

more
about
Tractebel

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CUTTING EDGE ENGINEERING & CONSULTING

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THIS ISN'T JUST AN ANNUAL REPORT

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- enjoy the video.

Start by watching our CEO statement!
Also check tractebel2017.com for extra stories.

CEO statement

DEAR READER,

Every invention, every improvement, every machine a man has ever engineered, started with imagination, with the desire to create a utopian world. It's exploring what we ideally want the future to be like. Hopefully, you will get this taste of the future by going through our Activity Report. Because that's our mission as an engineering and consultancy company: **shaping the world of tomorrow today as imaginative builders.**

I'm thinking of the construction of new desalination plants powered by renewable energy sources, which will provide drinking water to 2.4 million Tunisians, the possibility to transform Chernobyl's radioactive zone into a huge **solar farm** or the development of Belagavi, a future sustainable, **smart city** for 1 million Indians to live in. And to be even more imaginative, we made a big step towards research and development by welcoming Laborelec, ENGIE's Research Laboratory, in 2017. With the capacity to test **new technologies** and prototype **innovative solutions**, we are definitely looking to the future!


I would also like to thank you, clients, colleagues and partners, for your fruitful collaboration and trust during the past splendid years. It is with confidence that I pass the keys to Olivier Biancarelli, Tractebel's new CEO.

Wishing you all the best,
Daniel Develay, CEO

WHAT'S NEXT IN 2018?

Olivier Biancarelli: "Daniel and his team did a great job! My ambition is to drive a leading company that is ready to anticipate the trends of this complex world, which evolves at a fast pace. In line with ENGIE's strategy, I will focus - on top of our existing businesses - on consultancy services, digital solutions and the development of a fully-integrated urban system, combining energy, water and infrastructure. With a zesty portion of imagination, we are certain to succeed."



 Scan this page with the Layar app & watch our CEO statement with the purpose of our company.

facts and figures

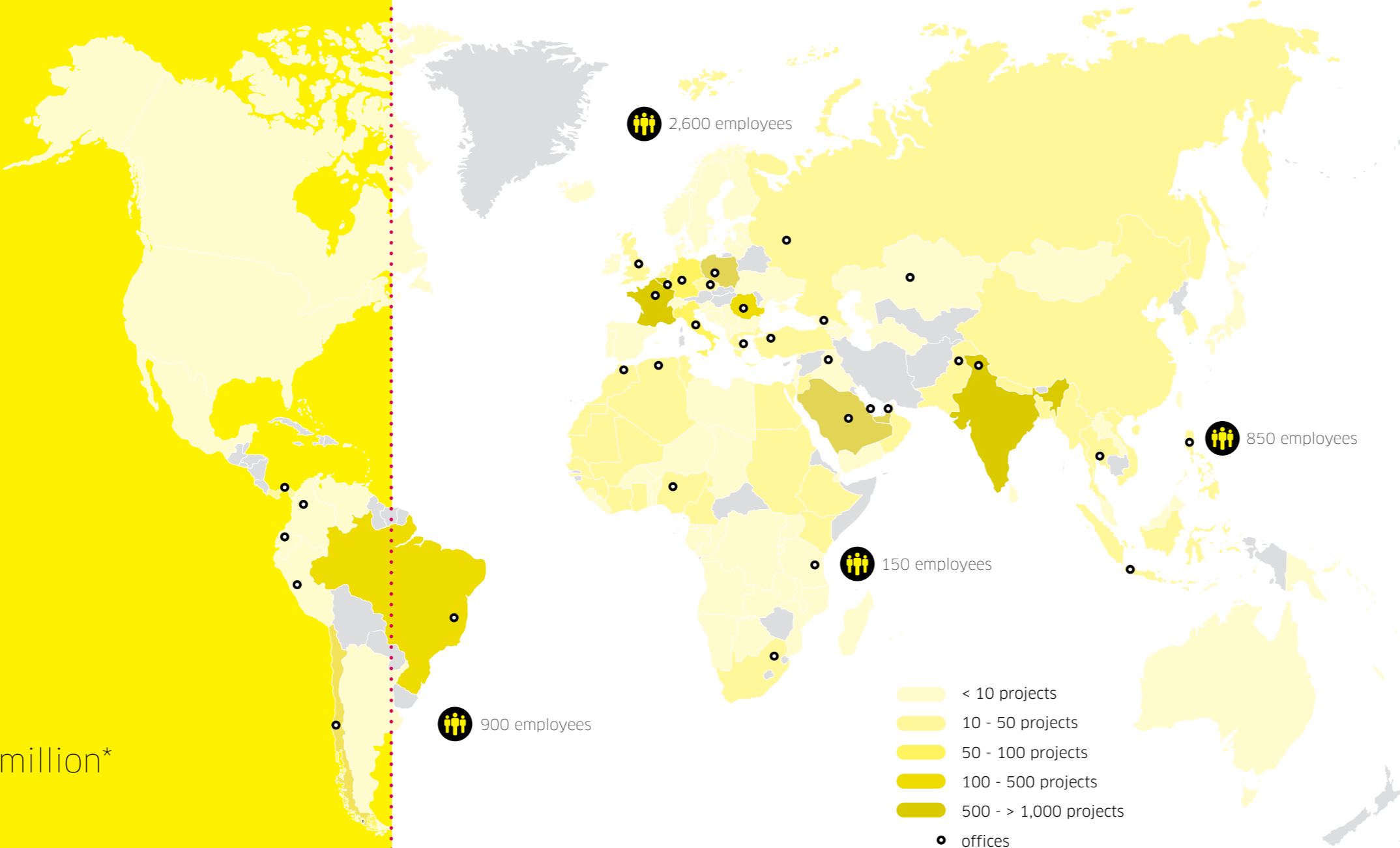
To shape the world of tomorrow, working together with our clients to provide them with first-class engineering and consulting services, that it is our mission. We want to play an active role in the world we live in, by developing solutions to mitigate climate change and its effects, and bringing electricity to everyone.

facts and figures



Turnover
€675 million*

ACTIVITY REPORT 2017



6

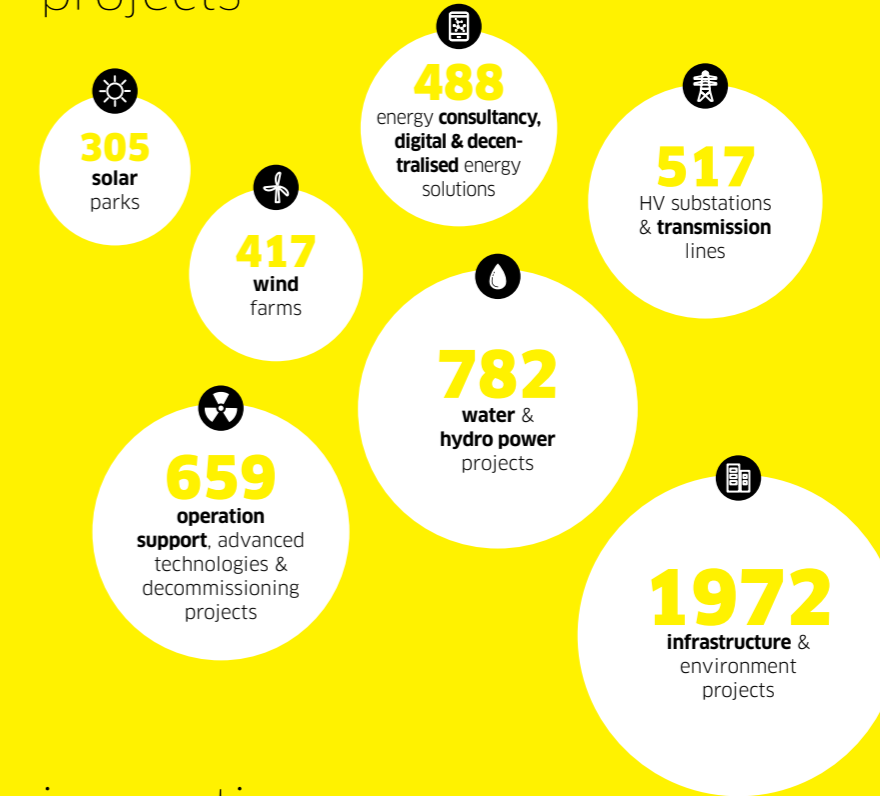
ENR ranking**

- # 2 HYDRO
- # 3 WIND ENERGY
- # 4 SOLAR ENERGY AND POWER
- # 5 T&D AND NUCLEAR

RANKING O EMPREITEIRO MAGAZINE
5 IN BRAZILIAN TOP 500 ENGINEERING CONSULTANCY COMPANIES

Organised by *O Empreiteiro* magazine, an important Brazilian technical publication, it showed that Tractebel climbed three positions, compared to 2016, and won the 5th place in the Engineering Consulting category.

projects



innovation



anniversary

70

Tractebel **France**

20

Tractebel **Romania**

quality & safety

92%

Global Satisfaction Index
92% of clients who responded to the survey declared themselves as satisfied or very satisfied with our services

28

Ethics and Compliance Officers

<1

Frequency rate

107

safety visits throughout 2017

trophies

2

ENGIE Innovation Trophies won in 2017

* Including Laborelec, our Research Laboratory
** ENR = Engineering News Record publishes rankings of the largest construction and engineering firms based on gross revenue. The rankings are generated from projects outside each firm's respective home country.

Beyond 3D

cover story
BIM

Rafael Moraes, Architect and BIM implementation manager, successfully delivered the basic civil and electromechanical design for Alto Maipo's Alfafal hydropower station together with his teams in Chile and Brazil. He explains why engineers should go beyond 3D drawing and designing to get the most value out of data.

BIM is more than a 3D model, because ...

"... an ordinary 3D object is just a shape with a certain volume and colour inside a layer. Like the word itself says: Building Information Modelling is an intelligent virtual model in which information or data sets are embedded. It goes far beyond 3D drawing and designing. In fact, it's a new way of working, a new methodology which allows the engineering and constructing industry to share accurate, up-to-date and digital 3D data in a shared space. As the stages of a project progress you can even lay an additional dimension of data on the project like scheduling information, so the constructor can see how

the plant will appear at each phase, develop the construction sequence and track the progress of the works. We call this 4D BIM. It's also possible to link in cost data which is known as 5D, sustainability, 6D or information related to operation and maintenance, 7D BIM."

BIM brings the extra thing, because ...

"... we can streamline the plant's design by taking full advantage of the model, as we prototype the plant in a virtual environment and get quick feedback. The MEP model communicates directly with the structural drawings, so we can detect inconsistencies accurately at an early stage through the software's algorithms. A beam, a duct or a pipe can be right in the path of pumps and valves. In the past, those clashes were often detected on-site, resulting in last-minute rework, delays and headaches. And thus, extra costs! Now, we can solve those conflicts much earlier, saving precious time and money. Thanks to the 3D model, we can also easily foresee enough space for construction workers and maintenance technicians to safely access the equipment, reduc-

ing the risk of accidents. The comprehensive 3D visualisation is really powerful. The client doesn't have to unriddle a 2D CAD drawing anymore to imagine how the section of a pipe will look like. He immediately gets a clear understanding and good impression of how his power plant will appear, which helps him and us in communicating with the project's stakeholders, making the discussions more transparent and smoother."

BIM allows us to design better structures and to build differently, because ...

"... thanks to BIM, I can connect equipment together as a system and add objects with cut-sheets and specifications. I can create P&IDs, piping and instrumentation diagrams, which connect in a direct and smart way with the 3D model to design and built a power plant in an efficient way. Schedules within the model allow me, for example, to calculate the pipe sizing, and if the pipe layout is modified during the design process, the calculated values are automatically updated in the entire model. This reduces human errors, which is especially interesting when we are dealing

with very complex shapes and structures. In a traditional way of working, I would have to update the values manually, one-by-one, with the chance of forgetting one. The fact that repetitive time-consuming tasks are automated, also helps me to deliver the project faster."

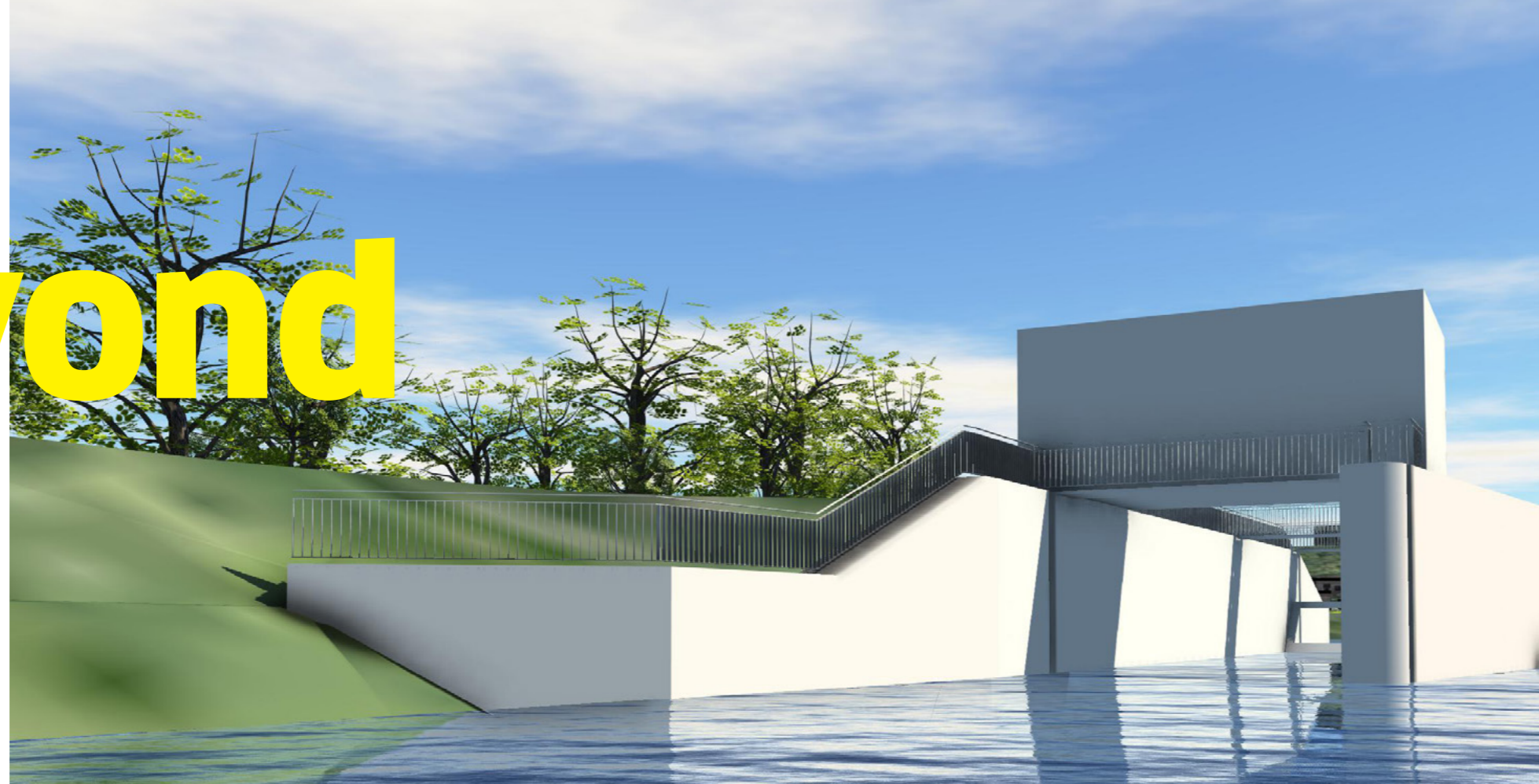
BIM changes the way architects, contractors and engineers interact, because ...

"... it's all about positive collaboration. Information flows freely, so we can all together optimise layouts, align efforts and, in the end, make our designs more efficient. Since BIM is a cloud-based solution, it can be used anywhere and anytime by all parties involved. The engineer's design, calculations and drawings are coupled with the architect's plans, which results in an overall clean vision. Detailed and constant feedback from the early conceptual phase, throughout the complete process lifecycle, brings to life the interactions between the architect, the contractor and the engineer, and helps the project team to better understand the implications of each other's choices. In one word: a win-win-win." ●



RAFAEL MORAES
ARCHITECT
AND BIM
IMPLEMENTATION
MANAGER

Scan this page with the Layar app and walk through Alfafal.



THE RTBF-PROJECT

The RTBF, Belgium's French-language public broadcasting company, is building a new media house to headquarter its 1,300 employees. The new volume of around 38,000 m² is more than a mere office building: it's an innovative audiovisual hub embracing the latest studio technologies.

Luc Leclair, project manager

Tractebel: "Our client would like to open a call for bids at the end of this summer. Therefore, our team of 20 designers is finalising the entire package of drawings and specifications. Different experts from Belgium and Romania are working at the same time on the same models, the same software (Revit®) and the same libraries. BIM is shaped for this purpose, giving us the digital space to move ahead. And this without losing a high level of quality. On the contrary. Like Rafa explained, thanks to the model we can extract a bill of quantities, detect clashes, integrate energy efficiency software, and much more, besides offering beautiful 3D drawings. The final BIM model will be very interesting for the Radio Télévision Belge Francophone, as they will be able to use it for their maintenance and facility management."

ONE-PACKAGE-SOLUTION

"To design a highly complex building like this one, an integrated building process is key. We are responsible for the civil engineering and concrete technology as well as for the MEP (Mechanical, Electrical and Plumbing) design, fire protection, acoustics and energy efficiency. The fact that we can offer a one-package-solution is a plus for architects V+ and MDW Architecture. V+ and MDW Architecture will soon connect our model to theirs, adding a second level of details. As the project progresses, the constructor will build in his richness, with a fully detailed model as a result. A benefit for the project team and the client."

highlights
2017
Latin America





**LARGEST ELECTRICITY SUPER HIGHWAY
STARTS OPERATION**

On 15 December, the Bipolo 1 became operational. The Bipolo 1 is a stretch of the well-known **Belo Monte Power Line**, which transmits electrical energy generated by Belo Monte's Hydro Power Plant in the north to the southeast of Brazil. Instead of the standard 600 kV, the transmission line uses a new technology with an **ultra-high voltage** of 800 kV, crossing four states: from Pará and Tocantins, through Goiás, until Minas Gerais.

We were awarded the contract for the basic and detailed engineering of the civil, electrical and electromechanical works. Our involvement in the project, for four years now, confirms our expertise in **electrical systems of high complexity**.

22 million

About 22 million people will benefit from the Bipolo 1.

2,077 km

With around 2,077 km, it is the largest direct current transmission line of Brazil, and even of the continent.



highlights
2017
Latin America

1

BLOWING IN THE MEXICAN WIND

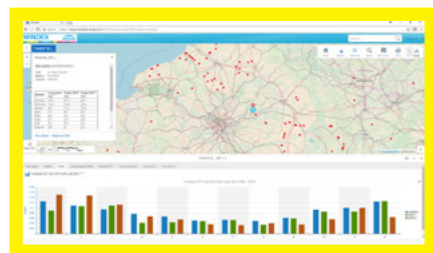
With its national policy, the Mexican government wants to increase the share of renewables in its energy mix to 25% in 2018 and 60% by 2050. The construction of the 52 MW **Tres Mesas 3 wind farm**, in the region of Tamaulipas, contributes to achieving this goal. Tractebel is owner's engineer, leading the procurement process, design review and supervision of construction works.

250,000 people

Once fully operational (foreseen in 2018) the plant's 15 turbines will generate enough clean energy to supply approximately 250,000 people.

WINDEX MAKES HISTORICAL RESOURCE ANOMALIES AVAILABLE IN AN EASY WAY FOR WINDFARMS WORLDWIDE.

Our geographical information system and wind power team developed **Windex**. This geoportal allows **ENGIE** to quickly and effortlessly pre-screen wind project sites anywhere around the world to identify potential zones for greenfield development. The tool provides an initial estimate of the annual energy production through wind energy in just a few clicks.



2

PROTECTING FLORA, FAUNA & SPECIES

To determine the potential impact to flora, fauna and species, we are executing **environmental impact studies** for the Acaray hydroelectric power plant and transmission line-substation Coronel Oviedo, both located in the east and centre of Paraguay. Furthermore, we are elaborating compliance **audits** for several other of ANDE's (Administración Nacional de Electricidad) substations and power lines.

3

BEYOND PURE HYDROPOWER CONSTRUCTION

Just calculate how easily your income will increase if your operating costs stay the same. We are going beyond pure hydro-power construction: our teams provide expert insight into **plant operation support and rehabilitation**. Corpoelec awarded us a contract for the factory inspection of Guri's equipment, also known as the Simón Bolívar hydroelectric plant, which was built in the sixties in Venezuela. For Mantaro in Peru, a multidisciplinary team, consisting of 25 specialists, works on the entire **modernisation and upgrading** of the plant, which is composed of the 700 MW Santiago Antunez de Mayolo station and the 300 MW Restitución station. Finally, we provide technical assessment services to ensure the **dam's safety** and develop geotechnical risk studies for 11 dams all over Brazil, allowing owners to take preventive decisions against dam rupture.

4

IMPROVING LIVING CONDITIONS IN BELÉM

Together with The Pará State Secretariat for Urban Development and Public Works in Brazil, we work on an **infrastructure project**, encompassing sanitation, complex buildings and roads, to uplift the north of Belém, in which some of the poorest citizens live in unfavourable conditions. In all, 2.5 million people in this metropolitan area will benefit from the works that are underway. In 2017, two important projects were carried out: **the Mangueirinho Poliesportivo Gymnasium and the duplication of the Perimetral Avenue**. The gymnasium is part of the Pará Olympic Stadium complex, Mangueirão, the only one in the northern region with a capacity of 12,000 people. The Avenue is the city's economic arterial road, and crucial for its citizens as it improves the supply of goods throughout the country. We provide consultancy services, social monitoring and are responsible for the planning, control and execution of the technical engineering management of the works.



Data generates value. And we can easily make it available through clear dashboards and a simple web browser. By using existing technology and giving it a twist, we add a breath of fresh air.

Tom De Leus,
GIS Expert Sustainable Urban Development

2



3



4



On radical innovation

peter hinssen speaks

Just before his flight to Silicon Valley, the ultimate utopian paradise for techies, we had the chance to catch Peter Hinssen for a chat. Peter is one of the most sought-after thought leaders on radical innovation, leadership and the impact of all things digital on society and business. He lectures at various business schools such as London Business School (UK) and MIT in Boston.



© Rob Clayton

ABOUT PETER HINSSEN
A serial entrepreneur, advisor, keynote speaker and author, Peter is one of the most sought-after thought leaders on radical innovation, leadership and the impact of all things digital on society and business.

Which game changers do you see taking place in the energy or infrastructure world in the coming years? Let's say the uberisation of the sector.

Peter Hinssen: "I think fundamentally, what could be a game changer is the fact that we are going to experience an enormous need to become more relevant to the end-consumer. Customers are looking for new ways to manage their life, making it easier, more meaningful and more fun. Take for example the electrification of vehicles and the role that energy and infrastructure play in that. Let's say I want to drive from my home to Amsterdam with my EV in 2019. I will need to make sure it's fully charged to reach my

destiny on time, without any accidents or delays. Therefore, I am going to need to get to a whole level of intelligence and relevance from an end-user perspective. Today, we get frustrated if our banking application doesn't work smoothly to pay our bills or if our Apple watch isn't synchronised fast enough. Imagine what would happen in a world where energy has to be really tailor-made to the individual... I think the energy sector, and in particular the utility and infrastructure sector, are currently not yet fully prepared to have that kind of intimacy and a smoothness in terms of interface and features. Customer behaviour will be disruptive and an absolute game changer for the industry."

What should energy companies do to remain cutting-edge on the market in 2018 and beyond?

Peter Hinssen: "The number one question for me is which utilities can provide added value. For a long time, we have seen that energy was purely a commodity market, where basically price and competition, and therefore efficiency, played a leading role. I think utility companies will become a lot cleverer in changing the customer experience. I always make the comparison with the telco sector. A few years ago, operators were essential because we couldn't function without telecommunication: they were crucial in our day-to-day life. Now, they have to watch out not to become the dumb pipe, which means to simply provide the network connectivity, transferring data to and from an end-device without capturing value. The emergence of the iPhone or WhatsApp are good examples to illustrate this phenomenon. Apple controls the total customer experience as users directly connect to the iTunes Store for purchasing music, films and applications. WhatsApp and other chat apps have overtaken the lucrative SMS business globally. That's why operators are looking for new services. In Belgium, for instance, a telco company just opened its first fictitious virtual reality world to immerse viewers in intense entertainment by physically letting them take part in their favourite programmes. If energy companies want to be the smart pipe, they will also have to come up with new applications, new services. This is essential. Data, and capturing value out of them, will be the new commodity, the new oil."

Peter, for more than 15 years, you led a life of technology start-ups. If tomorrow you would create a new start-up in the utility sector, what kind of firm would it be or what kind of product would you sell? And who would definitely get a seat in your disruption committee?

Peter Hinssen: "That's a difficult one. Start-ups are springing up like mushrooms. Just as we have Netflix, which is over-the-top, and people say 'Wow! That provides much more relevance!', I see an opportunity to build an over-the-top energy or utility company, where you have all sorts of value-

added services. Not as a mere provider but really as a platform on top of the dumb pipe. I am not a 100% sure of what it is, but I would spend most of my energy trying to figure it out. Because if you do, you probably have a chance of cracking the whole game. For sure, blockchain, algorithms and artificial intelligence which are incredibly interesting in complex and decentralized processes, just like the energy world by the way, will be vital. And if you could get Elon Musk in your board, I think you are set. I wouldn't hesitate for a moment."

I THINK UTILITY COMPANIES WILL BECOME A LOT CLEVERER IN CHANGING THE CUSTOMER EXPERIENCE.

Which pioneer helps you to move forward in your innovation thinking, in your life in general, whether it be professional or personal?

Peter Hinssen: "Well, I get inspired by a lot of people... One of the things I do quite a lot is reading science fiction. Ironically, science fiction is probably one of the best guides for the day after tomorrow now. *The Hitchhiker's Guide to the Galaxy* from Douglas Adams is one of my favourites. And more recently, I have started to read Chinese science fiction, which is really interesting. I have spent a lot of time in China trying to figure out how they are going to reshape the future. The lens that science fiction writers have to look at the future is absolutely fascinating. In that respect, *The Three-Body Problem* from Liu Cixin is terrific. But somebody who really inspired me is Kevin Kelly. He was the founding editor of *Wired* magazine. I had the chance to meet him and to write for him, as he was my editor in chief at *Wired* back in time. The way he looks at the future, I think, is truly, truly fascinating. I definitely put him on the list." ●

highlights
2017
Europe





THE WHITE ISLAND TURNING INTO GREEN

Graciosa island, also known as the white island, is a beautiful piece of land and the second smallest of the nine islands of the Azores. A completely **renewable energy system**, composed of a 4.5 MW wind park, a 1 MW solar farm and a 6 MW battery energy storage system, delivers 65% of clean energy penetration to the island.

Together with our experts of Laborelec, we conducted a due diligence investigation to provide comprehensive information about the risks and rewards of this energy system, as the project had to be completed in a very short period of time. For the **Graciosa hybrid microgrid plant** to be up and running before the end of the year, we brought in cutting-edge project management as well as commissioning support, which resulted in high added value for the client.



Scan this page with the Laya app and discover the island.

65%

A completely renewable energy system delivers 65% of energy penetration to Graciosa island (Portugal), bringing diesel savings up to two million euros per year.

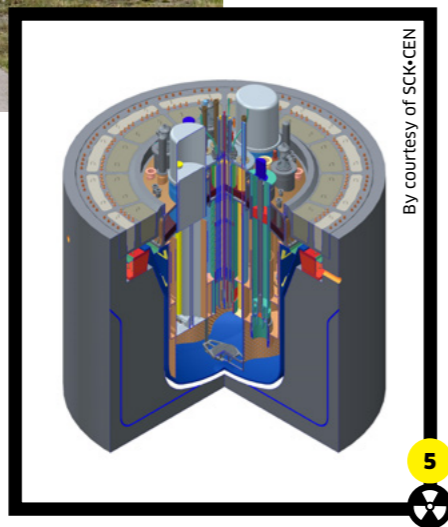


highlights
2017
Europe



The possibility of transforming the symbolic site of Chernobyl into an immense solar plant is an opportunity to turn the page to a bright new future.

Caroline Tjengdrawira,
Senior Project Manager Solar Power



By courtesy of SCK•CEN



© MDW/V+

1

2

4

3

5

6

CLEANING UP THE ZIG LAKE

The Zig lake is one of the most contaminated lakes in Azerbaijan. Wastewater from the surrounding industrial zone has been disposed of in the open water for several years now. The sediment layer at the bottom of the lake is over one meter thick and severely polluted by oil products and heavy metals. Not only the wildlife, flowers and plants, but also the more than one million people living in Baku are at risk of exposure to this **toxic pollution**. That's why we help Tamiz Shahar, Azerbaijan's state organisation, to **clean the Zig lake**. Our mission consists of several survey campaigns, the environmental impact assessment study, and the basic and detailed design for the rehabilitation and redevelopment of the river and adjacent areas.

WHIZZING AT HIGH SPEED

For years, France's south-west has been crying out for quicker connections with the capital and other major cities. On 28 February, the French president inaugurated the new **302 km high-speed line** between Tours and Bordeaux, also known as the **LGV Sud Europe Atlantique**. Since 2011, our team in France has been delivering its expertise to verify the conformity of the line's design and construction, according to the technical and environmental requirements. Valued at around 8 billion euros, the LGV Sud Europe Atlantique is one of the biggest infrastructure projects in Europe. Start buying your ticket from this summer onwards...

2 hours

Thanks to this new train line, it will take only two hours to travel from Bordeaux to the city of lights.

CHERNOBYL IS LOOKING AT THE SUNNY SIDE

Chernobyl's radioactive zone, which is a 2,600 km² of radioactive land that has largely been without human activity for 30 years, could be transformed in a **1.2 GW solar power plant**, enough to 'green' power 200,000 homes. That's the outcome of Tractebel's techno-commercial pre-feasibility study. The exclusion zone that surrounds the former reactor, which blew up in 1986, is a kind of wasteland that is unsuitable for agriculture or forestry. The solar farm offers a huge and attractive opportunity for Ukraine's government to **boost the region's development**, to increase the **renewable energy production**, ensuring sufficient energy supply and to revitalise the dormant grid infrastructure.

DRIVING THE FUTURE

What will we do if the wind is not blowing and the sun is not shining? Due to the variability of renewable energies and the lack of synchronisation of their production with peak load, **flexibility** is crucial for the integration of renewables in the grid. In a broad innovation outlook ordered by the International Renewable Energy Agency, our Centre of Expertise in Economic Modelling, Energy Transition Team and research experts are investigating the interdependence of both technologies and how the market will evolve by 2030 and 2050 respectively. We clearly see that the **decarbonisation** of the power system goes hand in hand with the **electrification of transport**. Different drivers of the EV market, such as smart charging, vehicle-to-grid, dynamic price signals, regulation, mobility-as-a-service and autonomous cars, are being explored by using various models and research methodologies.

AS THE PRICE OF BATTERIES IS DECREASING, ABOUT 100 MILLION ELECTRIC VEHICLES COULD BE DRIVING ON OUR ROADS BY 2030.

TOP-NOTCH NUCLEAR EXPERTISE

The Belgian Nuclear Research Centre (SCK•CEN) is currently developing **MYRRHA** (Multi-purpose hYbrid Research Reactor for High-tech Applications). MYRRHA is the **first prototype** in the world of a **subcritical reactor driven by a particle accelerator**. In this unique configuration, the 'subcritical' reactor core is characterised by the fact that there is insufficient fissile material to spontaneously maintain the fission chain reaction. The reactor has several applications, including a semi-industrial demonstrator to study the efficient transmutation of high-level spent nuclear fuel and radioisotope production for medical and industrial applications. We are supporting the first-of-a-kind design of the **secondary and tertiary cooling system** of this lead-bismuth cooled reactor. Our **specialists** have taken the challenge to ensure that the power generated in the primary system can be removed during all normal operation modes and transients, and that decay heat can be released in accidental conditions. The project, which has been listed as one of 50 projects to make Europe the leader in high-tech research in the next 20 years, is planned to be operational in 2034.

UNLIMITED BROADCASTING

Within a couple of years, the 1,300 employees of the RTBF (Radio-télévision belge de la Communauté française) will move to their new headquarters, a **transparent, modern and innovative audiovisual hub** of 38,000 m². The concept by MDW, in partnership with V+ and Tractebel, was selected by the Board of Directors of RTBF after an international call for projects. We will be responsible for the full civil engineering mission, the mechanical and electrical equipment engineering, acoustics and building energy performance.

This building is entirely designed in BIM. Check out our cover story on page 8.

highlights 2017 Europe



This commercial franchise realises a balanced partnership between three major players in the industry and the LNG business.

Martin Jahan de Lestang,
CEO of Elengy (2017)



© Dominique Perrault

7

EPC FOR ITALY'S LNG STATION

To expand the network of refuelling stations in Italy for Iveco truck customers, CNH Industrial decided to invest in the construction of an **LNG station** in Turin. Tractebel has been in charge of developing the preliminary design for the station, identifying the local regulations and required authorisation process, and building an optimised capex. Since February, we have been responsible for the **engineering and permitting process**. The following phases include procurement, construction, commissioning and start-up, under our full responsibility as **EPC contractor**.

Assisting LNG industrials in better decision-making

Tractebel, Elengy and consulting firm Assetman have signed a **Memorandum of Understanding** to jointly offer a new service to LNG industrials, evaluating the operational performance of their facilities: LNG Asset Management.

This solution, based on the ISO 55001 norm, combines analysis of financial, environmental and social costs, risks, quality, and performance throughout the entire lifecycle of LNG plants. It therefore allows managers of industrial infrastructures to conduct arbitrages, reduce security and commercial risks, and optimise their maintenance plans.

8

AJACCIO'S NEW LPG STATION

The Loretto station guarantees the supply of gas to Ajaccio (Corsica) by storing, vaporising, expanding and mixing propane with air. To meet the latest safety and technical standards, a new LPG station and storage vessels are being built on a **safe site** nearby. We assisted our client in the analysis of the preliminary studies and were appointed **owner's engineer**.

We are monitoring the studies, controlling the equipment and supervising the works, up to the final industrial tests and commissioning of the installation within a period of about forty-one months' time. Our added value is essentially technical and operational, to guarantee the relevance, quality and diligence of the services performed.

9

SAFELY EXTENDING NUCLEAR POWER STATIONS

We have been working on the Long-Term Operation of **Tihange 1**, one of Belgium's nuclear power stations, for about five years now in order to **safely extend its lifespan**. An integrated team, combining national and international expertise, brings in its deep and ground-based reactor knowledge and project management skills to meet the commitments agreed with the Federal Agency for Nuclear Control at the highest level.

We cite the construction of two emergency safety buildings, the manufacturing of a new full scope simulator and the upgrade of the fire detection and protection system. This very challenging and exciting mission will be finished in 2019.

10

THE MOST COMPLEX GROUND INVESTIGATION IN THE UK

We were very proud to be shortlisted for the Ground Investigation Project with a Geotechnical Value of over £500k and for the UK Geotechnical Team of the Year at the prestigious 2017 Ground Engineering Awards, together with our partners Fugro, NuGen and Amec Foster Wheeler.

For more than two years, we have been working on the Moorside project - a proposal to build three AP1000 nuclear reactors on a site near Sellafield - which is probably the **largest and most complex ground investigation** in the United Kingdom and beyond. Our scope of work includes the whole package of geo-engineering services: from the program definition, technical specification, supervision of operations and quality assurance until the interpretation of the acquired data and consecutive risk assessment.

The team's aim was to deliver an integrated site characterisation report:

- from over **300 boreholes** totalling over 16 km total depth;
- **20 km** of wireline logging;
- **120 km** of seismic reflection;
- gathering over **8,000 samples**;
- and undertaking over **50,000** in situ and lab tests.

11

LIKE A GALLOPING HORSE

The emblematic new **Longchamp racecourse of Paris**, designed by the renowned architect Dominique Perrault, will soon welcome the clip-clop of the horse's hooves. The racecourse consists of a large steel-concrete mixed structure designed to ensure exceptional visibility of the track and the transparency of volumes inside the building. The structure is being off-set, level by level, towards the track, in the direction of the race, to create an effect of 'a grandstand in motion, like a galloping horse'. Very large overhangs illustrate the architectural ambition that Tractebel has successfully implemented.

Advanced and complex studies were needed to justify such a structure, based on the latest international experiments in this field, in particular in terms of vibration under the coordinated movements of the spectators. To do this, we used vibration simulation with software adapted to the treatment of non-current dynamic problems.

women
in power

Diversity, stereotyping, gender equality. These are a hot topic today, instilling controversy from time to time. What does it mean to be a woman in our day-to-day (business) life? And, in particular in an engineering world which is mainly populated by men. Three women in power Ariadne Szekut, Cristina Romero and Rashmi Verma give their bold insights.

It's not just a man's business



Ariadne Szekut



Cristina Romero



Rashmi Verma

Could you describe your job in a few words?

Ariadne: "I'm managing the Energy Transition team in the Middle East. At the same time, I'm the point of contact for our clients and try to commercialise our entire range of products: from power system consulting to renewables and decentralised solutions. Every time we get an opportunity, we build a project team based on the best expertise in Dubai, Germany, Romania or wherever our colleagues are located."

Cristina: "As Scrum Master, I form part of the Digital Solutions team in Brussels. I studied telecommunication engineering and have always worked in software development firms, where we used to work with Scrum, which is basically an Agile framework for managing software development. So, my role is to introduce this Agile process, to coach the teams and help them to continuously improve, so they can create more awesome products, leading to happier customers."

Rashmi: "I'm currently heading the Transmission & Distribution department in India. My key responsibilities include the proper execution of our projects, the development of new competences and the mentoring of young engineers to take up enhanced roles and responsibilities."

When did you realise that technology, engineering, science was your passion?

Cristina: "In Spanish, my mother tongue, the word ingeniería derives from ingenio: ingenuity, inventiveness. I have always been keen on inventing, on understanding why the things work the way they do. And I loved maths. At secondary school, I was very good at it. And my older brother is an engineer..."



It's not just a man's business



Yes, she can

On 9 March, the University of Brussels (ULB) hosted an event to attract the next generation of engineers. It positioned the engineer's role as someone who builds tomorrow's society and solves today's problems. One of the key goals of the event was to emphasise that engineering is an equally valid option for women, traditionally under-represented in the profession.

I was very proud to bring my colleagues François-Xavier Bouchez and Isabelle Houtteman and to see how they illustrated our job with passion. I hope that our workshop showed these young people, especially the girls, the magnificent opportunities offered by engineering studies.

Isabelle Hendrickx, Product Director Transmission & Distribution at Tractebel, who supported the initiative, was excited to be back at the university she graduated from.

Rashmi: "I realised that engineering was my passion at secondary school. Although quite a considerable number of women studied science, only a few of us - around 2% at that time - chose for engineering. So, choosing for engineering meant to be very passionate about your course."

Ariadne: "I have been curious as far as I can remember. When I was six, our teacher enjoyed doing science experiments. One day we had to make a coil by using a wire, magnets and a battery. I saw the thing rotating and was amazed, even if I didn't understand why. It was magic! In my family, we also have a tradition of engineers and mathematicians, so somehow, I was pre-destined. At university, I choose electrical engineering and power system studies as a career."

Who has been your greatest influence in business and why? Who helped you along the way?

Ariadne: "Love, passion and commitment have been my natural habitat. My grandmothers and mum - three strong, powerful ladies filled with leadership - taught me to dream big. Always dream big, they say, as it's the only way to have a challenging career. If you dream small, your career will be boring. Once you try and challenge yourself, you'll see that you can succeed. When the management door opened, I went in, even if it was scary and not so obvious at the beginning. The support and the trust from Tractebel to embrace this new position was very important. And last but not least, my team helped me to get there."

Cristina: "I can't mention one specific person, to be honest. All the people I come across, professionally or personally, that are smart, humble and charismatic inspire me."

Rashmi: "When I joined Tractebel in India, I was introduced to some great mentors who gave me the opportunity and the support to take up new challenges besides my traditional engineering skills. The lessons learnt during the last couple of years still help me to face today's challenges. I'm convinced that we have an untapped growth potential on the Asian market even if the energy sector is facing a major transition."

Any observations about the challenges women face that are specific to engineering and consulting firms?

Ariadne: "To be very honest, I don't feel any struggle because of my gender. On the contrary, our charms could even be in our favour, I think. When I moved to Dubai four and a half years ago, I inherited a project from a male colleague. It took some time to gain trust, but once I delivered the technical study report, showing my competences, the respect was there. I'm living in a men's kind of world you see: my colleagues are men, my clients are men, sometimes there's not even a female toilet on a power plant... If you prove yourself as capable as them, you will be accepted. In Dubai, there are so many expats, so many distinct cultures, so many people coming from all around the world, that if you're open, respectful and a dreamer, the sky is the limit."

Rashmi: "Yes, we have equal opportunities in our company. Our expectations, hurdles and accolades are similar. Our growth, both for men and women, is driven by our potential, eagerness and expertise."

WOMEN BRING A DIFFERENT ENERGY TO THE GAME.



Cristina Romero

Cristina: "I agree with Ariadne and Rashmi. I also felt accepted, respected and trusted. Ok, my first team was composed of young guys, none of them above thirty, so they might have thought: 'She's a bit more experienced, let's

listen to her!' I don't see big differences due to the fact that we are women. Luckily. We bring a different energy to the game. Diversity of any kind is a great asset for a team or a company. Since things are changing so fast and we need to do things differently, getting more women on board could bring in this extra flavour."

People often wonder about the differences between how men and women lead. What are your thoughts on that?

Cristina: "In my opinion, regardless of the gender, each person has a unique leadership style. Unfortunately, I didn't have the chance to meet many female managers. And the ones I met played or had to play the male role to a certain extent to get where they were."

IF YOU CAN MEET YOUR DUTIES IN A RESPECTFUL WAY, YOU WILL BE APPRECIATED.



Ariadne Szekut

Ariadne: "This is a tricky question as I have been working my entire life, eleven years now, with men and never had the experience of being guided by a woman. As an engineer, you have to be practical, clear and to the point, as this is what your client and the people you are managing expect from you. I must admit that working with men is quite straightforward and that I enjoy it. In general, if you can meet your duties in a responsible and respectful way, you will be appreciated."

SENSITIVITY DOESN'T EQUAL WEAKNESS OR BEING EMOTIONAL.



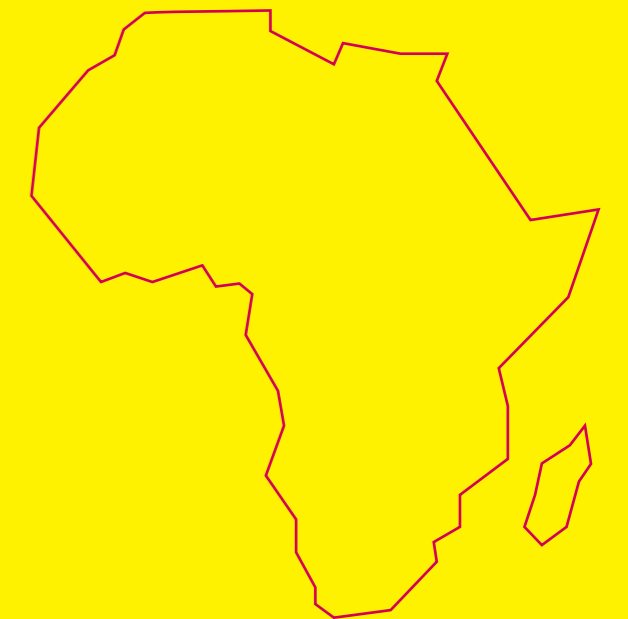
Rashmi Verma

Rashmi: "I believe that women usually lead with this extra touch of sensitivity and acceptability, and that men tend to pinpoint the objectives more. Sensitivity doesn't equal weakness or being emotional. On the contrary, women can be a new generation of strong leaders, if they can adjust the power of sensation while staying focused on the goals. An organisation which incorporates such a leadership style can flourish, as our purpose is not only to do business, but to make the world a better and more beautiful place."

Cristina: "We see that women have indeed strong soft skills such as communication, empathy and perseverance. They can be very passionate and determined to go for the ideas they believe in. Or maybe I feel this because I'm also a woman and we are connected."

Ariadne: "I don't think we should focus too much on a male or female way of leading, but rather on the most appropriate leadership style." ●

On the Girls & Boys Day, which took place on 27 April, three girls and two boys visited our company in Bad Vilbel. The girls learned about typical men's professions and the boys got in touch with typical women's jobs.





THE BIGGEST OF ITS KIND IN IVORY COAST

On 2 November, the **275 MW Soubré hydro power plant** was officially inaugurated. Our mission on the project spanned an incredibly long period, almost 20 years, from the early feasibility studies until the supervision of construction works. For the close collaboration and the services provided during all those years, the Minister for Oil, Energy and Renewables awarded Jean Teyssieux, Tractebel's Director of Hydraulics, the medal of Knight of the National Order of Merit. Moreover, in partnership with AREA Group, we helped our client CI-Energies to certify Soubré as a **Clean Development Mechanism Project** under the **United Nations Framework for Climate Change**.

10%

Soubré, which is located on the Sassandra River, approximately 120 km from the sea, is the biggest of its kind in Ivory Coast and increases the country's electric power by 10%.

highlights
2017
Africa

14 countries

WAPP IS COMPOSED OF 14 COUNTRIES OF WHICH SENEGAL, IVORY COAST AND NIGERIA ARE THE MOST WELL-KNOWN ONES.

1

THE RIGHT TO DRINKING WATER

Today, water scarcity is a major challenge, as 2.1 billion people lack access to safely managed drinking water services. In 2030, 2.4 million Tunisians will drink fresh water thanks to the National Water Quality Improvement Program and SONEDE, which is currently constructing ten **desalination plants**. We were awarded with the evaluation of the first phase of this program, as well as with the feasibility study of the second phase. Furthermore, we performed a **hydrogeological study** and identified new brackish water resources which will cover demand until 2035. Finally, to reduce fossil fuels and their impact on climate change, we investigated and advised the national water company to use renewable energy sources such as solar and wind energy to power the plants. As a result, we have now been awarded with the technical assistance for the realisation of six brackish water desalination plants for over 500,000 inhabitants, along with the necessary infrastructure like boreholes, reservoirs and transfer systems. At least one of these plants will be driven by **wind energy** and will be the first commercial large scale wind powered desalination plant in Africa.

2

SOLAR ON TOP IN THE COUNTRY OF THE PYRAMIDS

Our solar team, which is composed of a wide variety of experts in India, Belgium and Germany, is actively participating in the construction of **Benban solar park**, in the east of the Sahara Desert. We are acting as a **technical advisor**, we are in charge of the detailed engineering and fulfil the mission of owner's engineer for several of the plants. With its 98 million inhabitants, Egypt is one of the fastest-growing countries and the most populous area of the Arab world and is looking for green energy to drive growth and fight poverty. Upon completion (mid-2019) Benban will be the **largest solar farm** in the world with a total capacity of 1.8 GW.

3

STRATEGIC STUDY IN THE EAST NILE

Strategic studies are starting to play an essential role in the development of renewables. In this context, we, Tractebel and Lahmeyer, are executing an **environmental and social assessment analysis** for the New and Renewable Energy Authority of Egypt. The analysis covers the **East Nile region**, an area of 2,200 km², and includes the full scoping stage as well as stakeholder management and public opinion monitoring. The study will result in the identification of the best possible location for the development of **wind and solar parks**. Our services also include training sessions, from technical trainings up to detailed workshops focusing on the environmental and social impact of wind and solar projects.

4

SECURING WEST AFRICA'S ENERGY

To secure the region's power generation and transmission facilities, the West African Power Pool (WAPP) asked Tractebel's Energy Transition Department to make an update of the **Economic Community of West African States Master Plan**. For the Master Plan, we will identify the main challenges and factors affecting utilities in the way they plan, develop and operate their power systems, assess the opportunities and constraints for the deployment of **renewable energies** and will make a list of priority projects. Once completed, this comprehensive study will provide a rational basis for decision making and implementation in West Africa's power sector.

5

360° SOLUTIONS FOR CITIES' CHALLENGES

Do you live in a city? You are not alone. According to the United Nations, 55% of today's world's population resides in a city. **By 2030, almost two-thirds will live in a town**. And 80% of this growth will take place in Africa and Asia. Despite the power of a megapolis, global challenges such as **climate change**, cyberattacks, water scarcity, traffic jams and air pollution are putting pressure on the liveability of our cities.

To engage, discuss, investigate, benchmark and finally develop a strategic city management plan with local authorities, we built the 360° City Scan: a **tool which analyses urban needs** in a holistic way. We differentiate six perspectives - the circular, inclusive, attractive, productive, resilient and connected city - which reveal the underlying principles of how a city works.

In December, we had the pleasure to present the City Scan of **Ghana's capital**, to the World Bank and the Accra Metropolitan Assembly. The presentation was much appreciated, because together we were able to pinpoint some key challenges and suggested corresponding **consultancy**.

1



Countries with limited access to fossil fuels that want to reduce their dependency from the big oil states are looking with verve to renewables, as they will soon become mega-attractive for the desalination market.

Julia Seitter, GKW Consult Project Manager

2



3



4



On 23 October, Joseph Dubois, Product Director Energy System Consulting, presented his paper *Modern energy strategy implementation in Africa - Challenges left in terms of power generation planning and integration of renewable energies* at the Sustainable Energy in Africa Conference in Brussels.

5



© David Plus

As a lecturer working at a university I learned how to speak and listen to my students. Today, the 360° city scan is a kind of guide, which allows my client and me to assess and talk freely about the future development of their city.

Charlemagne Danoh, Business Development Manager



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Charlemagne Danoh, Business Development Manager



5

5

more
resilient

Defeating drought

In most parts of the world drought is a recurring feature of the climate. The last couple of years, though, extreme weather events like floods, heat waves and droughts have been occurring more frequently and with greater force all across the world, causing a devastating impact on the environment, crop yields and the broader economy.

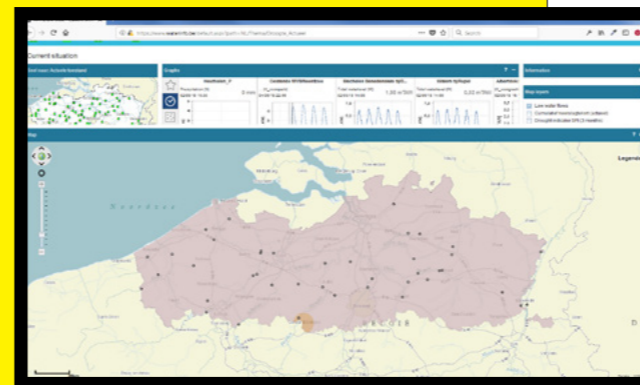
This year, Cape Town was almost the first town running out of water, due to rainfall declines, a non-resilient water supply system and the absence of a long-term water plan. But **Africa is not the only continent** being hit by recurring droughts. In India, for example, drought affecting the Ganges is of particular concern as it provides drinking water and irrigation to more than 500 million people. The Amazon Basin in Brazil, which experienced record-breaking high temperatures and severe drought two to three years ago, could be trapped by a death spiral of deforestation. And China, the United States and Europe are experiencing unexpected flash droughts, with low soil moisture and high evapotranspiration, leading to high risks of crop damage and forest fires. That's why governments, territories and cities have to start writing down **mitigation strategies** and urban resilience scenarios, including adaptation measures to address climate change impacts and supply security to water, food and energy.

The Northern Belgium-story Data and modelling at the forefront

The Flemish government is taking adaptation measures to increase the resilience of northern Belgium. The potential impact of increased rainfall intensity on flood occurrence has been studied quite intensively as a result of the region's history. However, due to the lack of a suitable model, the impacts of droughts and water scarcity remain less tangible. Contrary to what one might expect, Flanders is weighted down by water shortages because of its high population density and degree of urbanisation. Sectors affected are nature conservation, agriculture, navigation, energy provision, etc. During the last mid-century, the **groundwater level shrunk considerably**. Just recently, 2017 spring drought devastated part of the farmers' crops. To fill the hiatus, IMDC (International Marine and Dredging Consultants), an affiliate of Tractebel, has developed a **new drought tool**, combining the best available models for groundwater, soil water and surface water. Thanks to the data coming from soil moisture sensors and open data sets, the model gives better insights in the onset of droughts, both at farmer plots and in waterways. The model is fed with both historical data and climate change projections to identify vulnerable regions and river catchments.

This, in combination with advanced internet technology, results in a user-friendly web application, which allows the Flemish Environmental Agency to follow up and communicate the current drought status, to activate a crisis plan in periods of severe drought, refining measures, and prioritising water-saving behaviours and consumption by sector or region. IMDC is taking the upper hand to establish a reliable **open data ecosystem** together with private and public partners to stimulate innovation, since today's unexploited source of free, widespread data opens masses of possibilities to new solutions for territories, cities and citizens. ●

The new drought tool combines the best available models for groundwater, soil water and surface water.

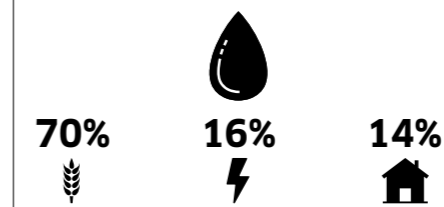


IMDC GIVING BACK TO NATURE

Working with Nature is an international initiative of PIANC (Permanent International Association of Navigation Conferences) to promote a proactive, integrated approach to sustainable navigation infrastructure projects. IMDC, the Flemish Waterways Authorities and the Agency for Nature, won the 3rd prize in the Working with Nature competition at the PIANC World Congress in Panama and received the Certificate of Recognition for the **Kalkense Meersen Cluster, Upper Sea Scheldt project, the design and construction of river training works in the Scheldt estuary** to improve both safety against flooding and navigation with nature-based solutions. The flood risk management project involved the construction of flood control areas along the river, creating opportunities to restore nature: wetland, meadows and reed swamps recreate a habitat for water birds and other species.

2.5%

Just 2.5% of the Earth's water is freshwater, and most is frozen in glaciers and ice sheets. Only about 0.3 percent of our freshwater is found in the surface water of lakes, rivers, and swamps. (National Geographic)



Currently, about 70% of the world's freshwater withdrawals are for agriculture, 16% are for energy and industry and 14% are for domestic purposes. (World Economic Forum)

+3-4°C

With a warming of 3-4°C up to 200 million people could become permanently displaced due to rising sea levels, flooding and droughts. (KPMG)

40%

estimated global gap between water supply and demand by 2030. (KPMG)

700 million people

Around 700 million people in 43 countries suffer today from water scarcity. By 2025, 1.8 billion people will be living in countries or regions with absolute water scarcity. (UN)

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BUILDING TOMORROW'S BANGLADESH

Economic and climatic challenges have long hampered growth in Bangladesh. A new project promises to help make dramatic **positive changes**, with the support from our experts based in the Philippines. Over a period of 10 months, our multidisciplinary team of urban planners and specialists in infrastructure, environment, financial and social development, focused on **plans to improve urban infrastructure** in the two key city regions of Dhaka and Khulna, involving efficient land use, and coordination of mechanisms of various agencies involved in delivering climate and disaster-resilient infrastructure solutions. We are also very grateful to our client, the Asian Development Bank, and wish to further strengthen our twenty years of strong partnership.

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1



The Smart City Mission is the most comprehensive and integrated mission to transform Indian cities into sustainable cities of tomorrow.

Vivek Sehgal,
CEO Tractebel India



2



3



© Jeddah Economic Company



4



Keeping everyone on track. That was my personal goal. But also making sure that a varied group of people feel at ease. That's why I was so proud of being a finalist of the Young Mission Critical Engineer of the Year Award.

Tom McDonagh,
Mechanical Engineer

5



6



1

AN AMBITIOUS SMART CITIES PROGRAM

In June 2015, the Indian government launched its **Smart Cities Mission**, an urban renewal and retrofitting program with the mission to **develop 100 cities** across the country, making them resilient, attractive and sustainable. We prepared a Smart City Challenge proposal for four cities, out of which three made it to the top 100 list. We provide **project management consultancy** for Belagavi, one of the fastest growing urban centres. Our involvement in the project will take five years, with the first seven months of planning, design and engineering, and the remainder as construction supervision and project manager, including components such as the development of intelligent transport operations, water solutions, smart grid and smart metering for electricity, solid waste management, e-governance, etc.

3

IT'S A COOLLY BUSINESS

With approximately 5 million square meters, **Jeddah Economic City** is the construction project in Saudi Arabia. The centrepiece will be the Jeddah Tower, which is planned to be the world's tallest skyscraper upon completion in 2020. The first phase of the project has a built-up area of 3 million m² and an expected demand load of 110,000 ton of refrigeration. Tractebel in Dubai acts as Technical Advisory for the selection of the Design Build Operate Transfer Provider for the delivery of the **district cooling plants**. Up to now we have identified several viable providers, rationalised the plant load to improve future utility rates for the development's tenants and improved the phasing and scalability of the plant design to prevent overinvestment and underutilisation.

5

BEST APPLIED RESEARCH AWARD

In October 2017, our experts Karim Karoui, Romani Fahmi and Kerstin Roscher were delighted to win the **Best Applied Research Award** together with our client Oman Electricity Transmission Company. The award was issued by the GCC Cigre, one of the leading organisations on electric power systems in the Middle East. Our paper *Strategic Development of Wide Area Monitoring on the Main Interconnected System in Oman* studies the interconnection of regional power networks and suggests implementing a Wide Area Monitoring System to increase the observability and controllability of Oman's grid in real time. This year, we have opened a **local branch** in the Sultanate of Oman. A logical step due to our growing number of projects in the region, such as master planning for the country's power generation and transmission through 2030, technical advisory as well as owner's engineer services for various power plants and wind projects, including grid connection studies. We already have subsidiaries and offices in Dubai, Riyadh, Al-Khobar, Doha and Abu Dhabi.

4

ATLAS' CUTTING-EDGE ENERGY EFFICIENT DESIGN

Last November, IsBank's **new data centre** Atlas won the Highly Commended - **Sustainable Project Prize** at the MEP Middle East Awards in Dubai. MEP valorises projects that are designed with sustainability criteria at the forefront, highlighting innovative technologies that have been deployed to create a green environment within the architectural or structural requirements. Moreover, the data centre is the first Tier IV constructed facility certified site in Turkey. And on top of that Atlas was awarded the Infrastructure Scale Out Award by DatacenterDynamics in London.

WITH OUR PARTNER
KPMG WE WILL
PROVIDE THE
SAME KIND OF
CONSULTANCY
SERVICES TO
MILLION-PLUS
CITIES RANCHI AND
GWALIOR.

2

1.8 GWH FOR LAOS

The **Xe Pian Xe Namnoy project** is a 410 MW **hydropower scheme** located on the Bolaven plateau in the southern region of Laos. The project is developed under a public-private partnership framework by a joint venture between Korean, Thai and Lao investors. The project includes the construction of **three dams along the Mekong River**. It will consist of a large storage reservoir, underground tunnels, shaft waterways, and an open-air powerhouse. Our global team of French and Thai engineers will take on the role of Owner's Engineer. We are working on the design review, and we are giving assistance to the supervision of works and the final commissioning.

44,000 m²

RED, a company of Tractebel, was the **lead design consultant** for this 44,000 m² new build seismically isolated data centre facility and responsible for the management and integration of all disciplines including architectural and structural engineering.

6

EMPOWERING PAKISTAN

With 100 million inhabitants, Punjab is the most densely populated province in Pakistan and contains 60% of Pakistan's manufacturing business, with an industrial growth rate of circa 3%. The **current electricity demand** of 3,000 to 5,000 MW is not being met. In view of this challenge, we have been cooperating in the development of the electric power generation capacity together with consulting firm National Engineering Services Pakistan Limited (NESPAK). In a record time of only seven months we completed the mission: from project specification tendering to the assessment of proposals, so the implementation of the **three gas and steam combined cycle power plants** Balloki, Haveli Bahadur Shah and Bhikki could be carried out. All plants are being equipped with six H-class gas turbines.

for a
better world



Going the extra mile

In May 2017, our colleague Nick Vaney travelled to Rwanda to take part in a Muskathlon: an ultimate endurance event – like a marathon – set in a remote area, during which he went the extra mile to raise funds to further the worldwide battle for justice. The adventure in Rwanda was specifically to support Compassion, a global charity supporting children in extreme poverty in various third-world countries.

Rwanda is a country that suffered unimaginable horror and tragedy with the genocide back in 1994, but really has the feel of a place getting back on its feet with hope for the future. “The people there are some of the friendliest I have ever met anywhere”, confirms Nick. Apart from cycling, climbing and running, Nick and his group spent several days visiting the Compassion projects. This included spending time at a child survival unit where mothers, who are unable to support their babies receive aid and education. Not just in how to care for their children, but also in a trade or skill, such as tailoring, which enables them to earn an income, so they can financially support their own families. “It was great to be able to see how the money is spent and that all of it really goes to support those that need it the most. It was an amazing and humbling experience to meet these families, we got to spend an afternoon with one family in their house where five family members lived in and was about the size of the average living room. We taught them how to play the card game UNO and had a really fun time with all three generations of the

family joining in. The most special moment was my afternoon with Ferdinand, the child whom I’m sponsoring and who turned out to be a talented footballer!”

TO RIDE FOR SUCH A PURPOSE, KNOWING THAT OUR EFFORTS WERE TRULY CHANGING PEOPLES’ LIVES, WAS A REAL PRIVILEGE.

The week culminated in an inspiring day, which left Nick awed. “Rwanda is the Land of a Thousand Hills and we cycled off-road through 120 km of beautiful terrain. It was truly the ride of a lifetime along hilly African tracks and trails with spectacular views and kids running alongside throughout the day. To ride for such a purpose, knowing that our efforts were truly changing peoples’ lives, was a real privilege and one of the best things I have ever done!” •



ABOUT NICK VANEY
In late 2004, Nick, a chartered mechanical engineer with over 25 years’ industry experience, set up RED with four colleagues. Today, he has taken on the role of Chief Technical Officer to drive expertise, innovation, and technical excellence within the RED group, part of Tractebel.



OTHER PROJECTS

Helping kids in need

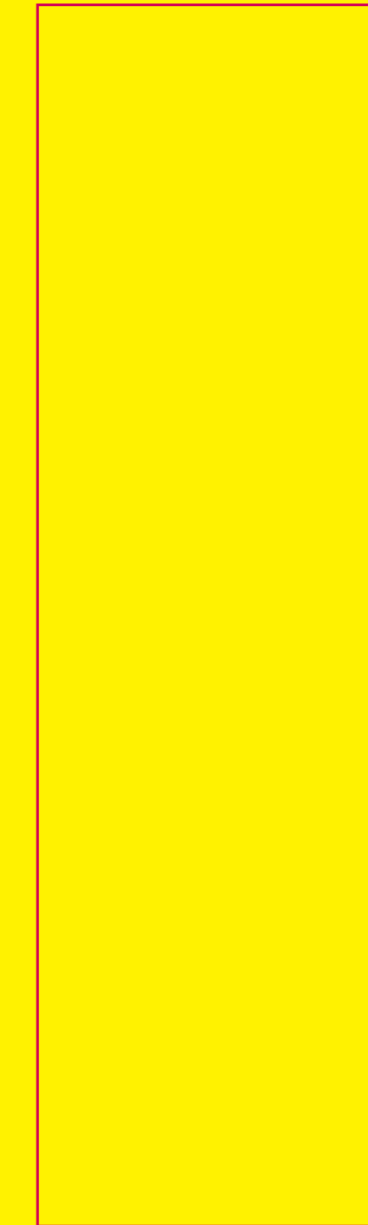
Like we do since many years now, we help charity organisations by sending e-cards. Last Christmas, we supported the Association for semi-abandoned Children and Adolescents of Mundaú in Brazil.

Each day, the Association helps the approximately 110 semi-abandoned children of the municipality of Mundaú, located in the State of Ceará, in the Northeast of Brazil. The children are being taken care of in the Contra-turno School, where they carry out activities like school reinforcement, computer classes, painting courses, carpentry, etc. Furthermore, the children receive two meals per period which, in many cases, end up being their main source of food. The project also raises awareness among families regarding the importance of personal hygiene habits. In this way, the charity workers improve the quality of life and health of the children. Moreover, lectures are organised to prevent the early use of drugs and child prostitution.

A day in the fight against cancer

Relay for Life is a festive event for all ages, centred around solidarity and fundraising for the fight against cancer. On 30 September, 125 Tractebel colleagues, including our CEO, mobilised for 24 hours to fight cancer and raise funds together. The 24 hours symbolise the struggle of every moment led by the patients and their relatives against the disease. It all began in 1985, when Gordy Klatt, an intestinal surgeon, organised the first Relay for Life in Tacoma (USA).

looking
to the future



Innovation
and R&D

looking
to the future



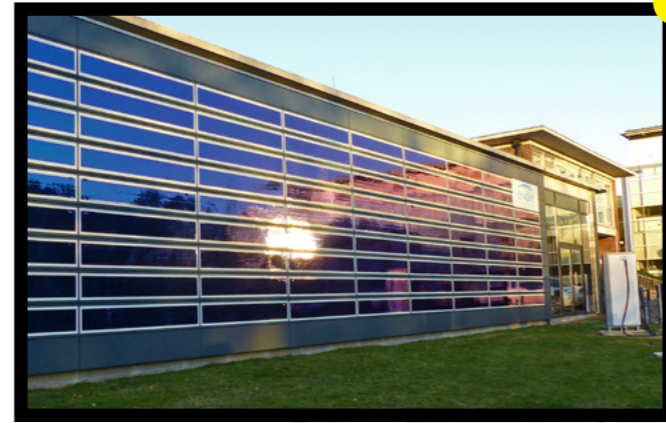
In 2017, we were very happy to welcome ENGIE Laborelec, a leading expertise and research centre in electrical power technology. Drawing on the skills of 240 specialised engineers and technicians, ENGIE Laborelec is active across the whole electricity value chain and backs a large set of customers in the fields of generation, transmission, distribution, storage and final use of electricity, with a particular focus on decentralisation, decarbonisation and digitalisation. By investing in research on promising new energy technologies, including studies on carbon capture and storage, smart energy and cities of tomorrow, we can prototype innovative solutions for the future.

Innovation
and R&D

ACTIVITY REPORT 2017



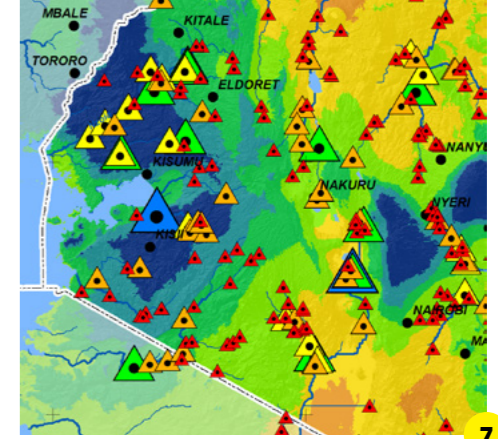
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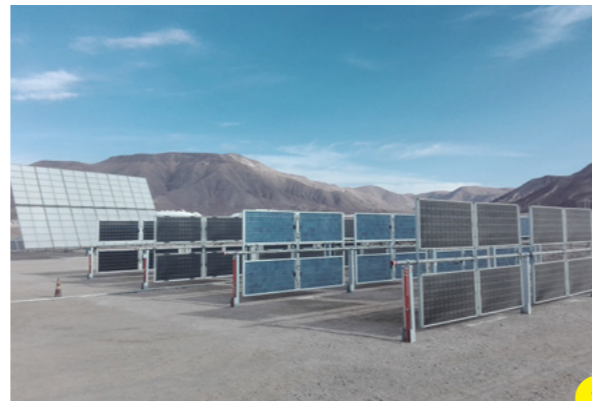
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7

2018 ENGIE Innovation Trophy: Coup de Cœur of the Jury

Scan this page with the Layar app and discover the bifacial solar PV.



2



4

3D printing will ultimately revolutionise the way a technical facility is managed and maintained.

Michael Marique,
Managing Director Laborelec



6

2018 ENGIE Innovation Trophy: Grand Prix Operational Performance



8

1 MAXIMISING REVENUES FROM WIND TURBINES

Operators can maximise the revenues from their wind turbines, saving several thousands of euros per turbine per year, by **correcting yaw misalignment**. A turbine suffers from losses when its nacelle is not perfectly aligned with the wind direction. By combining ground-based lidars with differential GPS sensors, Laborelec developed an innovative solution to correct yaw misalignment and, accordingly, to adjust wind vanes faster and cheaper than ever before. The gains in production can be as high as 5%. Knowing that utilities often operate a thousand turbines, the gain is quickly calculated.

2 BIFACIAL SOLAR PV 2.0 AT LARGE INDUSTRIAL SCALE

What happens if solar PV panels would generate electric power at both sides? Then we could, theoretically, increase the energy production **up to 25%** for the same surface. Today, this is possible by using bifacial solar modules which absorb the

ground reflected sunlight in an optimised way, better known as the albedo (literally whiteness). Bifacial PV also has the advantage of having a longer lifetime than conventional systems thanks to the innovative improvements on the light trapping inside the monocrystalline silicon solar cells and the glass-glass panel structure. Together with ENGIE, Tractebel and Laborelec design, build and test a bifacial solar PV 2.0 farm at large industrial scale in the Atacama Desert in Chile, making it a **unique outdoor laboratory** in extreme conditions. The insights we get on degradation of components, performance, annual yield and flexibility allow us to better support our customers at each stage of their solar energy project.

3 THE WORLD'S LARGEST ORGANIC PHOTOVOLTAIC PROJECT

At its test site in Belgium, Laborelec installed vertical and **flexible organic photovoltaics** integrated into the façade of the building, replacing the conventional building material. In the French seaport of La

Rochelle, the R&D centre took on the task of creating the world's largest rooftop organic photovoltaic project. The organic components of the cells, which are often made of molecules, carbon and polymers, make it possible to mix them with paints, ink or other materials to cover large thin surfaces, giving designers and architects the freedom to play around with transparency and colour.

4 A BRAND NEW 3D PRINTING LAB

On 21 September, Laborelec festively inaugurated its brand-new 3D Printing Lab. The Lab is the result of a productive collaboration with the University of Leuven and ENGIE Fabricom, and is composed of cutting-edge additive manufacturing machines and laboratories for the production and testing of high **accuracy and complex metallic parts**. 3D printing is especially interesting for the production of obsolete spare parts which are out of market, on-site repair for urgent maintenance and the decrease of lead times and transportation costs.

5 OPTIMISING URBAN HEATING AND COOLING NETWORKS

Energy Transition/CEEME (Centre of Expertise in Economic Modelling & Studies), developed NEMO, an algorithm capable of optimising the performance of urban heating and cooling networks, and thus saving energy. NEMO works like a **satnav system** for network management. It is the only digital solution on the market capable of optimising the means of production and hitting annual renewable energy targets at less cost than combustible fuels. The software cuts the daily primary energy consumption of heating and cooling networks by 3 to 5% in France and internationally.

6 RENEWABLES STABILISING THE GRID

In a world in which energy is becoming ever cheaper, the value of a reliable grid will become as valuable as the energy itself. Renewable energy sources, mainly wind and solar, which are known to be a stress factor for the grid due to its variability, can actually help to stabilise the grid by providing

essential balancing services, called ancillary services, usually provided by conventional power plants. In a **first-of-its-kind test** in Latin America, Laborelec collaborated with First Solar to demonstrate, with a 141 MW PV plant in Chile, that renewables can provide essential ancillary services for grid balancing such as fast frequency regulation and fast voltage regulation. High capacity for increasing grid flexibility through renewable power plants was shown.

7 SHERLOCK: A POWERFUL SPATIAL ANALYSIS TOOL

Finding new attractive energy production sites is a time-consuming, costly, laborious process: engineers have to scan through topographic maps, travel the world to detect interesting locations, crunch numbers and data to figure out the potential and, finally, determine the best design. This is particularly the case for hydropower, as disparate parameters such as inflow, reservoir regulation and transmission, have to be taken into account to assess the site's potential. That's why we developed Sherlock, a pow-

erful spatial analysis tool, which generates an exhaustive and semi-automatic **inventory of renewable energy sites** based on open data, modelling, algorithms and computing technologies. Sherlock's first mission, the identification of 16 Kenyan mini-hydropower sites with a combined power capacity of more than 380 MW, was completed successfully.

8 COMPANY VALUES THROUGH GAMIFICATION

The only constant is change, Heraclitus, a Greek philosopher said. At Tractebel, we believe continuous learning, opportunities for personal development and intrapreneurship, networks and new leadership styles are worth to combine our efforts on. HR, Communication and our business departments chipped in with ENIGM4, an innovative digital game to foster remote collaboration around the world. This disruptive **online escape game** brings our colleagues, often thousands of kilometres away, together to work virtually and cross-borders to experiment our company values for common success. ●

For our Excom members a book can be, just like a partner, an inspirational, wise and constant guide through life. Hopefully these books can inspire you. Pick out your must-read for this summer.

WHICH INTERESTING BOOK BROUGHT YOU TO THE EDGE OF YOUR SEAT IN 2017?

excom

DANIEL DEVELAY
CEO

Le miracle Spinoza
Frédéric Lenoir

"It relates the life of Baruch Spinoza and gives a clear, understandable analysis of the Ethics, the masterpiece of the 'prince' of philosophers."



BRIGITTE BOCQUÉ
CHIEF HUMAN RESOURCES AND QHS OFFICER

The Underground Railroad
Colson Whitehead

"A gut-wrenching reflection on the fundamentals of racism and a magnificent political pamphlet which helps understanding the way the American Society was built and still evolves today. Reading 'The Underground Railroad' challenges everything you thought you knew about human beings and history!"



MARC FRANCHIMONT
CFO

The Art of Meditation
Matthieu Ricard

"Since things are going so fast, it becomes almost a public health requirement to take a step back and think about our consciousness and emotions."



ERKAN TEKIRDAGLIOGLU
CHIEF OFFICER HYDRO

Together is Better
Simon Sinek

"This fable inspires the reader to ask for help, and helping the one in need, the one who asks. Fulfilment comes when we live our lives with purpose. And everything is more enjoyable when we share this purpose with someone else."



CHRISTIAN PIERLOT
CHIEF OFFICER NUCLEAR

The forgotten half of change
Luc De Brabandère

"This excellent book relates how changes in perception are indispensable for achieving greater creativity."



SABIEN VERMEULEN
CHIEF LEGAL, ETHICS AND COMPLIANCE OFFICER

War and Turpentine
Stefan Hertmans

"This New York Times best seller tells the true story of the author's grandfather as painter and soldier during the First World War. In the year marking the 100th anniversary of the end of the Great War, the horrors of the trenches of Flanders Fields remind us that no conflict can be solved by violence, war and the loss of lives."



MARTIN SEEGER
CHIEF EXECUTIVE OFFICER GERMANY AND ASSOCIATED TERRITORIES

Blackout
Marc Elsberg

"A thriller about a power failure in Europe with dramatic consequences. It should remind us about the fact that the energy world is complex and fragile."



MARC LEPIÈCE
CHIEF EXECUTIVE OFFICER BELGIUM AND ASSOCIATED TERRITORIES

What Google would do?
Jeff Jarvis

"The book is written like a manual for survival and success in today's internet-driven marketplace. The singular 'laws of Google' are decrypted to extract management principles, new behaviours and conceptions to drive innovation."



SAMY BENOUDIZ
CHIEF EXECUTIVE OFFICER FRANCE AND ASSOCIATED TERRITORIES

Sapiens, a brief history of humankind
Yoel Noa Harari

"This somewhat scientific book explains in simple words how our human ancestor conquered the world, and as such had a massive impact on all other species and the surrounding environment."



HEINI DIRIX
CHIEF OFFICER INFRASTRUCTURE AND ENVIRONMENT

The fifth discipline
Peter Senge

"It's my favourite book. The fifth discipline teaches you how to come up with auto-sustainable solutions that do not create new problems tomorrow."

ANNE HARVENGT
CHIEF STRATEGY, M&A, COMMUNICATIONS & CSR OFFICER

The first 90 days
Michael D. Watkins

"Transitions are a critical time for leaders. Missteps made during the crucial first three months in a new role can jeopardise or even derail your success."



MICHAEL MARIQUE
MANAGING DIRECTOR LABORELEC

The day after tomorrow
Peter Hinssen

"Peter explains how to survive in times of radical innovation. It's all about the talent, the mindset and the technologies we need to maximise our chances of survival."

RICHARD WILHELM
CHIEF OFFICER POWER & GAS

Germany 2064
Martin Walker

"A fictive world in the year 2064. A thought experiment on how our future could look like, how to ensure growth and prosperity for the future and, as a consequence, its impact on our social life."



CLAUDIO MAIA
CHIEF EXECUTIVE OFFICER LATIN AMERICA

Leaders eat last
Simon Sinek

"The book invites you to imagine a world where everyone wakes up inspired, feels valued and has a notion of fulfilment. I think this is truly possible and I have renewed my faith in this after reading it."

GILLIAN-ALEXANDRE HUART
CHIEF OFFICER ENERGY TRANSITION

ted.com

"Whenever I had some free time the past crazy year, I watched a couple of Ted Talks. Make sure to listen to Lewis Pugh, Paul Tasner or Dan Pink. I had the chance to meet Lewis Pugh in person and got captivated by the simple takeaways from his pioneering swimming projects, showing how fragile the world is."



BERNARD GILLIOT
CHIEF OFFICER GLOBAL BUSINESS DEVELOPMENT

The Hidden Life of Trees
Peter Wohlleben

"An astonishing book. The author brings us closer to and lets us discover, in a compelling way, the world of trees. Those social creatures who talk to each other and warn us in case of danger."

