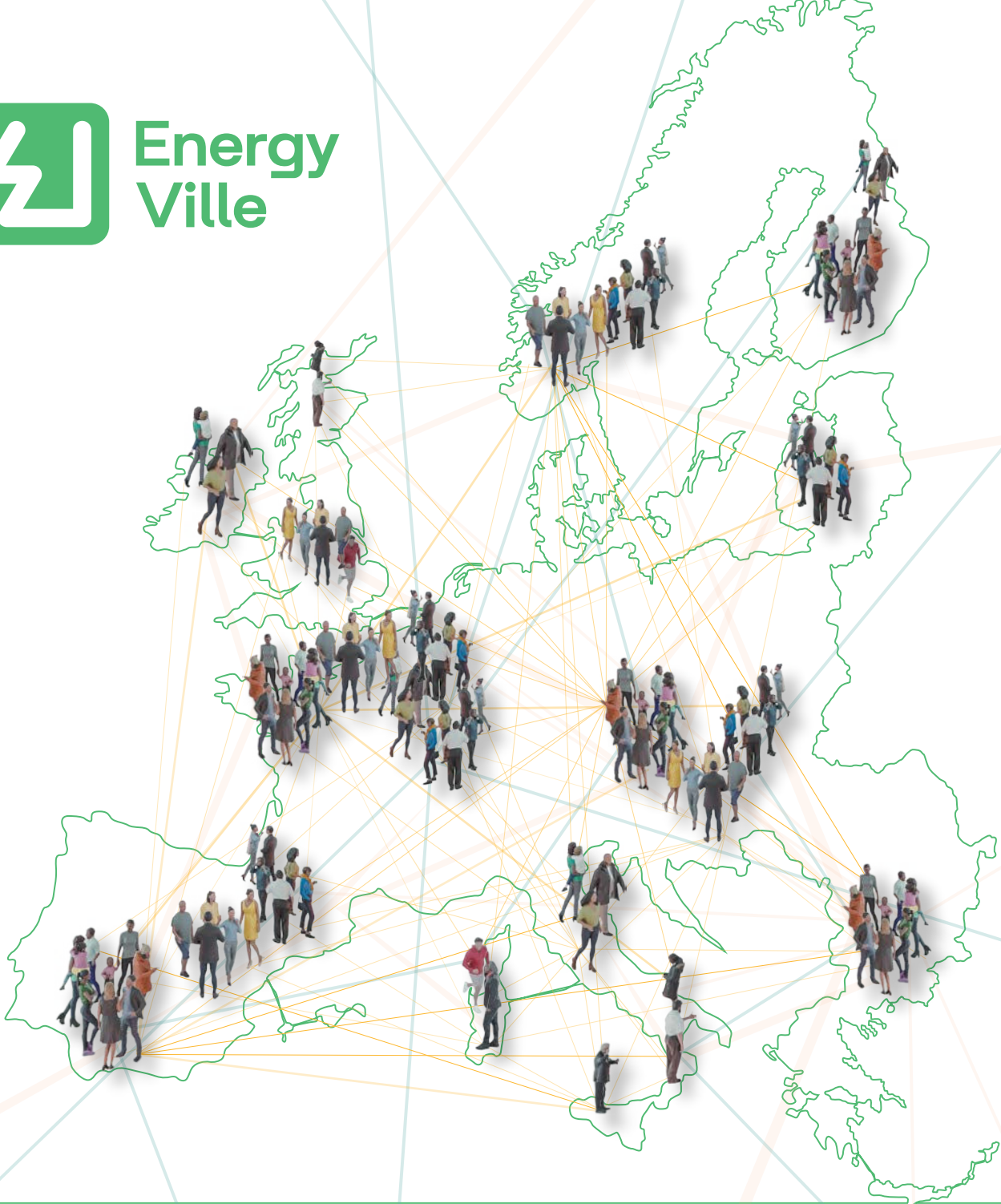




Energy  
Ville



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# PROLOGUE

## ON THE ENERGETIC PATH



In 2023, CO<sub>2</sub> emissions in Europe decreased significantly. We installed no less than 58 gigawatts of solar panels in Europe, capable of producing as much electricity as ten to fifteen coal or nuclear power plants, and over eighteen gigawatts of wind power, comparable to another five of these plants. Investments in renewable energy continued to rise. And, slowly but surely, a shift is taking place from the use of fossil fuels to electricity, leading us to expect electricity consumption to rise again in the coming years, but energy consumption to fall significantly as a result.

But there were also challenges in the energy market. With Europe's efforts to become less dependent on Russian gas, energy prices remained high and volatile. This precarious geopolitical context further emphasizes the need to continue investing in renewable energy. After all, the energy transition will also lead to better supply security. By generating more energy in Europe, we will become less reliant on other countries. And everyone will benefit from it.

How can we make Flanders, Belgium, and Europe carbon neutral and accelerate our energy independence? At EnergyVille, we are keen to contribute to this discussion through our research on energy strategies and markets. Along with others, because a successful energy transition requires clear direction from governments, innovative research from knowledge institutions, action from market players, and involvement from citizens and the financial sector. In this transition network, EnergyVille aims to do much

more than conduct groundbreaking research. We put our expertise to maximum use to support and bring together all stakeholders for a successful transition. A transition in which we aim to leave no one behind.

One of the highlights of the past year was undoubtedly the renovation project in the neighbouring residential districts, where, in collaboration with [Wonen in Limburg](#) and others, we began renovating more than thirty homes. In this [oPEN lab project](#), which is part of our [Open Thor Living Lab](#), we interweave real-life experiments with participation and co-creation of residents. Through our research on buildings and districts, we not only develop, test, and demonstrate our technological innovations, but also visualise how to approach such renovation projects on a large scale. In doing so, we aim to inspire others. We help find ways to make these types of projects financially affordable for millions of citizens and make our expertise available to construction companies through [EDIH-EBE](#) — the European Digital Innovation Hub for Energy in the Built Environment. This approach pays off, and with the additional funds we received from the Flemish government in 2023, we can further expand our living laboratory. Soon, this will make us the largest living lab in Europe.



We also aim to create lasting impact through groundbreaking research. And over the past year we did just that — together with our industrial players. In all eight of our research lines, we made progress and brought our innovations closer to the market, where they can soon make a real difference. Our innovative solar energy technologies achieved world-record efficiencies. By combining thin-film solar cells with silicon technology in tandem configurations, we can soon make another big efficiency leap. With our breakthroughs in wafer-thin solar films, anything that captures sunlight — from trucks, to shipping containers, to swimming pool covers — will soon be able to generate energy.



Wind energy may not be the core research focus of EnergyVille, but we are steadily building our expertise in electrical networks to install the cables of those wind turbines underground. By 2050, when at least four new "Ventilus" projects need to be rolled out, our technologies can offer a solution for sea to inland transmission. With the tools developed by our Thermal Systems research line, cities can develop smart district heating networks. Our battery research is also making progress every year — in terms of cost, lifespan, and energy density. This becomes increasingly important in a world where soon not only car fleets but also freight transport will be electrified. Knowing that heavy industry needs green molecules, and that electrification may not be a solution

for shipping and long-haul flights, we are investigating the role hydrogen and other green molecules can play in this. Over the past year, we have made considerable progress on a small scale in the efficiency of converting electricity to hydrogen. If we add to this the expertise of our power electronics researchers, we can make powerful strides forward. Converters will soon play a role in many parts of the power grid, after all, and any efficiency gains will provide significant added value.

With our eight research lines, we therefore cover a very large part of the energy spectrum at EnergyVille and can truly devise solutions for the major energy challenges of today and tomorrow. We develop roadmaps for Flanders, Belgium, and Europe to reduce CO<sub>2</sub> emissions and decrease our energy dependence. We join forces with market players, the financial sector, and citizens to develop, test, and demonstrate new innovations. We support governments with scientifically grounded studies. Together, we show what a sustainable future can look like. We are on the energetic path, towards a future of sustainable and reliable energy for everyone.

**Gerrit Jan Schaeffer**  
General Manager EnergyVille



# OPEN THOR LIVING LAB

## HERE THE ENERGY TRANSITION COMES TO LIFE

At the site in Genk where miners extracted black gold from the ground for years, a different kind of wealth is being mined today: innovative solutions that accelerate the energy transition. And those sustainable innovations are developed and tested in a real-world environment. The **Open Thor Living Lab** — a collaboration between EnergyVille, City of Genk, and Thor Park NV — is a living testbed where companies, knowledge institutions, citizens, and governments work together towards a greener future.

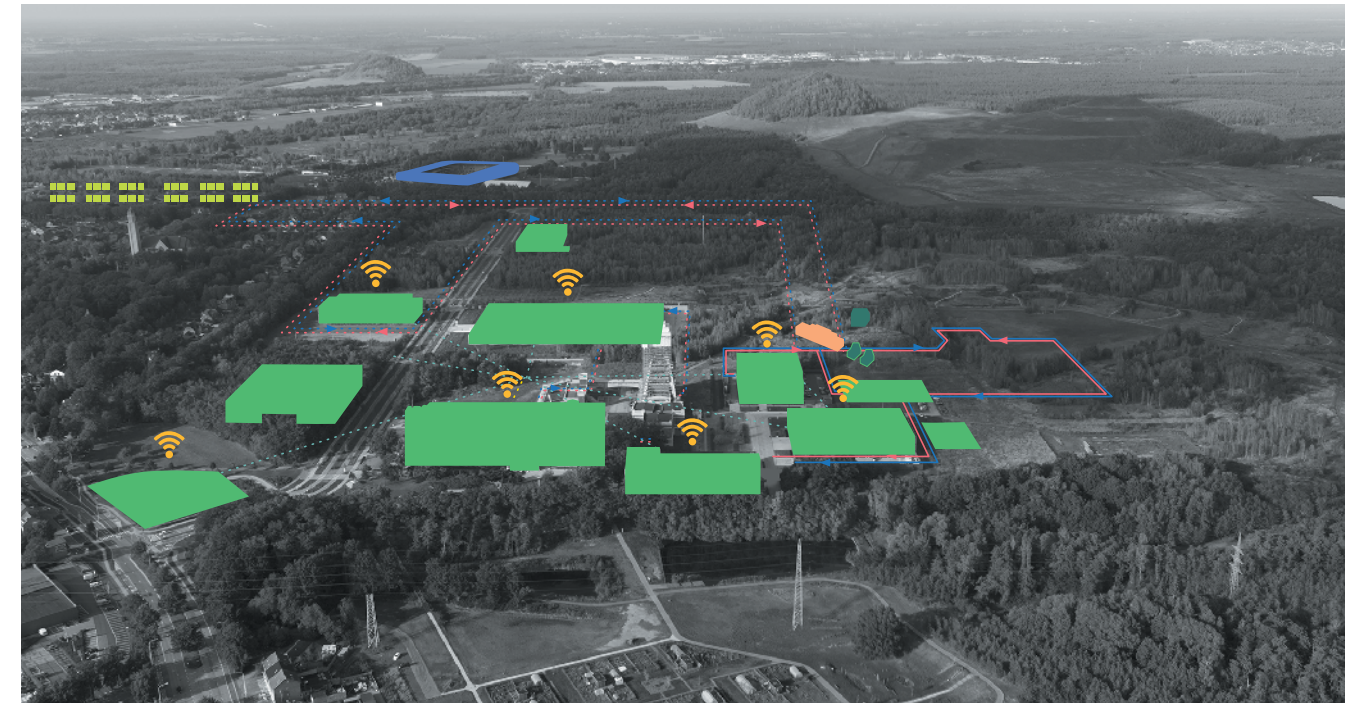
### FASTER TO THE MARKET

Companies testing and demonstrating their innovations in this living lab benefit not only from the scientific expertise and state-of-the-art living lab research infrastructure. Thanks to co-creation with local residents and the involvement of end users in experiments — both in the residential areas and in the science and business park — they receive direct feedback on their prototypes and innovative ideas, allowing them to adjust and optimise faster. A great added value to prove the relevance of their technology and minimise risks for investors. And a catalyst to bring their innovative energy concepts and technologies to the market faster.



### A VIBRANT ECOSYSTEM

The **Open Thor Living Lab** comprises three distinct zones: a residential area, a science and business park, and the buildings and grounds of **KRC Genk**. This captivating combination allows the (often complementary) energy needs of different stakeholders to be aligned, and also provides holistic insights into the real impact of the large-scale implementation of new technologies. For instance, by installing integrated technologies for energy efficiency, smart control, and collective energy production in over 30 homes in Nieuw Texas and the garden district of Waterschei, companies and governments gained valuable insights into how cities and neighbourhoods can be transformed into Positive Energy Neighbourhoods, producing more energy than they consume.



- oPEN Lab
- SmartThor
- KRC Genk
- ConstrucThor
- Thor Park
- CollectThor
- Junction
- ThoreaQ

### CLIMATE CHALLENGES FOR CITIES AND SECTORS

But the **Open Thor Living lab** also focuses on broader urban energy challenges, working, among other things, on the development of smart charging solutions for electric vehicles, the integration of solar panels in unused surfaces such as sound walls, or the implementation of large-scale low-temperature heat networks. Additionally, it aims to help industries become more sustainable by testing smart production processes for automation, digitalisation, and robotics, and developing new sustainable technologies in the construction sector. By collaborating with innovation partners in an open way and through the availability of state-of-the-art infrastructure, various future use cases can be tried out in a real-world context.

The **Open Thor Living Lab** is more than a place where green pilot projects are rolled out. It is a permanent, sustainable, and vibrant environment where people live and work, while innovative energy solutions are tested and demonstrated. Here, the energy transition truly comes to life.

# A SMALL SELECTION OF OUR BIGGEST SUCCESSES

## SOLAR ENERGY

### ANYTHING EXPOSED TO THE SUN CAN GENERATE ENERGY

At EnergyVille, we have been researching new solar cell technologies for years that are simpler, cheaper, and can be integrated in many more places than traditional silicon solar panels. In 2023, this research made significant progress in efficiency, stability, and scalability. This brings the commercial potential significantly closer.

#### WORLD RECORDS FOR PEROVSKITES

An EnergyVille collaboration between imec and UHasselt focused on improving the efficiency and stability of metal halide perovskites, promising materials for the next generation of solar cells. Our perovskite modules achieved a world-record efficiency on glass substrates of 30x30 cm<sup>2</sup>, which remained intact with larger modules. This demonstrates the viability of this technology under real-world conditions and opens possibilities for various applications, such as integration into windows and Agri-PV. The combination of perovskite with another promising material, CIGS, also resulted in the highest tandem solar cell efficiency worldwide within the [PERCISTAND](#) project. These innovations enable us to harvest solar energy smarter and more efficiently than ever before.



#### FOLDABLE SOLAR CELLS FOR THE LOGISTICS SECTOR

[EnFoil](#) — an EnergyVille spin-off of imec and UHasselt — introduced thin, foldable solar foils to the market in 2023. Based on CIGS technology, these lightweight and robust foils target new applications — from solar cells on corrugated roof tiles to sidewalls and roofs of trucks. The thin-film solar cells can be produced in all shapes and sizes on a large scale, making the technology affordable and thus no longer only accessible to exclusive projects.



## ON LAND, AT SEA, AND IN THE AIR

Other solar energy research from EnergyVille is also getting closer to practical application. Within the [SNRoof project](#), for instance, EnergyVille/imec/UHasselt researchers achieved a 6% efficiency gain with high-redundancy solar panels for curved car roofs. Additionally, EnergyVille/imec put EnergyVille's [Photovoltaic Module Lab](#) at the disposal of the KU Leuven student team participating in the [Bridgestone World Solar Challenge](#), the world championship for solar cars. This resulted in an improvement of the PV panels of the solar car from the [Innoptus Solar Team](#) and a second victory in the world championship.

Furthermore, EnergyVille Researchers from KU Leuven, imec, and UHasselt are exploring agrivoltaic solutions within the [SYMBIOSYST](#) project, where solar energy and agriculture converge. With our AgriPV developments, we demonstrate how PV can offer dual benefits for agriculture by combining sustainable energy generation with better crop protection.

Moreover, within the [DAPPER](#) project in 2023, we were able to model building-integrated PV modules in their interaction with the building for the first time and demonstrate new methods for fault detection. And the combined efforts of EnergyVille partners KU Leuven, imec, and UHasselt within the [MarineSPOTS](#) project proved that the same nominal capacity as for wind power can be installed in the Belgian marine zone, generating approximately 20% more energy.



# BATTERY STORAGE

## CHEAPER, MORE EFFICIENT, AND SAFER

Sustainable batteries with ultra-high performance and smart functionalities will play a crucial role in Europe's transition to renewable energy sources. Our research focuses on developing and demonstrating solutions for fully solid-state lithium-metal batteries (gen. 4b-c), the next generation 5 battery materials, and improved control through the integration of sensors and battery management systems (BMS) in the battery cells.

### MANY MILESTONES

In 2023, EnergyVille/VITO was able to publish a second patent on lithium nitride coatings, and researchers succeeded in stabilising promising electrode materials such as  $\text{LiNi}_{0.5}\text{Mn}_{1.5}\text{O}_4$ . Significant milestones were also achieved in battery support and integration. We further developed and validated our electrochemical battery models and ageing models, as well as the [BattSense](#) battery management technology. And the CSIR-VITO battery test bed in Pretoria (South Africa) became operational. This state-of-the-art facility will provide crucial insights into battery performance, lifespan, and durability under specific conditions. This will aid in developing battery storage solutions suitable for challenging environments in developing countries.



### FROM LAB TO PROTOTYPE

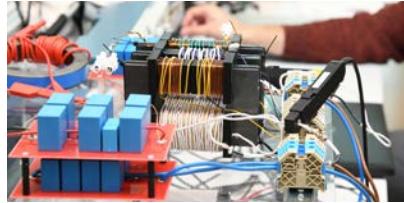
Europe is increasingly focusing on solid-state lithium-ion batteries due to their potential for low costs, high performance, and improved safety, but these batteries are not yet commercially viable. Within the [SOLiDIFY](#) project, Energyville researchers from imec and UHasselt — together with international academic and industrial partners — are working towards the fabrication of materials and production processes for lithium-metal solid-state batteries. This project aims to transition from lab demonstration to pilot line prototypes, already considering costs, environmental impact, and recyclability.

### REVOLUTION IN WATERBORNE TRANSPORT

The EnergyVille/VITO/UHasselt [Current Direct](#) project focuses on the transport sector, which currently generates a quarter of Europe's greenhouse gas emissions. Waterborne transport in particular poses a specific challenge. Although batteries can reverse this trend, they are currently too expensive. Within [Current Direct](#), an innovative lithium-ion cell is being developed and demonstrated, specifically designed for waterborne transport. The project is thus developing a swappable battery system and an Energy as a Service (EaaS) platform in the operational environment of the Port of Rotterdam.

# POWER ELECTRONICS

## MORE RELIABLE, MORE EFFICIENT, AND MORE AFFORDABLE



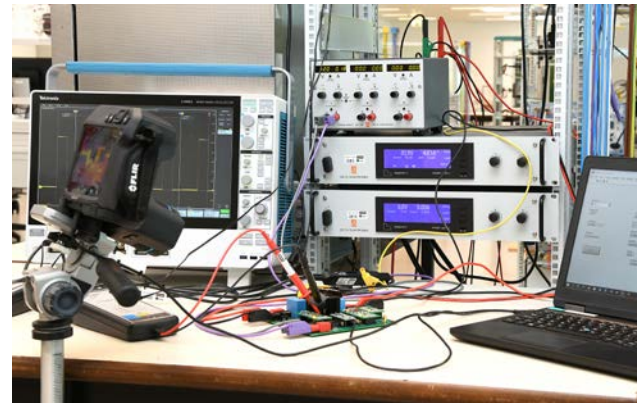
From solar panel converters and energy management systems to electric vehicle charging systems, power electronics play a crucial role in switching, controlling, and transforming electrical power. At a time when demand for these technologies is ever-increasing, optimising their efficiency and sustainability is vital. After all, even small improvements in efficiency have a big impact.

### MORE EFFECTIVE AND RELIABLE

With our in-depth expertise in wide bandgap semiconductors and passive components, we can create innovative solutions that are not only more efficient and reliable, but also cheaper. In 2023, for example, we significantly optimised battery charging with a second version of our GaN Dual Active Bridge Converter.

### SUPPORTING ELECTRIFICATION

We also developed new power conversion solutions in renewable energy, electric mobility, and energy management to support the electrification needed for the energy transition. Within the [SolarEMR](#) project — in which we addressed obstacles in integrated PV — we developed specific power electronics for DC solutions and PV setups. As part of [MarineSPOTS](#) — in which EnergyVille researchers from KU Leuven, imec and UHasselt investigated various aspects of Offshore Floating PhotoVoltaic (OFPV) technology — we optimised component selection and electrical architecture for maximum reliability and resilience. With the [PowerDrive](#) project, EnergyVille/KU Leuven researchers contributed to the next generation of power electronics in electric vehicles. And our newly launched software [PowerBrain](#) for converter design, won the second prize for best software tool at the [IEEE Energy Conversion Congress and Expo 2023](#).



# POWER-TO-MOLECULES

## TWO BIRDS WITH ONE STONE

The European Green Deal highlights the crucial role of hydrogen in the energy transition. Currently, however, “grey” hydrogen is still mainly produced from natural gas, which is not sustainable, as the electrolysis process releases a lot of CO<sub>2</sub>. To make that process sustainable, we need to replace natural gas with surplus renewable energy, light or a combination of light and renewable energy. And to make the production of “green” hydrogen competitive, the price must fall further, and economies of scale must be created. To make that happen, EnergyVille partners are joining forces.

### 100 X CURRENT DENSITY

EnergyVille/imec excels with its expertise in nanotechnology used in membranes and electrodes for electrolysis systems. Within the [Hyve](#) project, together with EnergyVille/VITO, they are trying to translate this technology into larger systems that are commercialisable. In 2022, they were able to improve the membrane electrode assembly (MEA) and implement it in an electrolysis system. And in 2023, EnergyVille partners KU Leuven and imec made an immense breakthrough with nanomesh structures, which increase current density up to 100 times compared to conventional nickel electrodes (MEA+). This opens up possibilities for more efficient and compact electrolysis systems, which are essential for the large-scale production of green hydrogen.



### NEW INFRASTRUCTURE TO EFFICIENTLY GENERATE AND USE HYDROGEN

Thanks to investments from the [Flemish Resilience relaunch plan](#), nanomesh activities at EnergyVille were scaled up in 2023 for research on larger areas of the material. The installation of a large-scale electrochemical pre-pilot line marks an important milestone in the technological maturity and affordability of nanomesh technology.

At the same time, EnergyVille partners imec and UHasselt are researching and developing innovative materials within [imo-imomec](#) — the Institute for Materials Research — that can convert solar energy into hydrogen and other sustainable chemical building blocks or fuels, with less use of critical raw materials. This will allow us to tackle the growing energy demand, while reducing our ecological footprint.

These investments in the EnergyVille labs in Genk and the Green Hydrogen Lab in Diepenbeek mark the beginning of the build-up of hydrogen infrastructure. This will considerably speed up our research and take an important step towards the commercialisation of green hydrogen technology.





## LESS DEPENDENT ON FOSSIL FUELS

By combining hydrogen with CO<sub>2</sub>, problematic CO<sub>2</sub> emissions can be converted into interesting chemicals like methane or methanol, which can then be used for further chemical synthesis. This approach kills two birds with one stone: it creates a new source for synthesising organic compounds and simultaneously tackles the issue of CO<sub>2</sub> emissions. Within the [Power-to-Molecules research line](#), EnergyVille/imec, together with other EnergyVille partners, investigates how CO<sub>2</sub> can be transformed into valuable molecules for industry. Last year, EnergyVille/imec made further progress in CO<sub>2</sub> reduction via electrolysis. In this way, we help make renewable and recycled carbon sources available to industries that are currently dependent on fossil fuels.

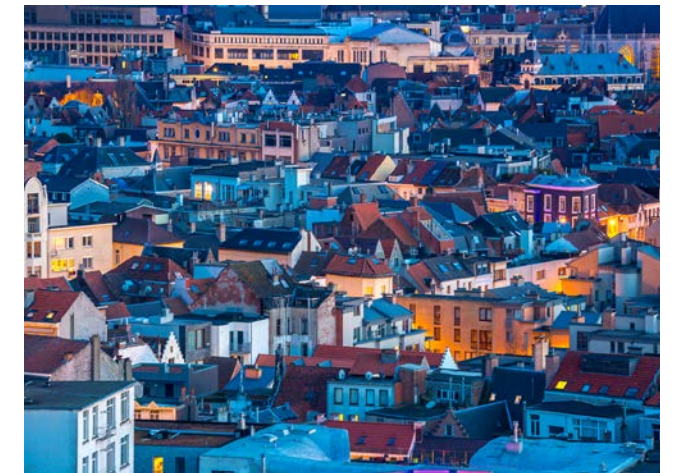
# BUILDINGS AND DISTRICTS

## SUSTAINABLE BUILDING AND RENOVATION

The [Open Thor Living Lab](#) adds great value to this research line, and over the past year, we were able to further expand our living lab infrastructure. The first phase of [ConstrucThor](#) was successfully completed, the structural work on the [THOREAQ](#) test houses and workshop was finished, and off-site work on the more than 30 houses in Nieuw Texas has begun. This expansion will greatly enhance our research. Indeed, it will not only allow us to investigate new construction methods on a larger scale, but also allow us to test the interaction between buildings and energy systems even more finely at the system level. Moreover, the real-life test environment — characterised by co-creation with local residents and end-user involvement — provides immediate feedback on our innovative ideas, allowing for quicker adjustments and optimisations. This makes us unique.

### LOCAL IMPACT

At EnergyVille, we are pleased to support local governments with our expertise. And so, this past year, EnergyVille partner VITO did just that by developing a digital district renovation tool commissioned by the Flemish Government. This tool aims to help local governments accelerate the renovation pace in Flanders and provide citizens with a clearer trajectory. The [Digital Twin Wijkrenovatiestool](#) project combines the most accurate data sources with advanced analyses — from planning to execution. Thanks to simulation tools and algorithms from EnergyVille/VITO, the tool will identify the most suitable renovation and decarbonisation strategies, map out the renovation needs of entire neighbourhoods, and uncover opportunities for collective heating and insulation projects.



Through [EDIH-EBE](#) — the European Digital Innovation Hub – Energy in the Built Environment — EnergyVille partners KU Leuven, VITO, imec, and UHasselt offer a joint package of innovations and opportunities in the field of digital transformation. This includes support for testing and providing training for start-ups, SMEs, midcaps, and public organisations involved in energy applications in the built environment. Thus [EDIH-EBE](#) — coordinated by EnergyVille/VITO — serves as a central digital-physical one-stop-hub with various services to enhance the digital knowledge, skills, and experience of Flemish enterprises, giving them a competitive edge.



## IMPACT BEYOND BORDERS

In 2023, EnergyVille/VITO conducted a [pilot project](#) on circular construction outside Europe. In this project, we responded to a request from Rwanda, which aims to link its housing needs with sustainable job creation and the use of local and sustainable materials. The project included a coaching programme for then local building material producers and the integration of these experiences into the development of guidelines

for a circular construction economy. The project was part of a broader [Enabel](#) initiative to support the national government of Rwanda and was carried out in collaboration with [Entrepreneurs for Entrepreneurs](#). It is a fine example of how we translate our vision of circularity into concrete actions beyond our borders, creating a positive impact — bottom-up and top-down.



# ELECTRICAL NETWORKS

## RENEWABLE ENERGY GAINING MOMENTUM

To achieve our climate goals, we must fully commit to electrification. Large-scale use of solar panels, wind turbines and other renewable energy sources is becoming the norm. However, this ambition poses an immense challenge to our current transmission networks. That is why the EnergyVille research line Electrical Networks focuses on improving both the transmission and distribution networks, and this for both traditional AC and DC networks.

### NEW CENTRE OF EXPERTISE

EnergyVille launched — with support from the Flemish government — the [Energy Transmission Competence Hub Etch](#) to accelerate the rollout of underground high-voltage connections in Flanders. [Etch](#) conducts pioneering research into the possibilities and limitations of underground transmission, with a focus on direct current transmission. The aim here is to create an environment where research, workforce development and valorisation go hand in hand, in collaboration with academic and industrial partners.

With an investment of 14 million euros — focused on research and specialised equipment — [Etch](#) is exploring the technology of future high-voltage electricity networks. In the process, [Etch](#) also provides a simulation centre where new technology can be tested and demonstrated in a realistic environment. The programme positions Flanders as a pioneer in research into underground high-voltage technology.



### LEADING ROLE IN THE NORTH SEA

Belgium is leading the way in offshore wind farm development, pioneering green power generation technology from offshore to onshore transmission. The [NEPTUNE](#) project — led by EnergyVille/KU Leuven and supported by the [Energy Transition Fund](#) — has built up a wealth of expertise over the past five years for seamless integration of offshore wind power into our energy system. It strengthened the financial and technical basis for large-scale electricity transmission in Europe, improved power system security and developed simulation and control models for these hybrid grids. [NEPTUNE](#) is crucial to prepare Belgium for further offshore wind energy roll-out in the coming decades.

# ENERGY STRATEGIES AND MARKETS

## ROADMAPS TO CARBON NEUTRALITY

### EVER-EXPANDING PATHS2050 PALETTE

In recent years, we at EnergyVille have conducted extensive research on the optimal way to make Belgium climate neutral by 2050, and this at the lowest possible societal cost. Our initial findings were launched in the autumn of 2022 on the specially established [PATHS2050 Platform](#), for which 200 EnergyVille researchers developed data-driven roadmaps for three different scenarios towards Belgian carbon neutrality.

Meanwhile, EnergyVille/VITO expanded the platform with new sensitivity scenarios. One commissioned by Febeliec, in which the lifespan of the nuclear power plants Doel 4 and Tihange 3 was extended by 20 years. And one commissioned by Ecolo-Groen, in which the impact of system shifts on the Belgian energy system could be analysed.

We thus added some more nuances to our ever-expanding palette of scenarios that feed and clarify the debate on the path towards a carbon-neutral Belgium — something we will continue to do through invariably in the future through our PATHS2050 Platform.

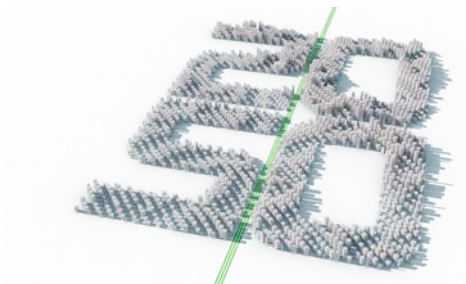
### DEVELOPMENT OF ENERGY AND FLEXIBILITY MARKETS

At EnergyVille, we actively contribute to the development of energy and flexibility markets in Belgium. In 2023, for example, EnergyVille/VITO conducted a study on the topic of energy transfer, commissioned by [Synergriid](#) among others. The results of this study are an important contribution to the debate on a new market design for flexibility in Belgium.

### CARBON-NEUTRAL EUROPE

At EnergyVille, we are also helping to chart the path to carbon neutrality on a European level. With the [AIDRES](#) database — sponsored by the [DG Energy](#) of the [European Commission](#) — our EnergyVille/VITO researchers support the long-term goal of the EU-27 to achieve a fully integrated industrial strategy. Their research evaluated the effectiveness, efficiency, and costs of various pathways to decarbonise the economy by 2030 and 2050, providing a valuable resource for regional, national, and European policymakers, industries, and researchers.

Furthermore, at EnergyVille, we support policymakers in developing qualitative and quantitative options for European integrated and coordinated market operations. For instance, commissioned by the [DG Energy](#) of the [European Commission](#), a comprehensive impact assessment was conducted to identify regulatory barriers to the participation of demand-side flexibility in electricity markets. And in several major European projects — such as [EUniversal](#) and [OneNet](#) — our EnergyVille/VITO researchers ensured the development of a long-term roadmap for a future-oriented market design at European, national, and local levels.



# THERMAL SYSTEMS

## SMART DISTRICT HEATING NETWORKS

In the search for new technologies for a carbon-free future, electrification and transport often take centre stage. But heat represents more than 60% of our energy needs. That is why at EnergyVille we also focus on thermal systems.

### THE OPTIMISATION TOOLBOX

Does it make sense for a neighbourhood, district, or city to build a new heat network or expand an existing one? To help decision-makers — at an early stage — make that decision, EnergyVille developed the optimisation toolbox [PATHOPT](#). The tool uses automatic design techniques to determine the best network layout based on specific geographical information. It calculates what the costs (CAPEX), operational costs (OPEX), and CO<sub>2</sub> reductions would be for different network plans, with multiple sources and temperature levels and with a phased rollout. This is what makes [PATHOPT](#) unique.

The aim is to provide heat efficiently without CO<sub>2</sub> emissions by, for example, utilising unused waste heat. The software supports the decision-making process at an early stage, and automates and optimises the high-level design process. And that results in fast, low-cost, and efficient designs that optimally connect homes and heat sources. With minimal input, [PATHOPT](#) automatically provides data on pipeline locations, thermal-hydraulic information, and economic considerations such as investment and operational costs and revenues. In 2023, EnergyVille's [PATHOPT](#) won the Runner-up prize of the [11<sup>th</sup> International DHC+ Student Awards](#).



### THE INNOVATIVE THERMAL GRID

In 2023, construction work started at [Thor Park](#) on the first fifth-generation thermal network. [CollecThor](#) will sustainably heat and cool the various — old, new and future — buildings on the site based on shallow geothermal energy, and will also be able to exchange waste heat and cold between the buildings. The innovative grid is modular and allows for further expansion and upgrades, demonstrating the benefits of a gradual rollout and staggered investment. With a smart control and management system, it provides the energy supplier with insight into the entire energy chain, and can be optimally controlled: from heat and cold production, through distribution, to off-take. Supported by the Flemish government, [CollecThor](#) will explore the potential of both intelligent district heating networks and local heat networks. By February 2025, the grid will be operational.



# WITHIN INDUSTRY

## A TURBO FOR THE ENERGY TRANSITION

At EnergyVille, we are building the future, and we do so in close cooperation with industry. By working closely with companies from the start, we integrate valuable market feedback into our research. This increases the relevance and clout of our research results. And the 79 companies — with whom we work in our labs — also gain from this synergy, as they can immediately integrate our findings into their processes and test new innovations in a real-life environment. Together, we create impact.

### SIX NEW ENERGY TRANSITION FUND PROJECTS

In 2023, the Federal Council of Ministers approved six EnergyVille projects for the [Energy Transition Fund](#), in which we — together with industrial partners — are fully charting innovative research around the energy transition.

In HARMONIC, EnergyVille/KU Leuven is developing a framework together with [Elia](#) and [BASF](#) to determine the hosting capacity of large-scale inverters, while in the FlexMyHeat consortium, EnergyVille/imec is evaluating the potential of heat pumps with decentralised storage to support the energy balance in Belgium in 2030 and 2050. In REINVENT, EnergyVille/KU Leuven/VITO — together with industrial partners — is developing a roadmap for sector coupling in Belgium based on advanced models and robust test cases, while in R-E-FLEX EnergyVille/KU Leuven is creating a scalable and modular charging plaza concept offering grid flexibility that can be immediately deployed in case of local or supra-local electricity shortages. In STERNA 2050, EnergyVille/KU Leuven explores the potential of superconducting system technologies for security of supply, with a focus on the North Sea as Europe's green power plant. And in HEFAISTOS, EnergyVille/VITO assesses how the electrification of high-energy industrial processes can contribute to the balance of the electricity transmission grid. With our expertise, we set things in motion.



### IN CONNECTION WITH OTHER STAKEHOLDERS

We also want to further expand Limburg's industrial ecosystem by fully connecting with local players such as the [City of Genk](#), [Thor Park](#), [VOKA](#), [POM Limburg](#) and [Embuild Limburg](#). And we also stay in close contact with spearhead cluster [Flux50](#) and its Walloon counterpart [Cluster TWEED](#), with whom we are happy to share our contacts and expertise to offer companies an integrated approach for innovation projects or bilateral research.

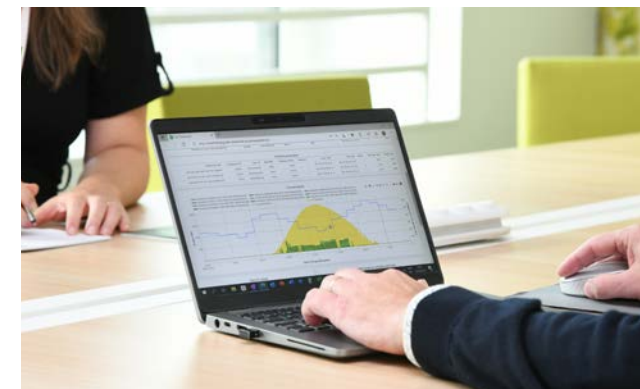
# WITHIN THE DIGITAL WORLD

## READY FOR THE DIGITAL REVOLUTION

The digitalisation of the energy sector continues at breakneck speed. And in this lightning-fast digitalisation lies a wealth of opportunities to improve energy efficiency (faster). At EnergyVille, we therefore not only integrate data into our own research and operations. We also enthusiastically share our expertise with other stakeholders to optimally prepare Flanders for this digital revolution. This is how we maximise our impact.

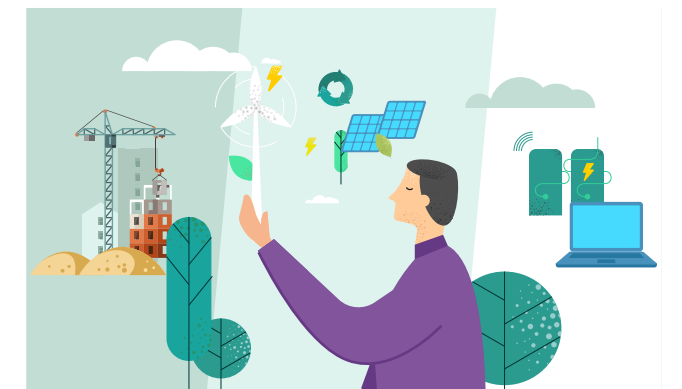
### A NEW SMARTHOR DATA PLATFORM

In the future, energy will no longer be a product, but a service. Consumers will — independent of specific energy sources such as gas or electricity — receive energy based on their needs. With [SmarThor](#), EnergyVille developed an advanced ICT platform that can drive a fully integrated multi-energy system. This allows companies developing innovative energy services to perform quality demonstrations in real-life residential areas or business parks. In 2023, we improved [SmarThor](#) even further. We integrated usage data from various buildings, made the dashboards more user-friendly, and optimised the security, reporting, and maintenance of the platform. This way, we offer even more opportunities to companies working with us on innovative energy solutions.



### BUILDING BRIDGES

Many Flemish companies and public organisations are not yet sufficiently familiar with the possibilities of digitalisation. As a result, many opportunities remain unexploited to improve the energy efficiency of construction and renovation projects. With [EDIH-EBE](#) — the European Digital Innovation Hub - Energy in the Built Environment — we bring together the expertise and support of top Flemish actors such as [T2-Campus](#), [Flux50](#), [Embuild Limburg](#), [Embuild Vlaanderen](#), and [POM Limburg](#). [EDIH-EBE](#) is a one-stop-hub for energy innovation in the construction sector for start-ups, SMEs, midcaps, and public organisations. Based in Flanders, but strongly connected to the other European digital hubs, we at EnergyVille help build bridges between stakeholders in the Flemish, Belgian, and European innovation ecosystem.



# WITHIN OUR POOL OF EMPLOYEES

## THE FUTURE OF ENERGY? THAT'S PEOPLE!

With the rapid growth of the renewable energy sector, the need for human capital is becoming increasingly urgent. At EnergyVille, we want to help close the gap between future labour requirements and available skills by creating a valuable talent pool for the Flemish industry. That is why we enthusiastically support initiatives that enthuse children and young people about science, train promising talents, and bring top researchers to Limburg.



### STEM — SCIENCE, TECHNOLOGY, ENGINEERING & MATHEMATICS

At EnergyVille, we like to give children and young people a taste for science. In 2023, we organised the KU Leuven Children's University for 8- to 13-year-olds, and — together with [T2-campus](#) — Energy Unplugged for 14- to 18-year-olds, with a special edition for their teachers. We participated in events such as [Dag van de Wetenschap](#), and co-launched educational initiatives such as the [EDUbox Energie](#) and [Power IT Up](#).

### MASTER PROGRAMMES

EnergyVille contributes to master's programmes that integrate energy transition into industry and government policies. EnergyVille partners KU Leuven and UHasselt both offer engineering and science courses closely linked to EnergyVille research. In 2022-2023, UHasselt also launched a new [Master in materiomics](#) with a materials-oriented focus on energy.

### DOCTORANDI

Energy experts are in high demand across Europe, and EnergyVille's strong competence centre helps to retain talent and expertise in Flanders. Indeed, EnergyVille acts as a magnet for top (international) researchers. With 201 active PhD students in 2023, we are a source of talent for Flemish industry. In the past year, we also organised several events for these young researchers, such as the EnergyVille PhD Day, Energy Talks, and company visits to [Port of Antwerp-Bruges](#) and [Umicore](#).

EnergyVille invests heavily in robust training and mentoring of its researchers. And those efforts are paying off. The research they conduct shines on an international level.







## WITHIN COMMUNITIES

### NO SUSTAINABLE GROWTH WITHOUT BROAD SOCIETAL SUPPORT

The transition to a climate-neutral society requires not only technological innovation, but also profound societal change. At EnergyVille, we recognise the importance of broad public support, and actively work to encourage and strengthen it. After all, without the support of the whole of society, sustainable growth is not possible.

#### CO-CREATION

At EnergyVille, we are taking several initiatives to engage communities in the transition to a sustainable future. Within the European Green Deal project [oPEN Lab](#), we organise co-creation sessions with local residents. In doing so, we increase public engagement and collect valuable input from the local community. Additionally, in cooperation with [Flux50](#), [POM Limburg](#), and [Thor Park](#), we organised the annual international Energy Mission conference again in 2023, where representatives of various living labs exchanged experiences and expertise.



#### SCIENCE COMMUNICATION

Our expertise spans a wide range of topics: from European climate targets and the digital meter, to heat pumps and the roll-out of offshore wind farms, to the sustainability aspects of PV. Our insights are of interest not only to companies, academia, and policymakers, but also to the general public. That is why we invest enthusiastically in broad science communication. We share our insights through our [PATHS2050 Platform](#), our Expert Talks, and an extensive press communication. In the past year, young EnergyVille researchers also participated in initiatives such as [Wetenschap Uitgedokterd](#), while our experts informed Flemish citizens about the energy transition via [Fluvius'](#) 'Energy Flash Sessions'. We also have an enthusiastic presence at numerous national and international events. We are convinced that this broad dissemination of our knowledge contributes substantially to the acceptance of new technologies in our society.

# ENERGYVILLE IN FIGURES

**746\***  
COLLEAGUES



**368\***  
BELGIAN  
COLLEAGUES



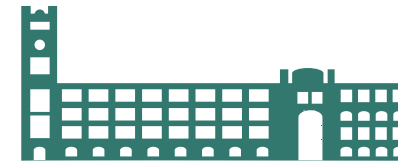
**135\***  
EUROPEAN  
COLLEAGUES



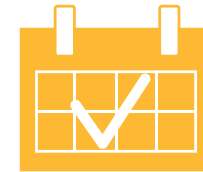
**243\***  
INTERNATIONAL  
COLLEAGUES



**201**  
PDHS



**2**  
INTERNATIONAL EVENTS  
AT THOR PARK



**9**  
REPRESENTATION OF ENERGYVILLE  
ON INTERNATIONAL  
EVENTS AND FAIRS



**78**  
COMPANIES ACTIVE  
IN OUR LIVING LAB



**6**  
EUROPEAN PROJECTS AWARDED  
TO TWO OR MORE ENERGYVILLE  
PARTNERS



**61**  
PUBLICATIONS WITH TWO OR  
MULTIPLE ENERGYVILLE PARTNERS  
IN LEADING MAGAZINES

\*April 2024



# EPILOGUE

## THE WAY FORWARD

Europe is on the right track. In recent years, we have made great strides in terms of energy transition. The share of renewable energy is rising rapidly. We will use less and less energy, partly due to rapid electrification. And user comfort is also growing at a rapid pace. Everyone — and the climate — can only benefit from this. These are good reasons to accelerate the energy transition, and to do so in a way that involves everyone and tries to keep them on board.



For EnergyVille, 2024 already started promisingly, with new developments and visible progress. Not only are we building on the existing THOREAQ houses, but we are also expanding the Open Thor Living Lab even further. With recent investments from the Flemish government, we

launched — together with Thor Park NV and the city of Genk — a new cooperative company around our living lab, which will then be the largest in Europe. It is fantastic to see that our work today is already inspiring others — even far beyond the country's borders. I am already looking forward to the impact that this larger living lab will create in the coming years.

What research breakthroughs will follow in 2024 is hard to predict. But that they will follow, is certain. Because we cover the entire energy landscape and are consistently committed to our eight research lines, we maintain a sharp focus. We pursue innovations that realise the greatest impact in each domain and also increasingly combine knowledge from different research lines to create even more added value. Our extensive modelling tools enable us to make the right

trade-offs. And by continuing to join forces with industrial partners, the financial sector, governments, and citizens, we will strengthen and accelerate the energy transition in Flanders, Belgium, and Europe with pioneering innovations.

How well is EnergyVille performing compared to other European energy knowledge clusters? We will investigate that in a comprehensive benchmark study. I am convinced that we can learn valuable lessons from this to keep improving ourselves. This ongoing pursuit of improvement, innovation, and collaboration remains essential to make the energy transition affordable, reliable, and successful throughout the further course of 2024. We hope that you — companies, organisations, financial institutions, and citizens — will continue to join forces with us for the rest of 2024 to make this a success. Because a powerful energy transition is the way forward!

**Walter Eevers**  
Chairman of the Supervisory Board of EnergyVille







## CONTACT

EnergyVille  
Thor Park 8310-8320  
3600 Genk  
Belgium  
Tel +32 (0)89 39 97 00  
info@energyville.be

## PUBLISHER

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## COORDINATION & COPYWRITING

Helene Claes  
Elisabeth Dutt  
Ann TSyen

## LAYOUT & DESIGN

Nathalie Belmans

## FOTOGRAFIE

Communication Departement EnergyVille  
KU Leuven, VITO, imec, UHasselt, Flux50

