily provides first-line advice and targeted referrals to specialised organisations and support mechanisms. For company-driven collective and collaborative projects outside its dedicated funding portfolio, Catalisti takes a more active role. By connecting the right partners, identifying suitable funding opportunities, and supporting project development, Catalisti helps transform innovation ambitions into concrete initiatives with the potential to generate lasting economic and societal impact.



Matching the right instruments to the needs of companies along the value chain

Organising first-line advice and targeted referral for individual company projects

Involving deeper in collective and collaborative projects

From lab to pilot: turning innovation into industrial reality, Thomas Cardinaels

One of the biggest challenges in industrial innovation is translating promising technology concepts into reliable industrial-scale processes. This transition is often referred to as the "valley of death": the stage where a technology has proven scientific merit, but has not yet demonstrated the robustness, economics and operational reliability needed to attract industrial investment. Pilot-scale validation is one of the most important mechanisms to bridge this gap because it reduces both technical and investment risks before commercial deployment.

Projects rarely fail because of a single technological obstacle. More often, they stall due to a combination of factors. Laboratory experiments are conducted under tightly controlled conditions and at small scale, but industrial reality is different. Process stability must be demonstrated continuously, product quality must remain consistent, supply chains need to function, safety and permitting requirements become more demanding, and sufficient quantities of material must be produced for downstream testing with customers. In addition, pilot infrastructure requires substantial capital investment and specialised operational expertise that individual companies, especially SMEs, often cannot justify building on their own. The result is that many promising innovations remain stranded between proof-of-concept and industrial deployment.

At VITO, we have experienced first-hand how dedicated pilot infrastructure can help overcome this challenge. A good example is our LignoValue installation and the complementary PILLAR II installation. Together, they form a unique, integrated pilot platform for converting lignin into renewable aromatic building blocks. Establishing and operating such infrastructure to demonstrate innovative processes requires appropriate support facilities and utilities, posing both practical and organisational challenges for research organisations such as VITO. We have established a dedicated pilot site and operator teams, enabling round-the-clock operation during pilot campaigns. A successful 72-hour continuous pilot run demonstrated stable operation, while pilot-produced material has also been supplied to industrial partners for application development. These milestones provide a concrete basis for further scale-up and industrial validation.

Pilot infrastructure can reduce technical risks, but it does not automatically create industrial adoption. The real challenge is connecting promising technologies with industrial needs, funding opportunities, application development and committed industrial partners. This is where Catalisti plays a crucial role. Pilot infrastructure delivers its full value when it is embedded within a broader innovation ecosystem. Catalisti brings together companies, knowledge institutions and public stakeholders around shared innovation roadmaps and collaborative projects. Through its coordinating role in Moonshot, Catalisti helps align long-term industrial challenges with research investments and build the project portfolio needed to fully leverage strategic infrastructure. To accelerate pilot deployment in Flanders, companies should engage early as co-developers, while VLAIO support, backed by streamlined and effective procedures, is essential for capital-intensive scale-up and demonstration. In this context, Catalisti can further strengthen its role as a neutral orchestrator, connecting industrial needs, pilot infrastructure, research expertise and funding into coherent innovation trajectories.

Flanders has world-class scientific capabilities. The challenge is ensuring that innovations become industrial reality. Pilot infrastructure, combined with strong ecosystem collaboration, is one of the most powerful tools we have to make that happen.

— **Thomas Cardinaels**
Research Director
Materials and Chemistry,
VITO



Catalisti's project stage-gate and earmarked funds

Catalisti supports its partners at every stage of their innovation journey. From the initial idea to final submission, Catalisti supports shaping the scope, building the consortium, strengthening the proposal and submitting the project. This project stage-gate safeguards focus and time in a complicated process, and guarantees the appropriate allocation of Catalisti's earmarked funds.



The right structure, expertise and guidance at every step, Stef Koelewijn

A successful collaborative innovation project rarely starts with a fully developed project proposal. More often, it begins with an idea, a challenge, or an opportunity that needs to be translated into a strong consortium and a clear innovation pathway. Bringing together the right partners, aligning ambitions, defining a common scope, and building a convincing business and innovation case is a complex process that requires both structure and experience.

At Catalisti, we have therefore developed a clear stage-gate approach that helps partners address the right questions at the right moment. Once we start working on a project, we have a clear goal in sight. Step by step, we support companies and research institutes in transforming promising ideas into high-quality collaborative innovation projects that have a strong chance of success.

A key element in this process is the interaction with our Innovation Committee (IC). With limited resources available, it is essential to focus on the projects that can create the greatest value for the sector. Project ideas are therefore assessed against Catalisti's innovation roadmap, their innovative character, their relevance for the ecosystem, their environmental and societal contribution, and their potential economic impact. It provides constructive and valuable feedback that helps strengthen project concepts, sharpen objectives, and identify opportunities for greater impact.

The combination of this stage-gate, the industry-oriented perspective of the IC, the project-building experience of the Catalisti team, and the technical expertise of all involved consortium partners creates a strong foundation for success. It gives partners confidence that they invest resources into innovations that truly matter and significantly increase the likelihood of a positive evaluation and successful implementation.

As a neutral party, we support the consortium in reaching a collaboration agreement that all partners can endorse, with clear arrangements on roles, intellectual property and the use of results.

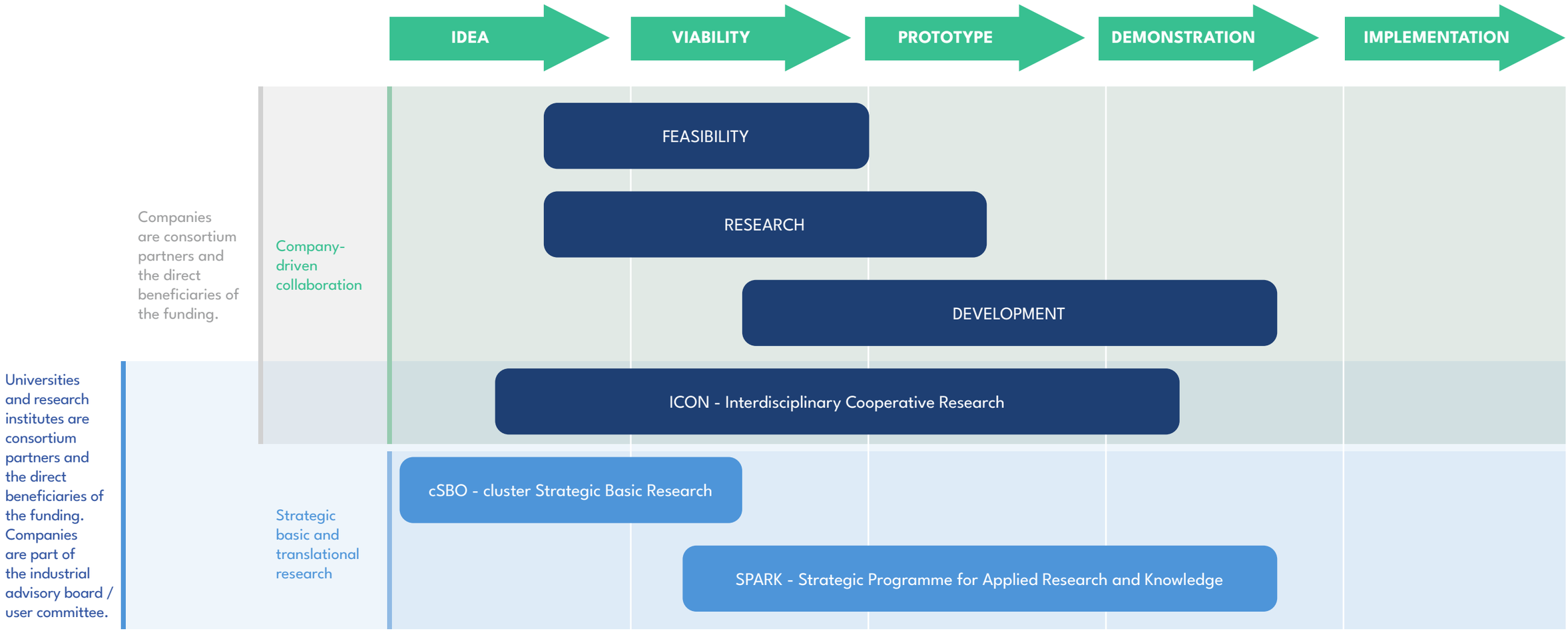
— **Stef Koelewijn**
Innovation broker, Catalisti



Did you know?

Catalisti has access to earmarked funds at the Flemish agency for innovation and entrepreneurship (VLAIO) to support collaborative innovation across the innovation pipeline in Flanders. Through these earmarked funds, Catalisti supports company-driven collaborative innovation projects, strategic basic research and translational research into opportunities for the wider sector. These instruments enable companies and research institutes to work together on shared innovation challenges, from developing breakthrough knowledge and technologies to accelerating their adoption and impact within industry. The basic requirement for eligibility across the different instruments for innovation clusters is the participation and collaboration of at least three companies (of which min. two should apply for subsidies).

Innovation project instruments



Enabling transition through collaborative innovation, Corien Struijk

Innovation rarely develops in isolation. Especially in chemistry and plastics, bringing innovation to industrial application can require a long trajectory, involving different technologies, companies, research institutes and positions in the value chain. A breakthrough at a university is only valuable to industry when someone can take it further. A promising technology needs partners to test, integrate and scale it. And the transition towards more circular, climate-neutral and competitive value chains requires actors to innovate not only within their own organisations, but increasingly with each other. That is where I see one of Catalisti's most important contributions.

As a neutral actor, Catalisti can connect partners around challenges and opportunities that go beyond the interests of one company. Catalisti knows the companies and research groups in the ecosystem, understands where complementary expertise can be found, and can bring together actors that may not naturally find each other. Just as importantly, the cluster can help build the trust required to share knowledge, define common ambitions and invest in collaboration. The renewed Flemish cluster policy explicitly reinforces this role of spearhead clusters as neutral actors and facilitators, combining knowledge valorisation with the articulation of companies' needs.

The role of the spearhead cluster becomes particularly valuable when innovation requires cooperation across a value chain. Circularity is an obvious example: feedstocks, product design, production processes, sorting, recycling and new applications cannot be optimised independently. The same applies to energy, digitalisation and advanced products. Innovation increasingly depends on understanding how one actor's solution connects to another's needs and constraints. Catalisti can create these connections, strengthen existing value chains and bring together the capabilities needed to develop new ones.

Projects are important, but they are not the destination. Their value lies in contributing to longer innovation trajectories and ultimately to the transitions the sector needs. Catalisti's roadmap spans the route from lower-TRL research, through collaborative research at intermediate TRLs, towards demonstration and industrial deployment. In chemistry, that journey can take many years, making connections between these stages at least as important as individual project success.

Catalisti is not starting from scratch. Over 10 years of collaboration between Catalisti, companies, research institutions, other stakeholders and VLAIO have created experience, networks and ways of working to build on. The new roadmap gives this ecosystem renewed direction: four innovation drivers, seven technical programmes and five cluster roles provide a framework to connect ideas and competences into trajectories with a common purpose.

For me, that is the real opportunity of this roadmap: to mobilise an ecosystem around meaningful transitions, particularly in these challenging times. If Catalisti can connect the right actors, build trust and help promising innovations progress from knowledge to application, individual projects become building blocks of something larger: new solutions, stronger value chains and a competitive, sustainable and resilient chemicals and plastics industry in Flanders.



— **Corien Struijk**
Account manager, VLAIO

Strengthening start-ups and scale-ups

7 **Start-up and scale-up project brokerage and funding support**

8 **Start-up and scale-up ecosystem connectivity**

AMBITION

Catalisti provides excellent and tailored support to start-ups and scale-ups with respect to project brokerage and networking. Start-up and scale-up support is well coordinated among different complementary partner organisations in Flanders, with Catalisti as one of the central network partners.

Why a start-up needs a network

In project brokerage we see a familiar pattern: a start-up with a strong technology that is not yet part of any value chain. It has a lab result and a first customer conversation, but rarely the industrial partner, the pilot infrastructure or the scale needed for the next step. Established companies, in turn, are looking for innovative technologies, yet hesitate to commit to a company that has not reached their level of industrial capacity.

Yet the success of a start-up or scale-up rarely depends on technology alone. Access to the right industrial partners, expertise and innovation networks is often the difference between a promising idea and a successful business. Many start-ups and scale-ups struggle to gain visibility, establish credibility and build the connections needed to access collaborative innovation projects and value chains.

By connecting emerging innovators with established companies, research institutes and collaborative innovation projects, Catalisti creates opportunities that would otherwise be difficult to unlock. Participation in such projects not only helps start-ups and scale-ups validate and scale their technologies but also enables them to build trusted relationships across the value chain. In doing so, Catalisti helps accelerate their growth, strengthen their market position and increase their contribution to a stronger, more innovative and future-proof ecosystem.



Strengthening start-ups and scale-ups

Start-ups and scale-ups play a vital role in driving disruptive and sustainable innovation. By developing breakthrough technologies and bringing them to market, they complement both established companies, which typically focus on optimising existing processes and operations, and research institutes, which concentrate on earlier-stage research and technology development. Despite their strong innovation potential, start-ups and scale-ups often face significant challenges, including limited access to finance, restricted resources, and insufficient connections across the value chain. Catalisti aims to address these barriers by working closely with ecosystem partners to strengthen links between innovators, industry, investors, and research institutes. By helping start-ups and scale-ups access relevant networks, expertise, collaboration opportunities, and support mechanisms, Catalisti enables them to accelerate technology development, strengthen their market position, and increase their contribution to the competitiveness, sustainability, and resilience of the wider ecosystem.

CATALISTI CONTACTS



— **Dieter Ruijten**
Innovation Broker



— **Laurie Braeckmans**
Business Developer

7

Start-up and scale-up project brokerage and funding support

As project brokerage remains at the core of Catalisti's activities, facilitating the active participation of start-ups and scale-ups in multi-partner innovation projects is a key priority. These collaborative projects not only support the development of innovative technologies but also provide start-ups and scale-ups with a unique opportunity to build relationships with established companies. Such connections are often difficult to establish independently, yet they can evolve into valuable long-term strategic partnerships.

Furthermore, Catalisti helps start-ups and scale-ups identify and secure funding opportunities through regional and international support programmes. To strengthen this support, Catalisti further develops its expertise in dedicated VLAIO instruments for start-ups and scale-ups. Catalisti acts as a trusted entry point, providing structured first-line guidance and facilitating access to the most appropriate support mechanisms. Beyond regional support instruments, Catalisti actively assists start-ups and scale-ups in accessing European funding opportunities and expanding their international innovation networks.



Facilitating active participation in multi-partner innovation projects with established companies

Providing first-line guidance on regional and international funding opportunities

Spin-offs, start-ups and licensing, Ignace Lemahieu

The choice of how to bring research into practice should be guided by its potential for lasting societal and economic impact. Collaboration with established companies, licensing and spin-offs offer complementary routes. A licence can be granted to either an established company or a spin-off; the most suitable approach depends on the technology and the resources needed to develop it.

An established company is a natural partner when the technology fits its business and it has the expertise, infrastructure and market access to take it forward. However, finding a willing partner can be difficult, and licensing negotiations may take time. Research teams therefore need sufficient funding to sustain development in the meantime. Licensing agreements should also ensure that the technology is actively developed and applied rather than shelved.

A spin-off may be more appropriate when a technology opens up a new market or business model, or requires a dedicated team to become commercially viable. It can also provide a way forward when substantial development remains and university resources are insufficient. By means of a Fast Lane standardised valuation approach, as for example used by Ghent University, spin-off companies can be created using standardised templates and agreements on very short notice (several weeks).

The decision ultimately depends on development risks, funding needs, entrepreneurial capacity and the commitment of potential industrial partners.

Once involved in collaborative projects, spin-offs should be recognised as full innovation partners from the project development stage, with a distinct contribution and a clear commercialisation pathway. Their limited staffing and financial resources call for manageable work packages, proportionate administration and careful attention to co-financing and cash flow. Clear agreements on existing knowledge, project results and usage rights are equally important. Collaboration should strengthen the intellectual property position that supports growth and attracts investors, while giving other partners sufficient scope to contribute.

Access to industrial testing facilities, infrastructure, expertise and first customers can help turn research into practical applications. Catalisti can support this process by connecting technology transfer offices, emerging spin-offs and established industry. Transfer offices contribute expertise in technology, intellectual property and commercialisation, while Catalisti adds insights into industrial needs, value chains, potential partners and possibly investors. Our business developers can help connect Catalisti with spin-offs in development.

By involving spin-offs early in consortium development, Catalisti can help identify testing partners and first customers and encourage balanced collaboration. Young companies should help shape projects while retaining room to develop their own businesses. For the Innovation Roadmap, we therefore propose systematically including spin-offs and start-ups in project development. Link each relevant collaboration pathway to a clear next step: further validation, a pilot, a licence, a first commercial application or additional funding. In this way, Catalisti can help research results develop into sustainable industrial activity in Flanders.



— **Ignace Lemahieu**
Director of Research,
University of Ghent

8

Start-up and scale-up ecosystem connectivity

By strengthening ecosystem connections and improving access to critical resources, Catalisti enables start-ups and scale-ups to overcome growth barriers, accelerate innovation, and maximise their contribution to the competitiveness, sustainability and resilience of the sector. Catalisti actively connects start-ups and scale-ups with established companies, research institutes, and other key stakeholders across the innovation ecosystem. By facilitating one-to-one introductions, increasing the visibility of emerging companies, and continuously monitoring the start-up and scale-up landscape, Catalisti helps promising innovators gain access to the network, expertise, and opportunities they need to grow.

Catalisti also shares insights on relevant start-ups and scale-ups across the ecosystem, fostering new collaborations and strengthening value-chain connections. In addition, Catalisti facilitates access to pilot and demonstration infrastructure, helping start-ups and scale-ups validate, scale, and accelerate the market uptake of their innovations. Where specialised support is required, Catalisti refers companies to the right partner. The closest of these is BlueChem, the incubator for sustainable chemistry of which Catalisti is a founding partner and where Catalisti is based. BlueChem gives start-ups lab infrastructure, incubation and a first industrial network, while Catalisti brings them into collaborative innovation projects, funding trajectories and the wider Flemish and European ecosystem.

- Facilitating connections across industry, research and the broader innovation landscape
- Accessing to pilot and demonstration infrastructure
- Connecting with experts in financing, business development and scale-up support

Turning the chemical transition into industrial reality, Isabel Vermeulen

The future of chemistry is already taking shape. Across Europe, entrepreneurs are developing new technologies, exploring alternative feedstocks and rethinking how chemicals and materials are produced. Meanwhile, industrial companies are looking for ways to make their processes more competitive, more resilient, thus more sustainable.

This momentum comes at a critical time. Rising costs, global competition and the urgent need to decarbonise are putting Europe's chemical industry under pressure. Yet we have the knowledge, technological capabilities and entrepreneurial talent to drive change. What we cannot afford is to work in isolation. The future will be shaped by those willing to connect expertise, share challenges and turn opportunities into action.

The challenge is no longer just to define what the chemical industry should look like in 2050. It is to translate that long-term ambition into concrete projects, investments and industrial applications today.

This is where innovative start-ups and scale-ups have a critical role to play. They challenge established processes and develop new technologies that can transform chemical production. However, long development cycles, substantial capital requirements and complex value chains make industrial scaling difficult.

As I see it, technological readiness isn't enough. We need to consider industrial relevance much earlier in the innovation process. Understanding market needs, industrial requirements and potential partnerships in the early stages can make the difference between a promising technology and a viable industrial solution.

This thinking guides our approach at BlueChem. Our strength lies in our broad ChemTech scope, connecting the different building blocks of tomorrow's chemistry. From feedstock alternatives like renewable carbon, recycled resources and electrified molecules (CO_2, H_2 or NH_3), over process development towards advanced materials. We bring complementary innovation pathways together, enabling new combinations and different perspectives.

Industrial transformation requires both the agility of emerging technology and the experience, infrastructure and market access of established industry. Bringing these strengths together is essential to accelerate the transition. With BlueChem BASE and our expansion to BlueChem PORT, we strengthen that connection.
Our location gives us a distinctive advantage, but our ambition extends far beyond it.

Antwerp is our home, offering direct access to one of the world's most significant integrated chemical clusters. Flanders and Europe is our reach, connecting research institutions, technology developers, industrial players and investors. The world is where we ultimately want to make an impact.

However, proximity alone does not create innovation. It takes active collaboration, shared ambitions and a willingness to engage across organisational boundaries. Partnerships are therefore fundamental. Our collaboration with Catalisti connects collective research and innovation with entrepreneurship and industrial valorisation. Together with our wider network of partners, we can help promising technologies enter industrial value chains.

In summary: the chemical transition will not be measured by the number of promising technologies we develop, but by how many find their way into industrial practice. The momentum is here. Now is the time to connect, to build, to scale our efforts.

— **Isabel Vermeulen**
General Manager of BlueChem



Collaborating across regions and borders

9 **Strategic European partnerships and network development**

10 **European funding access and project development support**

11 **Strategic participation in European innovation initiatives**

AMBITION

Catalisti and its Flemish ecosystem are known and appreciated throughout the European innovation landscape and are recognised as an excellent, and at moments indispensable, partner in European collaboration projects. Innovation funding from the European level significantly leverages the Flemish funding.

Building a trusted European network

As an innovation cluster for the chemicals and plastics sector, we recognise the value of European collaboration in tackling complex challenges and driving sustainable growth. That's why Catalisti is building a trusted international network to bundle forces, share expertise and foster new collaborations across borders. These partnerships are the driving force behind European projects. While further developing existing partnerships with innovation clusters in the Netherlands, Germany and France, we will also explore new collaborations with complementary European regions to create additional opportunities for our companies and the wider ecosystem.

— **Laurie Braeckmans**
Business Developer, Catalisti



Collaborating across regions and borders

Catalisti helps its members and ecosystem partners strengthen their international connections and access European funding opportunities. International collaboration plays a crucial role in enhancing the competitiveness, visibility and innovation capacity of the Flemish chemicals and plastics sector. By connecting the Flemish innovation ecosystem to leading European networks, partnerships and funding programmes, Catalisti creates new opportunities for collaboration and innovation.

By leveraging European funding alongside Flemish support, companies can significantly increase the impact of their innovation efforts and accelerate the development, piloting and demonstration of new technologies. To help unlock these opportunities, Catalisti provides targeted guidance throughout the European funding journey. This includes sharing relevant knowledge, facilitating matchmaking with potential partners, and offering expert reviews of project proposals to improve the quality and competitiveness of grant applications.

In parallel, Catalisti actively builds strategic partnerships with leading European clusters and innovation networks, creating new collaboration opportunities and strengthening the international position of its members. Through these efforts, Catalisti acts as a gateway between the Flemish innovation ecosystem and the broader European innovation landscape, ensuring that international collaboration translates into tangible technological and economic value for its members and the wider sector.

CATALISTI CONTACTS



— **Martijn Roosen**
Innovation Broker



— **Laurie Braeckmans**
Business Developer

9

Strategic European partnerships and network development

A strong European network forms the foundation for successful international collaboration. Catalisti continues its partnership with the Netherlands and the German region of North Rhine Westfalia within the framework of the Trilateral Chemical Region initiative. Also, Catalisti builds on strategic partnerships with sister organisations in other strong chemical regions such as Axelera in the French Auvergne-Rhône-Alpes region. Through these partnerships, Catalisti creates opportunities for cross-border innovation, knowledge exchange and collaborative project development, including initiatives such as the annual trilateral matchmaking event.

At the same time, Catalisti proactively expands its European network by establishing new bilateral and multilateral partnerships with clusters and innovation networks across the chemicals and plastics value chain. By connecting its members to leading European innovation ecosystems, Catalisti facilitates access to expertise, collaboration opportunities and European funding programmes.



Strengthening existing partnerships

Building new partnerships with other clusters and innovation networks

10

European funding access and project development support

Catalisti aims to increase the participation of Flemish companies in European innovation projects by actively identifying, monitoring and promoting relevant funding opportunities. Particular attention is given to start-ups, scale-ups and SMEs, which often lack the capacity to continuously track the rapidly evolving European funding landscape. Catalisti prioritises calls that align with its Innovation Roadmap and address the needs of the Flemish chemicals and plastics ecosystem, with a specific focus on funding instruments that complement Flemish support schemes and help bridge the gap towards pilot, demonstration and scale-up activities.

Catalisti can support projects by signing LOIs, but, in addition, also plays an active role in the development of European innovation projects. Through targeted matchmaking, consortium building, proposal reviews and strategic advice, Catalisti helps companies transform project ideas into competitive European proposals. By leveraging its extensive Flemish and European network, Catalisti connects companies with suitable partners and facilitate the formation of high-quality consortia, further reinforcing its role as a trusted innovation broker and facilitator within the European research and innovation landscape.



- Identifying and promote relevant European funding calls
- Organising targeted matchmaking and expert review of EU proposals

153

11

Strategic participation in European innovation initiatives

Catalisti actively participates in selected European initiatives where it can create broad and lasting value for the chemicals and plastics sector. Priority is given to projects that generate impact beyond the immediate consortium by facilitating knowledge transfer, strengthening innovation ecosystems, disseminating best practices and providing direct support to SMEs. Catalisti pays particular attention to instruments such as Euroclusters and Horizon Europe Coordination and Support Actions, which often include cascade funding mechanisms that enable a broad range of companies to access funding opportunities and benefit from project outcomes.

Through participation in these initiatives, Catalisti not only expands the opportunities available to its members, but also increases the visibility of the Flemish chemicals and plastics ecosystem at the European level, strengthens relationships with leading cluster organisations, gains early insights into emerging policy and innovation priorities, and contributes to shaping future European innovation agendas relevant to the sector.

Participating in initiatives focusing on e.g. ecosystem building, knowledge transfer and cascade funding

Increasing visibility of the Flemish chemicals and plastics ecosystem at EU level



Europe as a springboard for SMEs, start-ups and scale-ups, Martijn Roosen

European collaboration offers much more than access to additional funding. It enables companies to validate innovative technologies, demonstrate their value at industrial scale, access new markets and build strategic partnerships across Europe. We will help Flemish companies navigate this landscape by identifying relevant opportunities and supporting the development of high-quality European projects.

Particular attention is given to instruments that complement the Flemish funding landscape and help bridge the gap towards higher-TRL activities. We support the development of European projects, including programmes such as EIC Accelerator, Eureka and InvestEU, that help SMEs, start-ups and scale-ups collaborate, pilot, demonstrate and scale innovative technologies and business models. Through consortium building, proposal development, project positioning and strategic guidance, Catalisti helps companies transform promising ideas into competitive European innovation projects.

At the same time, we will actively engage in initiatives that create value far beyond individual projects. Special attention is given to projects that create impact beyond the immediate consortium through ecosystem building, knowledge transfer, dissemination activities and cascade funding mechanisms that provide direct support to SMEs. Examples include Euroclusters and Horizon Europe Coordination and Support Actions that offer Financial Support to Third Parties, enabling a much wider group of companies to benefit from European innovation initiatives.





— **Martijn Roosen**
Innovation broker, Catalisti

Collaborating across sectors and clusters

12 **Cross-sector collaboration and ecosystem alignment**

13 **Intercluster roadmap development and alignment**

14 **Strategic intercluster project brokerage**

AMBITION

Catalisti is strategically aligned across complementary sectors and clusters regarding collaborative innovation. Catalisti enables major innovative breakthroughs and spillovers in other sectors with other clusters.

Innovation often starts where sectors meet

Some of the most interesting innovation opportunities emerge when we look beyond the boundaries of our own sector. The chemicals and plastics industry provides materials, technologies and building blocks for many other value chains, while depending in turn on expertise in areas such as energy, food, logistics and healthcare. Connecting these different perspectives often reveals shared challenges and combinations of expertise that would otherwise remain unexplored.

For Catalisti, intercluster collaboration is therefore more than bringing two networks together. It means identifying where roadmaps converge, creating a common understanding of the challenge and translating that alignment into concrete project opportunities. This requires time and openness: every sector has its own language, priorities and way of working, and meaningful collaboration starts by understanding those differences.

What I personally enjoy most is the moment when partners stop thinking in terms of ‘our sector’ and ‘their sector’ and begin to see the opportunity as a shared challenge. That shift in perspective is often where a new value chain, project or long-term collaboration begins.

— **Bert Boekaerts**
Innovation broker, Catalisti



Collaborating across sectors and clusters

The chemicals and plastics industry forms the foundation of, and is closely interconnected with, many other industrial sectors. As a result, collaboration is essential not only within companies and across company boundaries, but also across sectors and value chains. This interdependence is reflected in the sectors' high demand for energy, its reliance on efficient logistics networks to collect and distribute raw materials, and the widespread use of chemical building blocks in industries such as healthcare and agri-food.

By strengthening cross-sector collaboration, companies can unlock new synergies, address shared challenges more effectively and accelerate the development and deployment of innovative solutions. Considerable potential remains to create additional value through stronger connections between sectors and ecosystems. Besides Catalisti, Flanders has six other spearhead clusters: De Blauwe Cluster (blue economy), Flanders Food (agri-food industry), Flux50 (energy), Biovia (health tech & healthcare), VIL (logistics) and ENT.A (entertainment). At its core, each spearhead cluster has its own business-driven strategic innovation agenda or roadmaps.

CATALISTI CONTACTS



— **Bert Boekaerts**
Innovation Broker



— **Ania Coen**
Innovation Broker

12

Cross-sector collaboration and ecosystem alignment

Catalisti actively engages with other spearhead clusters and complementary innovation initiatives to identify shared opportunities, align strategic priorities and develop collaborative initiatives across sectors and value chains. By strengthening these connections, Catalisti helps unlock new opportunities for innovation, project development and funding. Through structured collaboration and joint activities, Catalisti improves the visibility of intercluster opportunities and provides clearer pathways for companies, universities and research institutes, and other innovation actors to engage in collaborative projects and access relevant funding instruments.

Beyond the spearhead cluster ecosystem, Catalisti proactively seeks collaboration with complementary innovation platforms and sector initiatives. By connecting ecosystems and bringing together complementary expertise, Catalisti creates new opportunities to address cross-sector challenges and accelerate innovation with greater impact.



Identifying shared opportunities and align priorities on an ongoing basis

Clarifying how companies and research institutes can participate in intercluster projects and access funding

13

Intercluster roadmap development and alignment

Catalisti collaborates with other spearhead clusters to develop shared intercluster roadmaps in domains where sectoral roadmaps converge. These roadmaps help define common innovation priorities, identify strategic transition challenges and create a more coordinated approach to cross-sector collaboration and innovation. The development and implementation of these roadmaps relies on close engagement with companies, universities and research institutes, and other innovation stakeholders to ensure that priorities are aligned with ecosystem needs and opportunities.

As an initial focus, Catalisti has identified three priority themes for intercluster collaboration: (i) recycling of food packaging, together with Flanders Food and VIL; (ii) valorisation of biomass side streams, together with Flanders Food and VIL; and (iii) energy for chemistry, together with Flux50. Building on these priorities, Catalisti continues to explore additional innovation themes and collaboration opportunities with other spearhead clusters.

Recycling of food packaging and valorisation of biomass side streams, together with Flanders Food and VIL

Energy for chemistry, together with Flux50



159

14

Strategic intercluster project brokerage

Catalisti uses these intercluster roadmaps as a foundation to proactively initiate, shape and facilitate intercluster innovation projects. By translating shared priorities into concrete project opportunities, Catalisti helps build long-term innovation trajectories. This structured approach ensures that projects aligned with the priorities of multiple spearhead clusters are developed in a coordinated, systematic and strategic manner. As part of its role as an innovation broker, Catalisti applies the same project development methodology used across its own innovation portfolio, ensuring consistency in stakeholder engagement, consortium building and project support.

Catalisti focuses on collaborative innovation projects at mid-TRL, complemented by strategic basic research and translational research, with active involvement of companies as project partners or members of industrial advisory boards. Dedicated VLAIO funding is available to support companies and research institutes participating in these intercluster projects, helping to translate shared roadmap priorities into concrete innovation activities and impact.

Using the intercluster roadmaps as a basis for better defined, more focused long-term innovation trajectories

Applying the same way of working as for Catalisti projects



Optimising the interaction between energy vectors, Frederik Loeckx

In its new strategy, Flux50, the Flemish energy cluster, has chosen "Energy for industry" as one of its key impact pillars. Indeed, the transformation of the energy sector and that of industrial processes go hand in hand. Our future industrial ambitions will only be within reach if we can provide sufficient, affordable, secure and sustainable energy. Likewise, the energy transition will only accelerate if our industry can provide resilient materials and products.

Further electrification of the chemical sector is certainly one of the opportunities in this transition, but it can be enhanced considerably. This means we need to combine our expertise more closely: bringing together process knowledge and expertise in energy system integration and conversion. In this context, integrating components with different operating dynamics is a key challenge. However, if we manage to integrate energy flexibility with process management, we can reduce costs. Even greater savings are possible if we optimise the interaction between the different energy vectors: electricity, heat, cooling and molecules.

At the same time, we need to connect energy infrastructure and assets more efficiently, both within and between companies and industrial clusters. This requires developing new models for energy system design and management across company and regional boundaries. Flux50 is reaching out to other sectors to address this challenge.

The interaction between the energy and chemical sectors is already intensive. The next step is scaling up. Catalisti's Moonshot programme already holds very promising ideas, from flow batteries without rare earth metals and innovative heat exchangers to high-temperature heat pumps and efficient electrolysers. These ideas need a boost to move from the lab to the plant, and Flux50 wants to help them get there. In the coming years we will work with the coordinators of ongoing Moonshot projects to map the most promising follow-up paths. We will also bring energy companies and energy-intensive users into their industrial advisory boards, and guide around the most promising projects into the next phase. What we're aiming for is concrete: investment decisions in Flemish pilot projects and new jobs. Sector-specific knowledge networks will make sure smaller chemical companies can join this effort as well. Working more closely together this way will let the chemical and energy sectors position our industry with more impact in initiatives under the European Clean Industrial Deal, particularly the Industrial Accelerator Act.

— **Frederik Loeckx**
Managing Director,
Innovation cluster Flux50





An open invitation to shape the ecosystem with Catalisti, Aron Deneyer

Shaping the future of the Flemish chemicals and plastics industry is a collective challenge. The transition towards climate neutrality, circular value chains, higher productivity and new market opportunities requires innovation at a scale and speed that no single company, research institute or public actor can achieve alone. Meaningful progress will only be possible through collaboration across companies, value chains, sectors, regions and disciplines.

This Innovation Roadmap provides a shared direction for that journey. It identifies the key challenges and opportunities facing the sector and translates them into concrete innovation priorities, programmes and collaborative actions. However, a roadmap only creates value when it is actively used, challenged and further developed by the ecosystem it is intended to serve.

Catalisti therefore invites companies, universities and research institutes, start-ups, scale-ups, public authorities, investors and ecosystem partners to actively contribute to the innovation trajectories described in this roadmap. Whether by sharing expertise, identifying emerging challenges, participating in collaborative projects, opening infrastructure, providing funding, joining strategic partnerships or helping to create new value chains, every contribution strengthens the collective innovation capacity of the ecosystem.

As a trusted and neutral innovation broker, Catalisti will continue to create the conditions for successful collaboration. By connecting the right partners, facilitating knowledge exchange, building strong consortia and helping organisations navigate the innovation landscape, Catalisti lowers barriers to collaboration and helps translate ambitions into concrete projects, investments and impact.

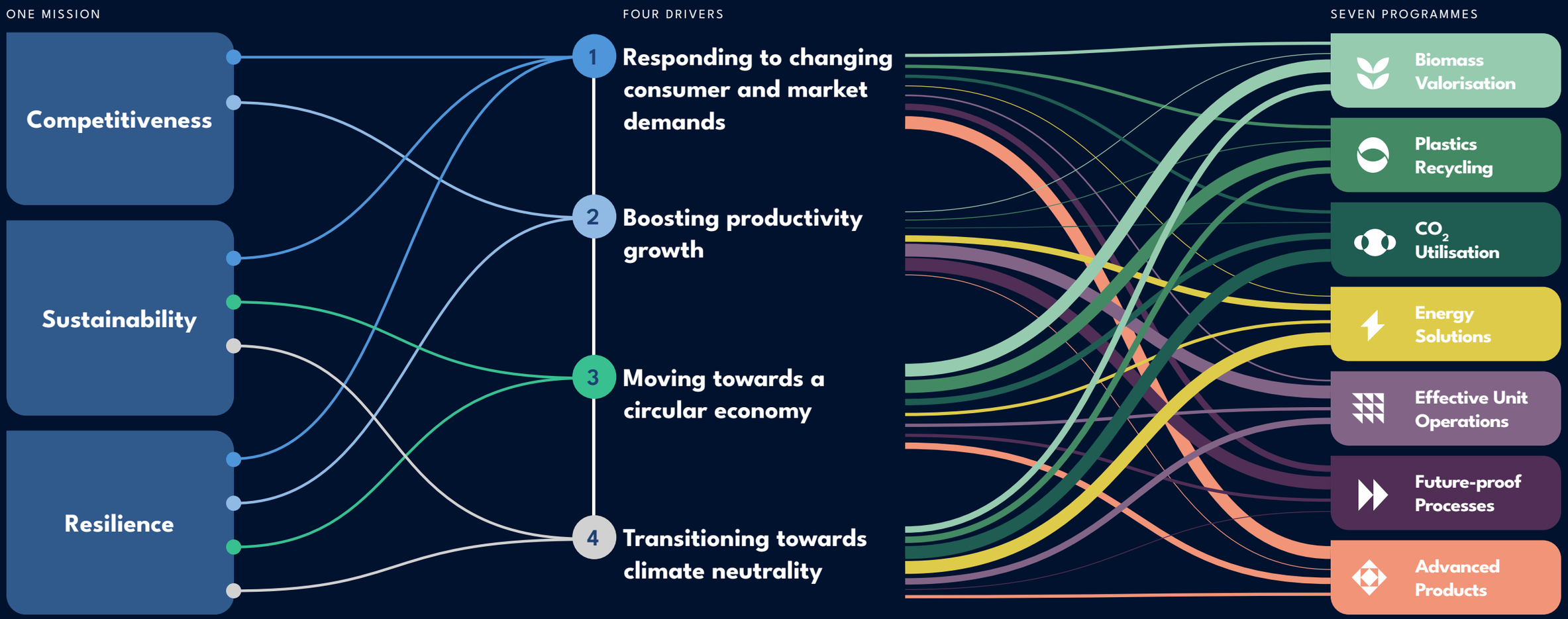
The opportunities ahead are significant. Flanders combines world-class industrial infrastructure, leading research capabilities, entrepreneurial talent and one of Europe's strongest chemical and plastics ecosystems. By combining these strengths through collaboration and innovation, we can reinforce the international competitiveness of our industry, accelerate the transition towards higher sustainability and build a resilient ecosystem capable of creating long-term economic and societal value.

We therefore invite all current and future partners of Catalisti to help shape, challenge and implement this roadmap. Join our knowledge networks, contribute to innovation projects, engage in strategic partnerships and help develop the breakthrough technologies, business models and value chains that will define the future of the chemicals and plastics industry in Flanders. Together, we can transform today's challenges into tomorrow's opportunities.



— **Aron Deneyer**
Innovation broker, Catalisti

The Innovation Roadmap at a glance



FIVE ROLES

- Building partnerships and knowledge networks
- Brokering innovation projects and trajectories
- Strengthening start-ups and scale-ups
- Collaborating across regions and borders
- Collaborating across sectors and clusters

165

Discover our members

Catalisti does not operate in isolation. It is embedded in an innovation ecosystem that brings together industry, universities and research institutes, government bodies, and a wide range of stakeholders. Each actor in this ecosystem plays a distinct role in enabling or driving innovation that strengthens the competitiveness, sustainability, and resilience of the chemicals and plastics industry in Flanders.

With a network of more than 170 members, complemented by a broader community of innovation stakeholders, Catalisti has the unique position to connect the right organisations, expertise and capabilities around shared innovation challenges and opportunities. The strength of the ecosystem lies not only in its size, but particularly in its diversity and complementarity.

Industry forms the backbone of the ecosystem. Catalisti's industrial members represent the full spectrum of the chemicals and plastics industry and span the entire value chain, from raw material suppliers and chemical producers to plastics manufacturers, technology providers, recyclers, and end users. Their needs, challenges and ambitions help shape Catalisti's innovation priorities and provide the foundation for new innovation projects and partnerships.

Catalisti's industrial network combines companies of different sizes, bringing together multinationals (47%), medium-sized enterprises (17%), small enterprises (25%) and micro-enterprises (11%). This diversity enables established industrial players, specialised SMEs and emerging companies to contribute complementary perspectives, technologies and capabilities to the innovation ecosystem. Alongside industry, Catalisti connects specialised research groups from leading Flemish universities and research organisations, both with each other and with its industrial members. They contribute the scientific expertise, advanced research infrastructure and talent required to explore new technologies, build knowledge and accelerate innovation, particularly in the earlier stages of the innovation funnel. By connecting these different actors, Catalisti creates an environment in which industrial challenges can meet scientific expertise, technological solutions and complementary capabilities. This ability to bring the right partners together and turn shared challenges into collaborative innovation is a key strength of the Catalisti ecosystem.

The strength of the Catalisti ecosystem lies in the diversity and complementarity of the organisations that form part of it. Together, our members bring the industrial expertise, scientific knowledge, technologies and capabilities needed to drive innovation across the chemicals and plastics value chains.

AC Biode
Actemium
Ad Rem
Against All Odds
AGC Glass Europe
Agfa
Agoria
Agricultural Management Consultancy
Air Liquide
Ajinomoto
Alco Energy Ghent
Alice Down The Rabbit Hole
Allnex
Alsico
Altarence
Amcor
ANRIC
Anziplast
Aquafin
Aquatreat
ArcelorMittal
Arnold & Siedsma
Arrow Carbon
Arteco
Ascorium
Astracite
Atlas Copco
Avecom
AVGI
B4Plastics

Barco
BASF Antwerpen
Bayer Agriculture
Beaulieu
BekaertDeslee
Bio Base Europe Pilot Plant
Blue Foot
Blue Salt
Borouge International
BOSAQ
Buildwise
Campine
Capricorn
Carboganic
Cargen Group
Cargill
Carpenter
Centexbel
ChemStream
Chevron Philips Chemical
Concordia Textiles
Covestro
Creaflow
Cronos
CTF2000
D-CRBN
DCM
De Clercq & Partners
Deceuninck
DESOTEC
Devan Chemicals
Dow
Eastman
Entras
Envalior
EOC
essenscia
Euralpack
Evonik Antwerpen
eXo membranes
Exolon Group
ExxonMobil
Fairbrics
Flanders Make
Fluxys
Galloo
Ghent University
Govaerts Recycling
Govi
Greenitio
Hasselt University
HBI
Healant
Henco
Holland Colours
Huntsman
I-Coats
imec
Incendin
Indaver
INEOS
Interscience
IP FAB
Johnson & Johnson
Kaneka
Kemin
Kingspan
KU Leuven
L-inc
Lawter
Lima
Luxilon
Lybover
LyondellBasell
Manetco
Matco Plastics
Materials Consult
MEAM
Milliken
Nero
Nippon Shokubai
Novatech
NovelYeast
Oleon
Orac
Pauwels Consulting
Plarebel
Plinius Labs
POLYMERA
PolySto
Port of Antwerp-Bruges
Prayon
PROCEPT
Prochemir
Procter & Gamble
Pryme
Puratos
PureCycle
Purtiso
QunaSys Europe
QustomDot
Rain Carbon
Recticel Insulation
REFAD
Renewi
ResourceFull
Sadechaf
Safety Pilots
Siemens
Sioen
Sirris
Solhyd
SOPREMA
Soudal
Spaas
Sumitomo
Suys
Sweco
Syensqo
Talenco
TekniPlex
Tereos
The Venturi Tribe
Thomas More
Tiense Suikerraffinaderij
TotalEnergies
Tramaco
Trinseo
Triple Helix
TÜV Austria
TWE
Umicore Specialty Materials Brugge
Unilin
University of Antwerp
V-Sure
Vandersanden
VdS Weaving
VITO
von Karman Institute for Fluid Dynamics
Voxdale
Vrije Universiteit Brussel
werecircle
Westlake Epoxy
Wm-Lightning
Worley
Zeopore

Become a Catalisti member

Whether you want to expand your network, turn ideas into breakthrough projects or shape the future of the chemicals and plastics industry, Catalisti offers a membership level that matches your company's ambitions. The overview below summarises the key benefits and services associated with each membership type for new members and projects as from 1 January 2027.

	CONNECT	INNOVATE	ENGAGE
Expand your network			
Free access to networking events & co-creation sessions	✓	✓	✓
On request connecting with Catalisti members	✓	✓	✓
Discover relevant collaboration opportunities	✓	✓	✓
Participation in advisory boards	✓	✓	✓
Visibility in Catalisti's communication channels	✓	✓	✓
Project support through a Letter of Intent	✓	✓	✓
Access to online member platform (once operational)	✓	✓	✓
Voting rights at Catalisti's General Assembly	✓	✓	✓
Turn ideas into breakthrough projects			
Participate in multi-partner innovation projects		✓	✓
Dedicated Catalisti account manager		✓	✓
Matchmaking & review for European, federal and regional projects		✓	✓
Increased visibility at Catalisti events		✓	✓
Free participation in advisory boards of ICON projects		✓	✓
Access to BlueChem networking events on request		✓	✓
Shape the future of the chemicals and plastics industry			
Access to the Innovation Committee			✓
Free participation in multi-partner innovation projects			✓
Free participation in advisory boards (except for cSBO projects)			✓

Interested in joining the Catalisti network?

Contact us to discover how Catalisti can support you with your next collaboration, funding or innovation opportunity.

Stay connected

Stay up to date on new opportunities, projects, calls and activities across the Catalisti ecosystem. Scan the QR code and subscribe to our newsletter.

CATALISTI CONTACTS



— **Laurie Braeckmans**
Business Developer



— **Michiel Wouters**
Communications Officer

List of tables and figures

List of figures

Figure 1: Key economic figures for chemical, plastics and life sciences sector in Flanders.
Source: essenscia, Chemie, kunststoffen en life sciences in Vlaanderen, Kerncijfers 2024.
https://www.essenscia.be/wp-content/uploads/2025/10/kerncijfers_2024-vland.pdf

Figure 2: Overview of the 1096 Belgian patent applications in chemistry, life sciences and biotechnology, including their share of total patent applications (43%), distribution across technological subdomains, and international comparison.
Source: European Patent Office, 2025
https://www.epo.org/en/about-us/statistics/statistics-centre

Figure 3: Deloitte identified six key segments in which the European Chemical industry can leverage its particular strengths and capitalising on the continuing trend towards sustainability and regionalisation: four with strong appeal and two with medium to strong appeal.
Source: Deloitte, Future of the European chemical industry: A positive outlook, 2026 (p.21-22)
https://www.catalisti.be/en/future-european-chemical-industry-positive-outlook

Figure 4: The hierarchical SSbD approach prioritises safety as a prerequisite for sustainability. Only when minimum safety requirements are met are environmental, social and economic aspects assessed, ensuring that sustainability gains do not come at the expense of human or environmental safety.
Source: European Commission, JRC Technical Report: Safe and Sustainable by Design chemicals and materials, 2022. (p.20)
https://publications.jrc.ec.europa.eu/repository/handle/JRC128591

Figure 5: A comprehensive non-exhaustive list of safety and sustainability dimensions to assess and design sustainable chemicals, materials, products and processes.
Source: Cefic, Safe and Sustainable-by-Design: A guidance to unleash the transformative power of innovation, 2024. (p.9)
https://cefic.org/resources/safe-and-sustainable-by-design-a-guidance-to-unleash-the-transformative-power-of-innovation/

Figure 6: A dominance analysis by Baarsma and D'Orey Neves, as presented in VARIO Recommendation 37, covering 24 countries over the period 2015-2020, found education to be the factor most strongly associated with productivity growth, followed by innovation. This result reinforces the importance of high-quality education and innovation as important factors in labour productivity
Source 1: Economisch Statistische Berichten (ESB), Nummer 4837S, Barbara Baarsma en Francisco D'Orey Neves, Onderwijs belangrijkste determinant van groei arbeidsproductiviteit, 2024. (p.13)
https://esb.nu/publicaties/jrg-109/4837s/
Source 2: VARIO, Advies 37: Naar een hogere productiviteitsgroei, 2024. (p.65)
https://www.vario.be/nl/adviezen-rapporten/vario-advies-37-naar-een-hogere-productiviteitsgroei

Figure 7: An overview of the technological, financial, human capital, and organisational challenges that need to be overcome to further drive and accelerate implementation of digital technologies in the chemical sector.
Source: Cefic & Arthur D. Little, Digital technologies for sustainability in the European chemical industry, 2023. (p.38)
https://cefic.org/app/uploads/2024/05/ADL_CEFIC_Digital_technologies_for_sustainability_2023.pdf

Figure 8: Projected evolution of the feedstock mix between 2019 and 2050.
Source: Cefic, The Carbon Managers: Modelling possible pathways for the EU chemical sector's transition towards climate-neutrality and circularity with iC2050, May 2025. (p.98)
https://cefic.org/resources/the-carbon-managers-ic-2050/

Figure 9: With the support of policymakers and increased collaboration with value chain partners, circular plastics will be able to grow and gradually replace fossil-based plastics.
Source: Plastics Europe, The Plastics Transition: Our industry's roadmap for plastics in Europe to be circular and have net-zero emissions by 2050, October 2023. (p.16)
https://plasticseurope.org/wp-content/uploads/2024/09/2310838_RoadmapCopyChange_110924.pdf

Figure 10: Analysis of eight technological transition pathways for Flemish industry and their projected GHG emissions.
Source: Deloitte, Naar een koolstofcirculaire en CO2-arme Vlaamse industrie, Contextanalyse en roadmapstudie - Publicatie voor het brede publiek, 2020. (p.25)
https://www.vlaanderen.be/publicaties/naar-een-koolstofcirculaire-en-co2-arme-vlaamse-industrie

List of tables

Table 1: Key economic figures for chemical and life sciences sector in Belgium.
Source: essenscia, Economische jaarcijfers 2025.
https://www.catalisti.be/en/2025-annual-economic-figures-chemicals-plastics-and-life-sciences-sector-belgium-essenscia

References

1 Erwin Douma et al., “European Chemical Closures and Investments Radar 2022-2025,” January 28, 2026, https://cefic.org/resources/european-chemical-closures-investments-radar-2022-2025/. Report prepared by Roland Berger on behalf of Cefic.

2 Moncef Hadhri, “Cefic Facts and Figures 2025,” Data set, December 2, 2025, https://cefic.org/resources/data-files-xls-2024-cefic-facts-and-figures/.

3, 4 essenscia, “Belgische chemie en farma op kantelpunt: minder jobs, export krimpt en investeringen blijven uit,” April 22, 2026, https://www.essenscia.be/belgische-chemie-en-farma-op-kantelpunt-minder-jobs-export-krimpt-en-investeringen-blijven-uit/.

5 Deloitte, “Future of the European Chemical Industry: A Positive Outlook,” July 25, 2025, https://www.deloitte.com/global/en/industries/energy-chemicals/perspectives/future-of-the-european-chemical-industry-a-positive-outlook.html.

6 essenscia, “België Bij Europese Koplopers Voor Innovatie in Chemie En Life Sciences,” April 8, 2026, https://www.essenscia.be/belgie-bevestigt-voortrekkersrol-in-chemie-en-life-sciences-met-sterke-patentcijfers/.

7 Deloitte, “Future of the European Chemical Industry: A Positive Outlook,” July 25, 2025, https://www.deloitte.com/global/en/industries/energy-chemicals/perspectives/future-of-the-european-chemical-industry-a-positive-outlook.html.

8 Cefic, “Safe and Sustainable-by-Design: a guidance to unleash the transformative power of innovation,” March 2024, https://cefic.org/resources/safe-and-sustainable-by-design-a-guidance-to-unleash-the-transformative-power-of-innovation/.

9 Flemish Government, “Vlaamse productiviteits- en competitiviteitsagenda. Visie en acties 2025,” February 2025, https://www.vlaanderen.be/publicaties/vlaamse-productiviteits-en-competitiviteitsagenda-visie-en-acties-2025.

10 VARIO, “Advies 37: Naar een hogere productiviteitsgroei,” November 6, 2024, https://www.vario.be/nl/adviezen-rapporten/vario-advies-37-naar-een-hogere-productiviteitsgroei.

11 European Commission, “A European Chemicals Industry Action Plan (COM/2025/530 final),” July 8, 2025, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex:52025DC0530.

12 Deloitte, “The Physical AI Dossier”, 2026, https://www.deloitte.com/content/dam/assets-shared/docs/about/ai-dossier/physical-ai-dossier.pdf?icid=lnc_download-the-full-dossier.

13 Cefic, “The Carbon Managers: Modelling possible pathways for the EU chemical sector’s transition towards climate-neutrality and circularity with iC2050,” May 23, 2025, https://cefic.org/resources/the-carbon-managers-ic-2050/.

14 The plastics transition. Our industry’s roadmap for plastics in Europe to be a circular and have net-zero emissions by 2050. Plastics Europe, October 2023.

15 Roadmap kunststofrecyclage. Eindrapport 2025. Study commissioned by Departement Werk, Economie, Wetenschap, Innovatie en Sociale Economie (WEWIS) in Flanders, June 2025. Study conducted by Deloitte Belgium.

16 Flanders Innovation & Entrepreneurship (VLAIO), “Contextanalyse en roadmapstudie: Naar een koolstofcirculaire en CO2-arme Vlaamse industrie,” November 2020. https://www.vlaanderen.be/publicaties/naar-een-koolstofcirculaire-en-co2-arme-vlaamse-industrie. Study conducted by Deloitte Belgium in collaboration with VUB-IES, Climact and AMS.

17 Eindrapport – Update contextanalyse en roadmapstudie: Naar een koolstofcirculaire, CO_2-arme en competitieve Vlaamse basisindustrie. Study commissioned by Agentschap Innoveren & Ondernemen (VLAIO), 30 June 2025. Study conducted by Deloitte Belgium in collaboration with VUB-IES.

18 Flanders Innovation & Entrepreneurship (VLAIO), “Contextanalyse en roadmapstudie: Naar een koolstofcirculaire en CO_2-arme Vlaamse industrie,” November 2020. https://www.vlaanderen.be/publicaties/naar-een-koolstofcirculaire-en-co2-arme-vlaamse-industrie. Study conducted by Deloitte Belgium in collaboration with VUB-IES, Climact and AMS.

19 Eindrapport – Update contextanalyse en roadmapstudie: Naar een koolstofcirculaire, CO_2-arme en competitieve Vlaamse basisindustrie. Study commissioned by Agentschap Innoveren & Ondernemen (VLAIO), 30 June 2025. Study conducted by Deloitte Belgium in collaboration with VUB-IES.

20 Faems, D., Janssens, M., Madhok, A. & B. Van Looy. 2008. Towards an integrative perspective on alliance Governance. Academy of Management Journal, 51, 6: 1053-1078.

21 Andries, P., Debackere, K. & B. Van Looy. 2013. Simultaneous experimentation as a learning strategy. Strategic Entrepreneurship Journal, 7, 4: 288-310.

22 Gambi, L. & K. Debackere. 2025. The importance of an inclusive technology transfer office culture in linking university and industry. CERN IdeaSquare Journal of Experimental Innovation, 9:1: 23-35.

23 Gambi, L. & K. Debackere. 2026. Organizational culture in technology transfer offices: from exploratory insights to extended evidence across LERU member universities. CERN IdeaSquare Journal of Experimental Innovation, 10, 3: in print.

24 Grimpe, C. & U. Kaiser. 2010. Balancing internal and external knowledge acquisition. Journal of Management Studies, 47, 8: 1483-1509.

Photo credits

All portrait photos of people who contributed and article to this roadmap, were provided to us by them with the explicit permission to use them in this roadmap.

All portrait photos of the Catalisti team. © Catalisti

All Photos on pages 32, 66, 78, 83, 100, 102, 104, 106, 108, 110, 112, 114, 116, 118 were licenced through Unsplash.com

p.48, 50, 52, 54, 56 cover photo Biomass Valorisation. © Cargill

p.51 © Oleon

p.56 Biocon facility for the production of bio-aromatics from wood and agricultural residues, developed as part of the Moonshot Flanders project PILLAR, located at KU Leuven's TRANSfarm. © KU Leuven/Rob Stevens

p.58, 60, 62, 64, 66, 68 cover photo Plastics Recycling. © Indaver

p.70, 72, 74, 76, 78 cover photo CO_2 Utilisation. © BASF

p.73 © ArcelorMittal Belgium

p.74 © Fluxys

p.80, 82, 84, 86, 88 cover photo Energy Solutions. © ArcelorMittal Belgium

p.90, 92, 94, 96, 98 cover photo Effective Unit Operations. © Indaver

p.93 © VdS Weaving

p.94 © Creaflow

p.98 © Zeopore

p.103, 113, 131, 138, 152, 153, 154, 155 © Catalisti
p.146 © Chemstars

p.158, 160 Innovfest 3.0. © Kris Van De Sande

p. 159 Innovfest 2.0. © Flux50

Notes

Notes

Design and layout
Niko Bruggemans, NIKONIC bv

Date of publication
24 November 2026

Publisher
Catalisti vzw
BlueChem, Olieweg 95,
2020 Antwerp
Belgium
—
info@catalisti.be
catalisti.be



