

VISION

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TOWARDS **CIRCULAR SOLUTIONS** FOR EXTERIOR JOINERY

G-STIC 2020: LEVERAGING TECHNOLOGY TRANSFORMATION OPPORTUNITIES BEYOND COVID-19

10 YEARS OF VLAKWA: A LOOK BACK AND A GLIMPSE TO THE FUTURE

FLATTEN THE CURVE: SHIFT THE **ENERGY DEMAND** WITH FLEXHARVESTER/STORM DISTRICT ENERGY CONTROLLER

TOWARDS COMPREHENSIVE **CHEMICAL RECYCLING OF PLASTIC**

03 UNDER REVIEW:
THE ORGANISATIONAL CULTURE
OF VITO



COVERSTORY

04 TOWARDS CIRCULAR
SOLUTIONS FOR
EXTERIOR JOINERY

06 G-STIC 2020: LEVERAGING
TECHNOLOGY TRANSFORMATION
OPPORTUNITIES BEYOND COVID-19

08 10 YEARS OF VLAKWA: A LOOK
BACK AND A GLIMPSE TO THE FUTURE

10 FLATTEN THE CURVE: SHIFT
THE ENERGY DEMAND WITH
FLEXHARVESTER/STORM
DISTRICT ENERGY CONTROLLER

12 'HEALTH HUB'
OPENS ITS DOORS

14 FIRST AID FOR
CIRCULAR CONSTRUCTION

16 TOWARDS COMPREHENSIVE
CHEMICAL RECYCLING OF
PLASTIC

18 REMOTE SENSING:
MUCH MORE THAN JUST
MONITORING

20 VITO EMPLOYEE
IN THE SPOTLIGHT

Dear reader,

With over 3,700 participants and 200 speakers from more than 140 countries, G-STIC, the annual sustainability and technology conference held by VITO in collaboration with seven other (foreign) knowledge institutions, was once again a success. That was certainly an achievement, when we realise that this conference was largely an online event, managed from a number of studios in Brussels. This was yet another demonstration of the power of digitalisation, which is itself a topic that was also discussed during the conference. Building further on that success, we are now working to prepare this year's conference, which will take place in October 2021 in Dubai, as part of the World Expo 2020.

The G-STIC conference demonstrated once again how digitalisation is capable of supporting urgently needed innovations in a variety of areas, from our climate, our education sector and energy, food security and health, to protecting our oceans and strengthening the circular economy. Digital innovations can also help us to achieve the Sustainable Development Goals (SDGs).

Another topic that was discussed during the G-STIC conference was the ambitious Green Deal that will hopefully enable Europe to become climate-neutral by 2050. Digitalisation will play an important role here too. At VITO, we are already very well aware that digital innovation has the power to facilitate the transition towards a sustainable society and a sustainable economy. In this edition, you can read how FLEXharvester enables us to offer a platform for applications that allow flexibility within energy networks to be "harvested". These applications will allow for organisations to flatten the curve in their energy consumption. Flatten the curve, yes, you heard it right. That's an expression we won't easily forget!

The Green Deal is also strongly dependent on the ongoing roll-out of the circular economy. At VITO, we have been devoting a great deal of effort towards developing circular business models for many years now. You can also read about how we are responding to the needs of the construction sector in Flanders. And in our cover story, we focus on one company in particular (Reynaers Aluminium) which wants to make the shift towards a circular business model and we explain what challenges will need to be faced.

Of course last year was a year we will never forget. Exceptional times required exceptional measures, including at VITO. Once again, we would like to express our thanks to those who kept our society going during that difficult period, especially the people working in the healthcare sector. But we must not forget that our own employees also have earned compliments for their continuous efforts and energetic motivation, dedication and effective collaboration.

Together, we will evolve into a sustainable society.
Happy reading!

Dirk Fransaer
Managing Director of VITO



COLOPHON

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UNDER REVIEW: THE ORGANISATIONAL CULTURE OF VITO

'Over the past twenty years, we have seen a major transformation in our organisational culture. Sustainability and innovation are now the core of it'. We spoke with Agnes Bosmans, Director of HR & General Services at VITO, about the results of the most recent cultural values survey.

First of all, VITO carries out a cultural values survey every four years, in collaboration with an external party. What is the point of this screening?

Agnes Bosmans: 'To measure is to know. Only once you can measure something can you then manage it. This is no different from the cultural values embodied by an organisation and that determine the day-to-day business operations. We want to know how the VITO values are perceived in the workplace, and to what extent they are aligned with the personal values of our employees and their expectations of the organisational culture. Based on the results, we can then take action. And because we redo this study every four years, we also get an idea of the impact of these actions'.

To measure is to know. But how does it work?

For its cultural values survey, VITO has collaborated with the Antwerp-based consultancy and training company Zenit for twenty years. 'Of course, everything starts with a baseline measurement, otherwise you don't have a reference point,' explains Zenit director Marcel Van der Avert. 'We already measured this at VITO in 2001.'

The measurement method consists of three values lists where employees choose ten values online that best express who they are (personal values), ten values that best describe how VITO operates (current cultural or organisational values) and ten values that they believe are essential for an extremely effective organisation (desired cultural values). The more alignment between these three lists of values, the stronger the organisational culture.

What are the most noteworthy highlights of the latest study carried out in June 2020?

Of the values we embody, sustainability stands out in particular, both in the current culture - as experienced by our employees today - and in the culture they would like. That is important, because it provides intrinsic motivation for our employees: they are part of an organisation that is involved in sustainable development on a daily basis.

On the organisational level, we see that a work/life balance scores very high. And again, in both the current culture and the culture people would like. Another improvement compared to 2016: employees indicate that there is less bureaucracy within VITO'.

The results also show that the 'cultural entropy' within VITO is currently at 15. What does that mean?

Like in physics, entropy is a measure of the disorder of a system. Cultural entropy says something about the chaos within an organisation. This value should therefore decrease ideally, which also means that the existing culture would conflict less with the desired culture.

Twenty years ago, in the first study in 2001, the entropy was 35. Today it is at 15. So there has definitely been a real transformation here, and we are of course delighted about that'.



Some noteworthy results of the 2020 cultural values survey, in which 67 % of VITO employees participated

- Employees and management are on the same wavelength for the desired culture
- The differences between current culture and desired culture are narrowing
- The five VITO core values are reflected in the current organisational culture, in which innovation and sustainability have become strong values
- The same trends reappear in all units, indicating that each unit is also developing a strong culture



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TOWARDS CIRCULAR SOLUTIONS FOR EXTERIOR JOINERY

Circular construction: more and more construction companies are realising that this is where the future lies. But for a thorough make-over of their current operations, there is often still too much uncertainty. Reynaers Aluminium, a developer of window, door and curtain wall systems, was no exception. Together with VITO, the Duffel-based company is currently looking for circular building solutions. At the end of the journey, these solutions will be compiled in a design guide for architects.

In a 2-year project (ending late 2021) and supported by Circular Flanders, Reynaers Aluminium, together with VITO and experts from the VUB, is looking for opportunities for aluminium exterior joinery within circular construction - hence the name of the project: Windows of Circular Opportunity. Their insight into these business opportunities should remove the persistent uncertainty surrounding circular construction in the construction sector. 'We are still currently working out exactly where we are going with "circular" in our industry,' explains Kurt Van Den Bergh from Reynaers Aluminium. 'What does the market expect from us, and how can we meet expectations? Up until now, we have primarily focused on the performance and sustainability of our products, their applications and the production processes: for example, by optimising them in terms of energy and the environment.'

As part of the project, VITO already carried out a so-called circularity scan on Reynaers Aluminium's extensive and varied product range last year. But of course the circular revolution is broader and more extensive. 'We need circular solutions at building level', according to Carolin Spirinckx from VITO/EnergyVille. 'From that level, we can feed back insights to the level of exterior joinery companies such as Reynaers Aluminium. That way, new opportunities may arise that we are currently unaware of, possibly in the form of differently defined products and services'. In this context, in December Reynaers Aluminium and VITO brought together stakeholders from the entire value chain in the first of three workshops organised in accordance with the co-creation formula.

Tailored guidance

One person who does work primarily at the building level is the architect. One of the objectives of the project is to compile a design guide for architects with circular solutions for exterior joinery. 'Via a sounding board group with architects, circular experts and the industry, we want to improve the circularity of the current solutions,' says Spirinckx. 'And through the co-creative workshops, we adapt the needs of architects and opportunities in the chain into suitable technical solutions. This should then all result in a complete guideline tailored to the architect'.

Today there are already general guidelines on circular construction, but they are not specific enough and not focused on external joinery. 'First and foremost, it's a matter of adapting the existing general guidelines into facade systems,' explains Damien Trigaux from VITO/EnergyVille. This general framework was partly developed by VITO, under the impetus of OVAM. 'We have therefore been looking into circular construction for a long time. In this regard, not only do we work qualitatively, but also quantitatively from the perspective of the entire value chain, by implementing a life cycle analysis (LCA). This allows us to examine the difference between the business-as-usual scenario and the more circular solution'. In the collaboration with Reynaers Aluminium, VITO will therefore subject a number of specific cases to an LCA. 'Finally, we also look at it from a financial perspective,' explains Spirinckx. 'What environmental benefits do we achieve, what is the investment cost and can it be justified at the end of the ride?'

After all, it all needs to be financially viable for investors. 'The cost of circular construction currently puts building principals off', admits Stefan Vandervelden from Reynaers Aluminium. 'Also because the benefits of circularity are often not immediately visible or tangible, and moreover, they are more long-term in nature. As a result, there is uncertainty about the return on investment. As a result, not only building principals but also financial institutions are holding back'.

Crucial role for governments

According to Spirinckx, it remains to be seen whether the cost is higher. 'We still need to specifically look into this, and it is crucial that we are transparent in this regard. As such, this is also discussed in depth during the workshops. We compare business-as-usual with circular, and zoom in on both the cost and the environmental aspect, for the entire value chain. We then look at the shifts that occur as a result of circular building solutions'.

As is the case in many areas, the government can also play a crucial role in the transition to a circular construction sector. This is already happening to a certain extent with our neighbours to the north. 'The Dutch government already incorporates criteria such as the Environmental Performance of Buildings (MPG), the environmental cost indicator (MKI) and the detachability index in its public tenders,' reveals Vandervelden. 'That way, it plays a guiding, however still limited, role towards more circularity'. In Belgium, too, invitations to tender already mention circular criteria, as part of so-called green public contracts. 'Unfortunately, very few quantitative requirements are imposed, meaning that the contractors can interpret them as they see fit. That is too non-binding. Tools such as TOTEM (to optimise the environmental impact of buildings and building elements) and GRO (the sustainability meter, of the Facility Company which focuses intensively on circular construction) can help in this regard'.

But first and foremost, the construction team needs to be better informed. 'In many buildings today, the circular construction principle is still limited to

a few materials', adds Van Den Bergh. 'There is currently too little knowledge and experience in the field to apply it across the board. We hope that our draft guide will soon change that'.



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The European H2020-project 'Building As Material Banks' (BAMB) united different parties from all over Europe (also VITO and Reynaers Aluminium) with one goal: to facilitate a system change for the construction industry by developing circular solutions. In this framework, Reynaers Aluminium together with constructor Beneens, developed simple exchangeable joinery for the total renovation of a few student homes at the VUB campus (Circular Retrofit Lab). This was a first step in their engagement for a transition towards a circular building economy.



*Impression of the project 't Centrum of Kamp C
This project was assigned to the consortium 'Kamp Circulair' after a circular tender procedure. Constructor Beneens, who was also involved in the Circular Retrofit Lab, will be responsible for the exterior joinery.*

G-STIC 2020

LEVERAGING TECHNOLOGY TRANSFORMATION OPPORTUNITIES BEYOND COVID-19

Amidst the current COVID-19 pandemic, the intersecting challenges of health and sustainability have never been more apparent. Therefore, the 2020 edition of the G-STIC conference came at the right time to underline the urgency to identify integrated technological solutions and promote multi-stakeholder cooperation to address this health crisis, mitigate its longer-term impacts, and prepare for future challenges that can threaten the achievement of the Sustainable Development Goals.

3,700 participants and 200 expert speakers from 140 countries joined the fourth conference of the Global Sustainable Technology & Innovation Community. For the first time, the conference was organised as an online event by VITO and its international partners ACTS, FIOCRUZ, GIEC, GIST, IITD, NACETEM, and TERI. During the sessions live-streamed from the studios in Brussels and the online sessions, world-renowned speakers and sustainability thought leaders explored how to leverage technology transformation opportunities beyond the current pandemic.

During her keynote, Gro Harlem Brundtland highlighted that the COVID-19 pandemic is a stark illustration of how we need to work together for inclusiveness, equality, empowerment and sustainability to safeguard our common future. UN Secretary-General António Guterres, in turn, emphasised that breakthrough technological innovations are crucial to address the COVID-19 pandemic,

the climate crisis, and the growing inequalities throughout the world. He considers this pandemic to be a wake-up call for a better relationship between science and policymaking and more effective international technology cooperation, and recognised the critical role of the Global Sustainable Technology and Innovation Community in this.



António Guterres



Gro Harlem Brundtland



Accelerating climate change adaptation

Especially as the climate crisis intensifies and climate change impacts become more visible, climate adaptation issues claim a more prominent role on the policy agenda and the science and technology agenda. Climate change impacts are generally felt locally and therefore require local, tailor-made technological solutions. But as climatologist Jean-Pascal van Ypersele stressed during the Climate opening session, the challenge of adapting to climate change is an international one that requires systemic changes.

The effectiveness of climate adaptation technologies relies indeed on being part of a broader strategy that acknowledges uncertainty, addresses the underlying drivers of people's current and future vulnerability and uses indigenous knowledge as a source of inspiration. Such a strategy requires the integration of climate adaptation with human and economic development efforts, using the SDGs as the framework.

Leveraging innovation beyond COVID-19

Not losing sight of the longer-term goals agreed upon in the 2030 Agenda for Sustainable Development is crucial in preparing for any future challenge that can threaten the achievement of the SDGs. As high-level representatives from countries championing technological innovation made it clear during the Inaugural conference session, we must continue to look further ahead - even if our focus during the past ten months has been on mitigating the economic consequences of the pandemic and the development of vaccines.

Together with the expert speakers participating in the various thematic

sessions, they provided countless examples of technological innovations, and digital innovations in particular, to fight COVID-19 and to leverage sustainable economic and social progress beyond the current pandemic.

Digital innovation empowering sustainable progress

During the COVID-19 pandemic, social technologies associated with digital tools have become essential to the implementation of nonpharmaceutical interventions. Scientists developed several prototypes, focused on increasing the protection of vulnerable populations, as well as establishing innovative methodologies to implement active surveillance of COVID-19. At the same time, health professionals used telehealth, robotics, and artificial intelligence tools to reach out to patients at home or in the isolation areas of the hospitals.

Digital innovation also creates opportunities for all challenges related to the production, marketing and consumption of food. In particular, emerging technologies such as Artificial Intelligence, the Internet of Things or big data can help develop monitoring capabilities and platforms to support sustainable food systems that improve cultivation management, automate farming operations, increase production, and save energy in harvesting and distribution.

Digitalisation programmes for continuous learning, training and reskilling are equally important because the transition to a carbon-neutral world will be inclusive, or it will

not be. Novel educational frameworks are needed to prepare students to become life-long learners through a variety of learning approaches including experiential learning, inquiry-based learning, challenge-based learning and interdisciplinary problem-based learning.

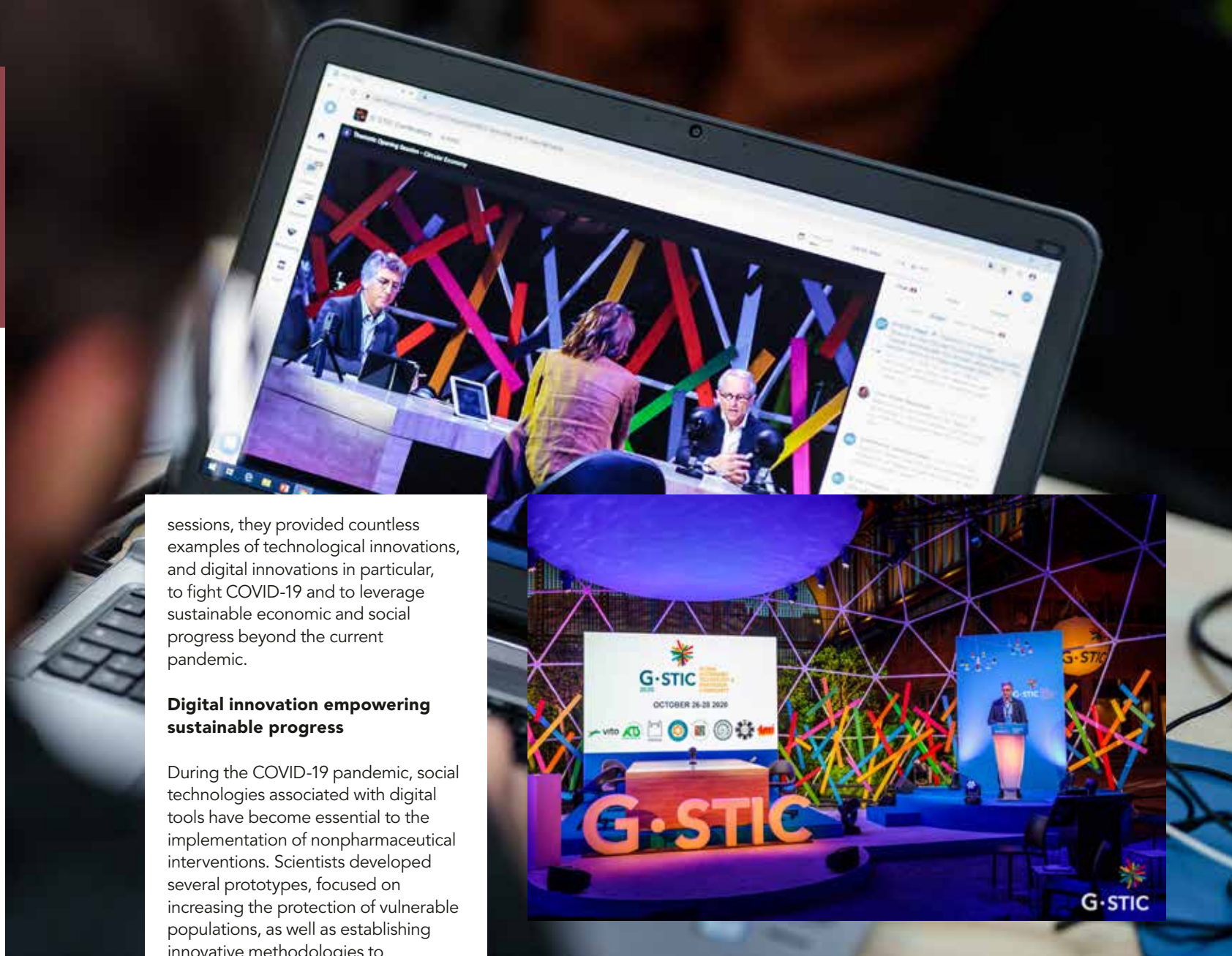
The European Green Deal

Breakthrough digital technologies such as Artificial Intelligence, the Internet of Things or digital cleantech are indispensable to realise circular value chains. During the Circular Economy closing session, experts from the industry and the European Commission discussed the innovation challenges to bridge the gap between digitalisation and circular economy, and the need to decrease the digital sector's dependency on imported and critical raw materials.

Along with the decarbonisation of the energy system and a farm-to-fork strategy for a fair and environmental-friendly food system, the acceleration of universal access to digital technologies and the transition to a circular economy are key components of the European Green Deal. Calling for a dramatic transformation on a well-defined timeline, this Green Deal is a template for what we should do to achieve the SDGs.



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10 YEARS OF VLAKWA: A LOOK BACK AND A GLIMPSE TO THE FUTURE

On 1 October 2020, the Flemish Knowledge Centre for Water (Vlakwa) celebrated its 10th anniversary. The perfect opportunity to give the organisation a new look with a revamped website and a redesigned logo. And to look back at the many waters that Vlakwa has swum through.



Several extreme droughts in recent years have made us face the facts: Flanders is particularly vulnerable when it comes to its water resources. Imminent water shortages not only have an impact on citizens (via hose pipe bans) and farmers (irrigation restrictions) but also on businesses. As a result, more and more sectors, companies, organisations and governments are focusing on robust water management, which should prompt 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.

Neutral, independent role

It typifies Vlakwa's economic and innovative drive, which has remained unchanged since its inception in 2010. 'From the outset, we have been bringing together parties with water-related problems with "problem solvers", usually knowledge organisations such as the two West Flemish colleges of higher education that were at the inauguration of Vlakwa together with agricultural and business organisations from this province,' explains Charlotte Boeckeaert from Vlakwa. The solution came (and still comes) mostly in the form of demonstration projects, more than twenty of which have been completed in the last ten years. 'Subscription to these projects is usually via open calls, after which companies and organisations can receive support to test an innovation for one year. Vlakwa always plays its neutral, independent role in this regard'.

Vlakwa attaches great importance to the system focus it uses. 'This implementation of the action line is based on three questions we ask ourselves,' explains Dirk Halet from

Vlakwa. '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?' In the roll-out of this action line, Vlakwa can count on the support of the Flemish Transition Platform within VITO.

Finger on the pulse of the business world

Vlakwa's economic approach naturally requires the organisation to keep a strong finger on the pulse of the water-related problems in the Flemish business world. 'In 2013 we produced a large-scale, detailed overview of the socio-economic importance of water in Flanders', says Halet. 'This gave us a good overview of the water-sensitive sectors and the added value they create, and how they are threatened by flooding or drought'. The needs and concerns of companies are also continuously monitored, including through close consultation. 'We keep a close eye on what is going on in the Flemish business world. We base our activities on this: by focusing on projects that meet the needs and concerns of the companies, we immediately become more involved. And we have also recently started working with the Flemish spearhead clusters, which set out the lines for innovation in Flanders. That way, we ensure that our priorities match'.

In addition, Vlakwa has a sounding board group in which various organisations from the research world, the government and the business world (including various drinking water companies active in Flanders) are represented. Halet: 'The sounding board group not only keeps us up to date, but is also important for our neutral position in the Flemish water landscape. And we can see that this advisory council is also an important asset in our

international operations'. According to Bart Naeyaert, West Flemish delegate and chair of the sounding board group, this body helps to guarantee the middle position between government, research and entrepreneurs. 'This middle position is important in order to be able to act with sufficient freedom for and between the various actors without having to implement the agenda of one of the actors alone. Also within the structure of VITO, we will continue to represent the relevant research organisations, entrepreneurial organisations, water companies and governments', explains Naeyaert.

Low-threshold and approachable image

Another important milestone in the past ten years was the roll-out of the Low Threshold Expertise and Service Centre (LED) for Water. 'SMEs can contact it for free first-line advice on solutions to their water problems and questions,' says Veerle Depuydt from Vlakwa. 'This ranges from the choice of water sources over new technologies for process water to purification and water management'. But of course, a low-threshold and approachable image cannot be achieved overnight. 'We have gradually built this up by networking and communicating clearly. Our personal approach has also contributed in this regard'.

Sometimes companies also point out new bottlenecks. Depuydt: 'A scrap metal processor, for example, came up with the question of what to do with run-off rainwater. On this basis, we set up a targeted project with the whole sector. It is an example of need detection that is a consequence of our strong feeling with the business world'.

In 2016, Vlakwa was 'incorporated' into VITO. 'This was a result of a rationalisation of the many Flemish

innovation structures, in which companies were often unable to see the wood for the trees,' explains Clemens Mensink of VITO. 'The valuable ones - like Vlakwa - were retained but integrated into a larger structure. VITO was a logical partner for Vlakwa'. This does not prevent Vlakwa from continuing to play an independent role in the Flemish water landscape. 'We fulfil the same role, but now it is within the VITO structure', explains Depuydt. Today, Mensink sees a clear synergy: 'In a short period of time, Vlakwa has brought a lot of international projects to Flanders for its partners, including some very interesting Horizon 2020 initiatives. That's quite an achievement for a team with six core members'. As such, Vlakwa is ready for the future. This is already happening today, with the Flemish economic recovery plan, among other things, to deal with the corona crisis. But above all in the context of the Blue Deal, which needs to prepare our region against water scarcity.



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FLATTEN THE CURVE: SHIFT THE ENERGY DEMAND WITH FLEXHARVESTER / STORM DISTRICT ENERGY CONTROLLER

Not only the extent of the energy consumption, but also the moment of consumption affects the energy bill and the greenhouse gas emissions of large customers. With FLEXharvester, VITO/EnergyVille has developed a turnkey platform for applications to manage flexibility within an energy grid. The first application, for peak heat demand reduction, is currently being demonstrated on five operational heat networks in the Benelux, France and Sweden.

On the premises of VITO-SCK-Belgoprocess in Mol, the buildings are heated via a thermal energy grid. Despite the fact that it is partly powered with geothermal energy from the deep subsoil below the Balmatt site, a large part of the heat is supplied by gas boilers. Especially in the morning, when the heating in the buildings is switched on again, the total heat demand of the thermal energy grid peaks. And it is precisely this peak that is primarily covered by the gas-fired boilers.

Flatten the curve

Since the STORM District Energy Controller was connected to five VITO buildings in 2018, these peaks have been flattened out. Was the heating turned down by a few degrees? Not at all, the energy demand has not been reduced, but it has been shifted in time. 'We push the consumption peaks down and therefore flatten the curve, so that the energy consumption is distributed more evenly over time,' explains Somil Miglani of VITO/EnergyVille. The controller does this in various ways, using smart, self-learning algorithms. 'For example, we use the thermal storage capacity of the buildings themselves. When the heating is on, the walls, floors and interior warm up at the same time. If you lower the heating, this stored energy is released and the temperature in the room remains almost constant. This way, the heat demand is shifted.' Fewer peaks not only reduce the energy bill (after all, energy is most expensive during peak demand), they also reduce greenhouse gas emissions. 'In modern, climate-

friendly heat networks, the baseload typically comes from renewable energy sources (such as geothermal energy) and peak demand is usually met by burning fossil fuels'.

The STORM controller can also respond to the highly fluctuating electricity market by regulating heat production from heat pumps, for example, to coincide as much as possible with the off-peak electricity prices. Finally, the controller can also be used to balance the exchange of heat between different grids - for example, an industrial and a residential heat network that both draw from the same geothermal energy source.

Ultimately, the STORM controller enables consumers to be more flexible with their energy consumption, in this case heat. It was developed on the FLEXharvester technology platform, which VITO/EnergyVille set up as an incubator for all kinds of applications to 'harvest' energy flexibility. FLEXharvester was developed to help solution providers in the energy market (software developers, system integrators, etc.) develop innovative solutions. 'By relying on our platform, they can shorten development times and go to market faster,' says Erik De Schutter of VITO/EnergyVille. 'FLEXharvester/STORM District Energy Controller has been extensively tested, demonstrated and approved at five different sites at home and abroad (see inset)'.

Role as technology supplier

What's more, FLEXharvester works with Microsoft software. In fact, it is

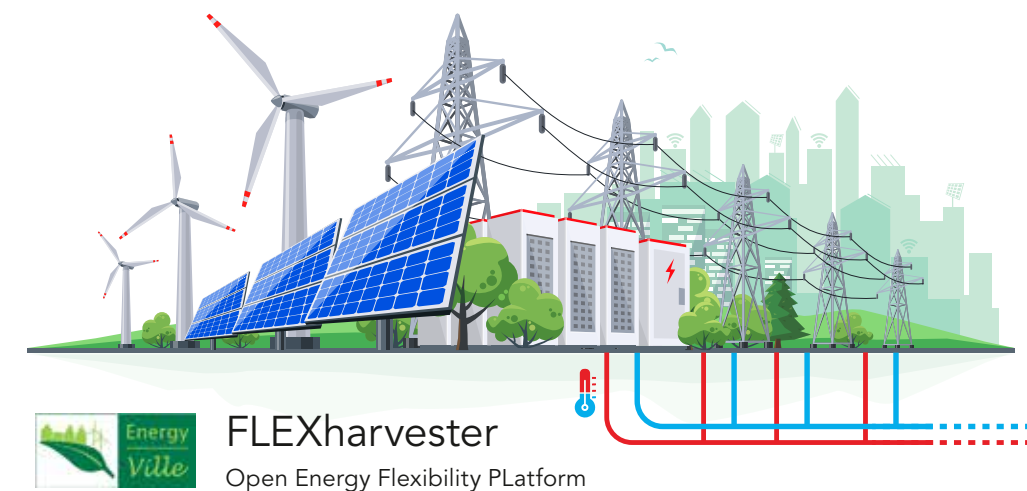
based on it, including the Microsoft Azure cloud platform. Companies that have experience with this (e.g. as Microsoft Solution Provider) will therefore find a familiar development environment. And it is precisely these companies that are the customers of VITO/EnergyVille. De Schutter: 'They build the energy flexibility solutions, which they then offer to grid operators and operators of energy grids'. As such, VITO/EnergyVille primarily profiles itself as a supplier of technology tested in the field, which can be immediately used by solution providers. 'The focus is therefore on triggering and supplying ready-to-use innovation to these companies, which means that we operate much closer to the market than you would expect from a research centre'.

The excellent collaboration with Microsoft is evidenced by the location where the STORM controller will soon be launched internationally. This will take place on 25 March 2021 at the Microsoft headquarters in Zaventem. 'Under the name FLEXharvester, VITO/EnergyVille is bringing innovative algorithms to partners and customers via Azure Marketplace', explains Erik Kerkhofs, regional director of Microsoft. 'The power of the Microsoft platform combined with the expertise of partners such as VITO/EnergyVille make our offering unique and the impact for customers in various industries indisputable'.

The fact that it is the solution providers that serve the end customers (the grid companies) does not mean that they do not come to VITO/EnergyVille. 'First and foremost, the end customer wants to know whether sufficient energy flexibility can be harvested in their grid,' explains Koen Allaerts of VITO/EnergyVille. 'We look into this in the form of a pilot project, a kind of exploration like we did with the STORM controller. It is a comprehensive exploration which ideally runs over several heating

seasons, so that the customer gets a good idea of the possibilities'.

Feedback from the end customer is also important in launching new energy flexibility applications. 'Various candidate applications are currently being assessed, including an application to reduce the peak demand caused by an electric company fleet', concludes De Schutter. 'Ultimately, the market decides which tools we will develop'.



FLEXharvester

Open Energy Flexibility Platform



The STORM District Energy Controller, a follow-up to a European Horizon 2020 project, is being tested and demonstrated at four other sites, in addition to the Balmatt site of VITO in Mol:

Heerlen (NL): The Mijnwater heat network supplies heat and cooling to homes, shops and industrial companies in and around the Limburg town of Heerlen. The grid is powered with heat from former coal mines. The controller streamlines the energy distribution between the different types of customers.

Eindhoven (NL): heating company Ennatuurlijk operates various heat networks in the Netherlands, including one in Eindhoven, which is powered with green heat from a biomass power plant. Through data collection, the controller learns the heating behaviour of the buildings to which it is connected, so that energy consumption can be easily monitored and managed. In addition, the controller allows buildings to be used as a heat buffer, which can reduce peak demand.

Paris-Saclay (FR): at this large 'green' campus, where both research organisations and companies with their R&D are located, a heat network is currently being constructed which is powered by geothermal energy. The controller is connected to five large buildings - three student flats and two university buildings. The peak heat demand is reduced so that the use of gas boilers is minimised, resulting in a greater share of geothermal energy in heat production.

Växjö (SWE): at the Rottne site, boilers fired with biofuel supply heat to surrounding homes and shops. Within the Horizon 2020 project, the peak reduction by the controller was tested on this site. This resulted in an average reduction of almost 13 %.



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'HEALTH HUB' OPENS ITS DOORS

The relocation of the VITO air quality measurements team (LKM) has finally been completed. It is now set up in the former Technology House, where it has since rebuilt its unique lab infrastructure and recently expanded with certified test equipment for face masks.

'We needed to move in any case' explains Gert Otten from VITO. 'As the LKM team, we were one of the last research groups still active on the nuclear site shared with the SCK on the main site at the Boeretang in Mol'. The relocation had already been included in VITO's master plan for some time, but gained momentum when the Technology House opportunity arose in the course of 2018

For some time, VITO has been working on bringing together different services around the Health theme in one campus. The Technology House is part of this 'Health Hub' and wants to house VITO's LKM team as well as other VITO activities or other companies in the field of sustainable health.

LKM started their relocation in the spring of 2019, and this was completed one year later, in the summer of 2020. Otten: 'It took a while before the building was completely ready to house our offices, and especially our laboratories. Moreover, our lab technicians didn't have any backup infrastructure to complete ongoing projects during the move. And we couldn't just pause or stop these projects. So it was quite a puzzle to get the labs moved'.

Link with human health

With its activities, the LKM team is at the cutting edge of health and the environment. 'Good air quality is and remains an important health issue and the core of our expertise is still high-quality air and aerosol measurements in various indoor and outdoor environments', explains Otten. 'In recent years, we focused intensively on validating and deploying innovative sensor technologies. They are slightly less accurate but cheaper and therefore allow data to be generated on a much larger spatial scale - including personal data'. Then you can quickly make the link between human health and the mission of the Health Hub. 'Examples include the current issue of particulate matter, the citizen science CurieuzeNeuzen project and various 'indoor air projects' for which VITO provided the analyses and scientific interpretation'.

The new laboratory infrastructure in the Technology House is run by a dozen VITO lab technicians. In addition to them, the LKM team also has twelve researchers, who also have their work stations in Technology House. The test labs are intensively used for sensor validation (e.g. CO₂ meters that indicate whether an indoor environment is well ventilated and therefore 'corona

safe') and for efficiency testing of industrial air purification techniques and of building materials that absorb harmful substances and thus provide a better indoor environment.

In addition, the unique generation lab, together with the new conduit, allow to receive around thirty delegations from company laboratories in Flanders, Wallonia, the Netherlands and Germany each year for extensive quality control in the form of so-called inter-laboratory tests.

In the summer of 2020, the LKM team obtained new testing infrastructure following the corona pandemic. At the request of Flemish Minister for the Economy Hilde Crevits, VITO rapidly developed a test lab for checking FFP face masks. VITO is currently the only Belgian research organisation accredited for this strict European standard. Among other things, VITO is responsible for the quality testing and certification of high-quality masks produced in Belgium.

Living lung cells

Also state-of-the-art is the air-liquid interface lab, where innovative simulations are done of exposure of lung cells to toxic gases and nanoparticles - minuscule particles

whose impact on health is not yet fully known. The expertise of air quality measurements is increasingly shifting towards a mapping of the risks to human health. And towards looking for new leads for innovative therapies or medicines. Otten: 'We have unique technology that allows us to study living lung cells and see how they react after exposure to air, contaminated or otherwise, or to specific chemicals'.

VITO recently purchased a sophisticated device for this lab which can test the safety and efficacy of inhalable pharmaceutical products. 'With this PreciseInhale®, an aerosol can be generated in a controlled and extremely accurate manner, to which in vitro human lung cells are then exposed,' explains Otten. 'That way, we can examine how aerosols and small particles affect our lungs after inhalation, and thus our health'.

Is there still room for spin-offs in Technology House - surely an important aspect of the original intention of the Health Hub? 'Spin-offs are always welcome to link their activities with us,' confirms Otten. 'Ideally, these would be start-ups with strong expertise in the area of health, which would also tie in with the local spearheads of policy in the Campine region - with which VITO's health activities would also be strongly matched, like for example the 3xG study that has been ongoing for several years. Moreover, there can also be spin-offs from VITO, as it is part of our task to make new mature technology stand on its own two feet'.

VITO rents Technology House from the Province of Antwerp, which in recent years has renovated the building at its own expense and prepared it for offices, meeting rooms and labs.



PreciseInhale®



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FIRST AID FOR CIRCULAR CONSTRUCTION



Sustainable construction is circular construction. But how do established construction companies make the switch to a circular business, without shooting themselves in the foot during the process? And what are the do's-and-don'ts for start-ups? In a unique co-creation process, entrepreneurs from the Flemish construction world sought and found support for the development and roll-out of a customised circular business model.

If the construction sector is to become radically more sustainable, in terms of both energy and raw materials consumption, the current linear way of working (the 'take-make-dispose' model) will have to be replaced. This implies a circular approach, using as few new raw materials as possible and keeping products - and the components and materials that go into them - in circulation for as long as possible.

But that is easier said than done. For many companies and businesses, it is far from clear how they can put a circular business into practice - without sacrificing profitability. 'The circular economy is a hot topic today, and it is a trend that will continue when the European Commission rolls out its Green Deal,' explains Helen Versluys of Möbius, which advises companies on the circular economy. 'So it is not surprising that circular building is also receiving a lot of attention. Unfortunately, it is not in line with the classic linear business model in the construction sector. Established companies do not always know how to make money with circular concepts such as adapted design, change-oriented construction and selective waste streams'.

Moreover, despite their often innovative and fresh image, start-ups don't have an easy ride. Versluys: 'Start-ups often focus too much on their product alone, as a result of which they lose sight of the market and go under.'

Unique co-creation process

In order to familiarise both established companies and start-ups with the world of circular construction, VITO, together with Möbius and Camp C, the Centre for Sustainability and Innovation in the Construction of the Province of Antwerp, set up the 'Building a Circular Campine' project in early 2019. A unique co-creation process was rolled out within the project, in which the participating companies went further into the opportunities of circular construction and how to capitalise on them via a suitable business model. It turned out to be a success, even in times of corona: at the end of last year, the third edition of the project was completed, bringing the total number of participants to 25. The project was supported by a grant from the European Regional Development Fund worth €111,924.62.

Each programme consists of an introductory inspiration session, followed by three content-related workshops. 'In these workshops, we focus on various aspects of circularity', explains Anse Smeets from VITO. 'First, we work with the participating companies to find out how they can create circular value, and what strategies are feasible in this regard. Then we study the value proposition: how can the needs of their customers be met? After all, circularity alone cannot be the only selling point. Finally, we shed light on the circular value network: which partners are needed, what are the preconditions for implementing the circular business model (e.g. legal and financial) and what obstacles are involved?'

'Companies often have basic ideas about circular construction, but they don't know yet how to turn them into a detailed model', explains Sofie Torfs from Camp C. 'We try to remedy this with this co-creation process. At the end, participating entrepreneurs have a clear picture of the strategies for circular value creation that offer potential within their specific context. They have learned which business models allow

them to implement these strategies while generating value for the client, but they are also aware of the focus points in order to realise them'.

Diverse field of participants

VITO is responsible for coordinating the co-creation process, and takes care of the organisational and administrative aspects. Smeets: 'The process is based on the structure of the Circulator framework that we developed at VITO.' In addition, VITO also arranged the content of the sessions. At the end of last year, this resulted in two interesting guides: an extensive manual for organising a co-creation process, and a manual on circular construction (available online via the link below).

Which (types of) companies are interested in circular construction? With three co-creation processes to their credit, the organisers have expertise in this regard. 'The participants were very diverse,' explains Smeets. 'We had established companies such as Willemen Groep and Eurodal, but also young companies such as Bao Living and Circomat. There is also a wide range of activities: from traditional construction companies to large building principals and interior designers. This rich mix ensured a good balance during the sessions'.



During the three previous processes, we observed that companies often equate circular construction with offering a service instead of a product - the so-called 'as-a-service' model. But even this model cannot be implemented overnight. 'It requires a completely different way of doing business, because instead of delivering a product, you remain responsible for it,' explains Torfs. 'So you have to factor in maintenance and repairs. Moreover, the income only comes in very sporadically, for example via subscription fees. And customers also often get cold feet, especially in the construction sector. Indeed, the Flemish prefer the idea that they own something'. Finally, the legal framework and financing channels are not yet perfectly set up for use rather than ownership.

'If your company switches to as-a-service, it is important that you also take away all the hassle for the customer,' explains Versluys. 'But that means that you have to work together with other companies. Take, for example, the circular idea of a facade-as-a-service. This involves a lot of different companies. So a construction company will have to work closely with a window installer'. But there also needs to be good cooperation within (large) companies. 'It is crucial that everyone is on the same wavelength in the company, from the work floor to management,' highlights Torfs. 'Circular construction requires a different approach to products and services, to materials, to waste, etc. In short, to the whole business'.



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TOWARDS COMPREHENSIVE CHEMICAL RECYCLING OF PLASTIC

By 2030, 55 % of plastic packaging waste in Europe must be recycled. In Flanders, the aim is to even achieve a recycling rate of 70 % for household waste. Today, we are still a long way from achieving these goals, and so waste processors, chemical companies and knowledge organisations such as VITO are stepping up their efforts. In the context of the four-year Catalisti project WATCH, innovative chemical recycling of various types of plastic waste into basic raw materials of plastics and high-grade chemicals is underway.

Despite selective collection and large-scale sorting, today only 30 % of plastic packaging waste from households in Flanders is recycled into new plastic. A similar percentage applies to packaging waste in general. The vast majority of that waste is therefore given an unsustainable, non-circular destination: it is dumped in landfill, incinerated or exported to countries outside Europe.

So we need to do better. But is that possible? 'Today, plastics are recycled in two main ways', explains Brecht Vanlerberghe from VITO. 'With mechanical recycling, the waste is remelted into plastic pellets, which are then returned to the industrial chain. However, this is only possible if the plastic waste is of good and certified quality'. However, the resulting plastic applications are typically inferior – hence the term downcycling. 'In a variant of this recycling, undesirable substances are first removed from the plastic waste using solvents, allowing the plastic to be used again for the same applications – this is then called upcycling. However, recycling in this way is only possible if the initial waste stream is sufficiently pure'.

Preferred by the chemical industry

An alternative is that the plastic waste is broken down into its building blocks and then reassembled. Vanlerberghe: 'This is called chemical recycling. Polyethylene terephthalate (PET), for example, is broken down into ethylene glycol and terephthalic acid, impurities are removed and it is converted back into PET. With polyolefins, the plastic is broken down into a kind of naphtha, which can replace fossil naphtha in existing crackers and thus re-enter the plastic chain'. This is also how the chemical sector sees it: it has a clear preference for chemical recycling. 'Unfortunately, today's techniques require us to know exactly what types of plastics are in the waste. To get around that problem, the WATCH project was launched'.

WATCH (Waste plastic To Chemicals by pyrolysis) started in 2019 and runs until 2023; this project is supported by VLAIO and coordinated in organisational terms by Catalisti, the Flemish spearhead cluster for chemistry and plastics. This project examines the chemical recycling of four types of plastic waste: mixed polyolefins, multi-layer packaging plastics, polystyrene (PS) and polyurethane (PUR). The aim is to convert the waste in an innovative reactor into various basic chemical raw materials - for the manufacture of plastics as well as high-grade chemicals - via rapid pyrolysis (chemical cracking at very high temperature in an oxygen-free environment). One of the most important end products is naphtha, i.e. the basis of plastic production. 'This is a new technique for chemically recycling plastic waste,' explains Wannes Libbrecht, Project Manager at Catalisti. 'If we want to significantly increase the recycling

rate, we have no choice but to look at new techniques. But we also need to look at the chemical sector in particular for solutions, because in the end it will have to work with the end products from recycling'. According to Libbrecht, pyrolysis technology is highly promising because the end products have many applications and are therefore of interest to industry. 'They form the basis of chemicals such as olefins, resins, aromatic compounds, styrenes and diols, as well as fuels'.

More energy-efficient recycling process

The various partners in the project each have their own focus. For VITO, this is primarily the separation and purification of the plastic oil obtained after pyrolysis. 'We investigate how we can make maximum use of our innovative membrane technology in these separation processes,' explains Pieter Vandezande from VITO. 'Before pyrolysis, during the decontamination of the waste, but especially afterwards, during the separation of products such as naphtha from the oil obtained'. At VITO, they believe that membrane separation provides a significantly more energy-efficient recycling process than current separation techniques. 'That is of course very important, because one of the main reasons why we recycle is to reduce CO₂ emissions'.

Researchers from Ghent University (who are coordinating the project in scientific terms) are in charge of pyrolysis, while their colleagues from KU Leuven are in charge of catalytic reprocessing. So all this will be done in an innovative reactor that has yet to be developed and built. 'This is about strategic, exploratory basic research', according to Roel Vleeschouwers from VITO. 'Experimentally, we mainly work on a lab scale, and we hope we will soon be able to produce a few litres of naphtha. The scaling up, for example in the form of an industrial pilot installation, is for a possible follow-up project'. 'We are starting at the start', confirms Vandezande. 'The aim is to build up our knowledge about chemical plastic recycling

via pyrolysis. But as VITO, we also want to use this project to position ourselves in this emerging domain'.

Broad advisory council

The chemical and recycling industry is now watching with interest, with a view to its plans for the near future. For example, within its own Plastics2Chemicals project (P2C), waste processing company Indaver envisages several recycling plants over the next ten years, including facilities to convert plastic waste such as PS and polyolefins into chemical building blocks such as naphtha, styrene and wax. 'Breakthroughs in chemical recycling

being investigated within WATCH can mean an extra step in increasing the yield and efficiency of our process, resulting in a significant improvement in our P2C business case', says Erik Moerman of Indaver. In the very short term, Indaver is planning a demo plant for the chemical recycling of polystyrene and polyolefins. 'A successful start-up of this demo plant at our Antwerp site will be a first important step in redirecting plastic waste towards innovative large-scale recycling applications'.

Indaver sits on the advisory council of the WATCH project, together with around ten other waste, recycling

and chemical companies. As such, the companies can exchange their experiences 'from the field' with the researchers. INEOS, one of the world's largest plastic producers, also sits on the council. 'As a world leader in the production of styrene, we focus strongly on making our product portfolio more sustainable,' explains Michiel Verswyvel of INEOS. 'Within the WATCH project there is time to consider more fundamental research - the chemical recycling of polystyrene into styrene monomer - which in turn leads to more advanced insights. This is something that is not always possible within the industrial environment'.



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REMOTE SENSING: MUCH MORE THAN JUST MONITORING

From the quality of water, through the paving of open spaces and the state of permanent grasslands to specific harvest forecasts: these are all developments 'on the ground' that can be monitored from space using remote sensing. The high time resolution of the new European satellite systems, the extensive digitisation of image processing and the achieved ease of use have prompted further incorporation of remote sensing applications in specific regional policy areas.

The Flanders Environment Agency (VMM) is currently working on the roll-out of the WaterMonitor. Ultimately, this tool is intended to serve as a kind of early warning system for the quality of surface water. The monitoring tool is based on images from the Sentinel satellites, the core of the ambitious European Earth observation programme Copernicus. Today, the image resolution is high enough for local and regional policy support. The algae growth in Flemish surface water is an example of a natural process that can be closely monitored from space, thanks in part to VITO's image processing technology, in collaboration with Informatie Vlaanderen.

The same Sentinel satellites and exactly the same processing technology also have the potential to monitor permanent grasslands in Flanders for the benefit of the Agency for Nature and Forest (ANB). The Flemish Department of Agriculture has used remote sensing applications to monitor crop production in the

context of a Programme for Innovation Procurement (PIO). Finally, the Environment Department is analysing the possibility of imaging the paving of open spaces in Flanders. 'It is important that the satellites transmit new images every two to three days', explains Jan Biesemans from VITO. 'That way, processes in a given environment can be monitored with unprecedented time resolution. Often they can even be quantified to an objective value (e.g. accurately estimating harvest yields) that is useful for the competent authorities'.

A cascade of applications

This is only a small selection of what is possible today thanks to the high time resolution of the satellite images, and the continuous combination of space and aerial images, which means that the spatial resolution is also continuously high. Remote sensing has therefore become an extremely powerful instrument that has launched a cascade of possible applications. But these applications also need to be developed and used properly. And by the right parties. 'In today's reality with dispersed competences - not only in Belgium and Flanders, but also in Europe - it is crucial that specific and thematic applications are set up from the relevant policy domain and policy level', explains Jurgen Everaerts from VITO. 'Take Terrascope, the virtual research platform of the federal government that gives everyone access to the data from the Sentinel satellites. This platform needs to be used much more by the regional and

local authorities and also by private companies and other organisations. And in this regard, the applications need to fit together seamlessly: the federal government provides for and finances a global framework (in this case Terrascope), but the development of applications should ideally come from the regions and from specific competences or industrial and economic sectors. In Flanders, we have a unique opportunity in this respect, because we can supplement the satellite data with, for example, high-resolution aerial and drone images'.

According to Jo Van Valckenborgh, programme manager at Informatie Vlaanderen, from a government perspective it is important that both a generic operational part and the development of specific remote sensing applications are aligned as much as possible with the relevant Flemish policy areas and levels. 'Maybe we need some kind of intermediary Flemish data platform within the Flemish government to complement Terrascope in support of the various policy areas, e.g. environment, agriculture, etc.' This intermediary platform can also serve research and industry. Everaerts: 'If we can demonstrate in Flanders that we can create a well-functioning remote sensing landscape, this is also possible for the EU as a whole, or in

other European regions and Member States. As such, we form a 'living lab' for all the applications that also offer international prospects'.

Validating regional policy

Once incorporated into the relevant policy levels, various remote sensing applications follow a striking circular motion. The WaterMonitor of the VMM, for example, emerged from a Horizon 2020 project (i.e. across Europe) into the monitoring of water quality from space. 'And the current European environmental legislation obliges Flanders to report back on the quality of its surface area to Europe', explains Van Valckenborgh. 'It's a similar story for other environmental facets'. Or agriculture. 'Europe allows Member States to set their own emphases and priorities within the broader framework of the Common Agricultural Policy', says Everaerts. 'To this end, any support measure granted to a farmer must be validated and sent back to the Commission. Satellite imagery can help validate regional policy in this way'.

The recent environmental and climate plans of the European Commission enhance this regional embedding of remote sensing applications. 'Ambitious policy instruments such as the Green Deal and the Digital Twin

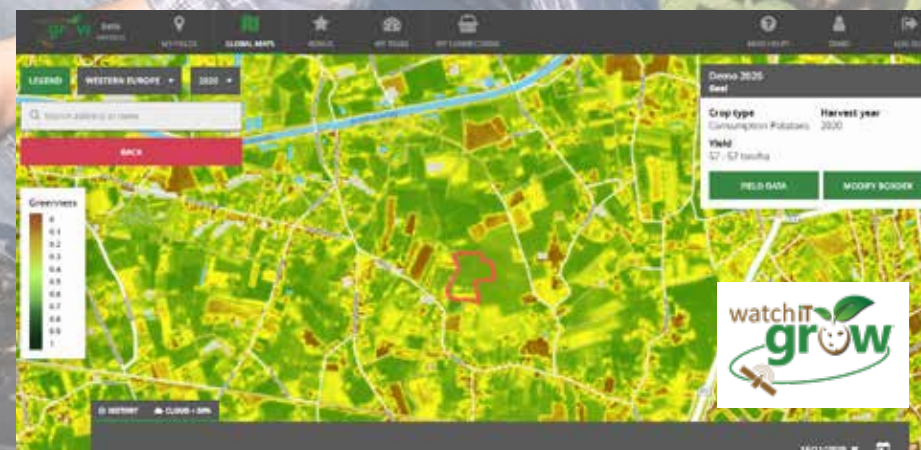
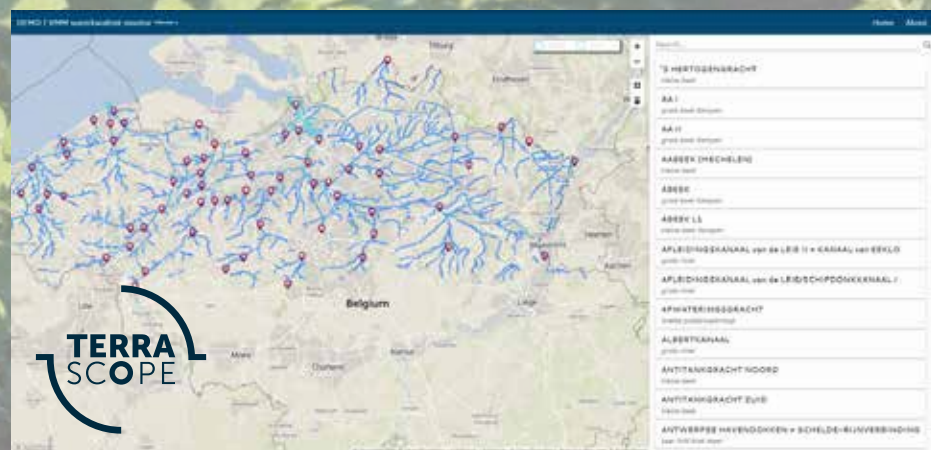
of the Earth all place great emphasis on using remote sensing data such as the Copernicus data,' explains Van Valckenborgh. 'It is clear that the data will be further incorporated into policy applications, up to a 'Smart City' level, where we no longer even notice the fact that it is based on satellite imagery'.

Removing hassles for the end user

The multitude of remote sensing applications would not have been possible without the extensive digitisation of image processing in recent years. 'If you want to know the evolution of a specific area today, you simply send an assignment to a backend, after which you are immediately served,' explains Biesemans. 'Up until a few years ago, you first had to download the satellite images and put the time series together yourself'. Extensive digitisation has greatly improved the ease of use of backend platforms such as Terrascope. User-friendliness was also improved thanks to the pre-treatment of supplied data, something that VITO, for example, has focused on intensively. 'As such, we make using the data platforms accessible and we remove the hassle for the end user'. As a result, Terrascope enjoys a good reputation in other European countries. Since Terrascope can be

used by anyone free of charge, it also offers opportunities for application developers to work with satellite data.

But ultimately it is the end users - people with knowledge of the terrain - who need to be involved in designing specific remote sensing applications. This is shown by, for example, the development and use of the WatchITgrow tool to monitor potato cultivation and increase production sustainably. The data for the tool comes from satellites and drones but also from sensors on agricultural machines. The Belgian potato sector was closely involved in the roll-out of the tool. 'It helps to predict harvests, which means that you are responding to market forces, and so you need that sector,' explains Everaerts. 'It demonstrates that successful remote sensing applications involve much more than just monitoring. They just need to be developed and used within the right framework'.



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VITO EMPLOYEE IN THE SPOTLIGHT

Five years ago, the extended Erasmus stay of Monika Kus (34) in Antwerp was coming to an end: she was about to return to her native Poland. And then she met VITO research director Walter Eevers. He encouraged her to keep applying for jobs in Belgium. And it paid off, as Kus found a job as a chemist in industry. And at the beginning of 2019 the circle was complete and she made the switch to VITO.

It's quite a story: how come five years ago you suddenly wanted to return to Poland when you had almost completed your PhD research at the UAntwerp?

'I never finished my PhD. I started applying for jobs in the summer of 2015. With my educational level, I expected to find a job quickly, but that wasn't the case. After a year of applying for jobs in vain, I decided to return to Poland. Until, through the Connect2Work programme of the integration and citizenship service of Antwerp - where I live - I was brought into contact with Walter

Eevers of VITO, who, like me, studied chemistry. He helped me renew my self-confidence and taught me some useful job application skills. It worked: I was hired as a chemist at a Belgian company'.

After that you ended up back at university, and then came into contact with VITO again.

'That was in the context of a collaboration between UAntwerp and VITO, where I was responsible for the synthesis of new materials that can then be used in metal absorption. Through that process, valuable metals can be recovered in chemical waste streams, for instance. However, during that project, I found out that there was a vacancy at VITO in the materials research division. Because I was already familiar with this specific research and various VITO employees knew my professional capacities, I had an advantage. I was hired.'

What do you do exactly?

'I mainly work on 3D-micro-extrusion. With this technique we can print 3D on microscale porous materials. This

allows us to manipulate the strength and stability of catalysts, meaning that many chemical reactions can be optimised. For example, a catalyst with a porous 3D structure not only decreases pressure drop in a reactor, but also improves mass and heat transfer'.

You have worked both at university and in industry, and now you are active at VITO. How do these three working environments differ from each other?

'In my job in industry, I mainly did chemical quality tests. I soon started to get bored with that, because it was largely routine work. I missed the real research, which is also less commercial in nature. In the joint research project between UAntwerp and VITO, I found what I wanted again, and that remained the case after I switched to VITO. Now my work is very varied: every day is different.

I also like the application-oriented aspect of VITO research, which gives me a strong drive. I didn't feel that so much at university. It is also nice that staff turnover at VITO is much lower. At university, a research group quickly goes its separate ways when a project is finished. Within a large organisation like VITO, there is more collegiality. I felt at home from day one. Or actually, from the Friday evening before my first working week, because the first time I saw my current team was during the New Year's party at the start of 2019. Not a bad way to meet your new colleagues!'

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