



VISION ON  
TECHNOLOGY  
FOR A  
BETTER WORLD

# ANNUAL REPORT

2020







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## PREFACE

Dear reader,

2020 was dominated by the coronavirus pandemic. Just like the rest of the country, VITO switched to large-scale remote working from mid-March 2020. Our labs continued to be staffed under strict safety measures so they were able to continue their important research in a safe way. This switch went well, with little impact on VITO's research results. In fact, our scientific output saw unprecedented growth, with 287 SCI papers and 23 patents submitted (30 granted) as a result.

VITO contributed to tackling the crisis by providing face masks and personal protective equipment to hospitals at the start. With the support of the Flemish government, VITO achieved accreditation for its FFP2/FFP3 face mask testing infrastructure. This allows Flemish face mask manufacturers to be assisted and certified closer to home.



A few numbers of the VITO approach during the coronavirus pandemic in 2020

Our employee on-boarding process was 100 % digital, thanks to our new welcome app. VITO welcomed 96 new staff in 2020, bringing the total number to 947, including 17 % nationals from 43 different countries. VITO's budget amounted to around 204 million euros.

Local and international collaboration to bring about a sustainable future is the central focus of VITO's research.

For example, VITO has joined Ghent University's Capture initiative and has started innovative research into new electrolyzers for the production of green hydrogen, as commissioned by The Blue Cluster spearhead group. This is a necessary component in the battle against global warming because captured CO<sub>2</sub> is given a new life, for example as green methane. VITO has launched several climate projects, also in Africa and India. Our presence in and collaboration with China lead to a valorisation trajectory for the STORM Energy district controller, in particular for thermal networks.

We joined Vlakwa in celebrating its 10-year anniversary and were awarded the WaterProof project, a necessary achievement to help remedy the consequences of global warming on the available water supplies in Flanders.

On 18th February 2020, just before the first lockdown, VITO organised its first Clean Vision Summit. This event that brought together entrepreneurs, investors and VITO experts welcomed 450 participants. G-STIC, the annual SDG (Sustainable Development Goals) conference with 7 other international research institutions, went digital. With almost 4,000 attendees from over 90 countries, it was an unprecedented success.

The coronavirus pandemic has continued to rage in early 2021 and vaccination campaigns have been launched. The pandemic, and certainly the social and economic consequences, will continue to affect us in 2021 and beyond. Nevertheless, we are hopeful of recovery and VITO, with the support of the Flemish government, will support the people and economy of Flanders even better in the future.

I hope you will enjoy reading this report.

Ir. I. Vanden Berghe  
Chairman of the Board of Directors

## BOARD OF DIRECTORS

**Chairman:** Ingrid Vanden Berghe

**Members:** Dirk Fransaer, Elke Van de Walle, Michel Meeus, Wim Van den Abbeele, Eric Vermeylen, Caroline Ven, Marc Decorte, Isabel Van Driessche, Luc De Schepper, Kurt Deketelaere (not present in picture), Renate Hufkens (not present in picture)

**Government commissioners:** Bob Van den Broeck, Nele Roobrouck

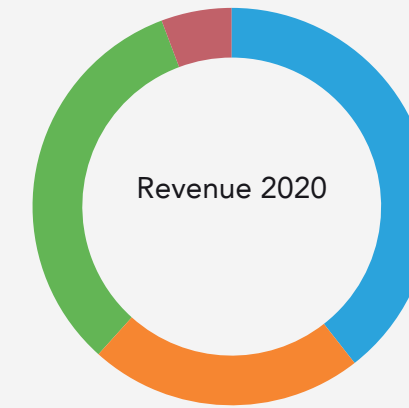
**Observers:** Frank Gérard (PMV), Wesley Boënné (VITO), Maarten Spruyt (VITO)



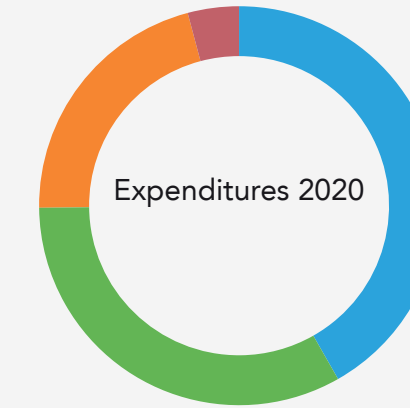
# VITO IN FIGURES

"In 2020 the coronavirus pandemic has had an impact on VITO. The impact of the limitations was clearly shown in lower operational means. Despite the difficult circumstances VITO was able to maintain its growth of the previous years so we can close 2020 with a positive result. It shows that VITO is ready for the challenges of the post-corona era with continued attention for good project management and cost efficiency."

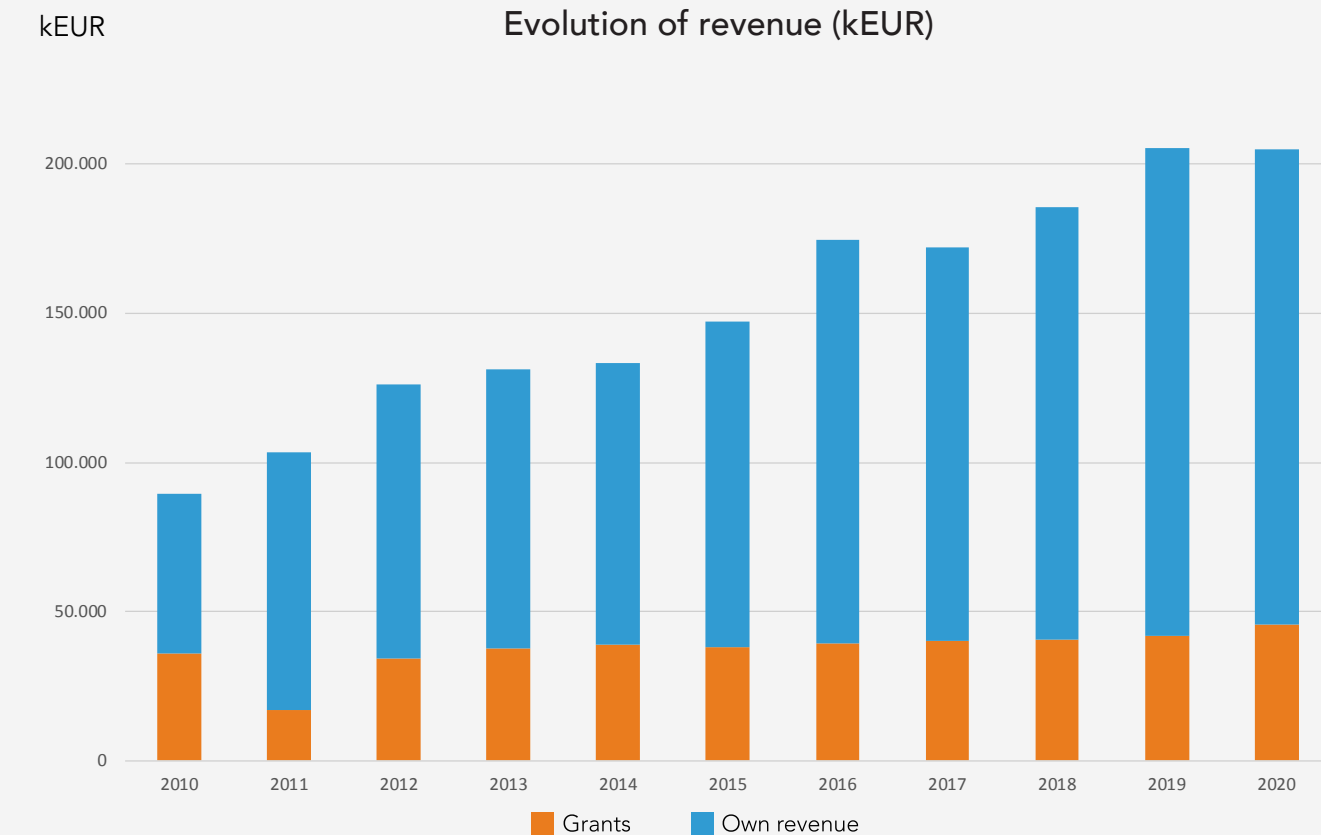
**DIRK FRANSAER**  
Managing Director



Business Revenue	81 036
Activation R&D	66 800
Grants	45 563
Financing Reference Tasks	11 727
<b>Totaal</b>	<b>205 126 (kEUR)</b>

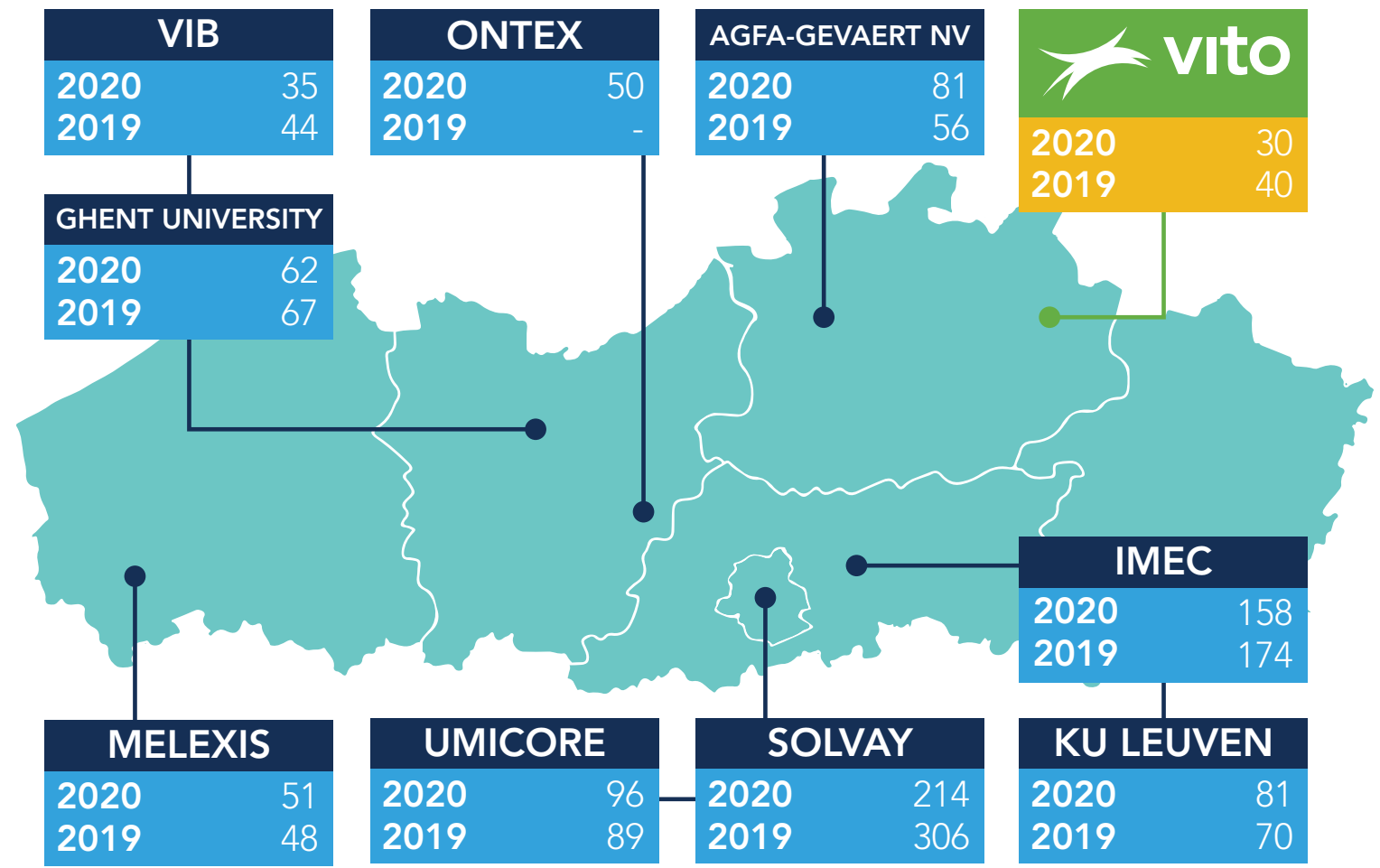


Salaries	84 332
Depreciation R&D	66 800
Operating Means	42 661
Normal Depreciation	8 358
<b>Totaal</b>	<b>202 151 (kEUR)</b>





**NUMBER OF PATENTS FOR UNIVERSITIES, RESEARCH ORGANISATIONS AND INDUSTRIES IN BELGIUM IN 2020**



**VITO RANKS AGAIN IN TOP 10 OF BELGIAN PATENT APPLICANTS IN 2020**

As in previous years, VITO strengthens the ranks of the top 10 Belgian organisations and companies that have applied for a patent at the European Patent Office (EPO) in 2020. A strategic selection of the geographic regions in which patent protection is sought, should enable an efficient cost control in function of valorisation planning.

In 2018, 32 applications were filed by VITO, which grew to 40 in 2019, and evolved towards 30 in 2020. Solvay still leads the list with 214 applications in 2020 and imec stays second in rank. With 30 applications, VITO is again following closely its colleague VIB.

All in all, the Belgian organisations and companies accounted for a total of 2,400 patent applications filed at the EPO in 2020, a slight decrease compared to the number of applications filed in 2019 (2 422). This is in line with the generally observed decrease in the total number of patent applications filed at the European Patent Office (- 0.7 %). The global pandemic that has been going on since the beginning of 2020 has everything to do with this.

65.9 % of Belgian applications originate from applicants located in Flanders (1 580), followed by the Walloon region (19.9 %) and the capital Region of Brussels (14.2 %). Flanders was number eleven in the top twenty European regions for patent applications.

According to EPO president António Campinos, it is innovation, research and science that will lead to a healthier world and a more solid and sustainable economy. Indeed, innovation supported by a strong IP system is the engine of recovery, in every sense of the word.

Medical technology was the big leader in terms of volume, while pharmaceuticals and biotechnology were the strongest growers.

Belgium is in 8th place in the ranking of number of applications per million inhabitants, with 205 applications per million inhabitants. Switzerland still leads the ranking with 966 applications per million inhabitants. The eight countries at the top of the list are all Western European. Israel comes in at number 9 (194), followed by Ireland (188), Korea (177) and Japan (175).



# VITO CONNECTS

WE ACCELERATE THE TRANSITION TO A SUSTAINABLE WORLD. WE DE-RISK INNOVATION FOR BUSINESSES AND WE STRENGTHEN THE ECONOMIC AND SOCIETAL FABRIC OF FLANDERS, WITH INTERDISCIPLINARY RESEARCH AND LARGE-SCALE PILOT INSTALLATIONS.



## VITO & SCIENCE

VITO has a strong reputation in the Flemish and European scientific communities and works together with internationally renowned institutions.

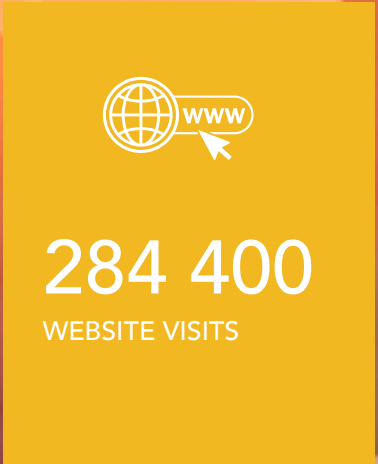
## VITO & COMPANIES

VITO is working together with companies, either directly or in partnership with industry networks such as the spearhead clusters and employers' organisations, to reduce the risk of sustainable innovation for companies. In Flanders and by extension internationally.

## VITO & SOCIETY

VITO makes objective and scientific information available to policymakers and citizens in order to have an impact on social debates about the transition to a sustainable society and the achievement of climate goals.

# VITO SHARES KNOWLEDGE





# SUSTAINABLE SOLUTIONS FOR BUILDINGS



## CIRCULAR AND SMART CONSTRUCTION

In order to make Europe climate neutral by 2050 the European Commission aims for an unseen renovation wave for the building heritage. By extension of this Green Deal, Flanders also has the ambition for a more sustainable construction sector, for example by the initiative of Circular Building. The challenges are extensive: Flanders must renovate 90 % of its building stock by 2050 to achieve the climate goals.

Whoever says sustainable, says circular. In a circular building economy waste is limited and there is maximum reuse of products and materials. However that is easier said than done, especially in a traditional sector like the building sector. That is why VITO maximizes the support of construction companies in their exploration and adoption of a circular business model. And the development of tools that can facilitate the roll-out of these circular business models.

A sustainable design and management of buildings is also smart. With smart, digital techniques for example, the energy use can be minimized and the energy system can become more flexible. That is also a strong focus of VITO/EnergyVille. Together we will continue to make the construction industry more sustainable.

## CIRCULAR CONSTRUCTION SOLUTIONS

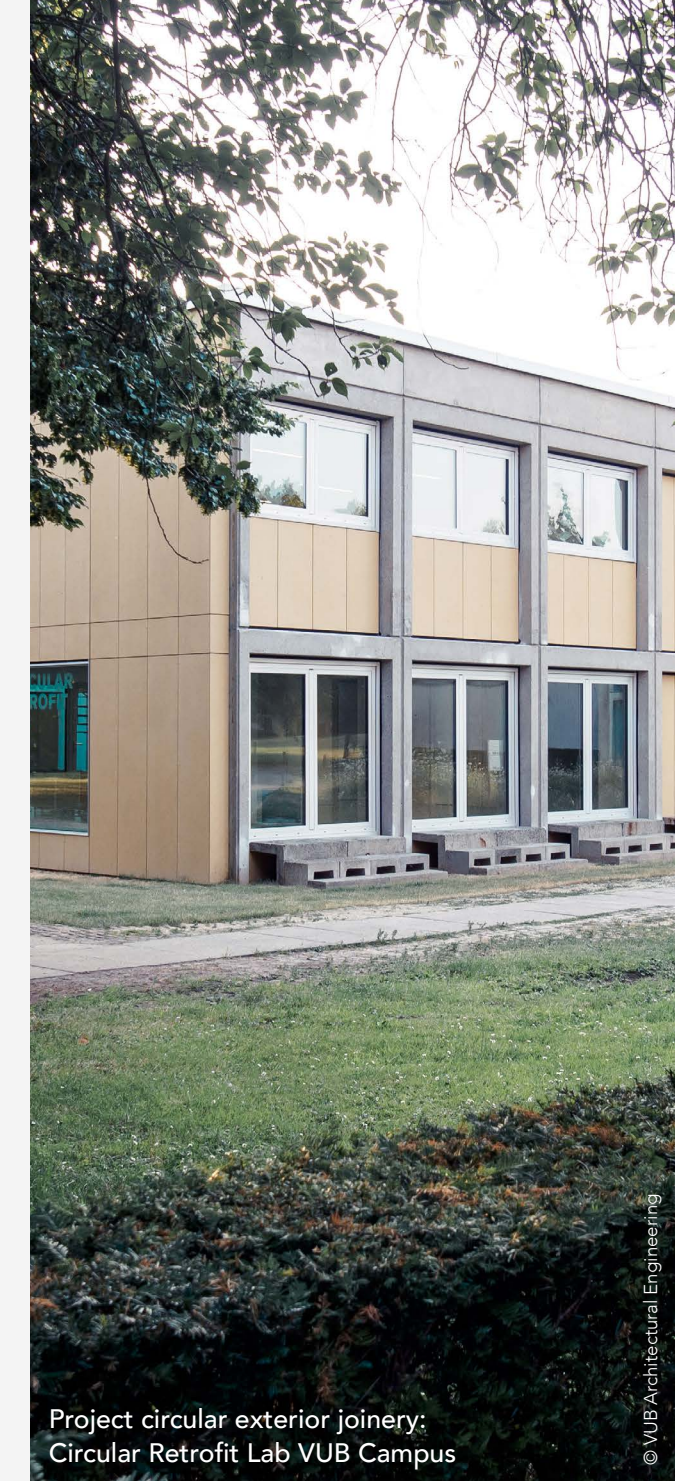
## OPPORTUNITIES FOR EXTERIOR JOINERY

Construction companies who want to make the transition towards circularity, often get cold feet due to the uncertainties. Although they realize that is where the future lies.

This is also the case for Reynaers Aluminium, a developer of window, door and curtain wall systems. At the end of 2019, the company based in Duffel started working together with VITO/EnergyVille in the search for circular construction solutions as opportunities for aluminum exterior joinery. This is part of the project Windows of Circular Opportunity, that runs until the end of this year.

At the start of the project, Reynaers Aluminium was still trying to figure out where the “circular” business was heading. The cooperation with VITO/EnergyVille should provide a better insight into business opportunities, and thus help to eliminate the uncertainty surrounding circular construction, both within the company and in its sector.

One of the objectives of this project is to compile a design guide with circular solutions for exterior joinery, tailor-made for architects. Because they primarily work and think at building level. This guide must help to extend the circular building principle globally to the entire construction chain, since today that is still limited to a number of materials.



Project circular exterior joinery:  
Circular Retrofit Lab VUB Campus



# FIRST AID FOR CIRCULAR BUILDING



## A UNIQUE CO-CREATION PROCESS

How can established construction companies make the switch to a circular business, without shooting themselves in the foot? And what are the do's-and-don'ts for start-ups? To these type of questions, entrepreneurs from the Flemish construction industry found answers in a unique co-creation process that started already in 2019 and was co-organised by VITO.

In this co-creation process that VITO set up with Möbius and Kamp C, the participating companies had the chance to discover the opportunities of circular building, and how to capitalize these via a suitable business model. Each programme consisted of an introductory inspiration session, followed by three content-related workshops with a focus on various aspects of circularity. How can circular value be created? How can the needs of customers be met? Which partners are needed within the circular value network?

The past editions of the co-creation process turned out to be a big success: at the end of last year, the third edition was completed, bringing the total number of participants to 25. Also the participants were very diverse: from established construction companies to young start-ups, and from large building principals to interior designers.

## TOWARDS SMARTER BUILDINGS

### SMART BUILDING



## A BUILDING'S IQ





Smart buildings are equipped with an energy management system that monitors the energy efficiency and the energy flexibility (and optimizes continually). Therefore these buildings do not only guarantee a lower energy invoice but also meet the needs of the consumer, for example at the level of comfort.

To make the added value of smart homes more tangible for users, owners, landlords or suppliers of smart services, VITO/EnergyVille has conducted a study about the so-called Smart Readiness Indicator, or SRI at the request of the European Commission. This indicator shows how 'technologically ready' a building

is to interact with their users and the energy grid. The SRI also indicates how more efficiency gain and a better performance in a building can be achieved with ICT technologies.

VITO/EnergyVille developed a methodology to calculate the SRI, based on smart services and functionalities in a building. To then display it and communicate about it. The latter resulted in a global impact score that shows how smart a building is. As a practical test, the methodology was used for the EnergyVille 1 building in Genk and also for a traditional single-family home in Manchester.

### EXPECTED ADVANTAGES

-  optimised energy use as a function of (local) production
-  optimised local (green) energy storage
-  automatic diagnosis and maintenance prediction
-  improved comfort for residents via automation





# ROBUST WATER MANAGEMENT



## 360 DEGREE VISION OF VITO

Flanders is part of the most water scarce regions in Europe and we have experienced this several times during the last years during long-term periods of drought. Not only our water reserves are sensitive to drought, also important parts of our economy and industry are.

So Flanders needs a water management that can not only lead us through periods of drought (that will become more extreme because of climate change), but that will also protect our region from water stress by heavy rainfall and, in the longer term, the rising sea level. This management must be robust: strong and shockproof, but also resilient and flexible.

VITO/Vlakwa approaches water management with a 360 degree vision where all aspects of our society that are influenced by water, are taken into account. From economy to legislation and social fabric to technological development.

## BLUE DEAL

### TOWARDS A MODEL REGION FOR EFFICIENT USE OF WATER

In the transition towards a robust management of our water system, last year the Flemish government has announced the Blue Deal, a series of measurements that must prepare Flanders against water scarcity and drought and must lead to a model region for efficient use of water in the long term.

VITO makes an important contribution to the Blue Deal with its water-related tools and innovation projects. At technological level for example VITO focuses on intelligent management systems that map out both the quality and the quantity of water in real time. Specific software tools must enable smart control for authorities and businesses.

A central aspect of robust water management is circular usage of water. That allows to separate the limited availability of water from economic growth. Monitoring also plays an important role. VITO designs water dashboards which give companies a high degree of autonomy in the management of their own water. A so-called Water Barometer Tool gives companies insight into the risks of drought.

With other tools like the WaterArchitect and the Nature Value Explorer VITO offers instruments to project developers, town planners, architects and policy officers for the use of alternative water sources or natural water buffering. These alternative sources can also support the water supply for agriculture, and that is exactly the goal of the VITO Irrigation 2.0 tool.







## LESS DROUGHT BY SMART BUFFERING

As part of the Blue Deal, VITO was awarded the contract by the Flemish government to coordinate the project of Flanders Waterproof. The focus of this ambitious project, that was started at the end of 2020 and that will run until the beginning of 2025, is on combating drought through smart buffering and efficient water (re)use.

With this project the Flemish government wants to put 'the spade in the ground' for sustainable and solution driven actions for water management. At the same time a thorough system analysis is set up to map cause and consequence relationships within the water system including interactions with other systems like energy, mobility, food and health.

In this project three large-scale demos will be set up, integrating the VITO experience together with Aquafin and several regional partners at system level. The knowledge and expertise that will be gathered here must be applied later at a broader Flemish scale. Finally this must result in a 'water reallocation project' that will make our region waterproof.

The demo area 'WaterArchitect' is focused on the development of a smart water network on a West Flemish industrial estate. In 'Climate ponds' the focus is on freshwater reserves and buffer options for the white sand lakes in the Campine region. The third demo area, called 'Water community', involves efficient water and soil management in the fruit orchards of Limburg.

With this project the Flemish government supports the future-oriented expansion of a strong research portfolio on water at VITO.

[vlaanderenwaterproof.be](http://vlaanderenwaterproof.be)

**FLANDERS  
WATERPROOF**

**WATER  
PROOF**

## 10 YEARS VLAKWA



**VLAKWA**  
Flanders Knowledge Centre Water

## CIRCULAR WATER ECONOMY

Imminent water shortages not only have an impact on citizens (via irrigation restrictions) and farmers (via hose pipe bans) but also on businesses. As a result, more and more sectors, companies, organisations and governments are focusing on robust water management, which should help them to move towards a circular water economy. Over the past ten years, they have been able to count on the extensive expertise of the Flemish Knowledge Centre for Water (Vlakwa), which has been a fully-integrated part of VITO since 2016.

On 1st October 2020 Vlakwa celebrated its 10th birthday. A look back on the past decade shows that the economic and innovative drive has remained unchanged since the start in 2010. Just like back then, the knowledge centre today brings parties with water-related issues together with 'problem solvers'. This often results in demonstration projects where new innovations can be tested and evaluated.

Vlakwa uses a strong system focus with 3 central aspects: what are the root causes of the water problem, how can innovation provide a solution and how can successful demonstration projects be scaled up and made ready for entrepreneurs to work with.



# CIRCULAR ECONOMY AND MATERIALS

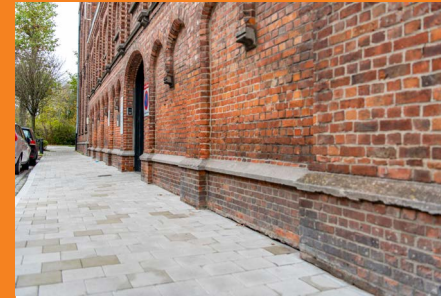


## SUSTAINABLE, ECONOMICAL AND ROBUST

Global warming, depletion of natural resources, rising demand for sustainably extracted raw materials and fabricated materials ... Piece by piece these are challenges that a circular economy, or at least partially, can address. VITO is helping governments and companies to make the transition to circular thinking and develops circular business models.

But the transition to a circular economy is also strongly technology driven. Innovation can transform waste streams into raw materials and basic materials for new or existing products that can be made more sustainable this way. This is how the need for primary resources and fuels can be reduced. VITO is supporting the achievement of this innovation with her knowledge and expertise.

Circularity rhymes with sustainability. But a circular economy is also robust for changes and therefore resilient in critical times. This was shown last year during the corona crisis, when local chains and a more limited use of materials turned out to be important assets for many companies in Flanders.



### A FOOTPATH TO A CIRCULAR CITY

Last year Ghent was the first city in Belgium to construct a circular footpath. The clinkers were made using the environmental and climate friendly Carbstone technology, developed by VITO together with Orbix.

In the production process residual waste from the steel industry reacts with CO<sub>2</sub>. During this process no green houses gases are emitted, because here CO<sub>2</sub> is a raw material. Furthermore, no cement is needed, what reduces the ecological footprint even more. The Carbstones are now ready to conquer the construction market.

## CAPTURE

### CIRCULAR (RE)USE OF CO<sub>2</sub>, PLASTICS AND WATER

Converting CO<sub>2</sub> into useful products, using plastic waste as raw material and ensuring the availability of high-quality water. These are not one, not two, but three challenges that the research platform CAPTURE, that was started about ten years ago by the University of Ghent, wants to tackle.

Today the platform unites not only Ghent University but also the University of Antwerp, Vrije Universiteit Brussel and VITO. This open collaborative model together with companies and governments in Flanders makes it possible to draw the full picture of the circular economy. Based on excellent fundamental and exploring research, all partners will work together to develop and scale up technology and to valorize it as quickly as possible.

Last year CAPTURE received €430,000 support from the Flemish Government. This funding will be used, among other things, to better frame scaling up projects and to link a broader range of companies with researchers. Some leading programmes are: the provision of circular water supply for industry, the production of methanol from CO<sub>2</sub> and the chemical and mechanical recycling of plastics.

[capture.resources.be](https://capture.resources.be)





# RESILIENCE IN TIMES OF CORONA

## CIRCULAR COMPANIES BETTER EQUIPPED TO FACE CRISIS

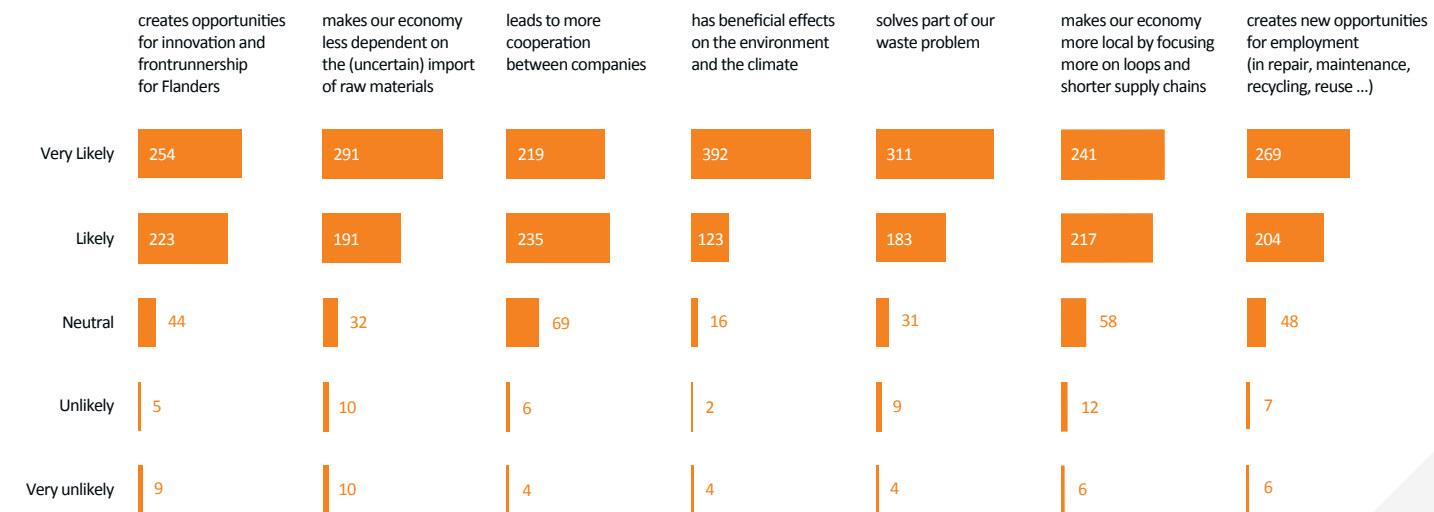
A survey held last year by Circular Flanders and VITO showed a striking result: two out of three circular companies (66 %) stated that they were not hindered by shortages during the corona crisis. While as many as 98 % of regular businesses in Flanders have experienced serious problems.

The secret of these circular companies? Focus on local chains, both for the supply of raw materials and parts as for the sales to customers, and a reduced use of materials. This local and connected business is

closely linked to circular economy because it makes the companies less dependent on (uncertain) imports of raw materials.

The conclusions of this survey and the roundtable discussions VITO has organised show that sustainability and resilience are almost inextricably linked. If sustainability is a long term goal, circular economy is a way to achieve that goal.

### To what extent do respondents consider the statements below likely? A more circular economy in Flanders...



# CHEMICAL RECYCLING

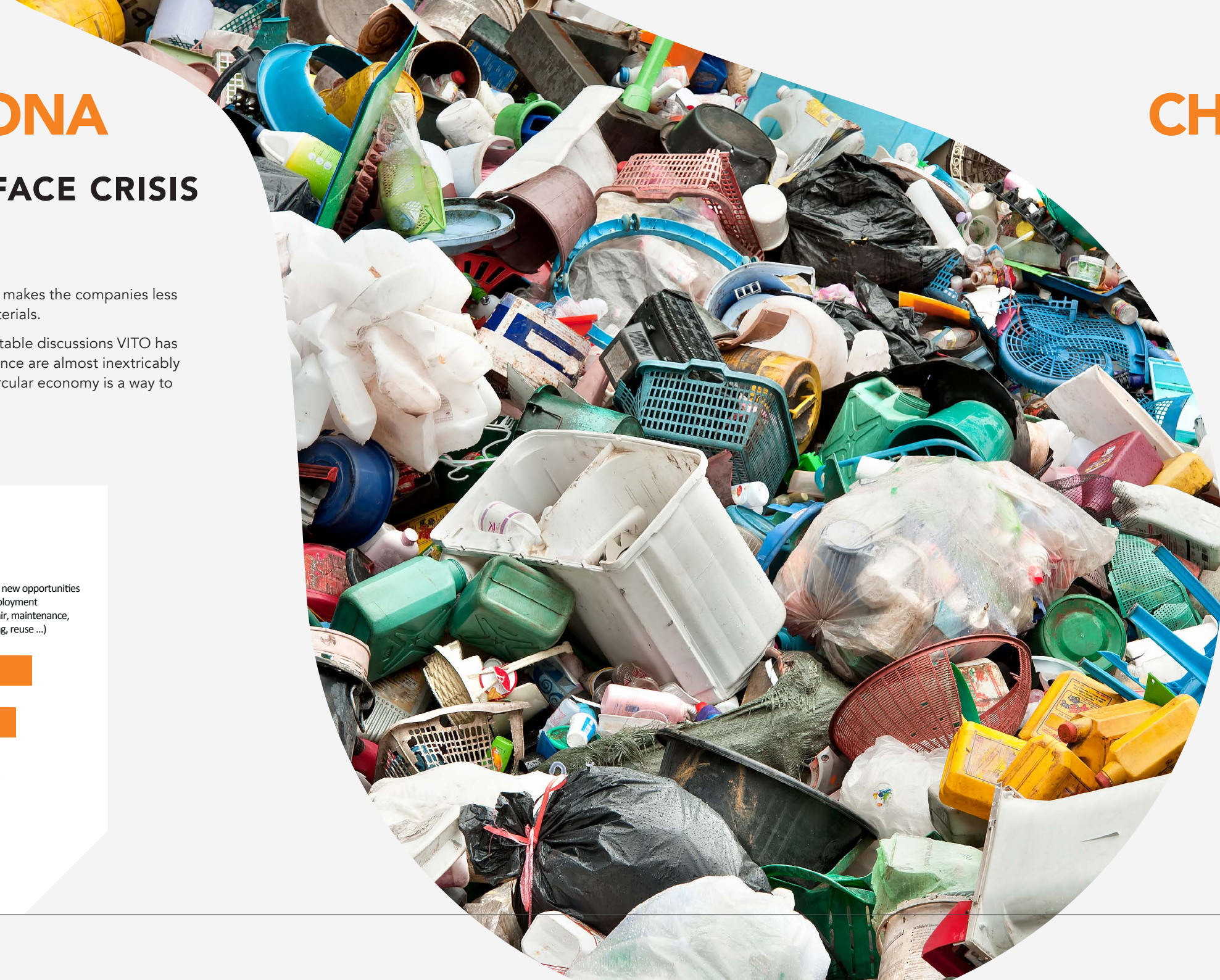
## FROM PLASTIC WASTE TO BASE CHEMICALS

In chemical recycling plastic waste is broken into molecular building blocks and then reassembled to be used again as raw material for plastic. This type of recycling is preferred by the chemical industry, over mechanical recycling that still often results in downcycling because of the impurity or lacking knowledge of the waste streams.

However the technology for chemical recycling is not market-ready yet. That is why VITO together with several partners examines in the Catalisti project WATCH how four types of plastic waste can be converted into different chemical basic raw materials like naphta by using new innovative technology. The conversion technique is based on rapid pyrolysis, chemical cracking at very high temperature in an oxygen-free environment.

The project is now working at lab scale, and when it finishes in 2023 the participating partners want to be able to produce a few liters of naphta. Then the technology can be scaled up to an industrial pilot installation.

The focus of VITO in the WATCH project is on the separation and the purification of the plastic oil obtained after pyrolysis. In these separation processes the innovative membrane technology of VITO can be maximized, this also results in lower energy consumption and reduced CO<sub>2</sub> emissions.







# ENERGY SOLUTIONS OF THE FUTURE

## TOWARDS A SUSTAINABLE ENERGY SYSTEM

The transition towards a safe, sustainable and affordable energy system is currently proceeding. In Europe the ambitions are big: by 2050 the European Union wants to be climate neutral. At the energy level, a large part of the profit can still be achieved, with a supply that today still strongly relies on fossil fuels. A sustainable energy system therefore starts with the largest possible share of low-carbon energy sources.

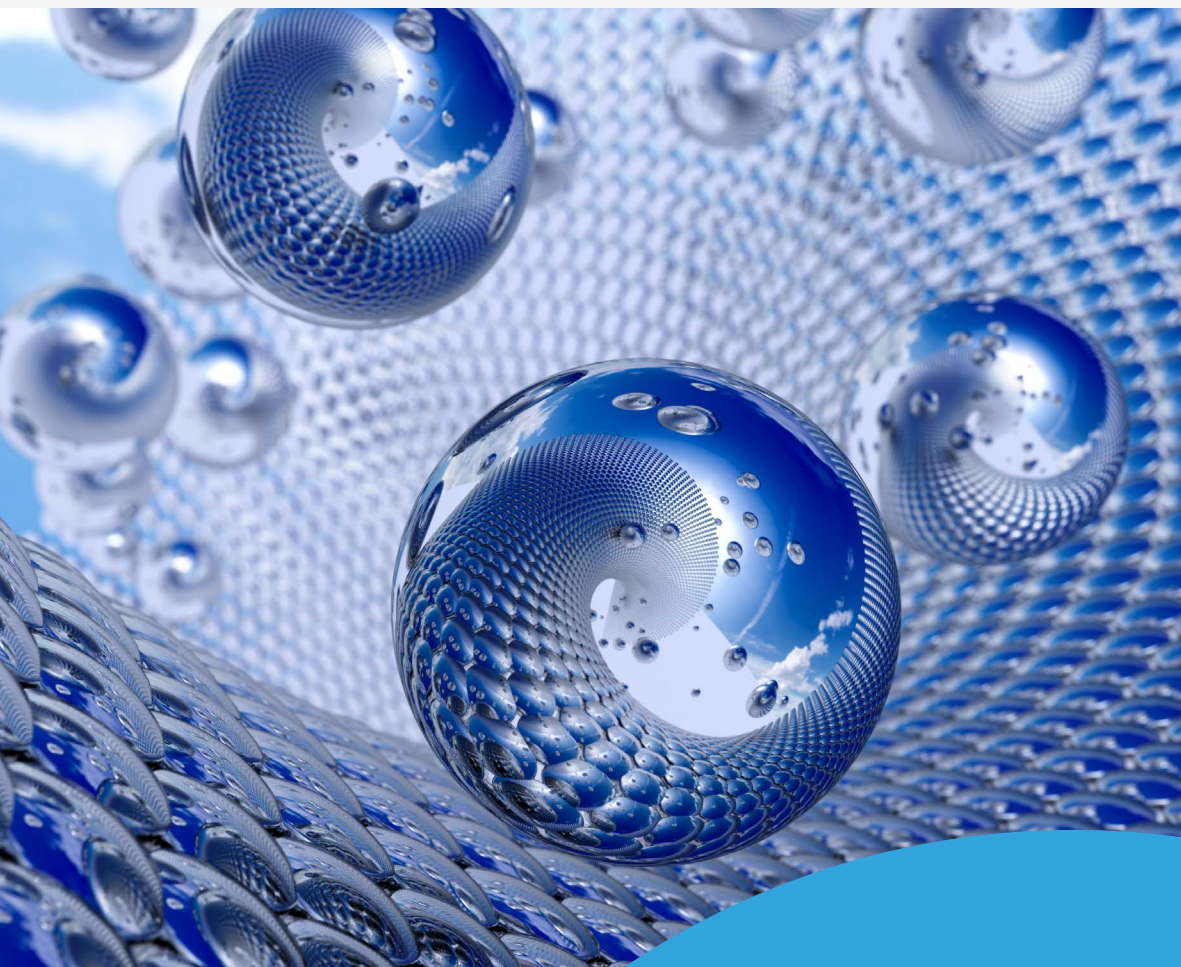
But sustainable energy generation is not the complete story. Also in other parts of the energy chain a strong decarbonization is needed. Think about the big challenge that our country is facing in terms of the non-ETS emissions that count for half of our green house gas emissions: by 2030 they must be reduced with one third. This means we must fully engage in climate friendly mobility and building heating, and to make sectors like agriculture and waste treatment more sustainable.

At VITO/EnergyVille we approach the energy transition with a system vision. And from different angles: technological, economical and sociological. Thanks to our strong multidisciplinary character and the complementarity of our research partners we fully cover our research in the entire value chain. Our research includes materials and components up to the level of complete energy systems, business models and strategies.





# GREEN HYDROGEN



## DEMOS OF EFFICIENT AND INEXPENSIVE ELECTROLYSERS

Hydrogen is ideally produced via electrolysis, by splitting water using electricity from renewable sources. This 'green hydrogen' can play an important role as a raw material in the chemical industry in processes that today mainly operate on 'grey hydrogen' (with high CO<sub>2</sub> emissions).

But in Belgium or even in Western Europe there are too little renewable energy sources available for a considerable production of green hydrogen. And therefore we are increasingly looking at regions with more sun and wind and with lots of open space, like the Arabian Peninsula, the Maghreb but also South America. The green hydrogen would be produced there and then transported to Europe.

But before this global hydrogen economy can emerge, the electrolysis process must first be made more efficient and cheaper. To help achieve this, VITO and her partners are working on electrolysis technology that can be demonstrated and that later should be able to produce 10 kilowatts of hydrogen. With the development of these 'demo electrolyzers' VITO wants to trigger commercial parties to further upscale this technology on an industrial scale.

# SYSTEM SCENARIOS

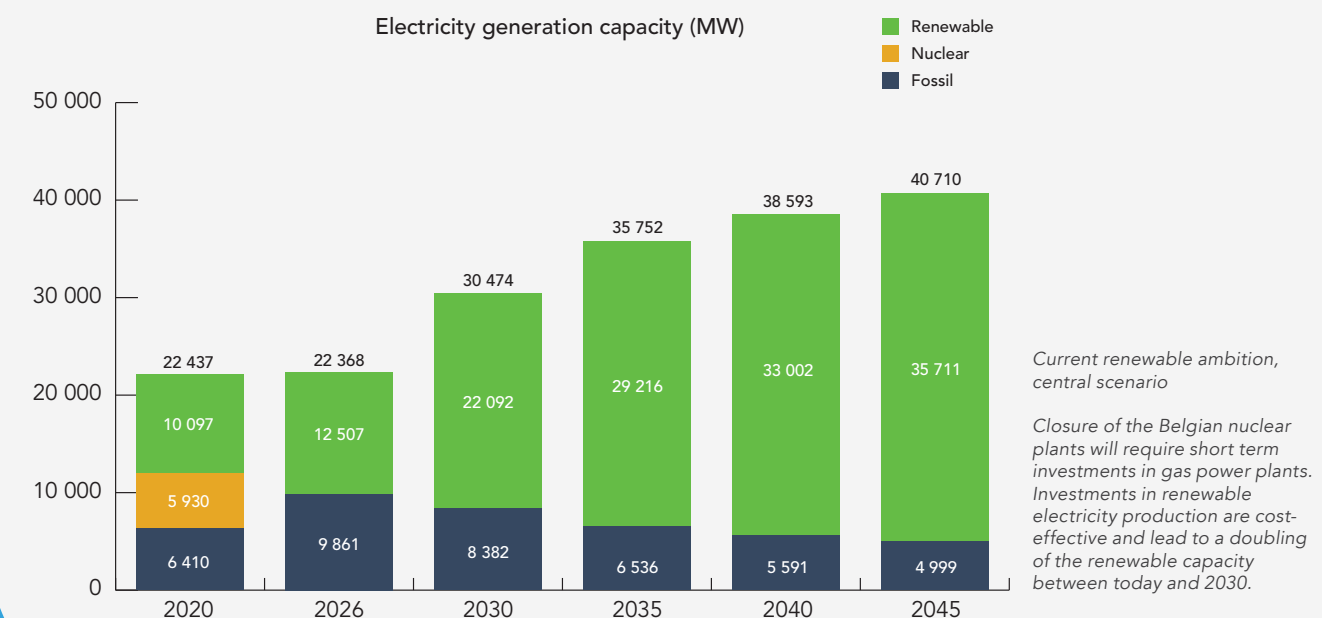
## BELGIAN ELECTRICITY SUPPLY IN 2030 AND 2050

In September last year VITO/EnergyVille updated her outlook on the Belgian electricity supply for both 2030 and 2050 – two important horizons for the climate and energy goals. Without any specific preference for certain technologies, the outlook provides an answer to the question of how our electricity supply will evolve, how energy will be produced and how much the electricity system will cost.

The study envisaged two long-term paths: one in which the current renewable ambitions would continue and one in which this would soon be stepped up. In each path three scenarios were developed, from maintaining the

complete nuclear closure to a lifespan extension of two nuclear power plants by 10 or 20 years.

In both pathways more electricity will need to be imported from abroad, although a partial limitation of the nuclear closure could limit the import. The pathways and scenarios also offer policy makers useful and specific predictions of the necessary use of flexible gas-fired power stations (still to be built). An important aspect is also that extending the lifespan of two nuclear power plants has a insignificant impact on investments in renewable energy – something that was feared until recently.





# BATTERY TESTING



## KEEPING A FINGER ON THE PULSE OF THE MARKET

VITO/EnergyVille is expanding her battery testing lab with state-of-the-art testing technology to meet the growing and evolving demands of the market. More customers are coming from very diverse battery application domains and have specific questions. VITO/EnergyVille keeps a finger on the pulse of the market and the needs of the industry.

To fulfill the recent demand of customers to test bigger batteries, the VITO/EnergyVille battery testing laboratory was equipped with a brand new battery tester that can handle voltages up to 150 Volt per module.

In addition, to address concerns about the ability of batteries to meet application requirements (performance, safety, lifetime), a new custom-built temperature chamber was added to the battery testing lab. Due to rising concern on the battery safety usage, the lab was also equipped with a new accelerated rate calorimeter (ARC). This is a well-insulated chamber suitable to investigate battery cell thermal behavior and it also acts as an explosion proof chamber to safely carry safety tests. An installation with these characteristics is unique in Belgium.

## LOW REGULATION ZONE

### A LIVING LAB FOR SUSTAINABLE ENERGY SOLUTIONS

At the beginning of last year Thor Park in Genk – home base of EnergyVille – became the very first low regulation zone in Flanders. This status allows experiments and demonstrations on energy innovations. For example systems that will enable and stimulate local exchange of renewable energy. Or systems that can optimally match different renewable sources.

From a content point of view, the low regulation zone fits in closely with the concept of the local energy community or 'LEC', which generates, consumes or stores energy within a cluster of buildings. At Thor Park, this LEC is formed by clusters of buildings and companies with locally coordinated and optimised energy management. That allows, at a very small scale, to do research into future energy markets, and how they might be organised and regulated.

The innovative technologies and services that are experimented with in the low regulation zone must shape the energy system of the future at a later stage. This is how Thor Park serves as a living lab for sustainable energy solutions.

Also other Flemish organisations and companies are welcome in Genk to experiment in the the low regulation zone together with VITO/EnergyVille.





# STORM DISTRICT ENERGY CONTROLLER

## FLATTEN THE CURVE: SHIFT HEAT DEMAND

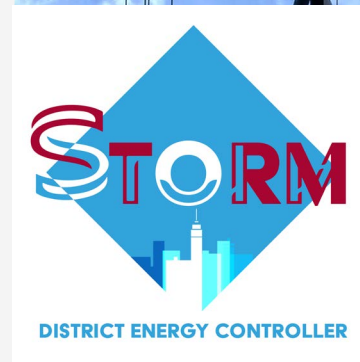
By 2030, 32 % of the European Union's energy must originate from renewable sources. Sustainable heat sources like residual heat from factories, heat from waste incineration and geothermal heat are essential. But because these sources are also limited, demand and supply must be aligned optimally.

That is why VITO/EnergVille has developed the STORM District Energy Controller. This self learning controller for heat distribution networks shifts the heat demand to moments where thermal energy is more available and therefore cheaper. The STORM Controller is also smart and self-learning: it interacts with the electricity market and balances at network level, in order to tackle local issues automatically.

The controller was extensively tested at demo sites in The Netherlands, Sweden, France and Belgium. On these sites the peak heat demand was clearly reduced, electricity bills were lowered and over 10 000 tonnes less CO<sub>2</sub> were emitted per year per optimised network.

Thanks to the STORM Controller heat demand is leveled off and both fossil and renewable resources are optimally utilised, as well as the capacity of the heat network.

[stormcontroller.eu](http://stormcontroller.eu)



# GEO THERMAL ENERGY IN LOMMEL

## MEASURING CAMPAIGN MAPS DEEP GEO THERMAL RESERVOIRS

Deep geothermal energy is a continuously present renewable energy source that is underused – to feed thermal networks but also to produce green power.

In Northern Limburg, in Lommel and surroundings lay a few interesting reservoirs of deep geothermal energy at a depth of 4 or 5 kilometers deep. However, to correctly and precisely assess that potential more data of the deep subsoil are needed.

This data is collected with the help of seismic measurements by using vibration trucks. At the end of last year VITO launched a

measuring campaign along the canal Bocholt-Herentals. Besides in Lommel, measurements were also taken in Balen, Bergeijk (The Netherlands), Dessel, Molt, Pelt en Valkenswaard (The Netherlands).

This campaign was part of the European Interreg project DGE-ROLLOUT that researches the potential of deep thermal energy extraction in N-W Europe. The measurement data are now being processed and analysed.

[aardwarmte.be](http://aardwarmte.be) (Dutch only)





# FOOD SECURITY AND SMART AGRICULTURE



## REMOTE SENSING FOR MORE EFFICIENT AND SUSTAINABLE AGRICULTURE

Data are the new gold, especially in the agricultural sector that is very dependent on many different factors like the weather, climate change, soil conditions, and plagues and diseases. In smart agriculture remote sensing data is used for example to make crops more disease-resistant or stronger against global warming. This is how innovative data driven technology can help farmers to obtain better yields.

With a broad range of remote sensing applications VITO is now a pioneer in smart agriculture. These tools and platforms allow farmers to respond quicker to sometimes very fast changing circumstances. Or they provide an extra pair of eyes to monitor their plots or make decisions using smart detection methods like for example crop height, blossom density etc.

This is how VITO supports agriculture of the future. Hereby remote sensing can also help to map the wider landscape around agricultural plots in more detail – and this information can then also be very useful for policy makers.

## DISEASE-RESISTANT SUGAR BEETS

## DRONES HELP TO IDENTIFY AND SELECT BETTER CROP VARIETIES

Seed breeders are always in search for new, disease-resistant cultivars to help farmers grow productive and healthy crops in a sustainable way. This is a labor and time-intensive job, because during the growing season, field experts must monitor the test plots for yield, disease and plague tolerance and other characteristics.

Drones can simplify this monitoring job. In the Belgian BEETPHEN project VITO together with SESVanderHave and CRA-w (Centre Wallon de Recherches Agronomiques) is evaluating the use of hyperspectral drone imagery and innovative remote sensing technology for crop phenotyping in sugar beet breeding trials. SESVanderHave is a leading

global player in the sugar beet sector and they have many field trials where the performance of different varieties can be tested.

Drone imagery is revolutionary for many agricultural applications due to its relative low cost and high degree of objectivity. To develop an easy-to-use, objective and efficient disease detection tool for sugar beet seed breeders, VITO compared advanced drone-based image processing solutions to time- and labor-intensive field observations of various diseases, such as powdery mildew. This research is financed by the STEREO III programme of BELSPO (Belgian Science Policy Office).





## MAPEO



## SEED BREEDERS RECEIVE AERIAL SUPPORT

With her remote sensing applications VITO also supports agricultural companies active in the sector of seed breeding and crop protection. With drones entire plots can be scanned in a short period of time and then the images can be processed. This last part takes place via the MAPEO platform, an end-to-end solution from VITO for drone imagery based analysis of agricultural plots.

The platform outputs exactly the data the customer is interested in like crop height, growth speed, leaf surface, blossom density, number of fruits per plant of symptoms of disease. This allows seed breeders and crop protection companies to use drones to speed up their cultivation and selection programmes.

MAPEO has been operational since spring 2018 and is now being used around the world, from Belgium and other European countries across North and South America and South Africa to Japan. In commercial collaborations VITO is responsible for the data processing. The drone flights are carried out by the customers themselves or outsourced.

VITO can steadily build up her expertise in terms of phenotyping via drone imagery which also takes place in close collaboration with private partners. Last year VITO entered a new strategic collaboration with SESVanderHave, a globally operating sugar beet seed company headquartered in the 'sugar city' of Tienen.

[mapeo.vito.be](http://mapeo.vito.be)

## WATCHITGROW



## AVR, AGRISTO & ILVO JOIN FORCES WITH VITO FOR SUSTAINABLE POTATO CULTIVATION

Crop monitoring plays an important role in precision agriculture. VITO has spent many years now researching and developing ways of making data obtained via remote sensing available to farmers to enable them to monitor their fields and crops and in turn increase their yields. The data are gathered from sensors on (unmanned) aircrafts, drones and satellites.

However, reliable and usable data do not always need to be generated from the air. They are also available on the fields, as real world data created by smart agricultural machinery.

This type of data generation on the ground has already been experimented with, for example in potato farming. One of the pioneers is AVR, a manufacturer of agricultural machinery in western Flanders. The company is in the process of equipping its harvesters and planters with sensors that are able to gather technical and agronomic data in and around the field.

At the end of 2019 AVR and VITO entered a collaborative partnership. Today the AVR data are fully integrated in the online information platform WatchITgrow from VITO, which farmers can use to monitor their plots easily and efficiently.

In the meantime VITO also started a broader cooperation with AGRISTO, AVR and ILVO on the innovative data match through the DjustConnect platform of ILVO. The purpose of this is to be able to exchange data and expertise smoothly between the various parties in the agro-food chain and to realise the flow of data 'from farm to fork'.

[watchitgrow.be](http://watchitgrow.be)



# ENVIRONMENT AND CLIMATE



## SOUND KNOWLEDGE AND EXPERTISE IN ENVIRONMENTAL AND CLIMATE APPLICATIONS

Air pollution and global warming are serious threats to our health and our environment. In both domains VITO can build upon many years of gathered knowledge and expertise. We use these to better monitor the environment and the climate but also to contribute to a cleaner living environment, better air quality and to the battle against global warming.

Governments, industry and the private sector: they can all call upon VITO in order to make decisions or for example to become more climate friendly or climate proof, or to improve the air quality. VITO offers services, policy supporting instruments, risk analysis and evidence based models that enable customers to make well informed decisions and then proceed to action.

## CARBON CAPTURE & UTILIZATION

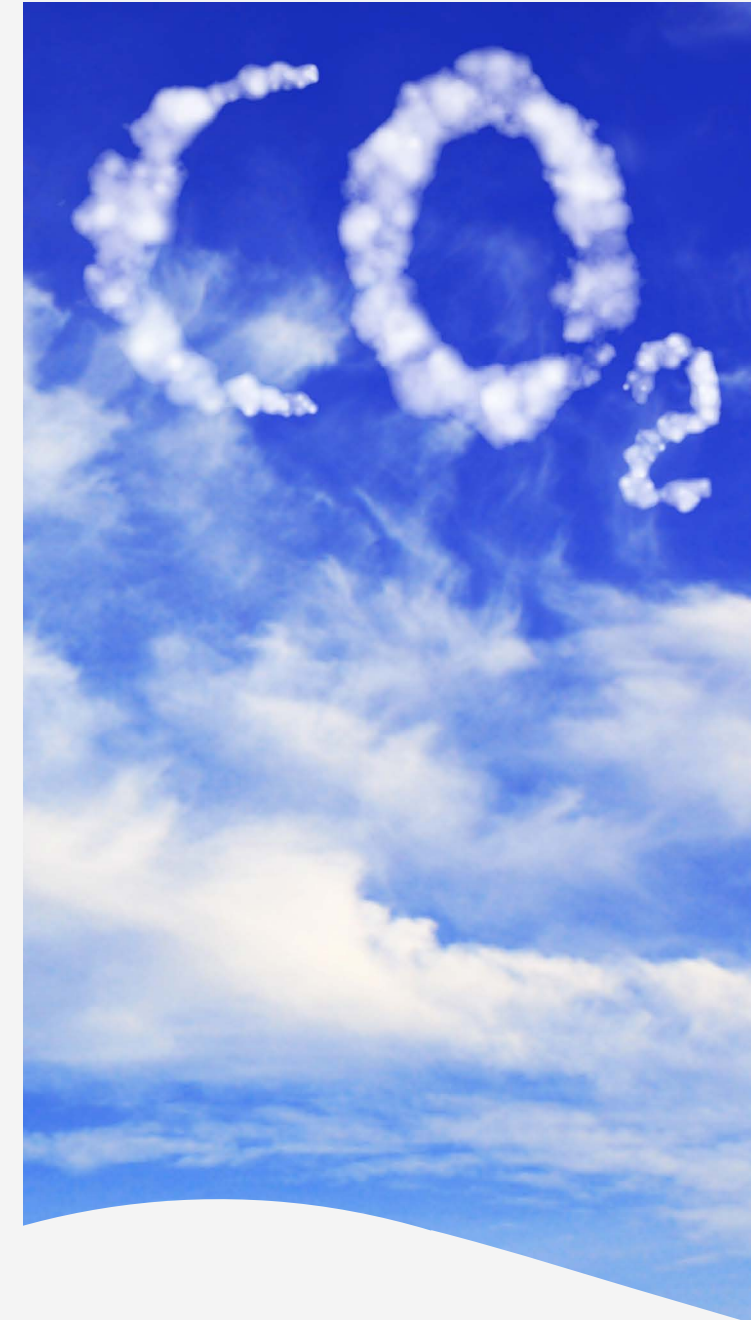


## FROM GREENHOUSE GAS TO RAW MATERIAL

CO<sub>2</sub> contains carbon, so it can be used as basic raw material for chemicals, synthetic fuels, building materials and many other applications. With her rich expertise VITO is contributing to the research of Carbon Capture & Utilization (CCU) through all of its research domains: from scientific and technical considerations to the economic aspects.

Three of VITO's research domains are involved in the CCU research: Sustainable Energy, Sustainable Chemistry and Sustainable Materials. The Energy Unit studies among other things the connection of CCU with the future supply of renewable energy. In the Chemistry and Materials Unit, VITO is actively working for example on a new generation of catalysts and technology to substantially increase the efficiency of chemical conversion processes for CO<sub>2</sub>. Among other things, this is being done by 3D printing of catalysts, CO<sub>2</sub> capture equipment and gas diffusion electrodes. Also in the Materials Unit CO<sub>2</sub> neutral building and raw materials are being developed for the construction industry.

CCU has also its place in the transition towards a circular economy and a more sustainable policy for materials, two important spearheads for the Flemish and European economy. In this regard VITO's research contributes to that.





# PROBA-V



## BELGIAN SATELLITE REMAINS ACTIVE AFTER RETIREMENT

Seven years – much longer than expected – the Belgian satellite PROBA-V has been monitoring our Earth. On 30th June 2020 PROBA-V has stopped transmitting its images – these were mainly focused on agriculture, climate and vegetation. Or at least officially – because the satellite will continue to provide images from Europe and Africa until October 2021.

Since the PROBA-V satellite, that is not bigger than a washing machine, is not equipped with a propulsion mechanism, the satellite cannot be adjusted. This has caused the satellite's orbit to end up in the nocturnal part of our planet with poor lighting conditions to still produce good images.

Between 2013 and 2020 the satellite monitored our Earth and provided detailed images on a daily basis, covering an area of 2,250 kilometers. Since the retirement of PROBA-V these images are now provided by two ESA Sentinel-3-satellites. All images are made available publicly by VITO through the online platform Terrascope that is easily accessible to Belgian users.

It is not even inconceivable that the PROBA-V satellite might be used again in about seven years' time when it starts to come into the light again on the other side of the Earth.

# TUNNEL EXITS

## GENERIC MODEL PREDICTS AIR QUALITY

In the past few decades, air quality in Flanders has improved considerably. Much of that progress can be attributed to road transport. Nevertheless, overview maps of air quality in Flanders still show too many hotspots, for example at the exits of (motorway) tunnels.

Around the exits of tunnels large quantities of air pollution can indeed build up. To limit these and to predict the impact of measures VITO developed a unique generic air quality model for tunnel exits for the Flemish government.

This model can be used to calculate local air quality quickly. It provides an estimate of the pollution to be expected at the exit of a tunnel, based on data such as the dimensions of the tunnel and the traffic flow. Based on the outcomes of the model the project owner can find out whether a problem is likely to arise and if needed, he can take timely action. Also the impact of those measures can be assessed accurately.

The future users of the model will primarily be EIA experts and consultancy firms commissioned by project developers. The predictive model will certainly be very useful for the largest construction site in our country, the Oosterweel link in Antwerp.





# CHARISMA



## CLIMATE HEALTH RISK MANAGEMENT INDIA

According to a recent McKinsey report (2020), due to climate change 160 to 200 million people in India will be exposed to heat waves that exceed the survival threshold, where urban areas in India are expected to be one of the first areas in the world to face fatal heat waves. Moreover, climate change also has a direct impact on vector-borne (e.g. mosquito) diseases, for example malaria or dengue. Many of these vectors are susceptible to variations in the climate and therefore settle in new areas.

In the three year CHARISMA project, VITO cooperates with the Flemish SME AVIA-GIS and the Indian partner "Public Health Foundation India-Centre for Environmental Health" to set up climate-health adaptation plans with a focus on urban areas.

During this project two demonstration cities (Lucknow and Guwahati) will start co-creation processes with local health bodies to deliver tailor-made information systems to tackle health issues, caused by extreme heat and vector-borne diseases.

# KLIMPALA

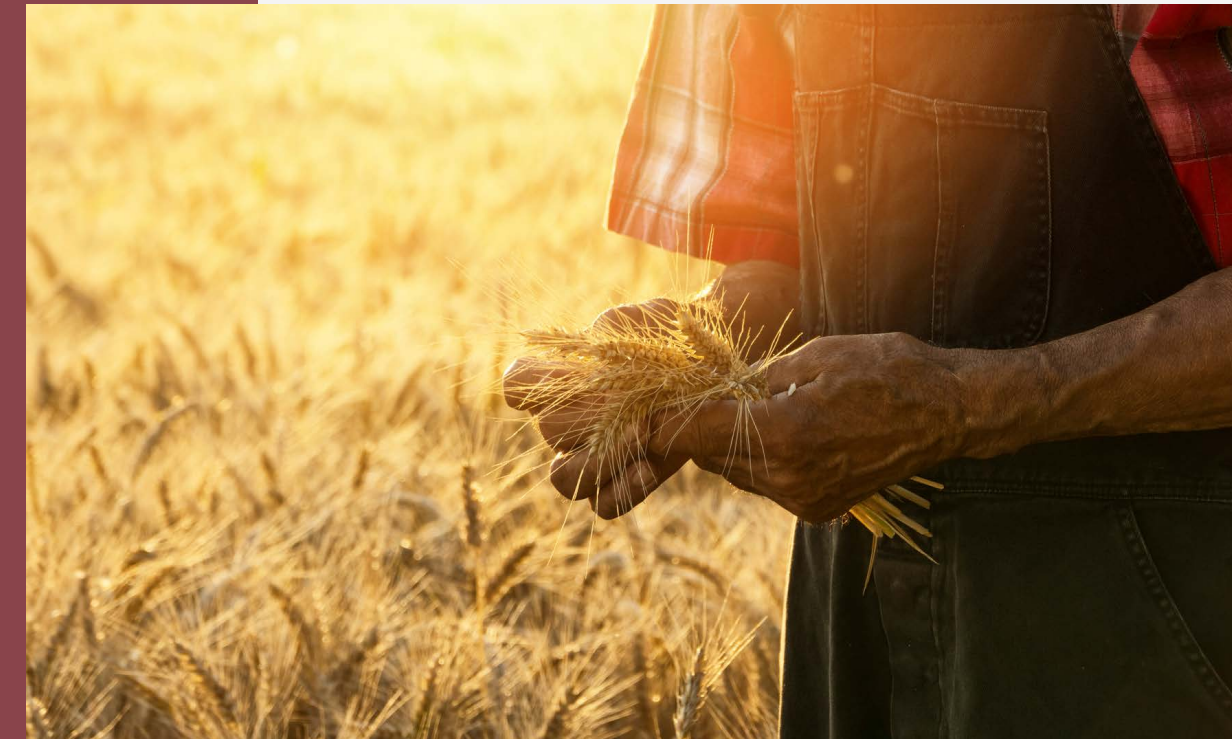
## CLIMATE INFORMATION PLATFORM SUPPORTS AFRICAN AGRICULTURE

Since the end of 2020 VITO cooperates with her partners ACMAD, KENTER, i-propeller and OVO on the roll-out of an online climate information platform tailor-made for the African agriculture. The ready-to-use climate information is important for national stakeholders to set up current and future adaptation plans, supports decision processes and reinforces requests for climate financing. That is how the KLIMPALA project contributes to the necessary climate adaptation of agriculture in African countries.

African agriculture is very sensitive to climate change. High-quality information about climate changes and their effects on agriculture are often not available, but very necessary for long term planning and a sustainable transition towards climate robust agricultural systems. At the beginning of 2020 VITO started the development of the climate platform

CLIMTAG™, supported by the European Copernicus programme. In this 3 year KLIMPALA project, financed by the Flemish government, VITO will enhance the pilot version, roll it out in more than 20 countries and align it even more with the needs of the African agricultural sector.

[climtag.vito.be](http://climtag.vito.be)





# NDC SUPPORT CENTER



## ENHANCING AFRICAN ENERGY AND CLIMATE PLANNING

Since September 2020, VITO, together with its partners AFREC (the African Energy Commission of the African Union) and CO<sub>2</sub>Logic, is implementing the African knowledge centre for Nationally Determined Contributions, also known as the 'NDC Support Center'. The project aims to enhance the technical expertise in three African countries (tentatively Morocco, Uganda and Malawi) in climate communication towards the UNFCCC under the Paris Agreement. The knowledge centre focuses on energy data management, energy system modelling and climate scenario development.

The NDC Support Center, which will initially be deployed for 3 years, aims to sustainably strengthen the African countries in the field of energy and greenhouse gas data and statistics, to put forward ambitious 2030 climate plans, to help realise the rollout of CO<sub>2</sub>-reducing technologies and thus better map out the national contribution to the international climate goals. VITO/EnergyVille is coordinating the entire project and taking the lead in improving energy and climate modelling.



# BATTERY TEST BED IN SOUTH AFRICA

## VITO ENCOURAGES RENEWABLE ENERGY DEVELOPMENT IN SOUTH AFRICA

Since December 2020 VITO and its South African counterpart CSIR roll out a "battery test bed" in South Africa. The test lab will offer South Africa the opportunity to test new battery technologies adapted to local climatic and technical conditions. The combination of electrical storage with increased investment in renewable energy will, on the one hand, lead to a more sustainable and stable energy supply and, on the other hand, can also provide access to electricity for a larger part of the population.

The project came about in the framework of the World Bank's Energy Storage Partnership (ESP), an important programme to promote energy storage in developing countries. Cooperation with the World Bank as a multilateral international financing institution will contribute to the internationalisation of Flemish expertise and technology and create opportunities for Flemish actors and companies. The project will contribute to the achievement of the Flemish objectives in the field of international climate financing.





# PERSONALISED HEALTH



## HEALTH CARE TAILORED TO THE INDIVIDUAL

Prevention is better than healing. In this case we can take this literally. Moreover, when this prevention is personalised, the health benefits are maximised, for both man and society. Through personalised prevention quick interventions are possible and worse can be avoided. With continuous monitoring by measuring multiple health parameters, tailor-made actions can be taken on an individual basis more quickly.

There is still large potential for health benefits when a better prediction of who has a higher risk of a specific illness would be possible, when certain conditions can be detected sooner and when medication or therapies can be tailor-made for the patient. Preventive and personalised are the characteristics that will define the health system of the future.

For VITO the end goal is a sustainable health system. And in the pathway towards this system, the focus is shifted from illness to health. This is shown in the vision of the '4P medicine', where 2 P's stand for prevention and personalised. The other P's stand for predictive and participatory, what clearly indicates that the health system of the future is also strongly data and technology driven, but always with respect for the privacy and the participation of citizens.

## FACE MASKS

## EUROPEAN ACCREDITATION FOR FFP2/FFP3

When at the beginning of the corona pandemic a few local companies switched to mass production of mouth masks, there was suddenly a big need for a sound and accredited quality control.

That is why VITO expanded her existing test infrastructure in the spring of last year for the quality control of FFP mouth masks. This quality control checks if a mouth mask complies with the current European EN149 standard. When a manufacturer of mouth masks receives approval, he will receive a compliance certificate that he can show to his customers.

At the end of June 2020 VITO already received the accreditation to check mouth masks according to a light version of the applicable EN149 standard. In December the final European accreditation was granted for the testing of high quality FFP2/FFP3 mouth masks.

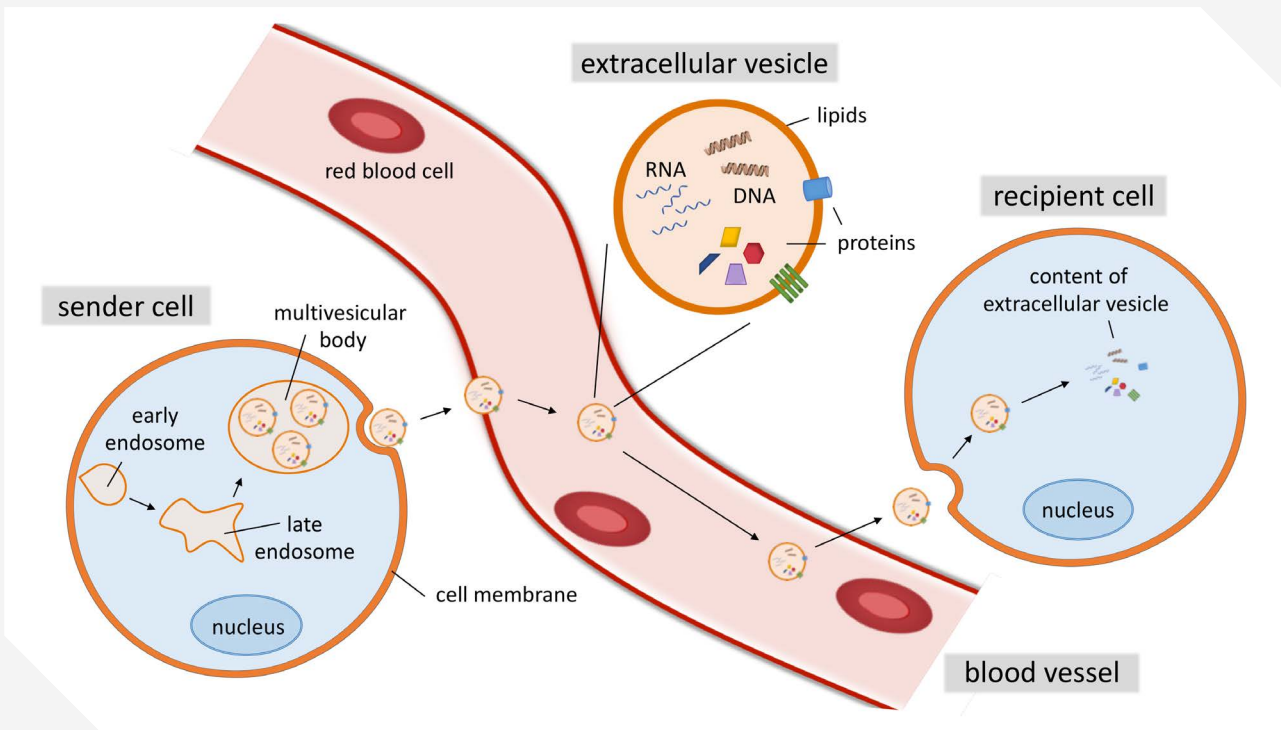
This enables VITO to test mouth masks according to the strictest European quality standards. Exactly this type of masks must be worn by medical and healthcare personnel when they come into contact with COVID positive patients. Hence the high demands placed both on the masks and the tests.

Achieving this complex accreditation in such a short period of time is a great achievement. The tight timing was required in view of the concrete demand from local producers of mouth masks in the start-up of their production.





# TRANS TECH DIAGNOSTICS



Cell communication through extracellular vesicles is regulated by biomolecules (proteins, lipids and nucleic acids) present in the membrane of 'sender' cells and provide targeted delivery of the vesicles and their cargo to 'recipient' cells. VITO is mapping these biomarkers using proteomics and is developing bio-assays for hypersensitive flow cytometry to read out the profile of these biomarkers.

## EARLY DIAGNOSTICS ON INTRACELLULAR VESICLES

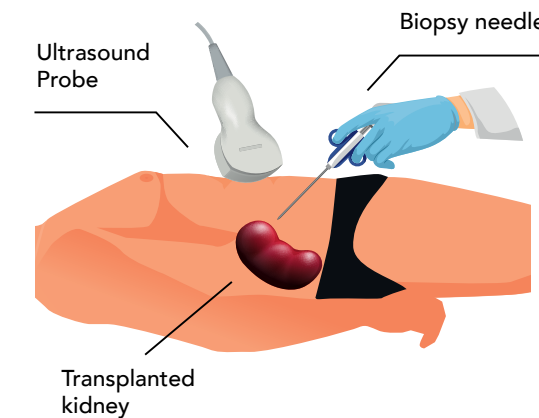
The risk of specific cardiovascular diseases cannot be reduced by a healthier lifestyle alone, but requires earlier diagnostics. Ideally even before the first symptoms appear.

This presymptomatic diagnostic was the core of Trans Tech Diagnostics, a European Interreg project that was concluded last year and where the development of an innovative technological platform for efficient accurate and low impact (for the patient) cardiovascular diagnostics was the central focus.

The project involved the early detection of an increased risk of cardiovascular disease via biomarkers in the form of minuscule vesicles that are emitted by the cells in our body and end up in our blood. VITO focused on the development of new and more refined detection methods for these vesicles and the identification of molecular profiles that can be an indicator for an increased risk of certain cardiovascular diseases.

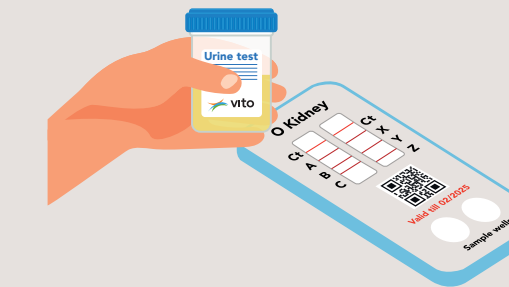
# ORGAN TRANSPLANT

## Current routine



**-**  
Invasive procedure + complications  
Cost  
Sampling errors  
Interpretation errors

## VITO solution: Novel test



**+**  
Non invasive test  
Reduced cost  
Reproducible and objective results  
Early diagnosis (subclinical)

## PROTEINS PREDICT KIDNEY REJECTION

After organ transplants there is always the risk of rejection of the donor organ by the immune system of the receiver. That is why transplant patients are carefully monitored after receiving a new organ. This is done by means of biopsies, where a long needle is used to remove part of the organ tissue, which is then tested in the medical lab.

These biopsies are extremely unpleasant. Furthermore, the rejection symptoms are often already at an advanced stage when they are discovered, so therapy will make little difference and it will no longer be possible to save the organ.

Together with Leuven University Hospital and European partners, VITO developed a non-invasive test that can offer a solution for kidney transplants. In the European Biomargin project proteins in the urine of the transplant patients were screened that can predict whether the kidney will be rejected – even before any symptoms will occur.

VITO and its partners are currently developing a first prototype of a urine test for kidney rejection that is as fast and user-friendly as a pregnancy test.



# CLEAN VISION SUMMIT

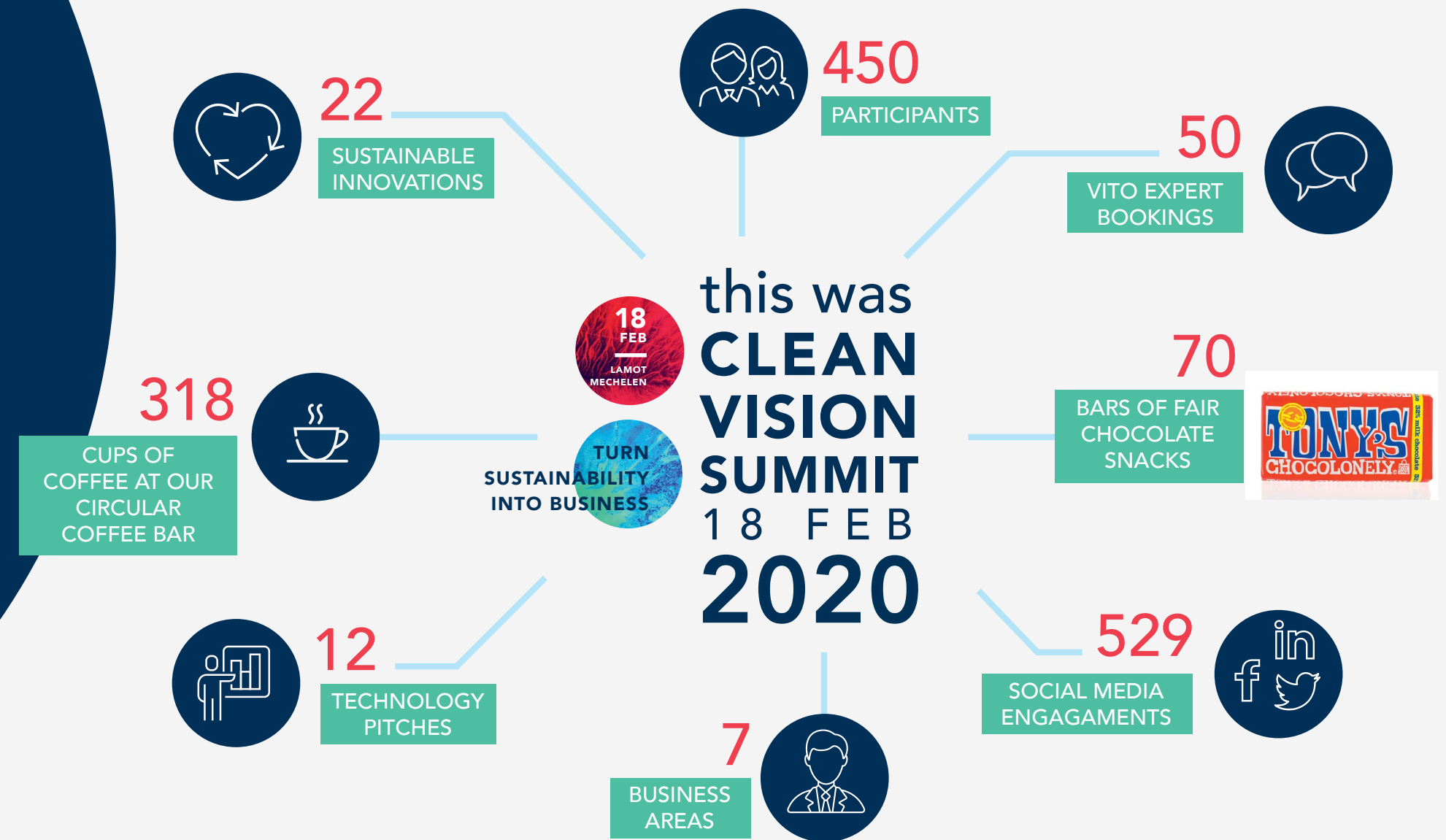
## First Clean Vision Summit meets all expectations

On 18th February 2020 VITO organized its first Clean Vision Summit in LAMOT Mechelen. "If we want to speed up the transition towards sustainability we need to find ways to get in touch with the user", says Bruno Reyntjens, commercial director at VITO. "Sustainability is inseparably connected with the economy, with companies. That is why a dialogue with companies is so important."

There was a great turn-out at the event. 450 participants were introduced to 22 innovations across 7 business areas. 12 VITO experts were challenged during a 15 minute scientific pitch. Visitors were able to get personal expert advice.

Hans Bruyninckx, Director of the European Environment Agency, opened the Summit. He pointed out the complexity of the challenges Europe now faces. He emphasised the economic aspects of the Green Deal. The European Green Deal represents an opportunity and it is up to the companies to seize it and act on it. Wim Michiels, CEO of Provion, has already implemented this transition in his company. He spoke about it in front of a full auditorium.

This first Summit was a great success. Bruno Reyntjens: "I am very pleased. We have achieved our first goal: setting up a direct line of communication with companies. The Summit has turned out a unique, professional and welcoming meeting place where research and business have found each other."







# G-STIC 2020

## 2020 G-STIC CONFERENCE

COVID-19: a wake up call for sustainable technological changes

3 700 participants and 200 expert speakers from 140 countries joined 50 thematic sessions of the fourth conference of the Global Sustainable Technology & Innovation Community (G-STIC) at the end of October 2020. For the first time, the G-STIC conference was organized as an online event by VITO and its international partners ACTS, FIOCRUZ, GIEC, GIST, IITD, NACETEM and TERI. Both during the sessions live-streamed from the studios in Brussels and during the online sessions, world-renowned speakers (such as Gro Harlem Brundtland and UN Secretary-General António Guterres) and thought leaders explored their vision on how

technological changes can not only offer solutions for the COVID-19 pandemic, but also for a whole series of challenges in sustainable development. Together with the expert speakers participating in the various thematic sessions, policy makers provided countless examples of technological innovations, and digital innovations in particular, to fight COVID-19 and to leverage sustainable economic and social progress. Also the European premiere of the documentary "Brave Blue World" was shown, it illustrates how innovative solutions can be put into practice for a robust water system. The next G-STIC conference will take place during the Dubai World Expo.

[gstic.org](http://gstic.org)

**Dietrich Van der Weken :** "Due to COVID-19, the intersecting challenges of health, climate and sustainability have never been clearer. This offers a unique opportunity to showcase the impact of technological solutions on the SDGs. Change can happen and technology is there to enable that."





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