

# VISION

Vision on technology for a better world



## VITO/ENERGYVILLE BATTERY TECHNOLOGY SUPPORTS VICTORY OF BELGIAN SOLAR CAR IN CHILE

INDIA AND EUROPE WORKING TOGETHER FOR A **CLEAN GANGES**

**ALGAE** ARE FULL OF **USEFUL COMPONENTS**

**GHENT OPTS FOR A CIRCULAR URBAN ECONOMY**





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Dear reader,

The historic victory of the Solar Team from Leuven in the solar car race in Chile has once again shown it: the transition to a sustainable society and economy requires not only targeted policy actions, but also the development of new and improved technology. In this issue you can read how VITO/EnergyVille supported the Belgian solar car to victory with its innovative battery management system.

But not only must policy and technology be re-discussed, the two also have to be harmoniously coordinated. This was also the key message at the second edition of the international conference G-STIC, organised by VITO, which took place in Brussels at the end of November 2018 – you can read all about it from page 6. At this conference, a broad group of multi-stakeholders thinks creatively about how technological solutions can contribute to the realisation of the sustainability goals of the United Nations, the renowned SDGs. Some important topics that were raised: energy-positive communities, recovery of waste water and, of course, circular economy.





Other articles in this issue are closely related to this latter theme. You will discover how VITO, through a unique and original approach, is helping the Ghent city region to encourage the reuse of plastic and construction waste. And you will learn more about the role of Vlakwa within the Clean Ganga Europe Desk, an initiative to help clean up the Ganges – one of the world’s most polluted rivers. We do this (among other things) by sharing our innovative technology for purification and reuse of waste water with stakeholders in India.

Together we are moving towards a sustainable society. Enjoy reading this issue of VITO VISION!

**Dirk Fransaer**  
Managing Director of VITO



COLOPHON

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# INNOVATIVE BATTERY TECHNOLOGY PROPELS BELGIAN SOLAR CAR TO GOLD

## COVER STORY

**On Sunday, 26 October 2018, Punch 2, the solar car single-handedly built by students of KU Leuven, was the first to cross the finish line in Arica, in the north of Chile. The victory is partly thanks to the battery technology of VITO/EnergyVille.**

The Carrera Solar Atacama is described as the most extreme solar car race. The 2,600 km long track runs right through the bone-dry Atacama Desert, in the north of Chile, and through the Andes mountain range. “The big differences in altitude (from sea level to peaks of 3,400 metres high) and the high levels of solar radiation made this race an ultimate test for our Punch 2”, says Sam Vanherbergen, engineering student at KU Leuven and responsible for the electric drive of the solar car within the Punch Powertrain Solar Team.

The Punch 2, which left all the opposition behind in Chile, is already the seventh solar car designed and built by students of Leuven University. Every year students form a new team that draws lessons from previous races to further improve solar car technology. “The knowledge that we have acquired so far is already being applied into a new car. We want to compete for the world title in Australia in October 2019.”

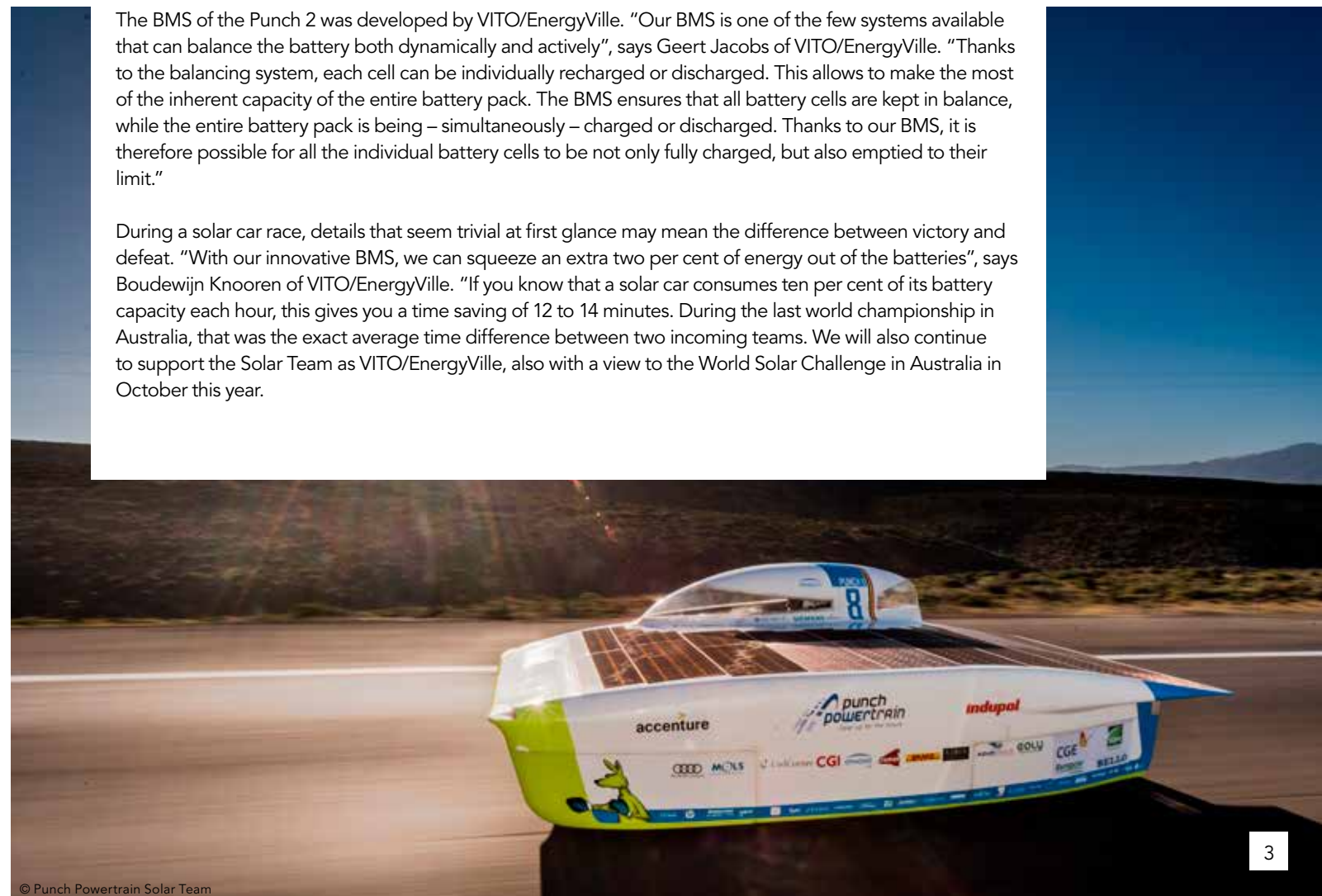
A solar car generates electricity via photovoltaic cells. This power does not only drive the electromotor, but it is also stored in the on-board batteries – so that the car does not come to a standstill in the absence of sunlight. A reliable battery management system (BMS) is indispensable here. “The electrical system monitors and protects the battery so that it doesn’t break down under extreme conditions”, says Vanherbergen. In addition, the BMS indicates, accurately and in real time, how much energy is left in the batteries.”

The BMS of the Punch 2 was developed by VITO/EnergyVille. “Our BMS is one of the few systems available that can balance the battery both dynamically and actively”, says Geert Jacobs of VITO/EnergyVille. “Thanks to the balancing system, each cell can be individually recharged or discharged. This allows to make the most of the inherent capacity of the entire battery pack. The BMS ensures that all battery cells are kept in balance, while the entire battery pack is being – simultaneously – charged or discharged. Thanks to our BMS, it is therefore possible for all the individual battery cells to be not only fully charged, but also emptied to their limit.”

During a solar car race, details that seem trivial at first glance may mean the difference between victory and defeat. “With our innovative BMS, we can squeeze an extra two per cent of energy out of the batteries”, says Boudewijn Knooren of VITO/EnergyVille. “If you know that a solar car consumes ten per cent of its battery capacity each hour, this gives you a time saving of 12 to 14 minutes. During the last world championship in Australia, that was the exact average time difference between two incoming teams. We will also continue to support the Solar Team as VITO/EnergyVille, also with a view to the World Solar Challenge in Australia in October this year.



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© Punch Powertrain Solar Team



WHAT WOULD OUR LIFE LOOK  
LIKE WITHOUT SCIENCE?

## DAY OF SCIENCE 2018

It sounds logic, but we rarely take time to think about it: a life without science is hard to imagine. On the 'Day of Science' on Sunday 25th November 2018 science lovers spread over 97 locations in Flanders and Brussels were ready to convince everybody about the fact that science is crucial in our life and in our society, with special attention for new technologies that are already being used today. Visitors could also visit VITO in Mol to discover our innovative themes and science communicator Lieven Scheire talked in 4 shows about the VITO technologies with a comic twist. Hereby a photo coverage.





# ACCELERATING TECHNOLOGICAL INNOVATION FOR THE SDGS

In 2015, the international community adopted the Paris Agreement on Climate Change and the 2030 Agenda for Sustainable Development, setting clear goals to shift the world onto a sustainable development path. Technological innovation offers excellent opportunities to realise that kind of shift, provided solutions can be deployed on a sufficiently large scale. That in turn requires policy and decision makers to be aware of the technological solutions that exist and recognise their potential to contribute to achieving the Sustainable Development Goals. At G-STIC 2018, over 1,300 experts met to discuss what needs to be done to make that happen.

Catastrophic wildfires destroyed more than 100,000 hectares of land across the state of California. Super typhoons flooded the Philippines and Southern China, urging the evacuation of more than three million people. Torrential downpours in southwestern Japan caused flooding and mudslides, destroying buildings and leaving thousands helpless and displaced. The impact of climate change on people's lives has never been more profound. This rapid succession of climate disasters around the globe is telling us that we urgently need to do much more to keep global temperature rise well below the 2 degrees Celsius outlined in the Paris Agreement. We need to do much more to achieve the ambitious Sustainable Development Goals (SDGs) of the 2030 Agenda. We need to do much more to eradicate poverty, eliminate hunger, provide energy services to all and work towards a world where it is good for all to live.

## Strengthening innovation efforts

Technological innovation offers excellent opportunities to do that, transforming current production and consumption processes and realising

a worldwide change that improves well-being and prosperity for all. But for this to happen, our efforts toward technological innovation need to be strengthened. That's precisely what G-STIC is all about. G-STIC is a series of Global Sustainable Technology & Innovation Conferences, co-hosted by VITO and its international partners ACTS, FIOCRUZ, IITD and TERI. G-STIC aims to catalyse the process of better utilising technological innovation to achieve the SDGs by 2030 and guide the world towards a better future, leaving no one behind.

## Integrated technological solutions

Over 1,300 participants from more than 90 countries joined G-STIC 2018 in Brussels from 28 to 30 November to review, discuss and identify technological innovations that can lead the world on a more sustainable development path. G-STIC participants included policymakers, technology researchers, business and industry captains, as well as members of civil society.

One of the unique things about G-STIC is its strong focus on integrated technological solutions that are good for

the planet, for the people and for the economy. Integrated technological solutions not just deal with one sustainable development challenge, but tackle multiple challenges at the same time to achieve significant social and economic benefits.

Local energy systems that generate and deliver renewable energy to cover the living and comfort needs within local communities are a typical example. The positive impact of such energy systems on local communities goes far beyond the delivery of energy services. They also help reduce poverty, increase employment and improve the quality of living through advancements in water supply, sanitation, health, education, and mobility. Besides, increasing the share of local renewable energy sources has a positive impact on global climate targets as well.

## An urgent need for policy action

G-STIC 2018 provided several real-life examples of such solutions (relating to the conference themes of Agroecology & Food, Circular Economy, Education, Energy, Geospatial Data, Health, and (Waste)Water as a Resource), and

gathered them in one forum. Examples include the integration of resource recovery in wastewater treatment facilities to create additional sources of income from the sales of bulk water, bio-energy or fertilisers, and the use of Remote Sensing data to help farmers improve food production or to develop insurance policies against drought and other natural hazards.

These examples confirmed that a lot of the technologies needed to achieve many SDG-related targets are available today. However, many policy and decision makers are not aware of the potential contribution of these technological solutions to achieving the SDGs. Policy action is therefore urgently needed if integrated technological solutions are to be deployed at a sufficiently large scale to make an impact. That's why G-STIC does not just focus on identifying technological solutions that can make a significant contribution to achieving the SDGs. G-STIC 2018 participants also discussed what needs to happen to bring these integrated technological solutions to the market in different regions of the world, and what is needed to make the G-STIC findings most useful for policy setting.

## Concrete recommendations

To translate the conference outcomes into tangible actions, G-STIC 2018 confirmed a strong commitment toward international processes that forward technological innovation for the SDGs. Starting from the real-life examples presented during the G-STIC 2018 thematic sessions and the related discussions on what is needed to bring technological solutions to the market at scale, G-STIC 2018 delivered several examples that can be input to these international processes.

These examples will be further consolidated into concrete recommendations on integrated technological solutions that promise to have a significant impact on the achievement of the SDGs. Complemented by easy-to-use checklists for public and private decision makers, and an identification of barriers to – and policy changes required for – their deployment at scale, these recommendations will help accelerate technological innovation for the SDGs.



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G-STIC 2019: 20-22 November





# INDIA AND EUROPE WORKING TOGETHER FOR A CLEAN GANGES



**The Ganges basin in eastern India is one of the world's most polluted water systems. In 2013, the Indian Prime Minister Narendra Modi launched an ambitious plan to clean up the river – and all its tributaries. India is looking to Europe for both policy and technology. Under the umbrella of the Clean Ganga Europe Desk, VITO and Vlakwa coordinate the efforts of European stakeholders in water management and treatment technology.**

The Clean Ganga Europe Desk is an initiative of VITO and the Indian technology institution IIT Kanpur, and is also supported by the Flanders Knowledge Center Water (Vlaams Kenniscentrum Water – Vlakwa). It was launched during the first G-STIC technology conference, in autumn 2017. The 'Desk' is housed in the premises of the WSSTP EU Technology Platform in Brussels, which strives to achieve better coordination and cooperation in

the field of research and innovation in the European water sector. The Desk therefore has easy access to the European Commission.

## Priority within Europe

Although the Clean Ganga Europe Desk has only existed for one and a half years, it has already been able to achieve some positive results. For example, the Desk has elevated the position of the cleaning of the Ganges basin on the priority list of the European Water Partnership, the European forum that coordinates the joint actions concerning the EU and India in the area of water policy. In addition, it organised its very first conference in September 2018, in which the framework of the cooperation between the EU and India in the area of water policy was presented and explained, and stakeholders from Europe and India were brought together. This is an example of VITO/Vlakwa successfully performing their role as a facilitator.

What is the ultimate goal of the project? "The Desk centralises all aspects relating to water management in companies and other institutions in Europe – information about technology, management, government policy, best practices – in order to pass this on to India in a structured and well-coordinated manner", says Paul Campling of VITO. "In addition, this initiative allows us to lower the barriers to cooperation between companies from Europe and India. We are also opening doors to European industry in the field of water management."

## Looking to Europe

The first coordinated plans to address the huge amount of pollution in the Ganges date back to 2013. The Indian Prime Minister Narendra Modi launched an ambitious roadmap that aimed to result in a clean river by 2020. It is clear that this schedule will not be met. "There is still a great deal of work to be done", says Campling. "India

is seeking additional experience and know-how in the area of good water management, particularly regarding the treatment of waste streams. After all, most of the pollution comes from domestic waste water, which simply flows into the rivers, and from industrial waste streams. The good thing however is that people in India know where they can obtain that know-how and expertise. The rivers and watercourses used to be heavily polluted in Europe as well, but, with coordinated actions, we have been able to resolve this."

It is true that, since the middle of the last century, Europe has made impressive progress in this area. Campling: "The aim is for India to make similar progress, partly because Europe and India are very similar in the area of water. They both have a number of large rivers that are also important economic arteries (the Ganges in India, the Danube and the Rhine in Europe). Just like Europe, however, India also works according to the principle of subsidiarity, whereby large, overarching plans prescribed by higher authorities are ultimately implemented by lower authorities."

In addition, India is of course a strongly growing economy, with a huge population of 1.3 billion – a third of whom live on the Indo-Gangetic Plain. As a result, the pressure on the natural and human environment has only increased in recent years.

According to Dirk van der Stede, CEO of Vlakwa, the Clean Ganga Europe Desk must improve access to the European technology and know-how. "Technology and expertise that, moreover, is cost-effective and innovative. This must ultimately lead to a rejuvenation of the Ganges basin, and of everything that lives in and around it. In addition, we keep the dialogue between the European Member States

and the Indian Government alive and strengthen it even further. By doing so, stakeholders on both sides can respond quickly and effectively to new developments and opportunities for companies."

## Pavitra Ganga

The abatement of the water pollution in the Ganges does not happen from an office in Brussels, of course. Concrete actions are needed on the ground, in the form of pilot projects. They can originate from European know-how, but they ultimately have to be adapted to the local Indian situation. One of the projects is the flagship Horizon 2020 project named Pavitra Ganga, which was submitted by VITO.

"In this project, we are focusing on three aspects of modern water management", says Niko D'hont, who is responsible for the communication about this project at VITO/Vlakwa. "Namely on water treatment technology, the recovery of raw materials from waste water, and so-called smart water technology."

Paul Campling coordinates the project for VITO, in which no less than 15 European and Indian partners are working together. Pavitra Ganga consists of two pilot plants, one in New Delhi and one in Kanpur. "One plant demonstrates solutions for an open sewer in a densely built-up city", explains Campling. "The other focuses on the renovation of existing treatment plants. Ultimately, we want our project to create business models that can contribute to sustainable and effective cleaning of the Ganges."



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# FROM MICRO TO MACRO: ALGAE ARE FULL OF USEFUL COMPONENTS

**Algae are an interesting sustainable alternative to chemicals that are still being extracted from oil today. And to natural products that are cultivated or transported in an unsustainable way. For this to be the case, however, the value chain – from algae cultivation through harvesting and processing to storage and application – would have to be successfully scaled up to an economically viable scale. VITO is taking a wide view and focusing on the entire value chain following algae cultivation.**

For years, VITO has been working on (micro)algae with a focus on algae harvesting and further processing and separation of the algal biomass. VITO has even developed its own technology for the harvesting: Membrane Algae Filtration (MAF). This technology forms the core of a continuous harvesting system that is now operational in the Sunbuilt facility, a (pilot)algae growth and harvesting infrastructure operated by VITO together with Thomas More in Geel. The photobioreactor – the algae grow under the influence of light – has a capacity of three thousand litres. That would seem like a lot, were it not for the fact that it is barely enough for three kilograms of concentrated dry algae. The flip side to that coin is that algae grow particularly quickly: under optimum growing conditions, VITO is able to grow over 1 kg of dry algae each week.

## Water recycling and reuse

The MAF technology and the Sun-built reactor are pilot installations. In order to be able to upscale the entire installation, the efficiency and reliability of the individual components and functions must be increased. One of these functions is the recycling and reuse of water (which accounts for 95 per cent of the content of the reactor) and of the salts with which the water is enriched. "With our MAF unit, which is based on our own membrane technology, we filter the algae out of the water and purify the algae to a high concentration", says Leen Bastiaens of VITO. The filtrate (water plus salts) is immediately reusable." The ability to reuse water quickly is indispensable for preserving the chances of the algae cultivation and value chain succeeding. "If you have to pump all the water out of the soil, this would not even be allowed when it comes to a full-scale installation with such large volumes. At least not in Flanders."

The advantage of concentrating the algae biomass is that the investment costs for the further processing do not rise too high, precisely because this can be done with smaller machines. A possible profile of a future algae cultivator is that of an 'algae farmer' who has an empty greenhouse in which microalgae grow inside transparent tubes. The European IDEA project, which looks for optimal conditions for

economically profitable algae cultivation in Northwest Europe (see box), also fits into that picture.

## Tough cell walls

After the algal biomass has been concentrated, the processing takes place. Here too, VITO has the required expertise and equipment to break open the tough cell walls of the microalgae and extract the various components and separate them from one other. "Micro-algae really are full of interesting components", says Bastiaens. "On the one hand, you have molecules that may be able to serve as a sustainable alternative to existing raw materials (such as omega-3 fatty acids, antioxidants, carotenoids, sugars, proteins and fats). On the other hand, there are also substances for which an application is yet to be found. Algae can therefore also give a boost to creative minds in industrial livestock production."

## Broad area of application

Microalgae are very sensitive to changes in the incidence of light and in temperature. If a cultivator is extremely interested in one or more specific components, he can fine tune the environmental conditions so that his algae start to produce those components. A future cultivator could therefore specialise as a raw material supplier with a focus on one or a few specific

applications.

The (potential) applications are extremely diverse. From sustainable and natural dyes for cosmetics (e.g. carotenoids) through food supplements (omega 3) to livestock feed (sugars and, in particular, proteins). The choice of application is strongly dependent on whether or not there is an economic success story in algae cultivation. Bastiaens: Not long ago, algae were seen above all as an alternative to biofuel. This did not make much sense, because that application is characterised by a low price per unit of mass and bulk quantities. For the application as a high-quality alternative to raw materials in cosmetics and nutrition (food supplements), it is exactly the other way around, and this creates a much stronger economic incentive. It is in this way that we want to build up the market".



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## Algae all year round

VITO is the driving force behind the EU-funded IDEA project (Implementation and Development of Economically Viable Algae-based Value Chains). This project looks for ways of being able to cultivate microalgae all year round, like in South Europe. If farmers know that they can harvest all year round, and not only in the sunny months (algae are very sensitive to light), it will be more advantageous to invest in the expensive harvesting technology. Specifically, IDEA is for example investigating which species of algae are the most suitable for the climate in North-West Europe. In addition, VITO is conducting research within IDEA into methods of stimulating every link in the value chain.

## Seaweed farms

VITO's investigation focuses primarily on microalgae. However, the general public is probably more familiar with macroalgae – or seaweed. These algae are also in the picture in order to play an important role in the transition to a more sustainable economy. In the Netherlands, for example, experiments are already being carried out with real seaweed farms, where algae are cultivated on textile mats or on ropes in the North Sea.

Seaweed is particularly rich in carbohydrates and proteins, and the industry is also aware of this (the protein alginate, for example, has already been used in toothpaste for years). VITO is primarily working on the extraction and purification of useful substances from seaweed.



# DRONES MONITORING TURBIDITY DURING DREDGING WORKS

**Dredging companies increasingly have to ensure that they do not increase sedimentary concentrations too drastically with their dredging works. They have to do this in particular when they are working in the vicinity of valuable and vulnerable ecological areas. After having already developed a tool to monitor these sediment values using satellites, VITO is now working on a similar technique based on drones.**

During dredging works, the seabed is excavated (for example to deepen a waterway) or sand is sucked up and then sprayed onto land (in order to build a dike). This can sometimes loosen a large quantity of sediment and cause it to move. This floating sediment makes the (sea)water turbid and can harm vulnerable and ecologically valuable ecosystems, such as coral reefs and mangrove areas – which need sunlight. Excessive sediment values can also cause problems for aquaculture, however. The sediment may contain contaminants that can be absorbed by, for example, oysters and mussels. Moreover, high concentrations of sediment are detrimental to the growth of shellfish.

## Real-time monitoring

In many countries, therefore, standards apply to these sediment values, in terms of both concentration and duration. Dredgers therefore do everything they can to restrict the spread of sediment, but, in order to do so, they have to map them first. They also like to have sediment value data for the purpose of efficient busi-

ness operations. They still generate this data themselves by means of (amongst other things) point measurements and buoys.

“If the standards are exceeded, a dredging company must, in the worst case scenario, suspend works for a certain period of time so that the sediment can sink back to the bottom”, says Els Knaeps of VITO. “Real-time monitoring of the values can help to prevent the standards from being exceeded in this way.”

VITO has previously already developed a software package enabling dredgers to extract the sediment values from satellite images. VITO now wants to extend its services to dredging companies – and to other companies or organisations that operate at sea – with images produced by drones. “They have the significant advantage of also being able to take photos when it is cloudy”, says Knaeps.

## To Texel

In order to refine sediment monitoring via drones even further, a VITO team travelled to the Dutch island of Texel in the Wadden Sea at the end of last year. There, dredging company Jan De Nul Group is reinforcing the coastline at Prins Hendrikpolder. Over a distance of three kilometres, it is constructing a dune that will take on the flood-defence function of the old dike. The Wadden Sea is also one of UNESCO’s World Heritage Marine Sites, therefore it is strictly protected.

“The problem with the current monitoring techniques is that they only show a limited number of measur-

ing points at any given moment,” says Liesbeth De Keukelaere of VITO. “However, a sediment plume (comparable to a plume of smoke, but underwater) can stretch several kilometres and continuously mutates, as a result of currents and tides.”

The drones use their multispectral cameras to capture images that allow accurate quantitative analysis of the sediment concentrations. The VITO software recognises the concentrations automatically and in real time, and then immediately matches them to the correct location. “In ideal conditions, a drone that flies at a height of 120 metres can cover a water surface area the size of a full football pitch in a single image capture”, says De Keukelaere.

According to Emile Lemey, environmental engineer at Jan De Nul Group, the monitoring technique (which, to be clear, is still in the test phase) saves time, manpower and fuel. “We are currently still doing everything via manual measurements, having to sail from buoy to buoy. In one movement, the drones give us a detailed spatial overview of the sediment plume. This signifies a big step forward in our day-to-day operations.”



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# VITO EMPLOYEE IN THE SPOTLIGHT



**When Ke Wang started working at VITO two and a half years ago, she was the hundredth foreign employee, a milestone at the time. In the meantime, she has become very familiar with Flanders and the Netherlands (Ke lives in Eindhoven with her Italian husband and their two children). “But learning Dutch is still the biggest challenge for me. I’m definitely doing my best, but everyone speaks such good English here!”**

**Amongst other things, you work on business models for ‘circular building’. What does that involve exactly?**

When you think of circular building, the first thing that comes to mind may be houses and buildings built from recycled materials and raw materials. That’s true to a certain extent, but it’s not the whole story. We ultimately also want to prevent buildings from being demolished prematurely (long before they have become run-down and worn-out) to make way for new buildings. This is common practice in our modern construction culture. With our circular approach, buildings are not demolished, but rather their function is changed. For instance, a hotel may be converted into an office building, or a community centre may be converted into a school. Of course, this approach only works if the original design and building plan is already transfunctional and modular in nature.

**What is the aim of this?**

We want to be able to convince clients or real estate agents that circular building represents an attractive investment. Because, in the end, the success of circular building stands or falls with the competitiveness of the business model.

**You are also the coordinator of another European project, named CIRCUSOL. What is this project about?**

In this project, managed by VITO, we develop circular business models for the solar power industry. Here too, everything revolves around recycling and reuse, of solar panels and batteries from electric vehicles, for example. And here too, we want to ensure that the circular approach becomes a logical choice, from an economic perspective. The boom in solar power and (further down the line) electric vehicles means more raw materials, energy and waste flows. In order to make them sustainable, we can evolve from a product-based business model to a more service-oriented model.

**The business behind the circular economy – this certainly contrasts with your training as a physicist at the prestigious Stanford University in the United States.**

(laughs) I’m certainly not an architect, let alone a financial advisor. In Eindhoven, I worked as an applied physicist at Philips for a number of years. I worked in R&D in the healthcare department there, on modern medical equipment, amongst other things. During a part-time MBA course at the Rotterdam School of Management four years ago, however, I realised that I personally attach great importance to the environment. I then began to search for vacancies, and that’s how I ended up at VITO.

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# INDEPENDENT FACILITATOR OF DISTRICT HEATING NETWORKS

**Flanders has serious ground to make up in the area of heating and cooling by district heating networks. However, the advantage of lagging behind is that we can optimally apply knowledge and experience from abroad in new networks here. A large-scale urban network will be rolled out in the south of Antwerp in the near future. VITO/EnergyVille has been showing its expertise in district heating networks for some time in the form of concept and feasibility studies.**

After the oil crisis in the seventies, Belgium (and later also Flanders) decided to make a large-scale transition to natural gas for heating houses and other buildings. During the nineties, this even led to the statutory obligation for the government to provide a gas connection in every new housing development. The outcome: no less than 90 % of Flanders is connected to the gas network.

## Water as an energy carrier

Due to the climate change issue – and other factors such as volatile prices and security of supply – heating by means of gas (and cooling by means of electricity) is no longer a valid option. A district heating network, in which houses and buildings are supplied with water that is already warm – the water is therefore acting as an energy carrier – has numerous advantages over gas. For instance, the energy is not generated in the houses and buildings themselves, but rather in a central installation, resulting in a significant CO<sub>2</sub> reduction. The hot water therefore feeds the district heating network, which can extend over several kilometres in an area that is ideally densely built-up.

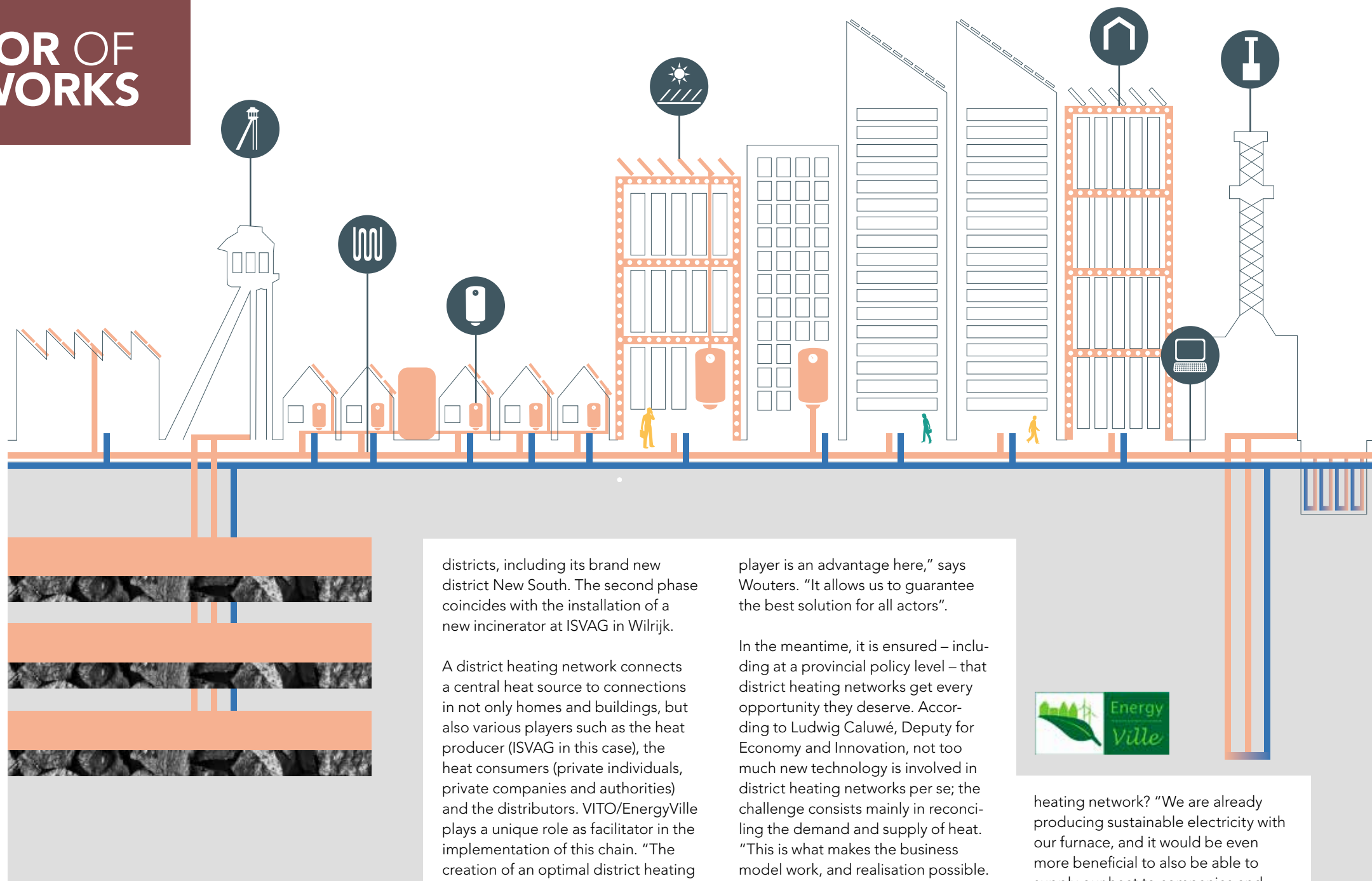
“Over 50 % of our energy consumption is taken up by heating and cooling buildings”, says Ann Wouters of VITO/EnergyVille. “If you use district heating networks to do this, you have a very powerful instrument for the transition to a sustainable energy system. Ideally, district heating networks are fed with residual heat from companies or with sustainable alter-

natives such as geothermal energy or biomass. Another major advantage of a district heating network is that the energy source (which centrally heats the water) can easily be replaced. District heating networks are therefore compatible with changes in our energy system, that we cannot always predict.”

## Starting from scratch

Other countries are much more familiar with this energy technology. For example, after the oil crisis of 1973, Sweden quickly made the decision to use district heating networks for heating. There was a similar evolution in the other Scandinavian countries, and even in our neighbouring countries. “We are taking a very close look at other countries”, says Rutger Baeten, also of VITO/EnergyVille. “In Scandinavia in particular, work has been carried out on high-efficiency district heating networks in recent years. We are now implementing this knowledge here, so that the district heating networks that we create are immediately among the best in class. The advantage here, of course, is that we are starting from scratch in Flanders. We do not have to experience all the teething problems again.”

At the end of November 2018, ISVAG and VITO/EnergyVille organised an international workshop on district heating in and around Antwerp ([districtheatingantwerpen.be](http://districtheatingantwerpen.be)), which was also attended by the Danish District Heating Association. During the workshop, a great deal of attention was given to the large-scale urban



network of Flanders, which is being built south of Antwerp.

## Antwerp's residential districts

The district heating network is to be fed by the waste incinerator of ISVAG in Wilrijk. In the first phase of implementation, the grid will be built on (or rather under) a neighbouring industrial site (Terbekehof). As a result, around ten SMEs and companies will be able to heat their buildings and generate hot water. In the second phase, the network will be rolled out to a number of neighbouring residential districts in Wilrijk, but also to a number of Antwerp's residential

districts, including its brand new district New South. The second phase coincides with the installation of a new incinerator at ISVAG in Wilrijk.

A district heating network connects a central heat source to connections in not only homes and buildings, but also various players such as the heat producer (ISVAG in this case), the heat consumers (private individuals, private companies and authorities) and the distributors. VITO/EnergyVille plays a unique role as facilitator in the implementation of this chain. “The creation of an optimal district heating network requires a lot of study work and planning”, says Baeten. “We have to research how much heat is available at the source, and how many potential consumers there are. In between, we have to map the most efficient route. It should not be too long and too complex, otherwise the heat loss would be too high and, moreover, the construction price would not be kept low. We are therefore studying the technical and economic feasibility.”

In addition, VITO/EnergyVille is helping to create a framework in which heat producers, consumers and distributors can identify each other – for the purposes of contracts, prices, etc. “The fact that we are an independent

player is an advantage here,” says Wouters. “It allows us to guarantee the best solution for all actors”.

In the meantime, it is ensured – including at a provincial policy level – that district heating networks get every opportunity they deserve. According to Ludwig Caluwé, Deputy for Economy and Innovation, not too much new technology is involved in district heating networks per se; the challenge consists mainly in reconciling the demand and supply of heat. “This is what makes the business model work, and realisation possible. This is precisely why we have created the role of energy broker. If they wish, municipalities can play a director's role between the various players, and thus make hay while the sun shines. After all, they have an excellent view of planned works and on supply and demand, and can therefore work on their sustainability goals. Our cooperation with VITO/EnergyVille also gives us the necessary knowledge to calculate the technical and economic feasibility. And as regional authority, we look for intermunicipal cooperation where necessary”, says Caluwé.

Finally, how does a company like ISVAG benefit from the connection of its waste-to-energy plant to a district



heating network? “We are already producing sustainable electricity with our furnace, and it would be even more beneficial to also be able to supply our heat to companies and individuals”, says Kristel Moulaert, managing director of ISVAG. “District heating networks fed by sustainable sources are vital in the quest for a climate-neutral urban environment.”



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# Ghent opts for a circular urban economy

**What can a city region do to encourage the collection, recycling and reuse of both plastic and construction waste? VITO has developed an online portal that is publicly accessible and whose content can be improved or supplemented. This 'living' overview should prompt the city region of Ghent to take targeted actions regarding the circular economy and involve local businesses.**

A while back, the City of Ghent issued a tender to analyse the potential of circular economy in the city region (Ghent together with the port area and the municipality of Destelbergen). The focus here was on two material streams: plastics and building materials. With such reporting, the streams are traditionally analysed in detail via an extensive survey and

stakeholders are questioned. All the information is then incorporated into a cumbersome report.

## Online overview

VITO, which has extensive experience with this type of task, decided to take a different approach this time. "We proposed to firstly bring together all our own knowledge and data, supplemented by the information we collect through our usual channels," says Kris Broos of VITO. "We then wanted to present this information in a user-friendly format that everyone is familiar with, namely that of a wiki (a Wikipedia page). Therefore, an online portal that is not only accessible to the public, but also invites feedback, in the form of corrections and additions."

The proposal was well received by the City of Ghent, and the wiki has been online since last summer. "You could describe our approach as top-down," says Ive Vanderreydt of VITO. "And it should be added that the result is transparent. Moreover, nobody feels excluded; on the contrary, the living nature of the wiki (which replaces the traditional final report) ensures that stakeholders can make additions in real time. This may in turn prompt other companies that have not yet made a contribution to participate."

## Unique at city level

According to Kris and Ive, the scale of the work is also unique. "Reports on circular economy very often cover high policy levels, such as European and Flemish, or very low, such as company level. This rarely takes place at city level." The wiki has already produced results through this scale. For example, the graphics on the portal clearly show that the plastic waste stream in a city region only has limited potential. Vanderreydt: "The collected waste streams are too small for this. Our wiki indicates that, if you want to help close the plastic cycle, it is best to adopt initiatives at regional level. Just think of the extension of the PMD bag (for plastics, metals and drinks cartons)."

The wiki can also lead to concrete suggestions for improvement. The purpose of the wiki is to show you how to work with a circular economy in a city region, specifically in the field of plastics and construction waste. "Circular economy is very popular nowadays, but it is also a catch-all term", says Ive Vanderreydt. "With our wiki, policymakers at city level can identify circular 'germs' in the existing linear economy. They can then stimulate them."

While the plastic stream offers few prospects for impact at city level, the opposite applies to construction waste. "Building materials and demolition waste are typically a given at local level", says Broos. "Producers

are generally in the area and with construction waste you do not have to drive to the other side of the country. Moreover, large quantities are available in a city like Ghent - particularly if you take the port into account".

For example, the wiki shows in a graphic how much bitumen is purchased each year, how much is on the Ghent roofs ('in stock'), and how much is disposed of as construction waste. This graphical representation is useful for stakeholders, because it immediately clearly shows where there are possible gaps. For example, are all by-products actually included in the analysis?

## CO<sub>2</sub>-negative stepping stones

Ghent would not be Ghent if the administration did not use the potential of circular economy to make the city more sustainable, with a strong focus on climate. Thus, the city wants to build a pavement this year consisting of CO<sub>2</sub>-negative 'stepping stones'. These stones are produced according to the Carbstone process, in which building materials are made from steel slags (e.g. originating from the steel plants in the port of Ghent) and considerable quantities of carbon dioxide. With the Stepping Stone project (which is subsidised by the Circular Flanders program, and which, in addition to VITO, includes

the cooperation of the City of Ghent, Orbix, Ghent University and the firm Peter Stouthuysen), we want to make the circular economy tangible in the urban environment", says Liesbeth Horckmans of VITO. On the one hand, we want to use this demonstration project to literally bring the people of Ghent into contact with a CO<sub>2</sub>-negative infrastructure. On the other hand, we want to learn from its practical implementation. A city administration has a lot of impetus in this area. For example, it can stimulate circular and sustainable building by prescribing it in its specifications for public works.

In the meantime, the City of Ghent wants to further stimulate the circular urban economy by means of, amongst other things, the wiki. Together with the partners of the Cleantech Cluster Regio Gent, which was founded in 2016, we want to focus strongly on a package of initiatives for the development of the circular economy in our region, in view also of the attention given to this by knowledge institutions and companies", says Adinda Baro of Ghent Economic Services. "The analysis of plastic and building material streams is an important step. It allows us to locate gaps in the value chain, which in turn can offer opportunities to companies. In the course of 2019, we want to continue working on the

establishment of specific value chains by meetings of stakeholders. At the same time, we are engaging in projects focusing on new materials and innovative forms of collection and processing, with companies from the Ghent region that show a strong interest, and with Flemish and European actors. As the Ghent region, we want to clearly show that cooperation between different partners does pay off, materials based on reuse or new compositions are reliable, and new business models can be created. In short, we want to fully assume our role as a testing ground by – amongst other things – using circular materials in buildings and infrastructure in our territory."

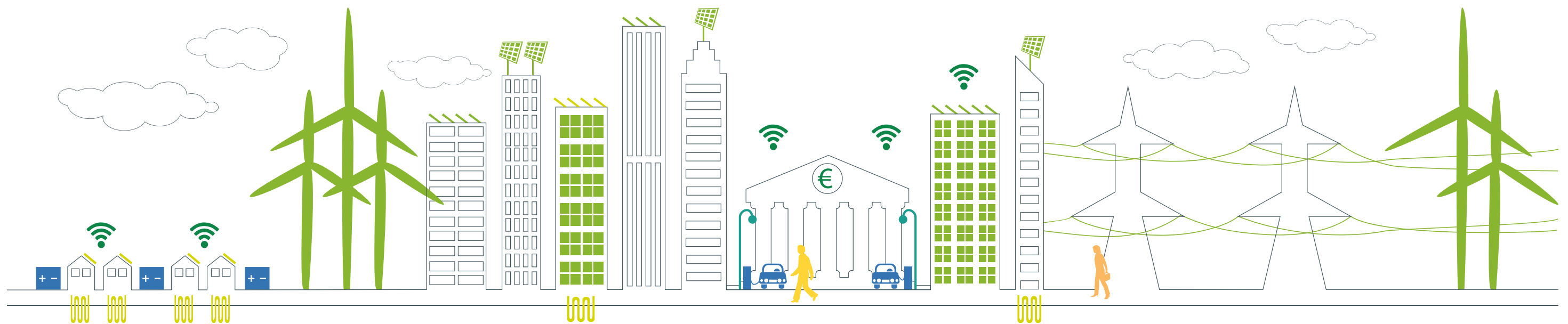


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# ON THE WAY TOWARDS A SUSTAINABLE AND RELIABLE BELGIAN ENERGY SYSTEM



**With the Energy Transition Fund, the Federal Government promotes research and development in the field of energy, from generation, through storage and distribution, to waste processing. EnergyVille has received approval for three of its project proposals. All three are intended to assist steering our country towards a low-carbon energy system.**

With the Energy Transition Fund, the FPS Economy is seeking to support R&D projects relating to renewable energy sources, such as offshore wind farms and biofuels, supply security and grid stability, and innovative nuclear research. The fund is being financed by operators of nuclear power plants and is commonly referred to as 'nuclear interest', which has been agreed upon in the framework of the lifetime extension of the nuclear plants in Belgium.

"With this fund, which this year comprises of around thirty million euros, the Federal Government intends to provide a stimulus for our energy system in its areas of competence," explains Pieter Vingerhoets from VITO/EnergyVille. He believes that the federal nature of the transi-

tion fund makes it a special kind of support mechanism. "It is one of the few sources of funding that promote collaboration across the linguistic border. This means that the perspective of the approved projects is always national, which is certainly a positive thing."

EnergyVille has had three projects approved in 2018, which account for a combined total of around twelve million euros. Although the projects are being led by EnergyVille, various partners are also involved in both the EPOC 2030-2050 project and the BREGILAB project. In EPOC 2030-2050, which is being coordinated by Pieter Vingerhoets, there are no fewer than fourteen partners: all are Belgian research organisations (from the three regions) who are working together on an integrated, overarching energy model framework for our country.

## Fragmentation and division

These days, it is still too often the case that policymakers commission one study on a particular energy topic from a single academic study group, and a study on another topic from another scientific institution. And even though both studies are conducted

according to the same rigorous scientific methods, it is still highly likely that they will be based on different energy models, potentially even with different (but not necessarily incorrect) assumptions and input data. "This fragmentation and division is also evident in the reporting on all aspects relating to energy, for example," notes Vingerhoets. "This means that news articles all too easily end up each with different conclusions, simply because the stated results are based on different data or models."

EPOC 2030-2050 is intended to culminate in the creation of a genuine (perhaps virtual) 'expertise and data centre', which policymakers can consult when they have queries regarding the Belgian energy system. "We want to collect and combine the relevant facts and figures, and models related to energy, and then join them with the scientific expertise available in our country," adds Vingerhoets.

## The usefulness of models

Apart from its typically Belgian character, what makes the project unique is that it covers the entire Belgian energy system, and therefore

not just the electricity supply. "The debate has been raging in the media for years now about whether or not to keep one or more nuclear reactors open," says the VITO/EnergyVille project coordinator. "It's an important issue, but the challenges of ensuring sustainable and cost-effective future energy provision go much further. For example, heat accounts for more than half of energy demand, and over 80 % of our heat demand is still being met by fossil fuels. Road transport is also largely dependent on petrol or diesel, which accounts for a third of energy-related emissions."

This complexity of the challenges is precisely why we need energy models that take account of all aspects of the energy system. "We use energy models to calculate the most cost-effective way of reducing greenhouse gases, guaranteeing the reliability of energy supply, and at the same time keeping customers' bills under control," adds Vingerhoets.

## Protecting the grid

The BREGILAB project is investigating the practical realisation of further expansion of renewable electricity sources in Belgium. "How can we continue to encourage the penetration of renewable energy sources into the electricity grid while minimising grid investment costs and risks to the stability of the grid?" asks Frank Meinke-Hubeny from VITO/EnergyVille. "We are looking at this from a technological perspective. For example, we're researching when is the best time to expand and mod-

ernise the electricity grid, and when we need to switch to battery storage in larger scale. Batteries are currently still expensive, so they need to be used efficiently once they have been installed." This project is being coordinated within EnergyVille by imec.

The BREGILAB project is studying different technologies that can be used to absorb peaks in solar or wind power, or even prevent them if necessary. "The solar panels on our roofs and the wind turbines on land and at sea can create power surges that can challenge the grid," says Meinke-Hubeny. We can protect the grid by making effective use of power control technologies (levelling off electricity generation), curtailment (temporarily switching off sources) and sufficient conversion capacity (the immediate consumption of the generated wind and solar power as electricity or heat)." Researchers are also looking at detailed weather forecasts to enable them to assess the impact of renewable energy on the grid more quickly and accurately.

## Throwing away excess current

Although the focus of BREGILAB is mainly on technology, it also uses economic analyses and market models. "The cheapest energy is the renewable energy that you are using straight away, without lengthy transport through the grid and without battery storage. By focusing on this, we can avoid the need to invest in premature upgrades of the grid or in costly battery technology," explains Meinke-Hubeny. "Take the example

of the (still rare) power surges in the summer: if you intelligently control surges like these (such as by capping or curtailment), you only lose a small percentage of the generated electricity. But you could potentially gain significant savings as a result by not having to invest in the grid or in storage. These are the kinds of considerations that we are studying."

Last but not least, there is the NEPTUNE project (coordinated by KU Leuven). This is conducting research into an 'electricity superhighway' at sea, a future electricity grid for wind power at sea that would run on direct current instead of alternating current.



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# MONITORING INDOOR AIR

**Air pollution from traffic, industry and households is very much under the spotlight today. Yet we also breathe in harmful substances inside our home – or at the office. Manufacturers of building materials must comply with national and European guide values for these so-called VOCs. And this will soon apply to furniture and consumer products as well. VITO has a long tradition in this area, both in terms of measuring these emissions and in terms of compliance with national legislation and with voluntary product labels.**

Air pollution has been receiving a great deal of attention in Flanders for several months now. It is much less well known that we also come into contact with (potentially) harmful chemical substances indoors – at home in the living room or bedroom, or at the office. In fact, while the (most significant) pollutants in the open air can be counted on one hand, a wide range of chemical substances float around the average house – 180 of which appear in the EU-LCI list, so substances to keep an eye on. These substances – referred to as volatile organic compounds (VOCs) – escape from building materials such as glue, processed wood and linoleum, or from interior objects such as furniture and even (scented) candles.

## **80 % of the time indoors**

"Everyone is talking about clean atmospheric air today," says Marc Lor

of VITO, "but we hardly hear anything about the substances we breathe in when we're at home. Yet on average we spend eighty per cent of our time there. And you should know that this is actually an overall package, because outside air also comes in along with all the pollution that it already contains.

Guide values currently apply to building materials such as floor coverings and glues in Europe, the so-called EU-LCI list. What the toxicological combination effect of all these VOCs is, is still largely unknown. Lor: "But we do know from basic substances such as formaldehyde and benzene that they are harmful, even carcinogenic. Others could also increase the risk of allergies, for example. Unfortunately, it is very difficult to determine the effect of VOCs on our health. You can focus on one substance in toxicological studies, but then you miss the 'cocktail effect' of a mixture of dozens of substances, something that reflects reality much more accurately.

For years VITO has been taking measurements regarding the emissions of all kinds of products on behalf of both authorities and companies. And its customer portfolio is constantly expanding, not only because VITO has suitable measurement technology, but also because it helps customers with compliance – with legislation and other rules and regulations – in other countries, both inside and outside Europe. "If a company wants to know

the emission levels of a specific hazardous substance, it would also like to know whether it complies with the regulations in the countries to which it exports," says Jeroen Van Deun. We monitor this closely at VITO. Moreover, we are also well aware of all product labels that exist, both domestically and abroad. This is all too complicated for most companies, and we have noticed that this is another reason why they like to turn to us.

VITO's expertise in the field of emission measurement is acknowledged not only by its customers, but also by its competitors. For example, VITO recently became the exclusive partner in Europe (for VOC emission testing) of the large US company Underwriters Laboratories (UL), a leading international company that is the undisputed market leader in the testing of hazardous substances.



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