

Annual report 2022

Vision on  
technology  
for a better  
world



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SUSTAINABLE SOLUTIONS FOR BUILDINGS



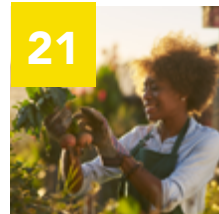
ROBUST WATER MANAGEMENT



TOWARDS A CIRCULAR AND BIO-BASED ECONOMY



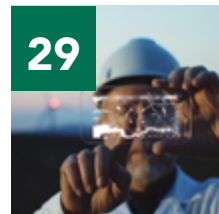
ENERGY SOLUTIONS FOR THE FUTURE



CLIMATE SERVICES



PERSONALISED AND PREVENTIVE HEALTHCARE



VALORISATION OF SUSTAINABLE TECHNOLOGY



OUTREACH



# Preface

Dear reader,

An annual report and annual accounts are much like a birthday party. The day after, the life of the person celebrating continues as usual, they are just one day older. In the same way, the research projects, stories and activities described in this annual report tie in with past as well as future projects, stories and activities. And everything forms a continuum: in 2021, the Flemish Government tasked Karl Vrancken with coordinating the PFAS issues in Flanders. In 2022, this task continued with the result of adapted legislation, an innovative approach to the PFAS issues ... and in 2023 Karl rejoined VITO, this time armed with more extensive knowledge.

Research projects under the EU Horizon programme typically run for four years. VITO was very successful in 2021 and in 2022 in securing this type of European, innovative research programmes. The growth in staff numbers in 2022 and those expected in 2023 can be seen as a direct result of this. For example, in 2022 VITO crossed the 1,000-employees milestone and will certainly also reach the 1,100th and possibly even 1,200th employee to join VITO. The fact that we are recruiting more and more international talent demonstrates that Flanders and VITO are playing - and winning - the 'war on talent' on a global scale. Digital tools, including a fully integrated onboarding app, help us considerably in this respect. Not only HR has been further digitised, but the entire internal VITO operation has received better digital support. The structural application of tele- and homeworking has created specific challenges, but also data management and protection, along with the protection of VITO intra- and internet traffic were given additional attention.

Other projects and activities that were continued or initiated include the official opening of the LignoValue Pilot, the Vlakwa operation and the contribution to an R&D agenda for water issues in Flanders, as well as the growth of the Water Climate Hub in Ostend. The collaboration with EnergyVille resulted in the establishment of the EnergyVille Foundation and the Foundation's first covenant with the Flemish government. The signing of the ESA Copernicus Data Access Service contract culminated in the development of a data space for the broad support of Digital Europe and the EU Green Deal.

The first edition of G-STIC at Tomorrowland, the Love Tomorrow Conference, was very successful. VITO established four spin-offs in 2022, guaranteed a continued high scientific output with 281 SCI papers and submitted 24 patent applications, licences for VITO research to SMEs and multinationals.

The VITO story, in 2022 with a slightly modified logo and visuals, carries on: continued growth in people and resources, support from the Flemish Government and industry, further knowledge acquisition and preparation for the next management agreement with the Flemish Government, which should be finalised by the end of 2023.

With the end of Covid-19 in sight in China and Covid-19 reduced to a manageable disease in Europe, the number of international VITO projects, supported by the World Bank or the Flemish Climate Programme, are once again on the rise. For example, further steps have been taken in the cooperation with South Africa and the Council for Scientific and Industrial Research (CSIR), Morocco and the Masen, Moroccan Agency for Sustainable Energy, as well as India and South America.

The tipping point in 2022 was undoubtedly the Russian invasion of Ukraine with untold human suffering, historically high energy prices and ditto inflation, as well as an assault on democracy and the way countries and governments should treat each other. The energy prices once again accentuated the need for more renewable energy production locally and globally and less dependence on countries with governments that are lax in international relations and cooperation. VITO has shown its support for Ukraine by collecting food products and supporting the Ukrainian Geographical Institute with hardware and access to data. VITO not only stands for providing knowledge about a sustainable society, but also initiating and supporting it. A sustainable society is only possible in harmony with nature and with its own humanity.

I hope you will enjoy reading this report.



I. Vanden Berghe  
Chairman of the Board of Directors

# Board of Directors

**Chairman:**

Ingrid Vanden Berghe

**Members:**

Dirk Fransaer, Michel Meeus, Christiane Malcorps, Francis De Meyere, Isabel Van Driessche, Eric Vermeylen, Jan Delcour en Elke Van de Walle  
not present in picture: Katrien Bonneux en Wim Van den Abbeele

**Government commissioners:**

Bob Van den Broeck

not present in picture: Elise Steyaert

**Observers:**

not present in picture: Wesley Boënné (VITO),  
Johan Keppens (PMV) en Maarten Spruyt (VITO)







# Sustainable solutions for buildings

## BUILDING ON A SUSTAINABLE AND CIRCULAR ECONOMY AND SOCIETY

If Flanders wants to fulfil its ambition and heat and cool its building stock in a fossil-free way by 2050, then many homes and buildings in our region will still have to be renovated and made climate-friendly. Or also: sustainable, because sustainability is more than just low-energy consumption. A sustainable home or building is also healthy, comfortable and inclusive for residents, users and visitors.

But renovations are also best done in a sustainable way. After all, the impact of the building sector on the climate, the environment and the use of raw materials and materials remains high. That is why VITO/ EnergyVille is helping to transform this sector. This is done through research into, and support in favour of, circular construction, because this reduces both the sector's climate and environmental impact and reduces the need for raw and other materials.

In turning the construction sector - and the building stock - more sustainable - assessment criteria for sustainability and circularity also play an increasingly important role. Such criteria can encourage builders, architects and contractors to draw as much as possible from an ever growing arsenal of building innovations. Every day, VITO/EnergyVille is working on the development of those innovations, and their application and integration into the wider economy and society.

**The impact of the building sector on the climate, the environment and the use of raw materials and materials remains high.**



# JRC Citizens Forum



## SUSTAINABILITY FRAMEWORK LEVEL(S) PUTS NEW EUROPEAN BAUHAUS INTO PRACTICE

The Joint Research Centre (JRC) site in Geel is undergoing an extensive renovation. The offices, laboratories and also the conference building of the European research centre are being thoroughly refurbished. The conference building will be transformed into a multi-purpose facility with a meeting and relaxation area for staff, and with a brand new visitor centre. When the works are finished, from 2025, people will be able to get to know the JRC and the European Commission in that 'citizens forum'.

The renovation of the JRC conference building is a unique opportunity to put the New European Bauhaus initiative into practice. The European Commission is fully committed to design and architecture that is not only sustainable but also inspiring and simply beautiful. The renovation has been selected as a pilot project within this initiative.

Sustainability is at the heart of the renovation. Not only the construction but also the design is completely infused with it. The follow-up and evaluation of design, construction and, soon, also the use are done through Level(s), a European framework that evaluates the sustainability of buildings across their entire life cycle. The sustainability framework was co-implemented by VITO/EnergyVille.

It is the first time the sustainability framework has been applied on this scale. Because of this, Level(s) not only has a guiding role in the renovation of the JRC site, but also within the broader context of building renovation.



# Digital neighbourhood renovation



## NEW TOOL MAPS RENOVATION NEEDS

Too many homes and buildings in Flanders are still outdated, making them far from energy-efficient, for example. In the fight against global warming, the Flemish building stock needs to be radically renovated.

So the need to renovate is clearly there, but there are also thresholds. It often costs people a lot of time and effort to draw up renovation plans and realise them. To unburden citizens and thus further increase the pace of renovation, the Flemish Government is therefore committed to using a new tool. With the digital neighbourhood renovation tool, the renovation needs of entire neighbourhoods can soon be mapped digitally in one time. Based on the results, customised renovation advice can then be issued for individual houses in the neighbourhood, including a cost-benefit analysis and also guaranteed follow-up. So the start is collective, but further down the line it can lead to renovation trajectories for individual homes. It is expected that in this way, renovations can be realised faster and also at lower cost.





For the development of the renovation tool, the Flemish Government has called on VITO/EnergyVille, which is building a new digital platform for this purpose. To this end, maximum use will be made of digital twin elements and standards resulting from the DITUR project, in which VITO/EnergyVille developed a digital twin concept for scaled-up renovations.

Through the platform, the tool will also be able to draw on publicly available data that can be relevant for renovations. The digital nature already has the advantage that economies of scale, resulting from the collective approach, can be simulated and thus predicted in advance.

## CIRCAT



### EMBEDDING CIRCULARITY IN TECHNICAL INSTALLATIONS IN BUILDINGS

More circular construction is a crucial part of the transition to a more sustainable economy and society. Today, the focus for circular construction is mainly on smarter design (e.g. by including adaptability and demountability in the design) and on better thought-out choices for building materials (which can, for instance, be easily recycled or reused).

One area in the construction industry where there has been little 'circularity' so far is that of technical installations - think of heating, ventilation and air conditioning (HVAC), electricity and sanitary facilities. Here, the traditional linear model is still largely used. Yet, it is important for circularity to be included here too. For example, technical installations often need to be replaced faster than other building components. As such, they offer high potential for using raw and other materials even more efficiently.

That is the essence of CIRCAT, a project of Flanders Circular that ran from 2020 to 2023 and in which VITO/EnergyVille was involved. As part of the project, a set of evaluation criteria were developed, specifically focused on technical installations. The criteria are intended to be included in tenders for construction projects. In this way, they can promote choices in favour of more circularity through innovative measures.

The circular assessment criteria were incorporated into an Excel tool, which also includes other aspects (of circular business models, of the application of specific circularity principles). This CIRCAT tool was tested in construction practice, in a specific case study of a tender dossier of a particular project development. With feedback from the contractors involved, among others, the tool can be further improved.



# Robust water management

## TOWARDS A WATER-RESISTANT FLANDERS

Flanders is increasingly facing water stress. It is alternately plagued by drought and water scarcity, and by water nuisance and flooding. These are two sides of the same coin, namely that of global warming.

From an area of chronic water stress to a water-resistance Flanders, as a model region also for efficient water use. That is the ambition of the Blue Deal, with which the Flemish Government wants to arm our region against water stress at an accelerated pace.

With its Water Climate Hub, VITO plays a leading role in the implementation of the Blue Deal, and in the transition to a 'waterproof' Flanders. How VITO and the fledgling research and innovation hub deal with water challenges is characterised by a strong systems vision. In this context, different water challenges are not regarded separately. After all, water is a common denominator in so many systems, from the industry and agriculture right through to energy and transport.

Within that system vision, the emphasis is on innovation, not only technological but also social and economic. Because indeed, even different water solutions cannot be viewed separately.

**Water is a common denominator in so many systems, from the industry and agriculture right through to energy and transport.**



# Water barometer

## FREE TOOL ARMS COMPANIES AGAINST WATER SCARCITY

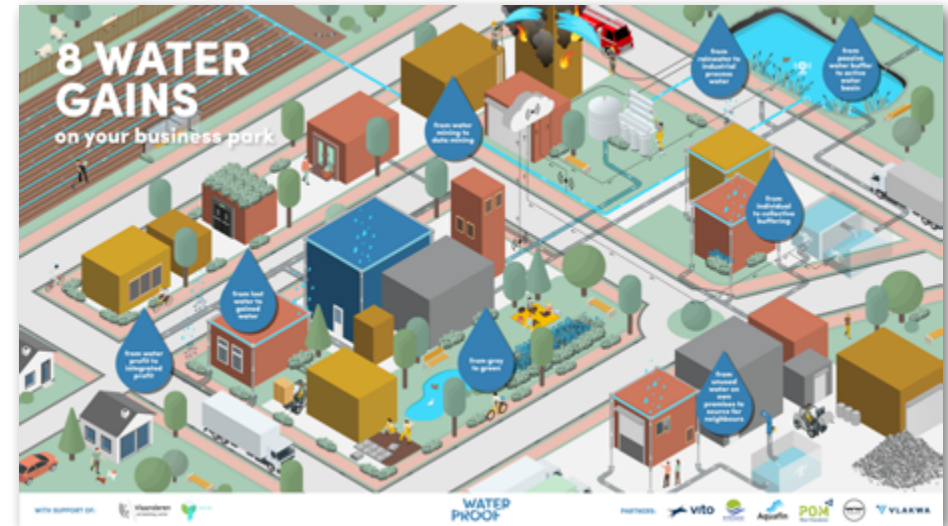
For several years now, groundwater levels in Flanders have been very closely monitored. This has everything to do with the water scarcity affecting our region more and more frequently, which poses a serious threat to our economy.



For companies that rely heavily on water, for example because they use it as a raw material or in their processes, water scarcity potentially poses a major problem. Consequently, these companies often face many questions. A new tool that VITO launched in 2022 offers solutions. Moreover, this Water Barometer tool also helps companies select the right measures against water scarcity.

The tool, which can be used free of charge, grants companies insight into their water management and suggests targeted optimisation measures. A comprehensive water balance sheet with all water flows and related costs is presented in a readily understood format. It also identifies the risks of the water sources which a company draws from.

By means of an environment analysis, the Water Barometer also gives companies insight into nearby alternative, sustainable water sources, including recommended techniques to purify this water before use, if necessary.



## Flanders WaterProof

### 'WATER GAINS' RENDER TIELT BUSINESS PARK WATERPROOF

How can we better arm our region against water stress: against drought (due to water scarcity) or against water nuisance (e.g. due to extreme precipitation)? This will be investigated in the Flanders WaterProof project until 2025. In three local, but large-scale demo sites in very different parts of Flanders, measures will be demonstrated. Should these prove successful, they can later be rolled out elsewhere as 'water gains'.

A large business park in Tiel (West Flanders) is one of the demo areas. Here, the challenge is to reconcile water solutions with the further development of the site and with a pleasant working environment. Eight possible water gains were taken as a starting point, and for each one the specific benefits for the entire business park are considered. They vary widely: from removing paved surfaces (turning concrete and asphalt into greenery), collective buffering right through to maximum reuse of rainwater. Water use at this Tiel business park is diverse and together with local companies, farmers and authorities, the potential of rainwater is fully maximised by infiltrating, buffering, purifying and reusing it. At the same time, there are also other gains, for example, more greenery for a more pleasant working environment and safer cycle paths when sewer systems and roads are being reconstructed. The aim is to make the business park a true

source of inspiration for water gains, so that business parks know what actions they can and should take.

In the Tielt demo area, as is the rule within Flanders WaterProof, there is very close cooperation with the local stakeholders, in this case some fifteen companies and also the local fire brigade. To further enhance local support, several meetings were also scheduled in 2022. Involved companies were able to sign up there to participate in one or more water gain initiatives. But they could also simply ask questions to the experts of, among others, VITO, which manages WaterProof. These questions are actually taken into account in the project implementation.

The water gains that prove successful in Tielt will later also be rolled out in other business parks in Flanders, rendering them waterproof as well. This way, a toolbox is created whereby the contents - the tools or water gains - can be used to suit a specific local situation.



## Water Climate Hub

### 'TOGETHER ABOUT WATER' JOINS STAKEHOLDERS FOR TACKLING WATER CHALLENGES

The Water Climate Hub was established in 2021 as VITO's new research and innovation hub. Its main mission is to accelerate the implementation of solutions to current and future water challenges. These water solutions are sought in technological, social and economic innovation. The hub is located in the Ostend Science Park.

On 21 April 2022, stakeholders of the Water Climate Hub met in Ostend during the first 'Together about Water' event. More than 150 people - water experts and delegates from involved companies and organisations - took part in inspiring lectures and discussions. There were also interactive sessions where companies could present their proposals to address water challenges to the public. In terms of content, the event had two main themes: doing more with less water, and getting a better grip on water pollution.

In her speech, Flemish Minister for the Economy, Agriculture and Innovation Hilde Crevits, on whose initiative the Water Climate Hub was established, emphasised the importance of cooperation in tackling water challenges. Helping stakeholders to find each other and join forces is also one of the Water Climate Hub's core tasks.

Inge Genné, Water Management and Technology programme manager at VITO, talked about the essential role water plays in climate adaptation, i.e. in measures to counter the consequences of global warming. These measures very often rely on water. At the same time, many consequences of global warming are water-related, just think of flooding due to extreme precipitation or drought due to water scarcity.





# Towards a circular and biobased economy

## MORE SUSTAINABLE THANKS TO MORE CIRCULAR AND BIO

Reusing and recycling (and preferably upcycling) raw and other materials are at the heart of a circular economy. Such an economy is also highly biobased: as an alternative to fossil-based raw materials, biomolecules are used that can be extracted from by-products of the bioeconomy. The extraction, processing and use, however, often require different processes and technologies. So innovation is indispensable to make the economy more circular and biobased.

More circularity also reduces dependence on imports of raw and other materials from abroad. When we experienced how first the corona crisis and then the war in Ukraine put firm pressure on the supply chains, the importance of this became even more apparent. So a circular economy is certainly also a more robust economy.

At the same time, more circularity also contributes to more sustainability. By treating by-products of production processes no longer as waste but as raw materials, for possibly very different applications, not only can the environmental impact of that waste be reduced, but some processes can also be made more climate-friendly and thus more sustainable. Almost a textbook example of this is the replacement of cement for concrete with alternative raw materials. So circular is certainly compatible with sustainable, too.

**More circularity reduces dependence on imports of raw and other materials from abroad.**





## INCITE

### ENZYMES ACCELERATE MORE SUSTAINABLE CHEMICAL INDUSTRY

New process technologies can help make the chemical industry more environmentally-friendly. They can make chemical processes more efficient, economical, cleaner and also safer, which reduces the industry's environmental and climate impact. One promising technology uses enzymes, proteins that accelerate chemical reactions in biological processes - they are nature's catalysts.

In the so-called enzymatic route, chemical reactions proceed without usually requiring auxiliary chemicals and solvents. As a result, the reactions involve significantly fewer steps than in conventional organic processes, and also generate less waste. This technology can be applied in the production of basic chemicals, such as esters in, among others, the food, agricultural and cosmetic industry.

VITO has been researching the enzymatic production for some time, including that of esters used in cosmetics and pet foods. For one of those esters, called isopropyl palmitate, production went so well that it was decided to set up an industrial demonstration of a production facility. This is being done jointly with the chemical company Oleon as part of the European INCITE project. The official opening of the demo installation, which will be able to produce several hundred litres of the ester using the enzymatic route, is scheduled for June 2023. The installation should pave the way for commercial use.

Besides the catalytic action of enzymes, VITO is also investigating within INCITE how water produced during the production of the esters can be efficiently drained. This is done via pervaporation, a combination of permeation and evaporation. The continuous elimination of water increases process efficiency and makes the technology economically interesting for the industry.



## LignoValue Pilot

### INNOVATIVE BIOAROMATIC COMPOUNDS FROM LIGNIN

On 6 October 2022, the first and, for the time being, only pilot installation in Europe for the production of bioaromatic compounds was officially opened at the VITO site in Mol. Bioaromatic compounds are molecules that can be used as basic building blocks for a wide range of chemicals. Since they are biobased, they offer an alternative to the use of raw materials of fossil origin.

The LignoValue Pilot produces bioaromatic compounds on a scale relevant to the chemical industry. The installation is fuelled by lignin, one of the most common organic materials on earth - it is the substance that, through the cell wall of plant cells, gives plants and trees their rigidity. Due to its chemical structure, lignin is ideal for replacing many substances with so-called aromatic compounds (e.g. phenol and bisphenol A), which are now mostly of fossil origin. Moreover, there is no shortage of biofuels: they are mass-produced as a by-product of bioindustries, such as the pulp and paper industry.



The pilot installation can handle a daily production of more than 100 kg of bioaromatic compounds. It not only provides proof-of-concepts of the various process steps, such as cutting up the lignin molecules into usable, functional building blocks, but also establishes new value chains of innovative bioaromatic compounds. These value chains help reduce the chemical industry's dependence on fossil fuels.

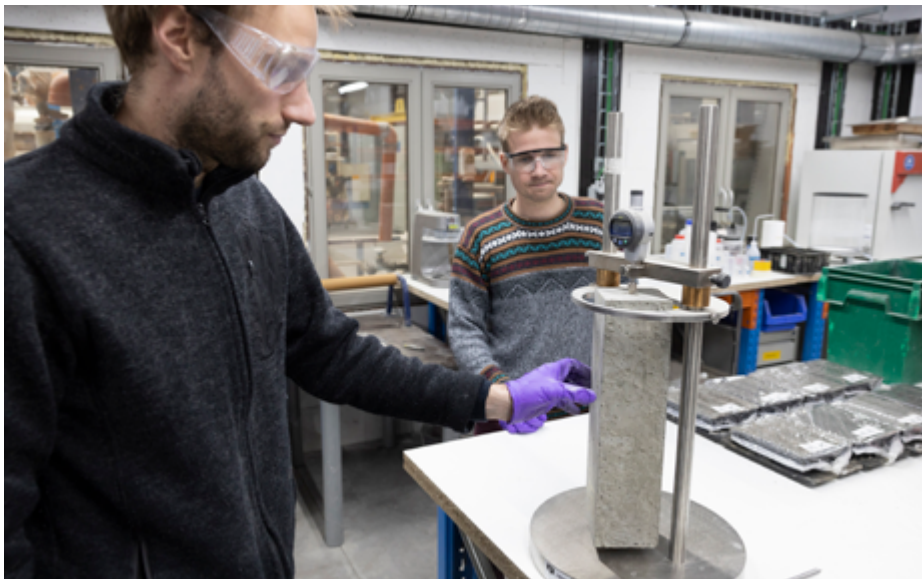
At the VITO site, the safety of the LignoValue Pilot and the supply of lignin and disposal of bioaromatic compounds are guaranteed. For years, VITO has been at the forefront of research into the use of lignin as a basic raw material for chemicals. Together with TNO from the Netherlands, it is also founder of the Shared Research Centre Biorizon and responsible for the research line that develops bioaromatic compounds from lignin.

# NEMO

## MINING WASTE UPCYCLED FOR MORE CIRCULAR CONCRETE

When metals, such as copper, nickel and zinc, are mined, large amounts of waste are formed. These so-called tailings have a major environmental impact: they are mainly dumped in lakes, as they would otherwise dissipate. In mining activities in Europe, 700 million tonnes of waste are generated every year.

As part of the European project NEMO, VITO, together with the Flemish company ResourceFull, investigated how part of the tailings, namely the mineral fraction, can be upgraded and reused as a raw material for building materials. Using it as an alternative raw material for concrete, for example, could also make that production more sustainable, which is much needed, as concrete production still has a very high impact on the climate.



Within NEMO, research was carried out on how the mineral part of tailings can be used as a cement substitute, and how it must first be pre-treated for this. Methods have also been developed to remove from the tailings substances that adversely affect the concrete or can be harmful to humans and the environment. The project has already culminated in a demonstration: three different concrete mixes, party based on tailings,

were developed. One of them was used in September 2022 in the construction of the new car park at VITO's Balmatt site in Mol.

Also the valorisation of tailings into aggregates was studied, the main raw material of concrete alongside cement. For the production of these aggregates, VITO has a new pilot installation, with a capacity of one tonne per day.

Now that it has been demonstrated that a more circular production of concrete is possible, namely by upcycling mining waste, it is up to the industry to embrace this technology and apply it.

## Flemish bioeconomy

### STRUCTURAL OVERVIEW MAPS FLOWS AND USES OF BIOMASS

The biobased economy is growing rapidly in Flanders. And more and more sectors are using biomass as a feedstock, often as an alternative to fossil fuels. A first structural overview, conducted by ILVO and VITO on behalf of the Flemish Government, maps the numerous flows of biomass and its processing and use. It also provides insight into the





economic aspect, and thus the potential. The study, of which the overview is the result, will be replicated every year. This should allow a targeted and stimulating policy on the Flemish bioeconomy to be adopted, and its impact to be evaluated.

The structural overview, published in late 2022, shows that agriculture and horticulture in Flanders are responsible for producing the vast majority of biomass (98 per cent). The majority of this is plant-based. Much smaller biomass-producing sectors are forestry, fisheries and waste treatment (together accounting for 2 per cent).

On the processing side, the food industry is the main consumer of biomass, followed by the chemical industry. The latter uses biomass to produce bulk volumes of fatty acids, fertilisers and biofuels, although the sector remains still largely dependent on fossil-based raw materials.

The Flemish bioeconomy is doing well, according to the economic section of the study. Between 2014 and 2018, the period for which data were available, the added value of the bioeconomy sectors rose sharply - each of them also outperforming the European average. Real standouts are the food and pharmaceutical industries, with a particularly striking listing for the beverage sector (70 per cent more added value). Equally striking is that the bioeconomy scores more than twice as well as the overall Flemish economy.

Because it is the first time it has been drawn up, the structural overview is a baseline measurement. The ILVO and the B2BE Facilitator, a new platform linking suppliers of biofeedstocks to potential processors, will continue to monitor the Flemish bioeconomy in annual updates, also with more focus on biomass flows and processing.

## Chitosan

### USEFUL BIOACTIVE SUBSTANCES FROM MUSHROOM WASTE

Chitin is a substance that occurs naturally in small animals, such as crustaceans, algae but also in mushrooms. For us too, the bioactive substance possesses numerous useful properties: its derivative, called chitosan, has antibacterial, antioxidant, anti-inflammatory, moisturising and UV-protection properties. That is why chitosan is used in a wide range of applications, from animal feeds and other agro-industrial products to cosmetics and pharmaceuticals. Understandably, the demand for chitosan is therefore high.



So, chitosan can be of both animal and plant origin. In the CHampITINE project, in which VITO was involved, the focus was on plant-based chitosan, produced from by-products of mushroom cultivation. After all, the base of commercial mushrooms, such as button mushrooms and oyster mushrooms that remains after harvesting, is ideal for this purpose. Up to five thousand tonnes of this waste is produced annually.

The exclusively vegetable nature of chitosan from mushroom waste also opens up prospects for high-value applications, such as in the medical field. Take bleeding-control bandages: the absence of animal chitosan avoids allergic reactions (e.g. shellfish allergy) in patients.

Moreover, if chitosan were produced from mushroom waste, it would be local, which means that it would also help mushroom growers render their businesses more circular.



# Energy solutions for the future

## CATALYST OF THE ENERGY TRANSITION

Belgium, like Europe, aims to be climate-neutral by 2050. The transition towards this is in full swing, and the evolution towards a carbon-neutral energy system is central to this. Managing this energy transition and helping to ensure that it is not only sustainable but also safe, affordable and convenient for citizens and for companies alike is part of VITO/EnergyVille's mission.

At VITO/EnergyVille, the energy transition is accelerated through insight and innovation. This happens in the technological field, by means of innovative energy technologies, but also at a more theoretical level, for example with state-of-the-art mathematical models with which various possible futures of a sustainable energy system are explored.

As it has itself emerged as a close collaboration between different partners, VITO/EnergyVille highly values teamwork. Forces are combined with other research organisations, both national and international. With governments at all levels. But also with companies, from SMEs to multinationals. This, too, contributes to VITO/EnergyVille's system vision of the energy system, which is always considered as a whole and where the entire energy chain is taken into account.

**Belgium, like Europe, aims to be  
climate-neutral by 2050.**





## Engie



### STRUCTURAL COOPERATION ON CARBON-NEUTRAL TECHNOLOGIES

Energy company Engie and VITO/EnergyVille had previously joined forces for joint energy research. And they did so again in 2022, when a new three-year contract for structural cooperation was concluded. Experts from the energy group, both from Belgian expertise centre Engie Laborelec and from similar foreign R&D centres, are working together with experts from VITO/EnergyVille on a few specific projects. These include innovative energy technologies in various fields, from energy efficiency and smart electricity grids to renewable energy and hydrogen and other 'green' gases. Out of those projects, concrete solutions should arise to accelerate the transition to a carbon-neutral energy system.

The aim of the joint effort is to identify the solutions, scale them up and subsequently roll them out, i.e. in the form of technologies. These include, for example, technologies to reduce energy consumption in homes, buildings and the industry, to adapt the electricity grid to the supply of increasingly renewable energy, and to integrate the use of green gases in energy and heat supply in the industry.

With the structural collaboration, VITO/EnergyVille intends to significantly accelerate the research. Instead of looking at what is needed on a project basis, a lot of paperwork can now be avoided and, as a result, things can be fast-tracked. The regulation-free zone at Genk's Thorpark, the home of EnergyVille, is also shifting up a gear. And it facilitates the upscaling of technologies, precisely because they can be tested and optimised on a large scale and with real end users.



## Five-year covenant



### MULTIANNUAL FLEMISH SUPPORT FOR ENERGYVILLE

Helping accelerate the sustainable energy transition through innovation, with the ultimate goal of an energy-efficient, CO<sub>2</sub>-neutral and sustainable society, where comfort and affordability for the citizens are central. That is what EnergyVille is working towards, day in out, always in close cooperation with its partners: imec, KU Leuven, UHasselt and of course, VITO.

While working towards that goal, milestones mark various objectives and criteria that can be strived for in the shorter term. These so-called Key Performance Indicators (KPIs) were established in consultation with the Flemish Government and are included in the first five-year covenant that the Government concluded with EnergyVille in 2022. The agreement helps determine the conditions for Flemish funding for EnergyVille. The annual amount involved is 3 million euros, and this until 2026.

KPIs can be strategic or operational. They include not only scientific results in the fields in which EnergyVille operates, but also cover the socio-economic impact on the daily lives of citizens and on the activities of Flemish companies. Some examples of such targets today: more cooperation between EnergyVille and the industry, more STEM initiatives, more supervision for PhD students, a stronger contribution to the digitisation of the energy system, and better dissemination of knowledge within both the energy sector and the general public.

The five-year covenant should help accelerate the sustainable energy transition in Flanders. That transition will also have to be fair, said Gerrit Jan Schaeffer, general manager of EnergyVille at the official signing. "Leaving no one behind in a world in transition is the essence of the work we have to do together with the government, the industry and citizens."



# PATHS 2050

## A ROADMAP TO A CLIMATE NEUTRAL BELGIUM BY 2050

What is the most optimal way for Belgium to become climate neutral by 2050? And is this at all feasible? To these (and other) questions, the energy experts of VITO/ EnergyVille in 2022, commissioned by Febeliec, came up with an answer. That answer is not unequivocal, which is, of course, no surprise, given the particularly complex subject matter and the many unknowns in the forecasts. Nevertheless, the answers are clear, and on a digital platform developed specifically for this purpose, they are clearly outlined.

The platform was named PATHS 2050 - The Power of Perspective. It guides visitors along three different roadmaps, each representing a different possible route to carbon neutrality by 2050. The roadmaps each start from a specific scenario in which some assumptions are made, for example about the future availability of (much) more offshore wind energy or about the limited storage of CO<sub>2</sub>.



The answers show that the years ahead will still be plagued by structural energy scarcity. That is why the further expansion of renewable energy and associated infrastructure remains a priority. On the customer side, there is the same urgency for the (energetic) renovation of the building stock.

As for the 2030 interim targets (a substantial reduction of greenhouse gas emissions), to achieve these, an ambitious climate policy will have to be pursued on buildings, investments in infrastructure, such as high-voltage grids and carbon capture, followed by carbon storage or reuse in the industry. The capacity of renewable energy sources must also increase considerably.

Projections for the 2050 targets remain optimistic, provided that offshore wind and solar power are substantially extended. Innovations, including small modular nuclear reactors, can help reduce the cost of the energy transition in this regard.

The conclusion, and this applies to all three scenarios, is that climate neutrality by 2050 in Belgium is feasible - both technically and socially - as well as affordable.



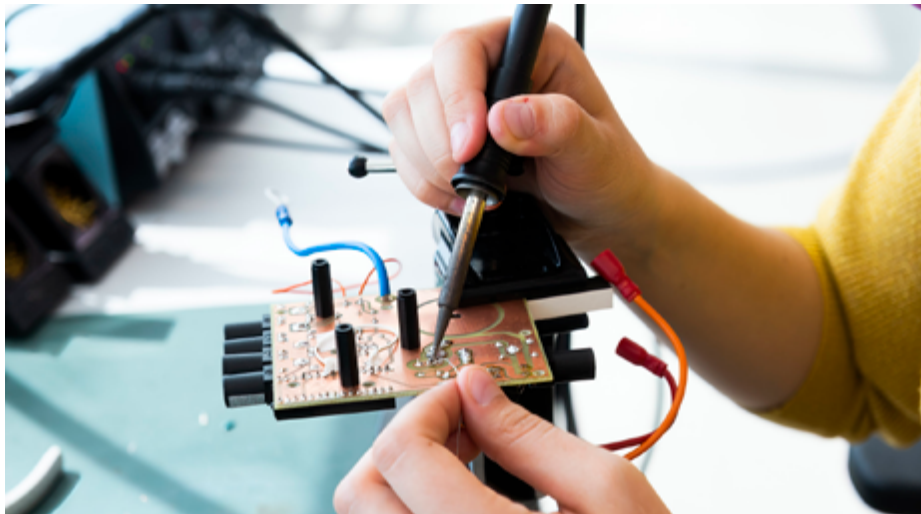


## Expansion of lab facilities



### UNIQUE TEST ENVIRONMENT FOR BATTERIES AND THERMAL SYSTEMS

In 2022, two labs were relocated from the VITO site in Mol to the EnergyVille site in Genk. This was accompanied by a substantial expansion of the lab facilities. VITO/EnergyVille now has a battery test lab that is twice the size in terms of surface area as before. A lot of new testing equipment was also installed in the lab, including a larger temperature room and an ARC device (for fire and explosion tests, among others), which is unique in Belgium.



The thermotechnical lab has also changed beyond recognition. Whereas previously, it was mainly focused on its own in-house research, it is now also open to developers of, for example, heating and ventilation equipment to subject them to a wide range of tests. The lab has as many as 25 parallel HVAC connections, allowing as many tests to be carried out at the same time.

External companies and research organisations are also welcome in the battery testing lab. They can use it for all kinds of performance, lifetime and safety tests for battery-powered products or systems. These tests closely match real-world scenarios. The larger

temperature chamber also serves this purpose: it is large enough to test electric car batteries as a whole in very different and varying weather conditions.

One of the main assets of both lab facilities is that they closely replicate the environments to which batteries and equipment may be exposed in real life. This is achievable precisely because they are not standard labs where tests are conducted according to established standards and specification limits.



## Bregilab

### TOOL REVEALS TECHNICAL POTENTIAL IN SOLAR AND WIND ENERGY

Where in Belgium is there still growth potential for generating renewable energy with solar panels or wind turbines? Answer: In the Flemish port regions, in the north of the province of East Flanders and the south of Hainaut, Limburg and Luxembourg, there is still a lot of additional wind energy to be harvested. And in highly urbanised regions, the same applies to solar energy, because there are still many roofs of houses and companies that are not equipped with solar panels.



This potential expansion scope for solar and wind energy (on land) is outlined in the online Bregilab tool. This is the result of a project of the same name in which, among others, VITO/EnergyVille studied this potential. The aim of the project was to find out how the generation, but also the use, of locally generated renewable energy can be maximised at minimum cost. The tool, which allows you to view - by region - the technical potential of solar and wind energy in Belgium, has been available since 2022.

The tool's main strength lies in the combination of two elements: the calculation of renewable energy generation potential on an hourly basis and at high spatial resolution, and an optimal location for onshore wind turbines and solar panels that also takes into account all kinds of preconditions, such as safety and policy criteria.

Moreover, the Bregilab project once again showed that Belgium has sufficient technical potential for renewable energy generation to meet its climate ambitions.

## Battery reuse

### CAR BATTERY BECOMES HOME BATTERY

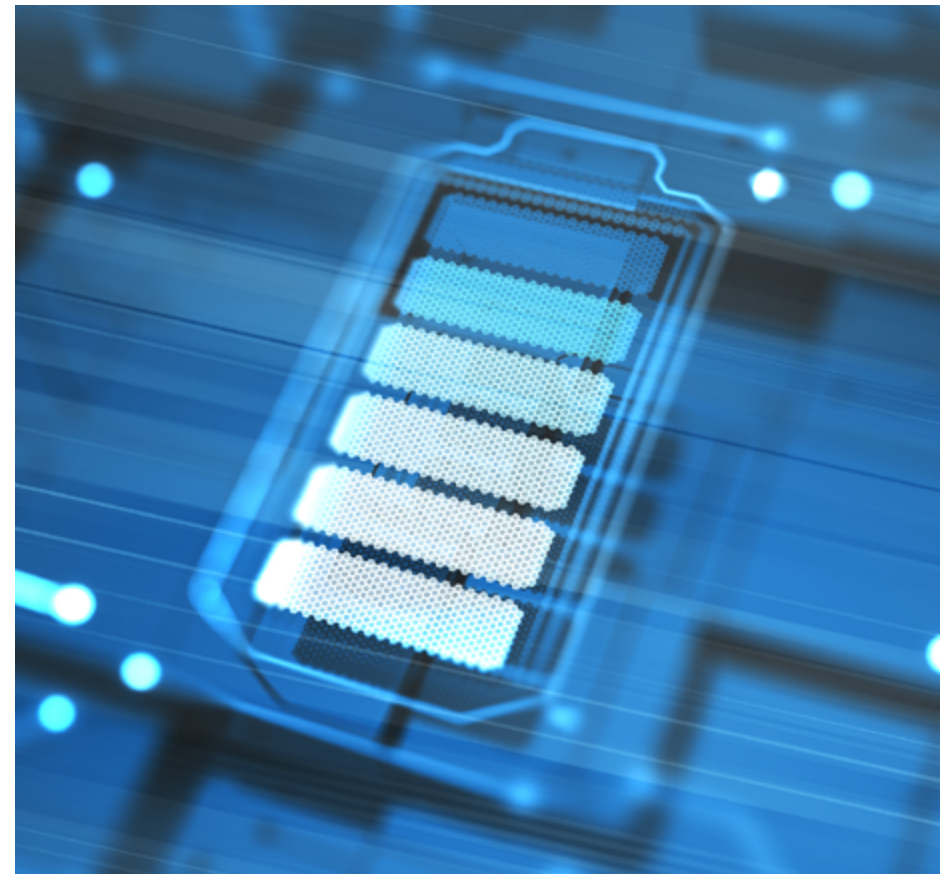
With our cars and transport being massively electrified, it is certainly the time to think about what we will do with all those car batteries later, when they are no longer suitable for electric vehicles. The batteries can be taken apart and the battery components can be recycled. Better, however, is to reuse them in lower-value applications, for which reduced capacity will still suffice. One such application that is attracting increasing attention is the 'second-hand' home battery.

Turning a car battery into a home battery, so that it can store power generated by rooftop solar panels, for example, requires conversion. Ideally, this is done in a specialised factory, a battery conversion plant. And according to research by VITO/EnergyVille, it might be worthwhile for Flanders to roll out a proper conversion industry. By 2030, such an industry could generate four billion euros of additional economic value compared to a scenario in which only batteries are recycled. 'Could', because there are still some unknowns. These unknowns are economic, such as further growth in demand for home batteries, but also technical, such as the lifespan of a car battery converted into a home battery.

The research into converting car batteries was done from the Circular Economy Support Centre. This charts the transition to a circular economy and investigates how it can be enhanced. The Flemish Government already strongly believes in recycling and reusing

batteries and also solar panels. It freed up another 15 million euro's worth of subsidies for the circular manufacturing industry in early 2022.

Reuse of car batteries, and of lithium-ion batteries in general, was also the core of the European Circusol project, which ended in 2022 and was coordinated by VITO/EnergyVille. The result was a voluminous report describing exactly what sustainable battery reuse means. From the introduction of new protocols, norms and standards which guarantee battery quality to be applied in as many countries as possible, to the development of techniques and methods to measure that quality. The Circusol report is very clear about one thing: when reusing batteries, it is crucial that that second life is not targeted at one application, such as only home batteries.





# Climate services

## AT THE SERVICE OF THE CLIMATE AND THE ENVIRONMENT

The state of climate and the environment: on monitoring but also on measures against global warming and pollution, VITO has a lot of in-house knowledge and expertise. Monitoring and measures cannot usually be separated. After all, targeted, effective intervention requires objective and detailed information. And conversely, when measures are effective, they trigger changes, which, in turn, affect monitoring.

In recent years, more and more services have been created to help countries contribute to the global fight against climate change. And these services involve both monitoring and measures. Such climate services are based on monitoring that is reliable and highly accurate - not only at the spatial level, in terms of resolution, but also over time, with rapid updates. From its wealth of experience in remote sensing, VITO is focusing increasingly on these climate services.

But VITO is also helping to improve the dissemination and exchange of useful information and knowledge about the climate and the living environment. Between countries, such as EU Member States. Between the many levels of government, both in Belgium and abroad, ranging from supranational authorities, such as the European Commission right through to local municipal councils. And also between knowledge organisations, companies and other bodies working around climate and environment. Partly because of this, VITO has for many years been in the privileged position of being able to follow everything that is happening regarding the environment and climate, in Belgium and Flanders but especially also in Europe, from the front row.

**Targeted, effective action requires objective and detailed information.**



## WorldCover

### RAPIDLY UPDATED LAND COVER MAP HELPS IN MONITORING CLIMATE AND BIODIVERSITY

Countries need to closely track their efforts and progress in the fight against global warming. Compiling the so-called nationally determined contributions (NDCs), however, requires complicated accounts. And these are correct only if they are based on objective and reliable data. An example of such data are those about land cover. In the NDCs, these play a key role in the calculation of greenhouse gas emissions.

As of late 2021, a map of global land cover exists that is accurate to within 10 metres. This is what is known as the WorldCover map, which is based on satellite images from 2020 and was co-developed by VITO on behalf of the European Space Agency ESA. In addition to the unprecedented level of detail of the map, the short time in which it was developed is also a major achievement. It took less than a year, but because it was the first time such a detailed land cover map was produced, the development could be much shorter still. VITO's remote sensing experts are convinced that it can also be done in as little as three months.

Thanks to such a brief development time, changes in land cover or land use can soon be monitored quickly, almost in real time. Also, successive maps (from successive observation years) can be used for comparison. Countries can thus start using the land cover maps when preparing their climate accounts. VITO's development of land cover maps can thus be seen as a form of climate service.

The near real-time info from land cover maps is also very useful when it comes to monitoring global biodiversity, which is also in crisis. It allows for accurate identification of natural resources in an area and changes in them. So the first WorldCover map and subsequent maps may soon also be able to help countries with their so-called natural capital accounting (NCA), or ecosystem accounting.



## European Topic Centres

### FINGER ON THE PULSE OF THE EUROPEAN ENVIRONMENT AND CLIMATE

The European Environment Agency (EEA) has a network of Topic Centres, each of which focuses on a specific aspect of Europe's environment and climate (and policies in that connection). These so-called European Topic Centres (ETCs) help the EEA in its monitoring of the state of climate and environment and in reporting and communicating its results. The information and knowledge collected and generated in this way can, among other things, be used by policymakers, for example from the European Commission, to prepare new legislation or adapt existing regulations.

VITO has been very active within the ETC context for many years. And in 2022, its role in it was further strengthened. For example, it is now part of four of the current eight ETCs. In two of them, VITO is even the coordinating partner. The themes here are circular economy (ETC CE) and climate mitigation (ETC CM). Until 2026, these ETCs support the EEA in further developing the knowledge base around these themes, which should contribute to an accelerated transition to a circular economy in Europe and an expedited transition to a climate-neutral society. The two other ETCs in which VITO is involved address the themes of climate adaptation & land use (ETC CA) and the impact of environmental pollution on human health (ETC HE).

Data and knowledge do not flow in one direction from the ETCs to the EEA. The centres are also closely interconnected, allowing them to exchange useful information about specific policies through the network. ETCs can call on knowledge organisations, such as VITO, but also other bodies, such as public authorities. The large diversity and broad European coverage, together with the knowledge and expertise all partners bring to the table, are a major asset.





## Personalised and preventive healthcare

### ALSO IN HEALTHCARE, TO MEASURE IS TO KNOW

To measure is to know. Especially when it comes to our health. In 2022, more than ever before, VITO was called upon for our expertise to perform measurements in air, water and soil ... but also in human blood. Just knowing what a person is exposed to says little about the health risks. That requires standards. Sometimes those standards already exist, sometimes they do not. It is at the same time a new challenge to determine those values. It is the scientific basis on which the government can build a policy. With PFAS, VITO is involved at all levels. It has been a very intensive process that has demanded a great deal from the VITO researchers.

To measure is to know. That also applies to the data we collect ourselves on the dozens of apps we are so familiar with by now. Where does our privacy begin and end? What are the possibilities for ourselves but also for society? The search for ways to use, store and share health data in a fair, ethical and responsible way has led to a solid plan in 2022, based on the Solid technology. And when you talk about data, artificial intelligence is automatically mentioned in the same breath. By providing, storing and linking lots of data, we can make faster and more appropriate diagnoses and suggest effective therapies. Digital twins are indispensable in this context, because they make the connection between data and individual. That, too, is part of the VITO expertise.

**The search for ways to use, store and share health data in a fair, ethical and responsible way has led to a solid plan in 2022.**

## The PFAS dossier: headed towards the end of 'forever chemicals'

It started in 2021 with the proverbial shovel in the ground in Zwijndrecht. This resulted in a shock wave throughout Flanders. Not just Zwijndrecht, but, by extension, all of Flanders is literally contaminated by PFAS. VITO's expertise soon proved indispensable, not only for monitoring the problem, but also in the search for solid standardisation and for a solution.

Karl Vrancken, until then sustainable materials management research leader at VITO, was approached by the Government as assignment holder. In this position, he had to coordinate between the various government departments. He completed that task in December 2022 with a voluminous final report.

At the Oosterweel site, the source of the pollution was quickly found: the 3M plant producing PFAS. For the rest of Flanders, the task had yet to begin. The fact that PFAS - which is inextricably linked to the firefighting foam that was formerly used - would be present near fire stations and in soil where extensive fires had raged, was obvious. This was also evident from the soil samples analysed by VITO. But PFAS contamination was also found around other companies. The search was no longer limited to soil samples either, but also covered PFAS in water (courses), in air, in factory chimneys ... and even in sea foam.

VITO was not only involved to make analyses. Very quickly, it became clear that our expertise was needed to gain insight into what was needed to decontaminate, but also to purify. What are the most effective methods that are not only technically but also economically feasible, the so-called best available techniques (BATs)? VITO was also consulted in the health sector. Internationally, there was literature about the health effects of exposure to PFAS and the WHO provided a number of publications, but what does this specifically mean for Flanders? The VITO expertise was deployed for modelling the distribution, degree of exposure, health effects and we were involved in monitoring levels and effects in humans. In doing so, we worked closely with the Agency for Care and Health (AZG) where we provided support in interpreting the blood test results and drafting no-regret measures.

Establishing the facts is one thing, drawing up a standards framework is another and aligning a policy that meets health requirements but is also feasible is a final step. After all, the fact that soil is contaminated with PFAS was not new. But what that contamination can cause in the population has long remained unknown. If we realise

**Very quickly, it became clear our expertise was needed to gain insight into what was needed to decontaminate, but also to purify.**



that in 15 years, the permitted level has decreased by as much as 10,000, it is because advancing scientific understanding has allowed us to gain increasingly better insight into the effects, which means we also have to adjust the standards.

In early October 2022, VITO submitted an updated PFAS standards framework. Based on the precautionary principle, strict no-regret measures had been in place for more than a year in the most contaminated areas. Incidentally, in some places where it was necessary and possible, remediation was also carried out in 2022. For example, the soil of a new residential area in Willebroek, which was contaminated, was excavated and remediated very quickly after a soil analysis by VITO.

By proposing an adapted standards framework, VITO offered policy makers a sound basis for drawing up a definitive and legally enforceable standards framework. This is new and unique for Europe. After all, there is no European standards framework for soil contamination. Each Member State must until now, determine itself what is justified and enforceable. The proposal of the Flemish standards framework drawn up by VITO had a sound scientific basis and received a scientific peer review. It was founded on the health-based limits that indicate when PFAS pose a health risk when ingested through food. But even that was no easy task. Indeed, PFAS has a bioaccumulative effect in the human body. Whereas low intakes do not pose a direct health risk, long-term exposure to those low concentrations can be harmful.



Therefore, the standards framework took as its basis the health-based limits set by the European food agency EFSA. It then worked out how these levels in food could be converted into limits in soil. To make that calculation, you need a scientific model based on a number of basic assumptions. Again, experts were consulted. The final step is to compare these results with the situation in Flanders. There, the experts encountered a rather shocking result. After all, the strictest remediation values were below the average PFAS already present in Flanders. In short, to meet those values you would have to remediate pretty much the whole of Flanders. That is not feasible, and the standards framework will therefore have to be supplemented by a broader, systemic approach to PFAS contamination.

The panel subsequently put forward a feasible framework for action. The ultimate decision will need to be taken by policy makers.

Besides the immense task that VITO had in this PFAS dossier, we also faced a number of 'side effects'. For instance, there were citizen groups and environmental activists who expressed their concerns and launched campaigns. All these stakeholders were heard and had the opportunity to contribute constructively. Some of them were unwilling to reach solutions and some members went so far as to even question scientific integrity. In the Environment Committee of the Flemish Parliament, minister Zuhair Demir connected the dots, talking about deliberate disinformation and populism. The work for VITO in this dossier is far from over. Only by measuring, can we know. And there is still a lot to measure ... As a result of the work done over the past year and the investigations that have taken place, 3M has decided to stop the PFAS production in Zwijndrecht. A clean-up contract has also been signed with 3M which, as the polluter, will have to cover the cost of the clean-up.

Karl Vrancken's mandate has expired. Rarely has there been constructive and very intensive cooperation with so many stakeholders and have results been achieved in such an intensive way.

PFAS has extraordinary qualities that are very useful and interesting. We are therefore facing two major challenges. On the one hand, we have to start looking for other molecules that are equally attractive and can replace PFAS. On the other hand, we urgently need to look for ways to break down these 'forever chemicals' so that they can no longer spread.



This is the future, and not just a future for Flanders. Nowhere in Europe has there ever been such a bold, intense and - above all - scientific way of dealing with PFAS pollution. What Flanders has achieved in one and a half years in knowledge building, measures and policy initiatives has no equal. Already we are being asked to share the expertise we have built up with our European allies because PFAS is not a Flemish problem, it is Europe-wide.

## We Are: citizens in control of their data

Activity-trackers that measure our fitness, calorie counters that track exactly how many calories we use up and eat, food apps that help us make the right choice at the supermarket ... Anyone who has a smartphone also has apps. Without much thought, we feed these apps with personal data about our health, our lifestyle, our experiences and preferences.

Increasingly, however, citizens are becoming aware of the value of those data, not only for themselves, but also for third parties, realising that they rarely know what will happen to the data they enter. Moreover, the data are fragmented. Yet they contain a lot of information that could be used, not only for innovation but also for other personalised services. For example, the citizens' care path could be enhanced with the data they themselves collected. In order to develop new technologies and provide better services, these data are incredibly important for knowledge organisations, governments, companies, healthcare providers and citizens themselves. With We Are, the citizens are given the key to the data they have collected themselves. They decide what happens to their data and who can use it.

Every day, we feed our apps with a lot of personal data. We gain from this ourselves, otherwise we wouldn't download them. But gradually, citizens are also becoming aware that much more is happening with those data and wondering what the opportunities are of the data they have to re-enter into the various apps over and over again. It would be a win for them if they had to look up and note down those data only once and then simply copy them for other apps. That way, they would only have to go through the process once. Those data could also add value for their general practitioners, who, in this way, gain more information than the traditional clinical parameters



they can collect in a snapshot. And it might be useful if their dieticians, with their permission, could monitor their diet without having to print out their app at every visit. And yes, maybe a drug company looking for a better therapy for diabetics would be interested in the data that diabetic patients enter into their apps.

Together with its partners - Domus Medica, Vlaams Patiëntenplatform vzw, Zorgnet Icuo and the King Baudouin Foundation, - VITO laid the foundations of We Are, which has one goal only: to create a sustainable participatory ecosystem for personal health data. The system is based on Solid technology. With Solid, citizens are given a data safe in their name in which they can store their personal data and the data they access via apps. Citizens own their POD - Personal Online Data - and they decide who has access to those data.

The most unique aspect to We Are is the management of these data. Solid Technology endorses this: We Are is a participatory organisation where each citizen can decide for themselves what happens to their own data, but where they also have a voice in the use of the data as a whole. This is the system's strength: transparency, trust and participation.



## NOT JUST SHARING

What is the big difference with the current system? Anyone who now downloads an app and uses it is sharing their data with the organisation or company that owns the application. If we start separating the data from the application via Solid, it will be possible to give the management of the data generated via an app back to its owner (the citizen). The latter will then decide with whom they wish to share their data.

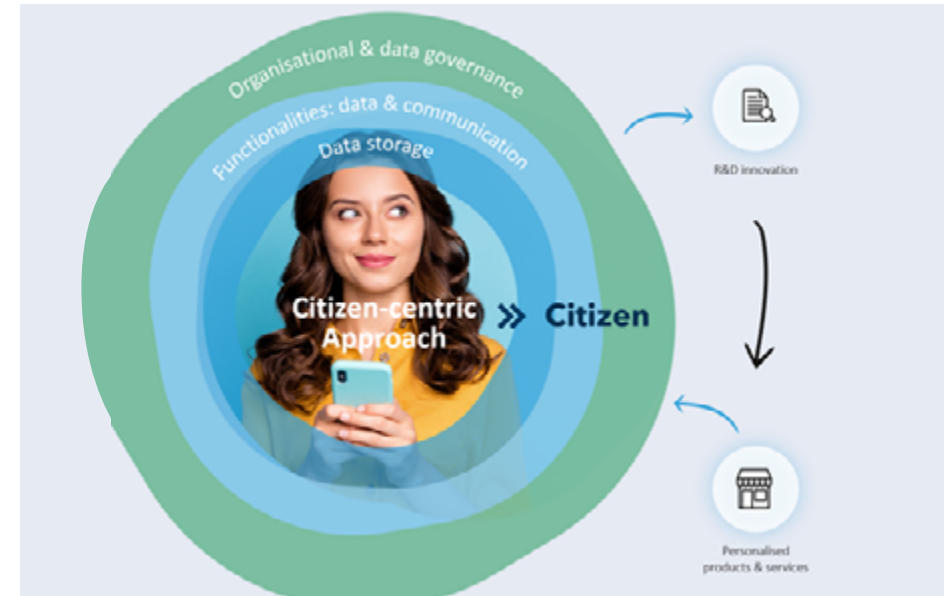
As an ecosystem, it is important that companies themselves benefit from joining. For instance, in the Save Data project (VLAIO COOCK), we are working with imec and Medvia on concrete applications to enable better data sharing between organisations, citizens and companies. That way, health data generated by citizens in app X can be reused in app Y. Because these can be much more personalised (thanks to access to a wider range of personal data), they can also be applied in the market more adequately and with a better chance of success.

In 2022, we received not only the official support of the Flemish Government but also resources through the recovery plan 'Flemish Resilience'. This allows us to further develop as a pioneer in digital data sharing. Incidentally, the Flemish Government is the first to opt resolutely in favour of Solid. VITO is in the driving seat here, completely in line with the government's vision.

## BIBOPP

An example on a small scale is the BIBOPP platform (Citizens Mobilised with an Online Prevention Platform) with digital tools that help citizens improve their health. This platform was further rolled out in the Campine region from Mol to Turnhout in 2022. BIBOPP draws on an evidence-based questionnaire prepared by GPs. By recovering data from the questionnaire, BIBOPP users can create a personalised action plan that allows them to actively work on their health. BIBOPP has a very strong local connection as the platform refers to local activities and healthcare providers nearby. Think, for example, of walking routes in the neighbourhood, cooking classes or specialised assistance, such as exercise coaches, dieticians and stop smoking counsellors. Users can also actively choose to share their results with their GPs.

Again, BIBOPP's strength lies in collaboration. This time from VITO, Living Care Lab LiCalab (Thomas More) and Domus Medica.



## FLANDERS AS A FRONTRUNNER

With We Are, an important step has been taken towards citizens having control over their own data. An initiative that was initially enthusiastically backed by Minister Crevits (Welfare) and Minister Brouns (Innovation). Meanwhile, at the request of Flemish Minister-President Jan Jambon (Digitisation), the Flemish Data Utility (Vlaamse Datanutsbedrijf) has also been set up. The Data Utility aims to increase public trust in data sharing by focusing on security, control and privacy. This is something that companies can also benefit from, as it makes data more findable, usable and exchangeable. The We Are PODs are supported technologically by the Data Utility. "Data exchange is the key to giving our society and our economy an enormous boost," Jambon argues. "But that requires trust." We Are plays a key role in this.

## ... EVEN ACROSS THE BORDER

We may be based in Belgium with We Are, but we also deploy our expertise internationally. For example, we are closely involved in EDITH, the Ecosystem for Digital Twins in Healthcare. This aims to promote an inclusive ecosystem for digital twins in healthcare in Europe and to establish a strategic roadmap for its wider development, integration and deployment.

A digital twin is a virtual representation of a product or system. For the healthcare sector, the digital twin is an important tool because it uses all possible data already collected or available in a specific clinical process. We can link those data to a specific patient's data. In this way, it is possible to detect pathologies much faster and more easily and to propose more effective therapies.

This project is led by the Virtual Physiological Human Institute (VPH) and is co-financed by the European Commission under the Digital Europe Programme. VITO has a dual role in this project. The primary task is to develop, evaluate and align the data access strategy for creating virtual twins from personal health data originating in different sources such as e-health, hospital records and/or real world (RDW) data. This is done in collaboration with the VITO Data Science Hub, in step with the We Are project methodology. But we are also contributing to the working group mapping the ecosystem of virtual twins in Europe and developing a sustainability model for virtual twins in healthcare and clinical practice.

## 3xG study

### LONG-TERM HEALTH RESEARCH SHOWS IMPACT OF ENVIRONMENTAL POLLUTION

Since 2010, the health of children in Dessel, Mol and Retie has been monitored by means of human biomonitoring as part of the 3xG study - Gezondheid (Health), Gemeenten (Municipalities), Geboorten (Births). This initiative is a value-added project as a prerequisite for the disposal of low- and intermediate-level short-lived waste in Dessel with a positive impact on welfare and well-being in the region. Samples of, among others, blood and urine are tested for numerous exposure and health markers, such as the presence and concentration of potentially harmful substances. The measured values are compared with the results of similar health studies at home and abroad. VITO is coordinator of this 3xG study.

The health of 301 3xG participants was monitored from pregnancy to age 18. Samples were taken during pregnancy and at birth, and at age seven. At age 14, the next measurement campaign takes place. All samples are stored in a biobank, forming a true health archive. In addition, a questionnaire is completed every year, which questions the living environment and lifestyle habits.



The children recently turned seven and were therefore tested for the second time over the course of 2019 to 2021. Two hundred and twelve Dessel, Mol and Retie children participated in the study. The results of their blood and urine analyses, communicated in September 2022, revealed some areas of concern for the Campine region.

For instance, about half of the children had levels of a specific class of pesticides above the most stringent health reference value. These are products used in professional agriculture and horticulture, but also by individuals. In addition, the level of arsenic, a toxic substance, exceeded the age-specific reference value in one quarter of the children. Part of the arsenic pollution is historical and linked to the former heavy metal industry, but the soil of the Campine region is already naturally rich in arsenic.

Apart from scientific value, 3xG also has a warning function for the region and potentially beyond. At the same time, we should also be aware that the strong value of this study lies mainly in the long-term follow-up of the participants.

The health study is commissioned by ONDRAF/NIRAS, the Belgian radioactive waste manager and the partnerships STORA and MONA. It was a condition of the Dessel and Mol municipalities for the surface disposal of short-lived radioactive waste in the region.



# Valorisation of sustainable technology

## TECH TRANSFER ENHANCES FLEMISH ECONOMY, MAKING IT MORE SUSTAINABLE

There are already more than ten of them, the spin-offs that were founded within VITO and which are now standing on their own two feet. With the autonomising of its spin-offs, VITO is strengthening the Flemish economic fabric, making it more sustainable.

Accommodating own innovations in spin-offs is only one way of conducting tech transfers. Another is selling licences to existing companies to apply innovations. Either way, VITO is injecting more sustainability into the Flemish business world.

In recent years, VITO's spin-off programme, and thus tech transfer, has been particularly successful. The many spin-offs that have been autonomised are the most visible illustration of this. This autonomisation also guarantees future success. For example, part of the proceeds will be placed in a brand new fund that VITO set up in 2022, which mainly provides financial support to fledgling spin-offs. As a result, the spin-off operation will continue to flourish and grow in the coming years. At VITO, there is no shortage of new ideas for innovations, the feedstock for a spin-off. The spin-off pipeline is continuously fuelled with ideas and opportunities that have potential to be valorised.

**With the autonomisation of its spin-offs, VITO is enhancing the Flemish economic fabric, making it more sustainable.**





## Clean Vision Invest

### YOUNG SPIN-OFFS GET A STRONG BOOST

A new innovation always comes from an idea. Helping develop sustainable innovations and making them ready for implementation is one of VITO's core tasks. It does so, among other things, by setting up spin-offs and supporting them in their development of innovations and the eventual marketing, and thus application, of these innovations.

To provide support, especially to young spin-offs in their often difficult but so important first years of operation, VITO launched a new fund in 2022: Clean Vision Invest. It finances spin-offs in that early phase so that they can grow strongly and also step into the economic reality quickly. The funding is intended for spin-offs developing a sustainable innovation, which could be a new energy technology, or a new recycling technique. By strengthening their financial viability, VITO prepares spin-offs for growth capital from investors or takeovers.

With Clean Vision Invest, VITO contributes even more to the transfer of technologies (tech transfer) and creates even more impact on the economic fabric in Flanders, which can therefore also become more sustainable. By developing its own innovations through spin-offs and commercialising their own innovations, VITO also receives a return on its investments. That is the way the fund is partly financed, namely with the proceeds from the sale of own spin-offs or shares in them. Because many spin-offs have been autonomised in recent years, the fund itself could already start with substantial initial capital.



## IP management

### INTELLECTUAL PROPERTY MANAGEMENT AT VITO ONCE AGAIN HONOURED

VITO is a hub for innovation. For these innovations to flourish and to be valorised, adequate patent management is needed. This is the task of the VITO IP department.

VITO's IP department sees and seizes new opportunities and takes up challenges in the world of intellectual property, which is constantly changing. And it does so excellently, as evidenced by the award it received in 2022 for the best IP department in the Benelux. It is already the second time that VITO has won this golden award.

The award ceremony took place during the latest edition of Innovation & IP Forum and Awards, an event that took place in Paris in May 2022. Every year, that event brings together IP managers and experts from all over the world. The gold award for VITO in the 'Best IP Department in the Benelux' competition was awarded by a jury of 80 and was based on long-term results, on achievements over the past three years, on innovative capabilities and of projects, strategies and commitment in the IP world. VITO beat major companies such as AB Inbev, ArcelorMittal, Shell and Solvay in the process.



# VITO4STARTERS

## NEW COMPETITION AWARDS FLEDGLING COMPANIES WITH SUSTAINABLE INNOVATIONS

VITO is not only active in the start-up community through its own spin-offs. It also boosts existing fledgling companies, or at least those who want to make the world more sustainable with their business ideas. This is done through the VITO4STARTERS competition, created in 2022 and whose first final took place at the end of July 2022 at the Love Tomorrow Conference.

During that event, which was all about sustainability, the six finalists of VITO4STARTERS were invited to pitch their innovative ideas. They did so in front of a jury of experts from imec, KBC and VITO but also a large audience. The winner received a cheque worth 20,000 euros from Flemish Minister-President Jan Jambon. However, it was not the prize money that counted, but support from VITO amounting to a similar value.

This support is precisely what a fledgling company often needs to make a difference and to really be able to realise, scale up and commercialise its idea or proof-of-concept. This may involve technological advice and assistance in the realisation of the proof-of-concept, but also the use of lab and test infrastructure and access to the VITO network and its channels, which is useful, for example, in terms of visibility and promotion. The concrete details of the support package will be verified with the winner of VITOSTARTERS.

## MOST COMPLETE STORY

In 2022, the first edition of the competition was won by Leuven-based start-up MyGrid. With the pitch of their innovation, a mobile home battery that is accessible and easy to use, founders Jan Wellens and Kristof Geerts were able to persuade the jury the most. The battery is intended for people who want to actively participate in the energy transition and also take more control of their own energy management, but who are not yet able to do so today (e.g. they do not have solar panels, an electric car or a fixed home battery).

MyGrid showed the most complete story during the finals of VITO4STARTERS, according to the expert jury. Not only had a prototype already been developed, the start-up's team of five had also already mapped out a road-to-market and had already paid attention to the look-and-feel of the mobile home battery. The support from VITO that the young company received as a prize revolved around testing and certifying batteries, with a focus on safety. VITO obviously has a lot of knowledge about this through EnergyVille.

VITO4STARTERS will also take place in 2023, and again the finalists will be able to pitch their ideas at the Love Tomorrow Conference at the end of July 2023. Applications for participating companies will reopen in April 2023.

[vito.be/VITO4starters](https://vito.be/VITO4starters)



**The battery is intended for people who want to actively participate in the energy transition and also take more control of their own energy management, but who are unable to do so today.**



## Spin-off programme

### VITO PROVIDES FERTILE GROUND FOR NEW BUSINESSES

Thanks to its spin-off programme, VITO translates the knowledge and expertise it has acquired into innovations that can then be commercialised and released onto the market. In this way, the Flemish economy is strengthened with new, innovative companies that can be active in very diverse fields. But what unites the VITO spin-offs is that they are always in the vanguard, and often in sectors with high growth potential.

Take Unifly, which was founded in 2015 from within VITO. The company, of which VITO is still a shareholder, is the world's leading developer and provider of air traffic control systems for drones. The drone market is seen as having enormous potential, especially now that autonomous drones have more freedom since early 2023 thanks to uniform European legislation. But to let them all hover around safely, and not interfere with other airspace users, new, 'unified' air traffic control systems are called for. When Unifly started developing software for it eight years ago, only NASA had taken similar steps. Partly because of this head start, the VITO spin-off in 2022 had enough time to get its systems ready for 2023, the 'year zero' for the drone.

A forward-thinking attitude was also shown by the founders of iFLUX, a VITO/UA spin-off established in 2017 that offers solutions to determine the dynamics of groundwater flow and pollution in the soil - based on innovative measurement technology and targeted data analysis. With the rising urgency of water issues in recent years, governments but also companies are following these solutions with increasing interest. After all, by relying on high-quality data, they can improve and adjust all kinds of water and soil processes in real time. Such real-time monitoring and control has been possible since 2022, when iFLUX switched to a brand new system for this purpose.

### TWO EXITS

2022 also meant the first two exits: VITO and the other original shareholders sold their shares to an acquirer, who will integrate the company. In early 2022, Laser Cladding Venture (LCV) was acquired by Swedish company SKF. And in the second half of 2022, there was the acquisition of Servaco Product Testing, which is now part of the Dutch Normec group, and renamed Normec Product Testing.

LCV's core business is laser cladding. This involves fusing metal powder with a laser onto an object, giving it a wear-resistant layer, for example. But laser cladding can also be used for 3D printing, allowing complex metal shapes and structures to be realised.

Normec Product Testing was born in 2019 as a joint venture between VITO and Servaco, which specialises in lab and industrial testing, analysis and certification, among others. The focus was on determining the impact of emissions from materials and products on indoor air quality. This created a service for manufacturers of building materials, for example, who have to meet strict product emission requirements.

With the proceeds from the sale of the shares in LCV and Normec Product Testing, VITO finances its Clean Vision Invest fund. This further supports young spin-offs, especially in their first years of life, which are often the most challenging ones. This allows the companies to grow faster and gain quicker access to economic reality. This is always done with a firm emphasis on sustainability. After all, it is one of VITO's core tasks to translate ideas into solutions that contribute to a more sustainable economy.





# Outreach



## CurieuzeNeuzen in de Tuin

### FIRST ANALYSIS PROVIDES INSIGHT INTO MICROCLIMATE ON POTATO FIELDS

The citizen science project CurieuzeNeuzen in de Tuin not only investigated the impact of heat and drought (and extreme weather) on gardens and parks, but also on potato fields. This was done via soil sensors - so-called lawn daggers - that, among other things, register the soil temperature and humidity. The project started in 2021 and was followed up in 2022.

2021 was the year our country was hit by massive water damage and floods, as a result of the 'water bomb' on 14 July. This also had consequences for the potato crop, which was plagued by increased pest stress, among other things. The prolonged high soil moisture levels were also recorded by the 500 soil sensors spread across almost 300 potato fields in Flanders. For further information, however, we were waiting for an analysis of the sensor data, combined with meteorological and satellite observations, as well as other soil data.

A first analysis was conducted by VITO in 2022. This focused on two potato fields, one in the west of our region (Heuvelland), on clay soil, and one in the east (Kasterlee), on sandy soil.

## TWO DIFFERENT SUMMERS

The summer of 2021 began dry and hot, the highest temperatures were measured in the first two weeks of June. In the fields, the temperatures measured by the sensors initially followed those of the bare soil, until the potato foliage closed. From that moment on, the soil temperature there was lower, it was even below the air temperature. In Kasterlee, this effect was more pronounced than in Heuvelland, a result of the Campine sandy soil. The lower temperature under the closed foliage is probably due to evaporation by the potato plants, having a cooling effect. Presumably this suggests good growing conditions, because evaporation requires the plants to draw enough water from the soil. From mid-June, the weather turned and it became cooler and, most importantly, much wetter. The sensors recorded higher soil moisture levels.

The VITO experts poured the sensor data into models and distinguished between the warm, dry period and the cooler, wet period. They established a link between the cooling effect and the so-called FAPAR, a measure of the amount of solar radiation absorbed by plants through photosynthesis. Apparently, potato plants perspire the most when photosynthesis is in full swing. This correlation was strongest during the warm period. During the cool period, the correlation was less evident and the cooling effect was also smaller.

This first analysis provides more insight into the specific microclimate prevailing under the foliage of potato plants, and how this is related to the physiological behaviour of the plants. A reduced cooling effect, or its absence, could mean, for example, that the plants are experiencing stress. This could be valuable information for potato growers.

The 2021 sensor data will be further analysed. And so will the data from 2022, as the success of the project meant CurieuzeNeuzen in de Tuin got a follow-up last year.

## High-profile visit

### JAN JAMBON IMPRESSED BY VITO'S INTERNATIONAL ACTIVITIES

Flemish Minister-President Jan Jambon paid a working visit to the Mol site on 10 March 2022. During that visit, special attention was paid to the international context in which VITO operates. This international touch was further highlighted by the fact that Jambon was accompanied by Claire Tillekaerts, then Managing Director of Flanders Investment & Trade.

VITO is active on all continents. An important field of activities is climate. For example, VITO carries out climate studies tailored to cities and is involved in national development programmes for the reduction of greenhouse gas emissions. With G-STIC, the international sustainability community that VITO founded in 2016, it also plays an active role in project recruitment in the context of international climate funding, with resources originating from the Flemish Climate Fund. A first call for such projects was launched in 2021 with the help of G-STIC. In the end, 12 projects were selected. The projects, involving Flemish partners, relate to the implementation and scaling-up of climate plans and solutions in developing countries.





VITO's international activities (outside Europe) take place in various ways. In China, India and the Middle East, for example, it has joined forces with industrial parties for the roll-out of innovative technologies. A partner with which VITO increasingly collaborates is the World Bank. It has already funded projects in which VITO collaborated in countries, such as Colombia, India and South Africa. Finally, VITO often works on the basis of bilateral cooperation, with funding coming partly from Flanders, (federal) Belgium or Europe.

Partly thanks to the cooperation with Flanders, VITO has enjoyed more and more international successes in recent years. Examples of such successes, underpinned by Flemish cooperation, are the G-STIC climate programme and the NDC Support Centre. The latter helps governments in Uganda, Malawi, Mozambique and Morocco, among others, in drawing up their climate statistics.

Apart from international activities, Jambon's visit also focused on several prestigious research projects that have been running for years at VITO, such as LignoValue Pilot, Flame and deep geothermal energy.

**Thanks in part to the collaboration with Flanders, VITO has been enjoying more and more international successes.**

## VITO and science communication

Science communication may not be the core task of a knowledge institution like VITO, but it is necessary to communicate what we do. Not only because citizens indirectly invest in knowledge centres, but especially because VITO's mission to accelerate the transition to a sustainable world can only succeed if we can implement the solutions VITO develops. We therefore need to convey the message to the general public, so that as many people as possible understand our innovations and realise their significance.

This is why we attach great importance to science communication. We do this through press releases to the wider public, through active and targeted use of social media, through our magazine VITO Vision, the newsletter VITO Pulse and our website. The best way to reach people, however, is direct interaction in the field. Corona put a brake on these physical activities for more than two years, but in 2022 we were able to pick up where we left off. We deliberately chose to concentrate our efforts in three ways.



**RESOURCITY:** the starting point of the VITO developers was to use an augmented reality game app to introduce young people (and adults) to circular economy. The game was developed in 2018 and quickly became extremely popular. The (tourist) services of Antwerp, Mechelen, Mol, Leuven, Herentals ... use it to guide residents and visitors to places where they can pick up locally inspired chemical facts. In 2022, we worked on opening up the app's management system so that teachers can, for free, add their own chemical elements into the system, personalising and adapting it to curriculum goals. Municipalities, companies and other interested parties can, for a small fee, roll out a fully customised ResourCity in their own regions.

**NERDLAND FESTIVAL 2022:** VITO stepped forward as big bang sponsor of Belgium's biggest science festival where some 13,000 visitors - old and young - could learn about science in all its facets during three days. VITO presented six key research projects, garnished with a very appetising sauce. For instance, we translated circular economy into the way we deal with (old) textiles and got volunteers to stitch tote bags from old sheets. We presented the Marscat project where, together with ESA, we use 3D-printed Martian dust as a catalyst to convert CO<sub>2</sub> into methane. A 3D printer made Pokemons on the spot. And immediately, the link was also drawn to ResourCity on Nerdland, where visitors were able to catch chemical elements in true Pokemon style. Sometimes research is like looking for a needle in a haystack. We taught visitors how to make the invisible really visible using all sorts of almost playful techniques. Machine learning and artificial intelligence were then linked to a photobooth, where we tried to teach a computer a new emotion: the Nerdland emotion. For VITO, it was the first edition of Nerdland in which we actively participated and to which we immediately linked an information stand about our knowledge centre - complete with employer branding.







**SCIENCE DAY:** Science Day in 2022 was also given a new focus. After two years in which Corona forced us to only go online, we could open the doors again physically in 2022. For the first time, we linked the Science Day to 'work in your own region'. We wanted to make visitors to Science Day - who traditionally live within a limited radius around an event - aware of interesting and exciting employers in the region who still have room for talent, who are looking to recruit talents and talents for which VITO is proving a particularly attractive employer. We showed this in the brand-new Tablooi in Dessel, which offered free entrance for this Science Day. So on 27 November 2022 in the Tablooi building, visitors had the opportunity to get to know the most important employers in the region, including VITO. Despite the very autumnal weather and notwithstanding the popular Belgium-Morocco match in the World Cup, we still managed to welcome 500 very enthusiastic visitors.





## VITO employee in the spotlight

### MILESTONE REACHED: VITO NOW HAS MORE THAN 1,000 EMPLOYEES

Every day, Partha Das is busy modelling and simulating energy systems. In doing so, he uses the internationally popular TIMES model, with which he has had experience since his PhD research in India. That experience brought the 36-year-old Indian to Belgium and to VITO/EnergyVille, where he became the thousandth VITO employee in February 2022. A milestone in the more than 30-year existence of the knowledge and research centre.

**'We only knew Belgium from Tintin, chocolates and the glass industry'**



### The thousandth VITO employee comes from a far place. How did you end up at VITO/EnergyVille?

'After my master's in engineering at the Jadavpur University (in eastern India), I started my PhD research at the Malaviya National Institute of Technology Jaipur (in western India). The topic was system planning for energy networks. Specifically, I developed new methodologies to tackle the impact of renewable energy variabilities in long-term energy system planning. In doing so, I focused on power grids in India.

Before getting my PhD, I taught at the Central University of Jharkhand (in eastern India) for a year. After my PhD I joined a non-profit company, where I worked on planning and modelling energy systems in India. I then joined a start-up where we developed models for power markets abroad, including in the Philippines.

System planners like me work with the TIMES model on a daily basis. We use it to explore long-term scenarios from a very broad, techno-economic approach. This is how

I got to know VITO/EnergyVille and its energy modellers: I regularly read their papers and sometimes quoted them in my own scientific articles. When I read that they were looking for a TIMES modeller, I decided to go all out for the job.'

### That was in January 2022, when the world was still under the spell of corona.

'Indeed. Initially, I was supposed to join VITO in mid-January 2022, but due to travel restrictions my wife and I had to reschedule the plan and were only able to reach Belgium in February 2022. All the interviews for the job took place online. By the way, it was the first time for us travelling outside India. We only knew Belgium from Tintin, chocolates and the glass industry (laughs), although of course I already knew VITO/EnergyVille.'

### In 2022, you worked on the major study for Febeliec on a climate-neutral Belgium by 2050, and how to get there. You helped carry out a similar exercise for the World Bank for Ahmedabad, a large city in western India. That's how you got back in touch with your motherland.

'That was very nice, of course. Specifically, for Ahmedabad, we developed a roadmap towards a climate-resilient, low-carbon future for the city. In doing so, we focused on greenhouse gas emissions from buildings, transport, municipal services, wastewater treatment, and solid waste management. Policymakers can soon use the roadmap to help the city grow in a more climate-friendly way, while also paying more attention to the impact of global warming. For the project funded by Febeliec I was happy that I could contribute towards the modeling of decarbonization options for the Belgian industry sector in the TIMES-BE model'.

### What differences do you see between India's approach to the energy transition, and the approach in Belgium and Europe?

'In Belgium there is a head start. That may be partly because people here were concerned about climate before. That awareness only came later in India. But since about ten years, there has also been a strong drive from the national and regional governments in India to decarbonise energy supplies. For instance, there has been a strong commitment to renewable energy in recent years, to the extent that states are competing with each other over who is the 'greenest'. Moreover, India is committed to being climate neutral by 2070.'

### Has your stay in Belgium also brought any surprises?

'What strikes me is that the workplace here is less stressful than in India. In Belgium, the work-life balance is clearly better. It comes down to efficient planning and execution. This ensures a good work balance. This is certainly the case at VITO/EnergyVille, as there is close interaction between colleagues, responsibilities are clearly divided and agreed, and the unit and team structure ensure a pleasant working environment'.



# Love Tomorrow conference

## A UNIQUE SUSTAINABILITY CONFERENCE OF TOMORROWLAND

The Love Tomorrow Conference is an organisation of the Love Tomorrow Foundation (Tomorrowland's sustainability platform), supported by VITO and G-STIC. The first edition of the Love Tomorrow Conference took place on 28 July 2022, right before the start of Tomorrowland's third festival weekend. It was an inspiring international event about sustainability and innovative projects that aim to make the future insightful and to create a positive impact.

## IMPRESSIVE LINE-UP OF ARCHITECTS OF TOMORROW

The first Love Tomorrow Conference immediately attracted the big name Yuval Noah Harari, author of Sapiens.

Other speakers were Nadine Bongaerts (Synthetic biologist), Ali Tabrizi (Filmmaker), Lieven Vanlommel (CEO Foodmaker), Jasna Rokegem (Fashion-tech designer), Lucas De Man (CEO Biobased Creations), Dennis Karpes (Social Entrepreneur), Dirk Standaert (Technological innovator), Cécile van Oppen (Co-founder Copper8), Jacob Bossaer (CEO Bosaq), Ida Engberg (DJ), Arash Aazami (Activist innovator), Liviu Babitz (Inventor), Frans Timmermans (Executive Vice-President for the European Green Deal) and David Sirota (Screenwriter of the film Don't Look Up starring Leonardo DiCaprio).

They encouraged the participants to take action for a better environment, climate and well-being with a view to the sustainable world of tomorrow.



## WORLD PREMIERE OF 'ONCE UPON A.I.' INSPIRED BY YUVAL NOAH HARARI

'Once Upon A.I.' is a short film experiment inspired by the writing of Yuval Noah Harari, featuring over 260 spectacular images that were generated by 13 different A.I. algorithms.

Yuval Noah Harari studies the evolution that humans have gone through and will go through on a macro scale. In his books, he refers to technological development as a constant and powerful driving force for change.

But what if we turn the tables? What happens when we let technology interpret Harari's epic non-fiction storytelling about our collective past and possible future?

Once Upon A.I. had its world premiere at the Love Tomorrow Conference.



## G-STIC CLIMATE ACTION PROGRAMME WITH CLIMATE SOLUTIONS FOR DEVELOPING COUNTRIES

The G-STIC Climate Action Programme supports developing countries in their fight against climate change. For the second project call in 2022, the Government of Flanders was providing €15,7 million in subsidies for climate projects in developing countries.

Representatives from the approved projects of the first project call in 2021 shared their insights on climate solutions in developing countries.

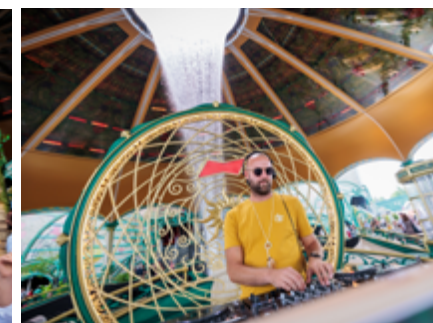
## MYGRID: THE WINNER OF THE VITO4STARTERS PITCH COMPETITION

With the VITO4STARTERS competition, VITO supports young companies that contribute to more sustainability with its technical knowledge, a proof-of-concept and/or access to infrastructure. During this Love Tomorrow Conference six finalists have pitched their idea:

- ClimateCamp which provides an open carbon infrastructure to share emission data from suppliers to manufacturers and customers.
- Sisqon which produces a biological, biodegradable, water-based glue out of an organic waste stream.
- Polyperception which uses AI and computer vision to provide real-time operational data to waste sorting and recycling facilities.
- MyGrid which provides a unique plug-and-play homebattery and portable battery pack all-in-one attractive device that can be plugged into any standard power outlet.
- Gro2 which develops a photobioreactor suited for microalgae cultivation on industrial sites while using residual heat.
- PANTA Club which provides a carefree and affordable subscription service of safe and premium urban-bikes for children with a circular business model.

Minister-President Jan Jambon and Dirk Fransaer (Managing Director, VITO) awarded the prize of €20,000 in VITO support to the winner MyGrid.

**The second edition of the Love Tomorrow Conference will take place on 27th July 2023.**





# VITO in figures

The year 2022 is economically marked by an unseen inflation of 9.59 % and the energy cost has tripled. Yet VITO is again able to present a positive financial end result. VITO continues to grow in budget and staff. The relevance of VITO's research is reaffirmed by the high success rate in acquiring new research projects, the start of 4 new spin-offs and new license agreements with industry in Belgium and abroad based on built VITO knowledge.

Dirk Fransaer  
Managing Director



## REVENUE 2022

Financing Reference Tasks

**12 582 kEUR**

Business Revenue

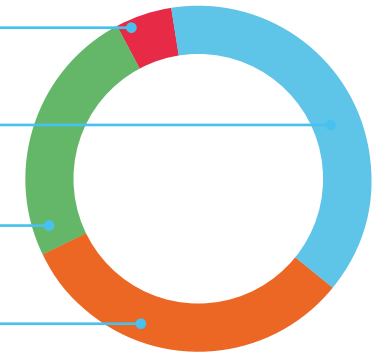
**90 704 kEUR**

Grants

**57 681 kEUR**

Activation R&D

**76 300 kEUR**



**TOTAL**

**237 267 kEUR**

## EXPENDITURES 2022

Depreciation and others

**7 758 kEUR**

Operating Means

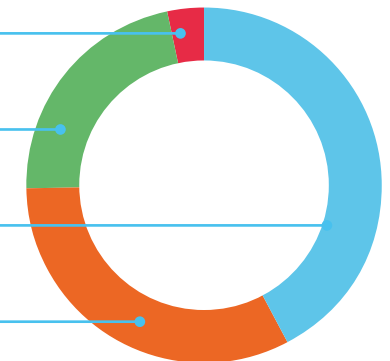
**51 666 kEUR**

Salaries

**99 783 kEUR**

Depreciation R&D

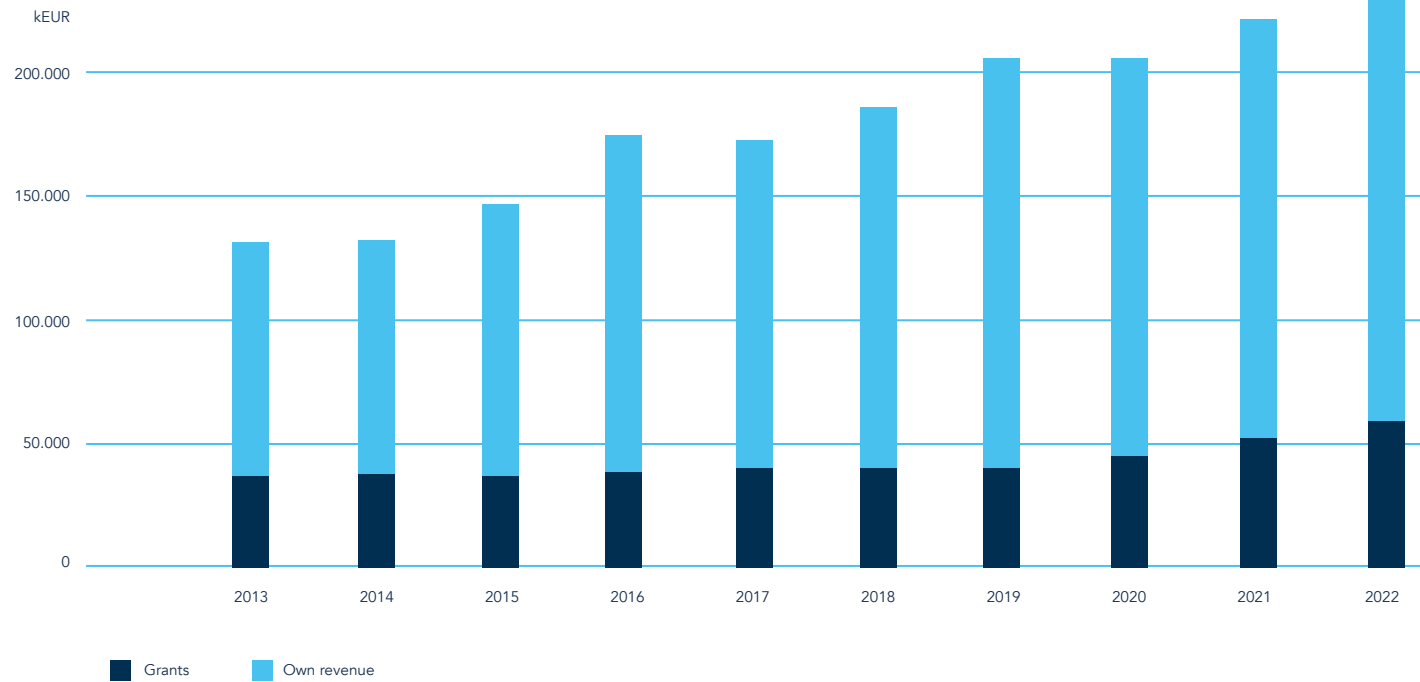
**76 300 kEUR**



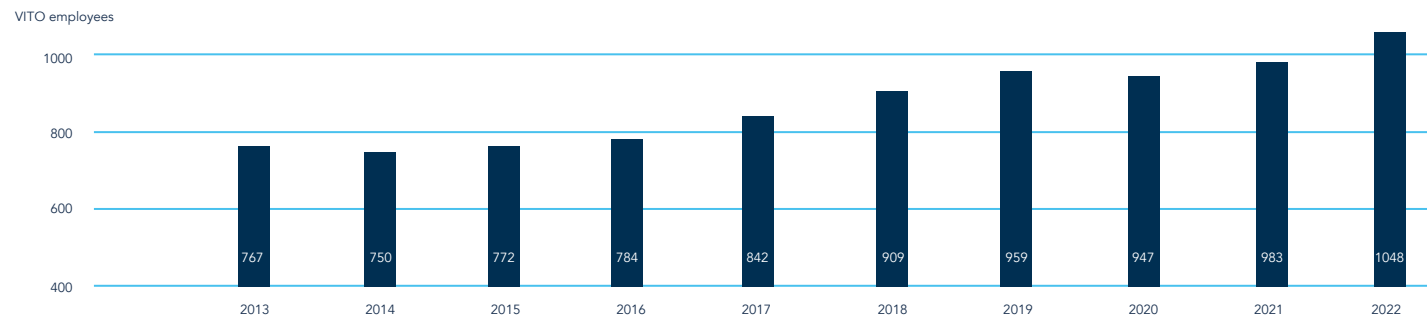
**TOTAL**

**235 507 kEUR**

## EVOLUTION OF REVENUE (KEUR)



## NUMBER OF VITO EMPLOYEES





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