vito

VISION

Vision on technology for a better world

BIOBASED COATINGS OF LIGNIN

20 YEARS REMOTE SENSING

VALORISING CRITICAL METALS FROM WASTE STREAMS

THE ROAD TO SUSTAINABLE ENERGY

COVER STORY

Dear readers,

Energy constitutes one of the most important elements of today's economy and society. It manifests itself in different forms, depending on how it is generated and consumed. Improving the sustainability of our energy system to create a reliable, affordable and climate-neutral model therefore presents us with considerable challenges. To help us achieve this energy transition, VITO/EnergyVille offers its extensive know-how and technological expertise to policy makers, businesses and even private citizens.

In this issue, our experts shine a light on the energy transition in Flanders. How can we improve the sustainability of energy supply in Flemish building stock? What heat sources can be considered to help us do this? And what trade-off needs to be made between more renewable energy on the one hand and greater energy efficiency on the other? VITO/EnergyVille believes that local authorities have an important role to play in this. If they address the issue in the right way, provincial, city and municipal governments can develop into powerful facilitators of the energy transition. To do this, they can draw on numerous useful tools that VITO/EnergyVille has developed over the past few years. In this way, we help local governments to set out their own energy paths.

In the meantime, VITO is continuing to make its contribution towards creating a sustainable society. It is not surprising that our research into healthy air quality continues to play an important role in this. It is something for which we are known far beyond Flanders, as evidenced by the intensive training that VITO has provided here to visiting prominent environmental officials from China. Plus, the results of CurieuzeNeuzen citizen science project were presented at the unique SuperNova event in Antwerp at the end of September 2018. Read our review for another opportunity to sample the atmosphere of this 'celebration of sustainable technology'.

Together, we are evolving towards a sustainable society.

I hope you will enjoy reading this issue of VITO VISION!

Dirk Fransaer
Managing Director of VITO

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More info: vito@vito.be - www.vito.be/en

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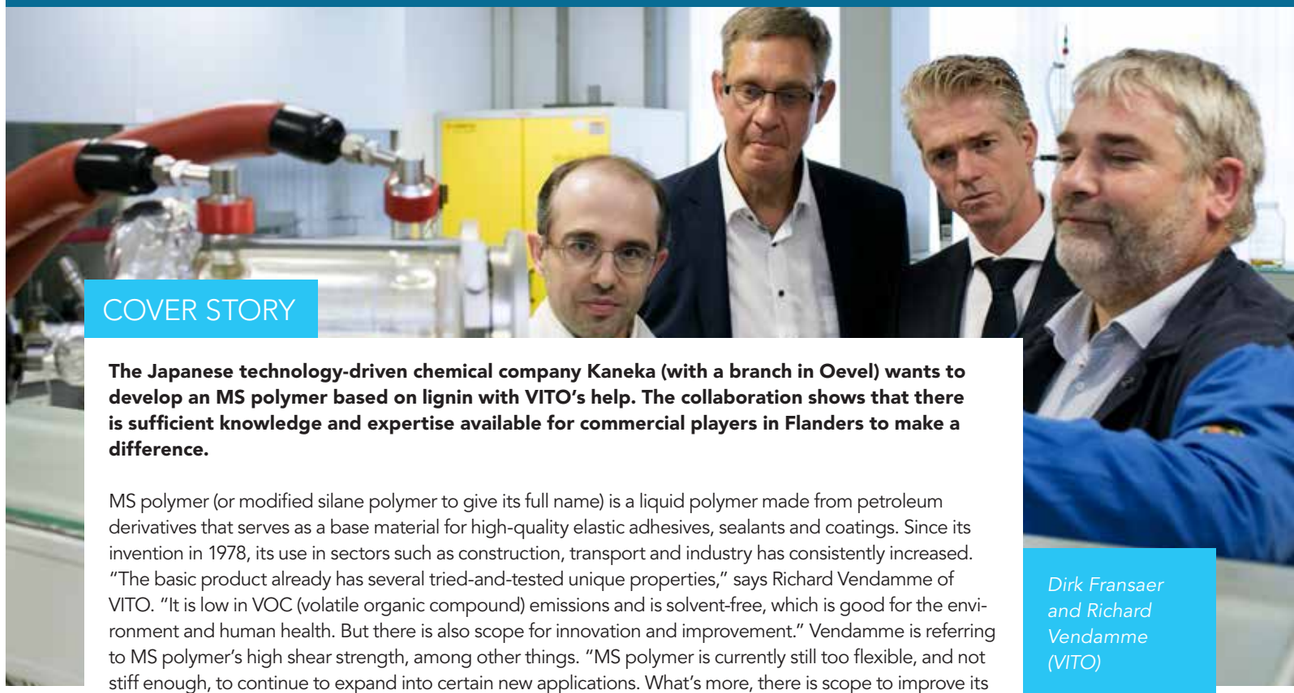
KANEKA AND VITO JOIN FORCES TO CREATE BIO-BASED AND BETTER QUALITY POLYMERS



COVER STORY

The Japanese technology-driven chemical company Kaneka (with a branch in Oevel) wants to develop an MS polymer based on lignin with VITO's help. The collaboration shows that there is sufficient knowledge and expertise available for commercial players in Flanders to make a difference.

MS polymer (or modified silane polymer to give its full name) is a liquid polymer made from petroleum derivatives that serves as a base material for high-quality elastic adhesives, sealants and coatings. Since its invention in 1978, its use in sectors such as construction, transport and industry has consistently increased. "The basic product already has several tried-and-tested unique properties," says Richard Vendamme of VITO. "It is low in VOC (volatile organic compound) emissions and is solvent-free, which is good for the environment and human health. But there is also scope for innovation and improvement." Vendamme is referring to MS polymer's high shear strength, among other things. "MS polymer is currently still too flexible, and not stiff enough, to continue to expand into certain new applications. What's more, there is scope to improve its adhesive force, for example on moist subsoils such as showers or swimming pools."

Dirk Fransaer and Richard Vendamme (VITO)

Olivier Renson and Luc Peeters (KANEKA)

Bio-based and better

In order to make a genuine breakthrough, a bio-based product has to be 'green', as well as 'better'. That fact has not escaped the attention of Kaneka Belgium in Oevel, where the Japanese chemical multinational has its European headquarters. Kaneka has already begun working together with VITO to develop an improved, bio-based version of its MS polymer, which has been one of the company's most successful products for many years. The collaboration is part of an ambitious VLAIO [Flemish agency for innovation and enterprise] project worth 2.5 million euros. The Flemish government and Kaneka are each contributing half of the costs of the project, which was launched in June 2018 and will run for three years. The collaboration came about naturally, says Luc Peeters, R&D Manager at Kaneka: "We noticed that there is a great deal of knowledge and expertise available in Flanders in the field of bio-based chemistry, and this know-how is ready and waiting to be tapped into by companies such as ours. That is how we ended up working with VITO."

Two birds with one stone

Kaneka's R&D department will be working closely with VITO until the summer of 2021 to develop an improved MS polymer based on lignin. Over past years, VITO has built up considerable expertise in the use of lignin, which is the second most commonly-occurring organic material on Earth after cellulose. "The best thing about it is that lignin naturally has a firm and rigid structure," explains Vendamme. "Plus, it is highly adhesive and moisture-resistant." By the end of project, the researchers hope to have killed two birds with one stone. "We want to make an end-product that is both bio-based and has even better properties."
The (future) development of the new MS polymer will provide a boost for Kaneka's Oevel site in any case. "It is a prime example of how VITO's innovation can contribute towards the embedding of chemical companies in Flanders," comments Dirk Fransaer, Managing Director of VITO. "We are especially proud that our research, which we began long before there was any demand for sustainable alternatives, is being used in the chemicals industry, and in Flanders."

More information
richard.vendamme@vito.be

VISION

THE ROAD TO **SUSTAINABLE ENERGY**

2030 and 2050 are the horizons against which the outlines of the energy transition will be drawn. This transition must ultimately result in an energy system that is reliable, affordable and climate-neutral. As always, VITO/EnergyVille is providing its expertise to policy makers to support them in developing their long-term plans. What can we expect over the coming years and decades?

Since the Paris Agreement on climate change was signed almost three years ago, countries can no longer continue emitting greenhouse gases into the atmosphere without obligation. While this historic agreement may not be strictly binding, it is binding in reality for EU Member States, since the European Commission issued the Effort Sharing Regulation earlier this year. This sets binding greenhouse gas emission targets that Member States must achieve by 2030.

In our country, greenhouse gas emissions of sectors not covered by the European Emissions Trading System (ETS) must be reduced by 35 % over the next twelve years. These sectors are those in which Member States are still responsible for implementing climate policy, such as transport, buildings, small businesses, agriculture, and waste management. The roadmap for 2050 aims to achieve a total reduction in greenhouse gas emissions (both ETS and non-ETS) of 80 to 90 % compared with emission values in 1990.

First regionally, then nationally

Not only do we we have to reduce emissions, we also have to significantly increase the share of renewable sources in the European energy mix. The EU's target is for renewable energy to account for as much as 32 % of the energy supply by 2030. The EU also hopes to reduce energy consumption significantly, by over 30 % compared with a 'business-as-usual' scenario. Member States must have completed their 'homework' by the end of this year, when the European Commission expects every national government to have produced a (preliminary) plan on how it intends to achieve the targets. Due to the division of powers in Belgium, this means that plans will need to have been drawn up at a regional level first.

Various policy and advisory bodies of the Flemish government have been using the services of VITO/EnergyVille for years to provide support on energy and climate policy. Researchers at VITO/EnergyVille have provided input for a blueprint of the Flemish Energy and Climate Plan 2030 for the Departments of the Environment (Minister Schauvliege) and Energy (Minister Tommelein), as well as for the Flemish Energy Agency. VITO/EnergyVille has also been involved in producing the section on the energy system for the Milieuverkenning Vlaanderen [Flanders exploratory environmental study] (MIRA) report, which will be published in the next issue of VISION. This will describe realistic solutions, barriers and 'levers' for each sector in Flanders, this time with a horizon of 2050.

The built environment

It is not surprising that some of the same elements feature in both reports. VITO/EnergyVille states that we need to focus on both energy efficiency and renewable energy sources in order to make the energy supply in the building industry more sustainable. This means that Flanders needs to switch up a few gears when it comes to renovating its existing building stock, and heat plays a crucial role in this. According to the researchers, we must aim to produce lower-temperature heat derived from renewable sources. This could take the form of heat networks (fourth generation, supplied by residual heat or sustainable heat via biomass burning or geothermal energy), heat pumps (also known as the all-electric option), or heating and cooling of individual buildings using biomass or green gas.
Since the degree of renovation depends heavily on the investment choices of individual citizens, and is therefore difficult to control, heat networks (90-degree heat) offer an alternative route to achieving sustainability more quickly. After all, these heat networks can be easily converted into fourth generation networks, since the basic infrastructure is more or less the same.

Local perspective

The precise extent to which work is required to increase energy efficiency (by renovating and insulating), and the extent to which the energy supply must or can be made more sustainable depends strongly on the local situation. Due to the high building density, cities are the perfect location to lay heat networks, but this requires investments, so a high connection rate per running metre is a necessary requirement. For this reason, it is important that multiple sources can be integrated into fourth-generation heat networks. This creates sustainable back-up systems and provides a higher level of reliability. For example, residual heat from a CHP plant could be combined with geothermal energy or heat derived from biomass. One example by way of illustration is the Port of Antwerp, which generates more residual heat than necessary for supplying the city of Antwerp.

In less built-up areas, heat pumps may be more appropriate than a heat network, on condition that they can run on electricity generated from renewable sources such as solar, wind and biomass.

Not only does VITO/EnergyVille provide support and advice to policy makers, but it also develops tools for authorities (especially local authorities) to take action. Provincial, city and municipal authorities traditionally have the best overview of the state of building stock and infrastructure on their territories, and obviously they are involved in determining the agenda for public works. They are also the most aware of public needs, as has always been the case. VITO/EnergyVille holds the view that the municipality therefore has an important role to play as a facilitator of the energy transition on a local scale. There are numerous examples of how that role can be performed, from planning for the combined laying of a cycle path and a heat network, to inviting local research partners and companies to join the discussion.

Local authorities lack certain expertise and know-how when it comes to heat (heat networks, geothermal energy and residual heat). The tools provided by VITO/EnergyVille can help visualise complex processes, for example by identifying hotspots with high levels of residual heat, or by illustrating how a local authority can draw up an 'energy inventory'. One of the most ambitious tools is undoubtedly the Urban Energy Pathfinder, which assists authorities with developing their energy planning.

Plentiful renewable energy

When it comes to energy supply, VITO/EnergyVille believes that improving sustainability will result in intensive electrification of various sectors, namely transport (electric vehicles), buildings (heat pumps), and industry. The application of the European scenarios to the situation in Flanders, and the assumption that our region will cease to import green energy in due course, suggest that Flanders will produce between 62 and 85 TWh per year of renewable electricity by 2050 - representing 80 to 97 % of the total power generation. This target is ambitious, but achievable, primarily because important technological breakthroughs have already been made and parties in the region are working intensively on other necessary technological innovations (such as battery technology). In short, the most important thing now is to create a large market for existing renewable technologies.

Obviously, the transport and building sectors are not the only ones we need to make more sustainable; the same can be said of non-ETS industry and small businesses. It must be pointed out that Flemish industry still has some ground to make up, both when compared with other countries and other sectors in Flanders (such as agriculture). We are still waiting for the sector to provide a specific roadmap with a 2050 horizon. Researchers point to the Netherlands, where industry itself is taking control and developing ambitious plans.

In tomorrow's energy system, supply (production) and demand (consumption) must also match seamlessly.
In the view of VITO/EnergyVille, the storage of electricity in batteries will become an important enabler in promoting the integration of renewable energy sources and limiting the impact on the existing electricity grid. VITO/EnergyVille also holds the extensive expertise and tools to do this. For example, the Battery Total Cost of Ownership tool estimates the cost-effectiveness of electrical storage quickly and in detail. VITO/EnergyVille also has an extensive tool set for estimating the value of investments in flexibility (such as the Renovation Business Modelling Tool and Proflex).

Conversion between different forms of energy (electricity, heat, cold, gas and chemicals) also features in the VITO/EnergyVille researchers' future vision.

Intensive electrification

Flanders, Brussels and the Netherlands have seen further investment in charging and refuelling infrastructure for alternative fuels for transport. The attention here has been devoted to several categories of fuels, such as charging infrastructure for electric vehicles, taxis and buses, but also for CNG and LNG infrastructure, hydrogen filling stations, and shore-side electricity for inland shipping.

In view of the continued electrification of road transport, VITO/EnergyVille is conducting research into technologies and strategies to enable the mass introduction of electric vehicles, and smart charging forms one of its core elements. After all, with a large concentration of electric vehicles, it is not possible to charge all built-in batteries at the same time – this would create unprecedented peaks in electricity consumption. Therefore, it is essential that the charging process is managed effectively in order to reduce the impact on the electricity grid.
However, smart charging also reduces the cost of charging, and the share of renewable energy is increased. Companies could set up their own 'mobile battery', so to speak, in the form of an electric commercial vehicle fleet. They could be charged using power derived from solar panels on the roof of company buildings or from wind turbines on the company's site.
A number of projects are also investigating the possibility of returning the battery power to the grid when the vehicles are not in use, so that it can be used at peak times.
Even so, all these forms of smart charging still leave open the issue of mobility demand among end-users. In order to educate parties about smart charging and to facilitate collaboration between (market) parties, VITO/EnergyVille set up the Vlaams Kennisplatform Slim Laden [Flemish smart charging knowledge platform] in collaboration with The New Drive and VOLTA.

Let us be clear: the energy transition to a low-carbon economy and society presents us with challenges in several areas: technological, regulatory and social. These challenges cannot be solved in isolation; they require a systemic approach. VITO/EnergyVille combines its expertise with technological developments to facilitate energy transition at a local, national and European level, and to support industry and authorities in making the transition to a low-carbon future.

More information
pieter.lodewijks@vito.be
www.vksl.be

TIME FOR A NEW TARIFF

When we pay our electricity bill, we are not only paying for the electricity we use, but also for the use of the electricity grid that supplies the power to us. The distribution network tariffs used for this are still based on traditional network usage, i.e. large-scale and centralised generation and the pure consumption of electricity. The energy transition already under way and the large-scale installation of decentralised renewable energy sources have resulted in a situation in which we use electricity differently. Consequently, distribution network operators are faced with a decrease in net power consumption, and in turn they generate less revenue.

VITO/EnergyVille was commissioned by the Flemish Regulator of the Electricity and Gas Market (VREG) to conduct a detailed study with a view to reforming distribution network tariffs for residential and small business customers. This study has analysed various options for distribution network tariffs in detail.

It has concluded that a tariff structure based on connection capacity is preferable for customers with a conventional metre, while there are multiple options for customers with a digital metre. The data in this study will form the input for a reformed tariff structure, which VREG will be developing further.

FROM SATELLITE IMAGE PROCESSOR TO DEVELOPER OF INNOVATIVE DATA PRODUCTS

TWENTY YEARS OF **VITO REMOTE SENSING**

March 2018 marked exactly twenty years since the launch of the Spot 4 satellite, with the Vegetation sensor on board. VITO was asked to process the images, and makes them available to the end users worldwide to this day. It was the beginning of a unique story.

On 24 March 1998, the Spot 4 satellite was launched from French Guyana, with the Vegetation camera sensor on board; it was an important day not only for European space travel, but also for VITO. The mission was the result of a cooperation between the European Commission, France, Belgium, Italy and Sweden. It marked the beginning of an ambitious project to monitor the surface and vegetation of our planet, and the mission continues to this day. The cameras on board the Spot satellites (the Spot 4 was the first, but not the only one) take images of the entire land mass on a daily basis. Twenty years ago, the resolution of the images was 1 kilometre, and it has since then been improved to sometimes less than 100 metres. But the images not only excel in terms of frequency and quality, the processing speed is also unprecedented: end-users can access the images within 24 hours.

From CTAP to Remote Sensing

VITO and the (then) newly established Centre for Remote Sensing and Atmospheric Processes (CTAP) were tasked with the image processing – this team was later renamed VITO Remote Sensing. The department initially consisted of a small but motivated team of image processing experts. A number of them were sent to Toulouse – the Mecca of the French air and space industry – where they worked together with French experts to develop the first image processing software and the archiving platform for the Vegetation camera.

"The Spot Vegetation mission was in response to the growing need in the 1990s to monitor CO_2 emissions and the uptake of greenhouse gases by the world's vegetation," explains Dirk Van Speybroeck, one of the pioneers of VITO Remote Sensing and now a strategic adviser to the department. "The UN conferences of Stockholm and Rio de Janeiro (in 1972 and 1992 respectively, ed.) put environmental protection and the climate on the political agenda. Europe soon realised that such protection would not be possible without high-quality, long-term monitoring from space."

The Vegetation campaign was a great success and ran until 2013. During the 15 years of missions, the Spot-4 and Spot-5 satellites provided scientists with enormous quantities of detailed and objective data. And its succession is ensured by the Sentinel satellites, half of which are already in orbit; the Sentinels are part of Copernicus, the EU's Earth observation programme. Ambitions have only grown over the past twenty years: dozens of other (European) observation satellites have been launched, while the level of technology has increased. Van Speybroeck, who was involved in the early years from the outset, illustrates this with an anecdote: "We had an open data policy for the Vegetation images from the start. I still remember we had made a harmonised image bank of the entire land mass for the 2000 reference year. We sent it to thirty different research teams all over the world, which was no easy task back then. We had to burn the images to DVDs and send them by conventional post. These days, our images are available through web services and virtual laboratories through specialized cloud services"

PROBA-V

VITO Remote Sensing also played an important role in the PROBA-V mission, the Belgian satellite that has been orbiting the Earth since 2013. It is the successor to Spot-4 and Spot-5, but with an increased resolution. "PROBA-V is what we call a gap filler," says Van Speybroeck. "Thanks to this microsatellite (it is no larger than a washing machine and therefore relatively cheap, ed.), we have been able to continue the global monitoring of vegetation without interruption. That's important, because it would otherwise be difficult for scientists to perform reliable analyses and time series. We expect PROBA-V to remain in space for another year."

VITO Remote Sensing also provides data to the Flanders Information Agency, which among other things manages the website geopunt.be, the central gateway for geographical public information. The data include images with an exceptionally high resolution, sometimes as much as 10 to 20 centimetres.

These data, managed by the Flemish government, can form the basis for a range of applications, such as a type of 'Google Street View' for Flanders, or the well-known Flanders 'The 'Solar Potential Map' (Zonnekaart). It's an online tool that calculates the solar potential of any rooftop in Flanders. Citizens can easily check whether it's possible and worth the investment of installing solar panels or boilers.

The imminent end of the PROBA-V mission does not mean that the, currently 95, employees in the VITO Remote Sensing department will soon be out of work. "On the contrary – our image processing expertise is now also being applied in many other fields. For example, we are contracted by the European Commission to supply global biogeophysical products (within the Copernicus Global Land Service), and we produce long-term time series for climate research (within the Copernicus Climate Change Service). It means our research and knowledge have resulted in operational information products." adds Van Speybroeck.

Precision agriculture

The extension of satellite image processing to aircraft, drone and mobile images corresponds seamlessly to the shift made by VITO Remote Sensing in past years: from primarily providing a service to authorities and academic institutions to a more client-orientated, open and international business model which also specifically examines the needs of commercial and industrial players.

One example is the development of user-friendly remote sensing tools, which companies in Flanders (and beyond) can use to optimise their production. One sector that particularly benefits from remote sensing is agriculture. Images from space (satellites) and from the air (aircraft and drones) enable farmers to practise precision agriculture. Last year, for example, VITO launched WatchITgrow, an online platform for the Belgian potato sector, which allows farms to combine different types of data (weather forecasts, soil measurements, harvest simulations, etc.) in order to increase their yields. MapEO is a similar tool that was also developed by VITO and also launched in 2017. MapEO is an end-to-end image processing tool which combines world class image analytics and easy to use drone technology to collect data and get an objective view of your breeding lines and plant characteristics.

VITO's agricultural applications are also being used on a global scale. For example, a warning system known as ASIS was developed on behalf of the United Nations' Food and Agriculture Organisation (FAO), which uses satellite images to very quickly detect drought and other forms of crop stress, allowing to predict at an early stage where harvests are likely to fail.

Support from Belspo

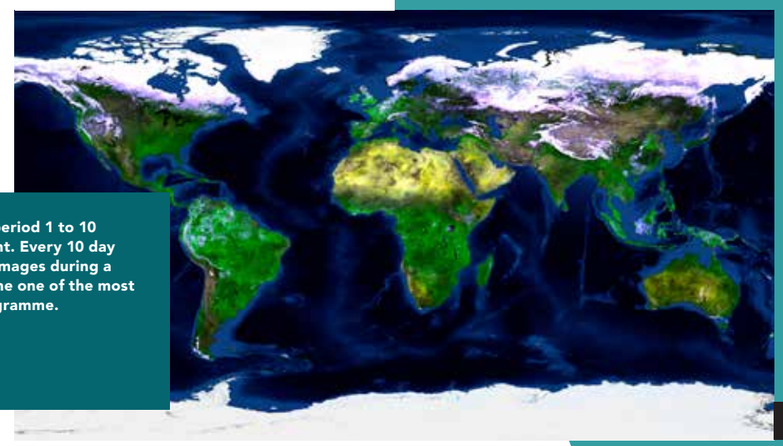
It is not just farms and businesses that can benefit from VITO Remote Sensing's services; individual citizens can do so too, free of charge. Terrascope, for example, provides all members of the public in Belgium with a user-friendly platform for accessing satellite data and derived information. It was developed with the support of Belspo, the Belgian Science Policy Office, which has been promoting research in the development of Earth observation applications for many years. Steven Krekels, Unit Manager of VITO Remote Sensing, endorses this: "Over the years, Belspo has supported us in different ways. Thanks to this continued support we have been able to develop our skills in remote sensing and have become a recognized European player making a difference in the world."

Frank De Winne (one of the two Belgian astronauts):

"Organisations such as VITO convert satellites' raw big data into products and services that are useful for policy makers, scientists and end-users alike. The latter could be businesses or even individual citizens."

Looking back on the past twenty years, VITO Remote Sensing has seen a unique course of development. "When we started back in 1998, we mainly had technical expertise in the field of satellite image processing. Since then, we have evolved into a provider of a wide range of remote sensing applications, which include observation by unmanned planes and drones, as well as the development of innovative products and services related to big data," notes Krekels.

More information
steven.krekels@vito.be
dirk.van.speybroeck@vito.be
terrascope.be
geopunt.be



The very first 10 day world synthesis for the period 1 to 10 April 1998 of the Spot 4-Vegetation instrument. Every 10 day synthesis is calculated based on all recorded images during a period of 10 days. The 10 day synthesis became one of the most popular products of the Spot-Vegetation programme.

The technology festival SuperNova was organised in Antwerp from 27 until 30 September 2018. This four-day event was a meeting place for entrepreneurs, companies, investors, researchers, creative minds and the general public. Visitors were able to discover innovative technologies under the flag of Tomorrow is unstoppable, Embrace the future.

In the VITO Sustainability pavilion our view on the future and the technology and innovation of tomorrow was shown. Science communicator Lieven Scheire brought a show about the VITO topics with a comic twist. Lieven also entertained the launch event of Cleantech Flanders. Hereby a photo coverage.

During SuperNova the results of "Curieuzeneuzen", the wide scale citizen science project about air quality in Flanders, were presented.

REPAIRING PRODUCTS

ECONOMIC IMPACT ANALYSIS FROM A CONSUMER PERSPECTIVE

WHAT TO DO WHEN YOUR VACUUM CLEANER BREAKS DOWN?

REPAIR OR REPLACE?

REPAIR!

VITO and **KU LEUVEN** investigated the economical feasibility of four different repair strategies in a project for the **Benelux Union.**

For each consumer strategy, the total monetary costs related to the purchase, use, repair and disposal of the appliance is modeled. This is called the Life Cycle Cost or LCC.

Comparing the LCC's for the different scenario's shows that all three repair scenario's are favourable compared to the replace scenario.

THREE REPAIR & ONE REPLACE SCENARIO

1 buy additional warranty & repair minor failures

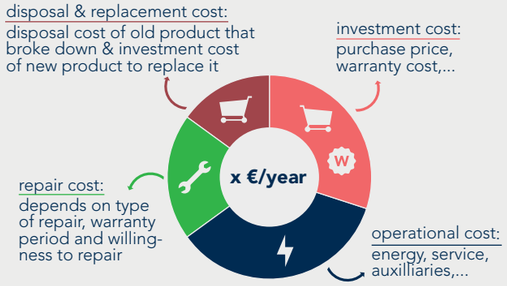
2 buy additional warranty & repair all failures

3 repair all failures without additional warranty

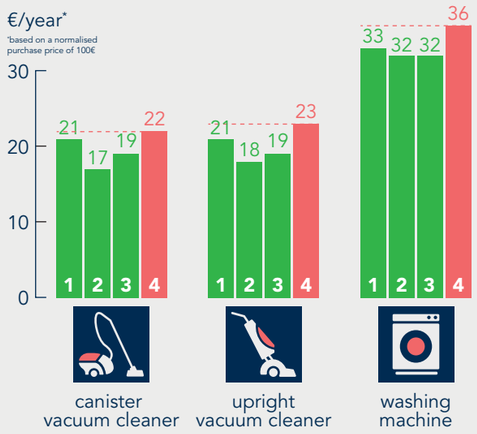
4 replace whole product without repair

MODELING THE AVERAGE COST FOR ALL SCENARIOS & THREE PRODUCT TYPES

For each of the repair strategies, the average Life Cycle Cost (LCC) was modeled. The LCC is expressed in €/year indicating the total cost of owning and using a product in a certain reference period.



REPAIR OR REPLACE? REPAIR IS CHEAPER!



FULL REPORT AVAILABLE AT

http://www.benelux.int/files/7915/2896/0920/FINAL_Report_Benelux.pdf

PROJECT COMMISSIONED BY BENELUX UNION

http://www.benelux.int

PROJECT PARTNERS

More information
yoko.dams@vito.be

VITO EMPLOYEE IN THE SPOTLIGHT

Sindy Sterckx works as a researcher in the Remote Sensing department. She calibrates camera sensors and processes images generated from space and from the air, including from the Belgian 'microsatellite' PROBA-V, balancing the technical side of her work with providing service to end-users. "I am familiar with both the algorithms behind the image processing and the various applications of remote sensing, such as monitoring vegetation or mapping water quality.

You have been working at VITO since 2002. A substantial part of your career coincides with the PROBA-V mission.
That's right. We have been working with PROBA-V for over eight years now. The satellite was launched in May 2013, but in the years before that, we were involved in planning and preparing the mission. PROBA-V is an earth observation satellite that takes images of the entire land mass of our planet every day. The images are used for example to monitor the development of the Earth's vegetation. What is crucial here is that we continuously calibrate the camera sensors, so we can be certain that the images are stable and that there is no degradation. This is because we need to be absolutely certain that any differences we notice in the images are actually due to changes in the vegetation (as a result of global warming, for example, ed.). During a radiometric calibration of this kind, we briefly point the satellite at the moon or at the oceans, and then apply correction factors if necessary. To do this, we send commands to the control station in Redu where the satellite is constantly monitored. In addition to the calibration, I am also involved in processing the images so our end-users have access to correct and usable data. I also do this for other satellites and remote sensing applications.

The number of satellites orbiting the Earth is growing exponentially. How do you make sure that from all this data the correct information is gathered?
Correct! It is indeed a challenge to deduct the information you need from the huge amount of data. Therefore it is crucial that the data collected from different satellites are harmonized (we make the data "consistent"), so that we maximize the outcome from a combination of satellites. In addition, we can combine satellite data with data from airplanes/drones. We develop specific algorithms or use techniques like artificial intelligence. We provide all this information on online platforms for use in the agricultural sector for example.

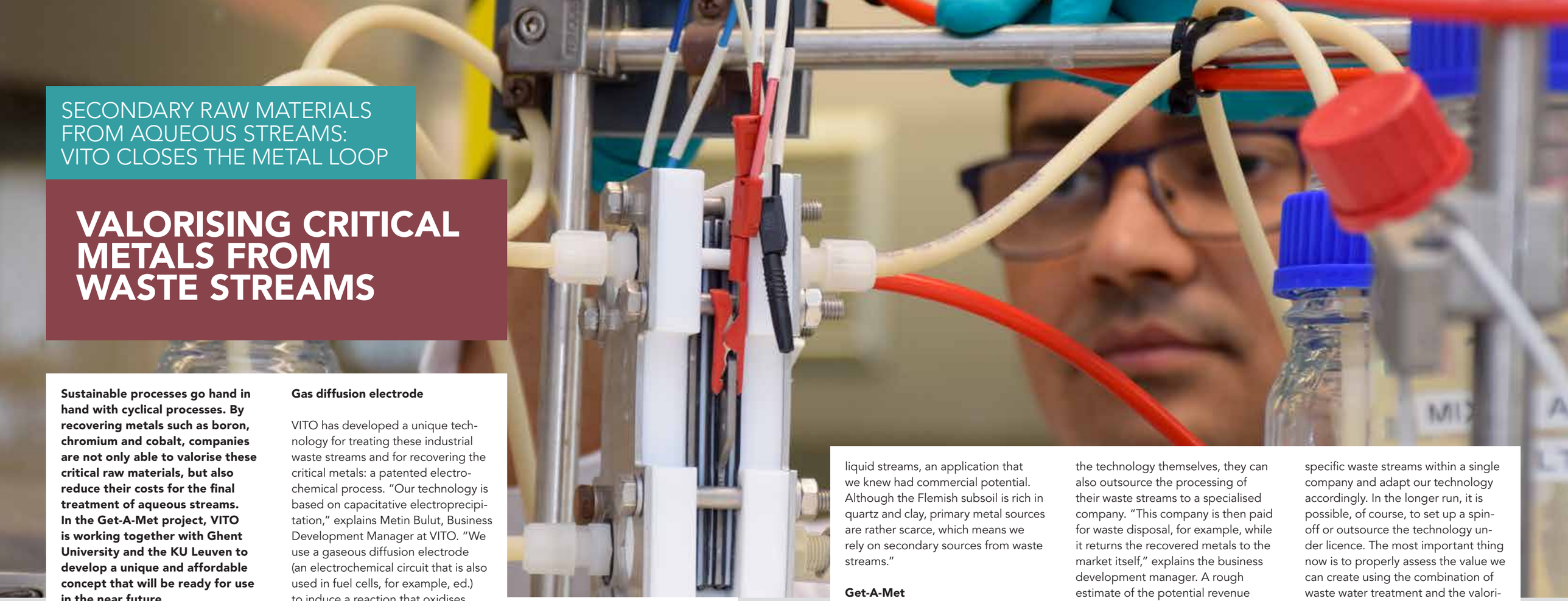
After graduating as a bioengineer at KU Leuven, you spent two years working on an academic project on remote sensing. How do you think that differs from your job at VITO?
University research is always done at quite a fundamental level. At VITO, we focus more on the usability of the results and how they can be valorised – possibly by external partners. What's more, we have more and better facilities than a university. Staff turnover is also lower, which helps if you are used to working in a team.

You also sit on a panel of the European Space Science Committee (ESSC). What does that involve exactly?
The ESSC is an independent body that advises on the various space programmes and missions of among others the ESA and the European Commission. I am part of the Earth Sciences Panel along with five other scientists, and we focus on Earth observation. At the six-monthly meetings, we ensure that there is sufficient scientific and research basis in the space programmes.

More information
sindy.sterckx@vito.be

SECONDARY RAW MATERIALS FROM AQUEOUS STREAMS: VITO CLOSES THE METAL LOOP

VALORISING CRITICAL METALS FROM WASTE STREAMS



Sustainable processes go hand in hand with cyclical processes. By recovering metals such as boron, chromium and cobalt, companies are not only able to valorise these critical raw materials, but also reduce their costs for the final treatment of aqueous streams. In the Get-A-Met project, VITO is working together with Ghent University and the KU Leuven to develop a unique and affordable concept that will be ready for use in the near future.

Companies in the metallurgical industry often generate large volumes of liquid waste. They usually process that aqueous waste, or have this done by another party, but the costs of that processing can mount up. For this reason, large metal companies are keen to find a way of closing the loop.

But reducing the costs of processing the aqueous waste streams is not the only incentive to close the loop. In most cases, while waste streams contain various metals in low concentrations, their total mass is not insignificant given the large volumes. Some metals are even critical, meaning they are scarce and therefore expensive, and need to be imported from outside the European Union. If metal companies are able to recover these critical metals from their waste streams, they will be able to kill two birds with one stone.

Gas diffusion electrode

VITO has developed a unique technology for treating these industrial waste streams and for recovering the critical metals: a patented electrochemical process. "Our technology is based on capacitative electroprecipitation," explains Metin Bulut, Business Development Manager at VITO. "We use a gaseous diffusion electrode (an electrochemical circuit that is also used in fuel cells, for example, ed.) to induce a reaction that oxidises the metals and then results in their precipitation. The cathode and anode are also made of carbon in the form of a very fine matrix, and this enables us to adapt the structure easily, allowing a wide range of metals to be recovered." A selection from that range, by increasing atomic number, includes boron and magnesium, chromium and manganese, and cobalt and copper.

The carbon matrix in the cathode is partly hydrophobic (water-repelling) and hydrophilic (water-attracting). One side of it is also coated with a Teflon layer, which only allows air particles to pass through and therefore keeps the matrix separate from the liquid medium. "Normally, a reduction reaction takes place at the cathode," continues Bulut, "but in our set-up the cathode oxidises the metal ions. This causes the metals to cluster and precipitate as sediment, which we can separate."

Nanocrystals

The technology was developed as part of VITO's research into sustainable chemistry. It was originally intended to facilitate the production of what we call nanocrystals – minuscule crystals composed of just a hundred atoms – that have extraordinary properties precisely because they are so small (for example, they emit light whose colour depends on their own size).

Critical metals are usually what we refer to as rare earth metals, which are incorporated in all kinds of electronic equipment and which can be recovered and reused from E-waste through the practice of urban mining. VITO's technology, however, focuses on liquid industrial waste streams, where the metals are rather present in low concentrations. "During our research into nanocrystals, we discovered that we could also use our technology to extract metals from liquid streams, an application that we knew had commercial potential. Although the Flemish subsoil is rich in quartz and clay, primary metal sources are rather scarce, which means we rely on secondary sources from waste streams."

Get-A-Met

Until very recently, there was no way of efficiently extracting metals from a liquid medium in such small concentrations, and in such a way that the metals could also be reused, and therefore valorised. In the Get-A-Met project, which is being supported by the Strategic Initiative Materials (by VLAIO) and which involves KU Leuven and Ghent University, even a provisional business model has already been developed. This shows that the technology has a good chance of being used in the metal industry. This is due to the technology's many strengths: it is flexible (it can be used for different metals), efficient (over 99 percent of the metal fraction is recovered!) and relatively cheap (around forty euro cents per m^3 of waste water).

The business model shows that the recovery and valorisation can be organised in different ways. While metal companies can, of course, acquire the technology themselves, they can also outsource the processing of their waste streams to a specialised company. "This company is then paid for waste disposal, for example, while it returns the recovered metals to the market itself," explains the business development manager. A rough estimate of the potential revenue from the valorisation was also already developed in the model: around two million euros - and this being within the consortium of stakeholders behind Get-A-Met. "If we are able to roll out the technology throughout Flanders, we will achieve gross revenue of ten million euros. Besides, this does not even take into account the savings that were made as a result of lower water treatment costs.

Open to collaboration

Over the next two years (the Get A Met project runs from 2016 until 2020), we will be investigating how the technology can be scaled up to greater processing capacity, and then commercialised. "We possess the technology and the know-how together with KU Leuven and Ghent University," says Bulut, "and as always, we are open to collaboration with commercial partners, whether or not in the form of contract research. For example, we could investigate specific waste streams within a single company and adapt our technology accordingly. In the longer run, it is possible, of course, to set up a spin-off or outsource the technology under licence. The most important thing now is to properly assess the value we can create using the combination of waste water treatment and the valorisation of critical metals. We want to know to which extent closing critical metal loops in a range of industries will deliver an economic benefit."

More information
metin.bulut@vito.be

CHINESE POLICY MAKERS ATTEND SUMMER COURSE IN MOL

CHINA VALUES VITO'S EXTENSIVE EXPERIENCE IN AIR QUALITY

In its battle against air pollution the Chinese government is increasingly taking its examples from the European Union, which has put in place an integrated policy package and mandatory limit and threshold values for air pollutants. Chinese policy makers and advisers have a keen interest in how the top-down European policies are translated into specific measures at a regional level, like in Flanders. This summer a delegation from Beijing attended an intensive training course at VITO.

VVITO has extensive and wide-ranging expertise about air quality. For many years now, it has been providing its knowledge and technologies to Flemish, Belgian and also foreign policy makers, who apply them to develop and implement measures to combat air pollution. This is also a reason why some policy makers choose VITO for training course for their staff.

Its reputation as a "training centre" has spread wide and far, even beyond European borders. And so, VITO had the honour of hosting a delegation from the Chinese Ministry of Ecology and Environment over the last week of June and the first week of July 2018. The twelve delegates consisted of civil servants and advisers wishing to update their knowledge on the process underpinning the development of policy measures to combat air pollution and specifically the implementation of overall regulations (such as European Directives) at national, regional and local authority level.

Face masks and air purifiers

To say China struggles with poor air quality would be an understatement. A few years ago, it was difficult to step outside without a face mask in major cities such as Beijing when heavy pollution episodes occurred. Most urban citizens would also have an air purifier in their living rooms or bedrooms. Even so, there have been significant changes in recent years. One example is last winter, when the residents of Beijing were able to enjoy blue, smog-free sky in a long time, although this was admittedly in part due to the sustained due to the favourable weather conditions. cold temperatures. Official measurements nevertheless indicate a sharp drop in a range of pollutants, including particulates. It therefore seems that this vast country is making great efforts to improve air quality.

However, there is a lot more work required. 'In practical terms, China only began to tackle this enormous problem in the past decade,' says VITO's Lisa Blyth. 'Over the past years we have seen local authorities in some of the most polluted regions taking action, mostly by tackling coal-fired power stations and other main sources of pollution. These actions are linked to a national ambition to reduce concentration levels of particulate matter (specifically PM2.5). This is a start, but of course the approach needs to be significantly widened to include other sources of pollution and other regions.'

A firm foothold in China

VITO has had a firm foothold in China since 2010. It operates through its subsidiary LiboVITO, a company which (primarily) implements air quality modelling systems that support local authorities in predicting pollution episodes so that they can warn their citizens and understand were the pollution is originating from. Blyth states: 'For many years now, through LiboVITO, we have been offering our expertise, as well as software and computer models developed in Flanders'.

Naturally, the Chinese civil servants and advisers who came to visit VITO at the start of the summer already had a good background in effective policies for improving air quality. Their main interest therefore lay in the methods of rolling out such policies on different political and geographical levels. Blyth illustrates: 'What are the appropriate measures at each level? How are European limit and threshold values translated into Flemish policies? How do each of the stakeholders (the European Union, its Member States, cities and citizens) contribute to the implementation of the policies? And how does the European Commission promote effective implementation? Aspects like these interest the Chinese very much.'

National and regional authorities

VITO had previously organised similar training courses to delegates from Chinese regional authorities, specifically Jinan, Tianjin and Hebei province. The latest delegates, however, represented the national authorities. Blyth explains: 'The aim of the national government is to give regions powers to tackle air pollution themselves. But to be able to do so, the regions first need access to the appropriate information, such as the sources of pollution. The delegates were very keen to learn how VITO could assist with this.'

The training course was held over two weeks. With mornings focused on explaining policies and legislations, afternoons were spent exploring specific case studies and tools – tools that are part of VITO's core business. Although VITO itself is not directly involved in policy implementation, they provide decision supporting software that is essential in supporting policy makers in managing air pollution. The programme also included two 'field trips' to Brussels – one to visit the Flemish Department for the Environment and the other to meet policy officers from the Directorate-General for Environment at the European Commission.

Expectations met

Lei Yu (雷宇), delegation organizer and adviser at the Chinese Academy for Environmental Planning, noted that the group's expectations were more than fulfilled. 'China is currently working on the second phase of its strategy to tackle air pollution. Together with the Ministry [of Ecology and Environment - ed.] we are focussing on the development of a new policy framework for tackling pollution in specific areas, such as the Beijing, Tianjin and Hebei regions, the Yangtze river delta, and the Fenhe and Weihe river plains. We will collaborate intensively with regional and local executives to this end, so we are not pursuing a top-down approach.'

The VITO training course has provided Yu and his colleagues with greater insights into the mechanisms underpinning European policies and specifically the roll-out of those policies across Member States and different policy levels. 'We now also have a much better understanding of the role played by the various stakeholders, from the European policy makers and national governments to city councils and individual citizens.'

But exactly how comparable are China and Europe where air quality is concerned? 'Europe is at a much more advanced stage', states Blyth. 'There are various major challenges that Europe found solutions to years ago. Examples include sulphur emissions, as well as the smog that used to affect our major cities. In addition to this, strict European regulations have led to a drastic drop in the emission of pollutants in a wide range of sectors. As a result, industry is no longer the largest polluter in European cities, whereas this is still a major issue in China. The Chinese government is aware that it will need to decide on various important aspects in the very short term. What measures should they take? And another, almost equally important, aspect is whether such action should be taken at national, regional or local level. All of this helps to explain the great interest from the Chinese delegations that have previously visited us.'

More information
lisa.blyth@vito.be

VITO/ENERGYVILLE COMPLETES COMPREHENSIVE RESEARCH INTO ENERGY TRANSITION

ON THE WAY TO A **SUSTAINABLE MULTI-ENERGY SYSTEM**

The energy landscape is undergoing major change. The emergence of renewable sources and the trend towards more decentralised energy generation poses significant challenges for our energy grid. EnergyVille has identified these challenges and sought solutions.

Due to the changing and unpredictable (intermittent) nature of energy sources such as wind and solar power, and the transformation of energy consumers into 'prosumers', there will soon be a need for a system that is not only intelligently balanced but also inherently flexible. A system in which electrical and thermal sources are also integrated. Creating that system poses one of the greatest challenges for the coming years and decades.

Three innovative research projects

The final event of the ERDF/SALK project entitled 'Towards a sustainable energy supply in cities' was held at Thor Park in Genk at the end of May 2018. This three-year project, funded by the province of Limburg, the Flemish Government and the EU, examined the current energy issue from the perspective of three innovative lines of research: technologies and materials for better solar cells and batteries (SolSThore), fourth-generation thermal networks and further integration of deep geothermal energy (GeoWatt), and ICT solutions for a smart multi-energy system (SmarThor).

The project combined the expertise of some 200 researchers associated with the universities KU Leuven and UHasselt, and imec and VITO. The results of the three studies were presented at an event in Genk, supported by presentations from leading researchers who shared their vision of the energy transition. After the speeches and presentations, attendees had the opportunity to visit the EnergyVille labs, where the four project partners demonstrated their research work in the field of sustainable energy.

"The impact of renewable sources on our energy supply has grown massively over the last ten years," remarks Ronnie Belmans, CEO of EnergyVille. "Prices have dropped significantly, while efficiency has increased. At the same time, electricity generation is increasingly shifting from a centralised model with large power plants to a decentralised scenario based on local sources and flows. What's more, we are seeing how making thermal energy production more eco-friendly is becoming more important, not just for heating purposes but also for cooling."

A harmonious and sustainable multi-energy system

The EnergyVille researchers focused on the individual technologies within the research projects, as well as on combining and integrating them in a harmonious, sustainable 'multi-energy system'. "Instead of specialising in several technological innovations, we decided on a system-based approach focusing on the interaction between the various technologies," says Belmans. That approach required the EnergyVille researchers to work together closely and, consequently, step beyond the boundaries of their own familiar area of expertise.

WHAT HAS BEEN THE SPECIFIC OUTCOME OF THE PROJECT? WHAT ACHIEVEMENTS HAVE BEEN MADE? AND WHAT NEW INSIGHTS HAVE BEEN GAINED?

1. SOLSTHORE

It has been said many times that solar panels only generate electricity when the sun shines, and that this is often not the case in our region. But the observation is true, of course. For this reason, SolSThore investigated new, more efficient types of solar cells, as well as the latest generation of battery technologies.

This project focused not only on improving the efficiency of solar modules and reducing electricity losses (such as with local DC grids, which reduced the number of inverters required), but also on the esthetic element. After all, the smart city, powered largely by locally generated solar power, is glinting on the horizon. The EnergyVille researchers therefore developed photovoltaic cells that can be integrated into the roof (i.e. not just in the panels lying on it), the external walls and even the windows. Building components therefore become electrical sources at the same time, plus it provides architects with an additional opportunity for embellishing houses and buildings.

Solar panels generally generate the most during hours in which the average Flemish household's electricity consumption is low. It is therefore extremely important that this energy is stored for use during times of peak demand. The SolSThore project examined electrochemical storage in the form of improved solid electrolytes. Researchers also continued to work on management systems for (home) batteries.

2. GEOWATT

Sustainable heating and cooling will continue to play a key role in the energy system of the city (or urban environment) of the future. Densely built environments are ideal for running heat networks, both for higher temperatures (such as deep geothermal energy) and for low temperatures (residual and solar heat, shallow geothermal energy).

The successful roll-out of heat networks depends on whether they can guarantee that users' (heat) requirements and comfort are provided for at any time of day. A heat network must therefore be inherently flexible and permit local additional heating. Fourth-generation thermal networks, as they are known, can meet this need, but the technologies to do this in a cost-effective and energy-efficient way are still in their infancy. Functions such as network control, automatic fault detection (in order to quickly detect losses) and thermal storage are also essential in ensuring successful integration into the district heating system.

In the case of deep geothermal energy, the temperature of the available heat is high enough to feed a heat grid and supply a limited amount of electricity at the same time. The GeoWatt project served to develop cost-efficiency methods for both exploring the deep subsoil and dimensioning and controlling geothermal systems.

Finally, EnergyVille developed a number of concept studies for the Genk region to serve as practical examples of fourth generation networks. In addition to industrial residual heat, geothermal energy and surface water, the unique value of the flooded Limburg coal mines was also evaluated as a potential source.

3. SMARTHOR

In tomorrow's (multi-)energy system, energy will be supplied as a service rather than as a product. When today's consumers opt for a gas boiler or pellet boiler, or a heat pump, they will make themselves dependent on the stock of gas, pellets or electricity in the years to come. In the future, energy demand (heating, cooling, electricity, etc.) will be disconnected from the energy source used (gas, solar energy, etc.). Consumers will be supplied with energy as a service based on their needs in terms of comfort, costs, and so forth. The provider of the 'energy service' then decides how this energy is generated, depending on its cost-effectiveness for that location at that time.

In order to enable these services to be developed within an energy system in which electricity, heat and cold are traded, an enormous amount of information from a wide range of data sources must be combined into a communal platform – the 'brain', so to speak, of the smart multi-energy system. Data from local sources (such as smart thermostats and energy meters) are combined with data from forecasts (e.g. weather forecasts for wind and solar farms) and from energy markets where gas, power and other energy forms are traded. The technological and economic aspects of this platform were investigated in SmarThor, and the EnergyVille researchers built an ICT platform that enabled them to monitor, optimise and control the energy consumption in their own laboratories and buildings. Further simulations also showed that a multi-energy market model can reduce the costs of energy generation and distribution for society - a consequence of more effective coordination with production of renewable energy.

More information
SolSThore jef.poortmans@energyville.be
GeoWatt carlo.mol@energyville.be
SmarThor wim.cardinaels@energyville.be

Europese Unie
Europees Fonds voor Regionale Ontwikkeling
AGENTSCHAP INNOVEREN & ONDERNEMEN
EFRO EUROPEES FONDS VOOR REGIONALE ONTWIKKELING
provincie Limburg met steun van limburg.be
EnergyVille

G-STIC INTERNATIONAL CONFERENCE

BRUSSELS, 28 TO 30 NOVEMBER 2018

BRIDGING THE GAP BETWEEN TECHNOLOGY AND POLICY

Workable technological solutions are needed in order to achieve the United Nations' Sustainable Development Goals (SDGs). Ideally, they should be easy to scale up, while addressing multiple challenges simultaneously using the same solution. Following the successful first edition of 2017, the steadily increasing community of policy makers, scientists and technology developers will again be attending the G-STIC international conference in Brussels from 28 to 30 November 2018.

"The second edition of G-STIC (Global Sustainable Technology and Innovation Conference, ed.) hasn't even taken place yet," says Robby Berloznik of VITO, "and yet our concept already chimes with everyone involved with the SDGs. We notice this especially at fora focusing on the STI (Science, Technology & Innovation) policy of the United Nations, such as in the headquarters in New York and Geneva. You could say that G-STIC has acquired a dynamic of its own."

Specifically, the concept behind G-STIC is to provide an opportunity for an independent (read non-governmental) group of multi-stakeholders to think creatively about how technological solutions can contribute towards the realisation of the SDGs: solutions that are not only workable in the short term, but can also be scaled up easily in an integrated way (they address multiple challenges simultaneously). The integrated nature of specific solutions is also reflected in the scheduling of the forthcoming edition of G-STIC. "The people and organisations involved with the SDGs – our ecosystem, so to speak – can be divided into many separate communities and events focusing on a particular issue such as energy and water," explains Berloznik. "With our overarching approach, we are attempting to bring a highly heterogeneous group together, focusing on technology and sustainable development, and obviously the link with policy."

The second day (Tuesday 29 November 2018) will zoom in on integrated technological solutions in a series of parallel sessions. The seven themes for this year will be education, health, geospatial data (all three are new this year), energy, water, agro-ecology and finally the circular economy. What new things can attendees expect who also came to the previous, and very first edition, of G-STIC? "We want to focus even more closely on tangible and workable solutions, and on the urgency of some issues," replies Berloznik. "We also want to emphasise the link with policy. For this reason, the chairs of the theme-based sessions will be making a number of specific recommendations that policy makers can put into action immediately."

It already seems to be a given that the forthcoming edition of G-STIC will be followed by many more. As an organising co-host, VITO was able to bring on board research institutions from South America (Fiocruz from Brazil), Asia (TERI and IITD from India) and Africa (ACTS from Kenya), now making a total of five co-hosts. Negotiations are also ongoing with potential co-hosts from China and Nigeria.

More information
www.gstic.org
dietrich.vanderweken@vito.be
robby.berloznik@vito.be

African Centre for Technology Studies

FIOCRUZ