

hypower

by Voith Hydro — N° 31

p. 10

Voith and AXPO on the
shape of things to come

p. 20

A hydropower portrait of
Indonesia

p. 32

HydroSchool: industry
training goes global

How hydropower is transforming one of the world's largest archipelagos

Powering Indonesia



Editorial



Global demand for renewables is growing; particularly in developing markets, which have experienced some of the largest shifts in clean energy investment. As a reliable, stable and proven technology, hydropower is ideally positioned to deliver sustainable solutions. Digitalization is also continuing its rapid evolution and creating new possibilities. The current challenge is how to determine which digital developments have a place in the new renewable landscape – and why.

As an industry leader with a rich history of technical expertise, Voith Hydro has long been invested in exploring these topics. This edition of HyPower offers insights into our approach, from state-of-the-art platforms, forward-thinking collaborations, intelligent OnPerformance.Lab solutions to the globalization of the HydroSchool training program. Also in focus: how innovative Small Hydro design has helped bring power to remote parts of Indonesia and Kenya. Enjoy the issue!

Uwe Wehnardt
President & CEO, Voith Hydro

Content

Zoom

- 04 A new end corona protection concept offers reliability and robustness

News

- 06 Surface technology certification milestones and hydropower development in Africa

07 innovate

State-of-the-art robotics

- 08 Simplified and unified

The new MyVoith platform delivers a seamless online experience

- 10 Shape of things to come

Voith Hydro's CTO and forward-thinking client AXPO discuss digitalization and the future

- 14 Intelligent collaboration

Exciting digital development at the OnPerformance.Lab



Facing industry transformation and exploring new opportunities – globally, digitally and regionally

17 transform

Introducing Emilie Lavoie

- 18 On the move

What Voith Hydro's charismatic new CSO has in store

- 20 Hydropower in Indonesia

A journey through Indonesia and the Voith Hydro projects contributing to its renewable energy mix

27 reflect

The IHA on sustainability

- 28 A history of success

Reflecting on 40 years of effective teamwork with KenGen

- 32 HydroSchool goes global

Cutting-edge industry training with big plans in mind

- 35 Out of the box

The fascinating world of phytoplankton – the rainforest of the ocean



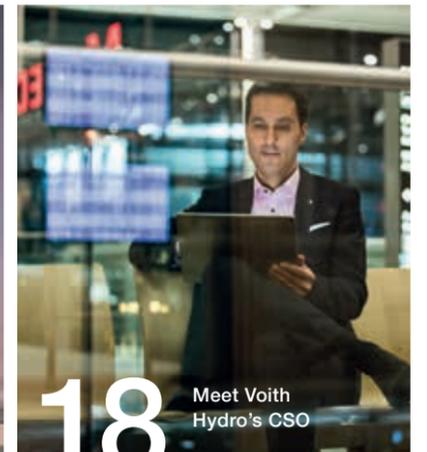
10

Voith Hydro CTO and client AXPO on the key topics, trends and developments shaping the industry



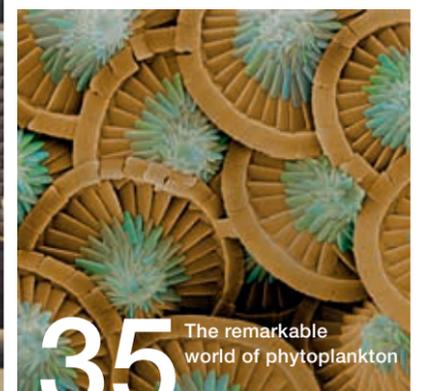
20

How Voith Hydro's innovative solutions support renewable energy in Indonesia



18

Meet Voith Hydro's CSO



35

The remarkable world of phytoplankton

Robust and reliable

As a key factor in stator winding reliability, robustness is a critical consideration in stator bar design, particularly for generator units within the 1,000 MVA class.

In developing its new end corona protection (ECP) concept, Voith Hydro eliminated intermediate steps in the manufacturing process by applying ECP tape over the ground wall, prior to vacuum pressure impregnation (VPI).

This simplification has not only reduced the risk of failures, but also significantly improved the stator bar robustness in operation, without hindering performance. As a result, the new stator bars deliver considerably higher winding reliability, contributing to the greater availability and performance of the entire power plant.

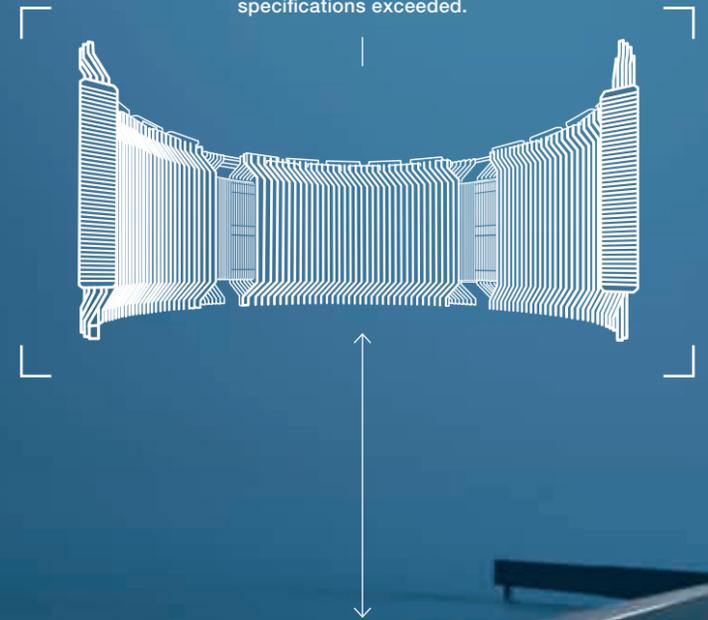


New end corona protection concept

ECP tape is applied before VPI, reducing the risk of failures and improving robustness.

The new design balances multiple thermal, insulation and economic aspects to deliver optimal performance in operation.

Requirements of all relevant international standards and client test specifications exceeded.



News

A quick round-up

A world first

Voith Hydro in Heidenheim became the first company in the world to meet a new international quality standard in surface technology: the FROSIO-CP Certification. Surface coatings and corrosion protection for components that come into contact with water are crucial quality and safety factors and important topics within the hydropower industry. In receiving certificate number 0001 from FROSIO, one of the world's leading certification bodies for surface treatments, Voith has achieved an important milestone and is now working with optimized and externally certified knowledge of these technologies.

Compact and maintenance-friendly

The Small Hydro power plant, Storr Lochs, in Scotland is celebrating more than a year of reliable operation after undergoing an extensive modernization. As part of the upgrade, completed at the end of 2017, Voith equipped the 2 MW power plant with two turbine control units, featuring a unique compact design. This was achieved by utilizing a servo-hydraulic linear-drive closed-loop differential pump (CLDP) concept developed by Voith Turbo – a Voith division specialized in power transmission. The design, which does not require an additional accumulator or piping and can operate with a very low volume of hydraulic fluid, offers easy installation and maintenance. Further, because the units could be preassembled, implementation and commissioning efforts were reduced, delivering significant savings.



**Storr
Lochs**
=
**innovative
design**

**2 MW Francis
turbine units**
Low volume of
hydraulic fluid
allows for
environmentally
friendly, safe
operation.

**Compact unit
concept based on
proven Voith Turbo
CLDP design**
Water flow
regulated through
adjusting turbine
blades.

**HyPower
is online!**

Following the digital
30th edition of
HyPower, all of the
articles from your
favorite hydropower
magazine are now
also available at



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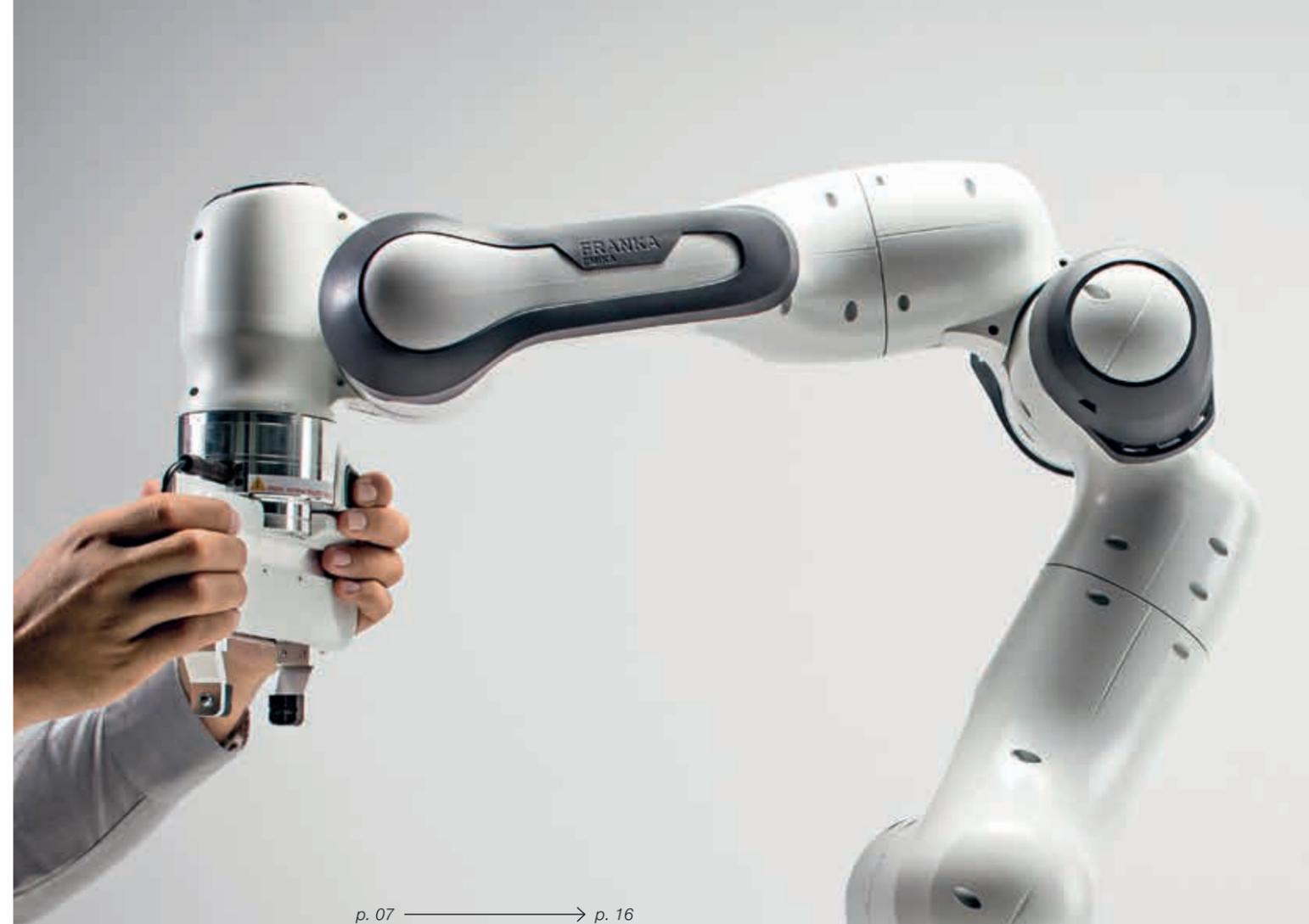
The latest from Africa

Voith has won the order for the extensive refurbishment and modernization of the Nangbeto hydropower plant (65 MW), located on the Togo-Benin border. The modernization work, to be carried out during normal operation, is to be completed in 2022.

Further south, more than 50 industry representatives met for the inaugural Zambian Small Hydro Summit, organized and hosted by Voith. Participants welcomed the opportunity to discuss Small Hydro potential, at a time when Zambian authorities are collaborating with the GET FIT Zambia program to create a framework for the development and implementation of Small Hydro projects.

**“Currently,
Nangbeto is the
only power
plant simultane-
ously supplying
Togo and Benin
with renewable
energy. We are
proud to make
this plant fit
for the future.”**

Heike Bergmann
Senior Vice President Sales Africa, Voith Hydro



p. 07 —————> p. 16

innovate

A closer look at the latest generation
of technological innovations

Introducing Panda

Compact, white and sleek, Panda makes an immediate impression. However, the robotic arm provided by Voith Robotics (a joint venture between Voith and Franka Emika) has much more to offer than just impeccable aesthetics.

Engineered to achieve sensitivity, agility, human-like dexterity and the ability to learn and master various and repetitive tasks, it represents a new generation of out-of-the-box robotic solutions. As a natural addition to Voith's automation competence, it is also a powerful proposition for customers, across different industries, who are looking for ready-to-use and affordable ways to optimize their production processes and environments.

The newly launched MyVoith platform is simplifying, unifying and optimizing its digital services to provide customers, partners and suppliers with state-of-the-art user experience and functionality.

Digitally interconnected

Simplified and unified

Harnessing the power of digitalization, Voith has brought its digital applications, services and tools to one central location – <https://my.voith.com>.

The brand-new MyVoith platform, which will replace the existing Voith customer portals, consolidates the company's digital services behind a single login, to deliver a seamless, homogeneous and user-friendly experience.

"MyVoith is the next logical and systematic step in our digitalization strategy," says Felix Holzer, Head of E-Business Operations at

Voith. "It has the goal of providing innovative solutions and improving productivity through digital services." The platform delivers powerful digital content in a clean, responsive design that can be tailored to the specific needs of users. In doing so, Holzer says, it offers Voith customers the perfect opportunity to exploit the potential of digitalization in daily business operations. At a time of rapid digital evolution, MyVoith provides a unified, simple and convenient online environment for the industry of today and tomorrow.

MyVoith dashboard

A single login grants access to the MyVoith dashboard, delivering a consistent user experience to all of Voith's digital services. Once signed in, users can personalize the area, by selecting apps and tools, to suit their specific needs. The clean, intuitive design offers an overview of features such as messages, notifications and a calendar, as well as a range of industry apps. As a further benefit, the platform has been developed as a responsive web application, compatible with a range of smart devices, to allow easy use on the go.

App Zone

Through the App Zone, registered MyVoith users gain entry to a selection of industry-specific applications. Initially, users will have access to 19 service applications from different Voith Group Divisions. These will include asset management solutions, self-service applications, Industrial Internet of Things (IIoT) solutions and webshops. More apps will continue to be developed and added to MyVoith in reaction to industry needs.

OnCumulus

Exploiting the full potential of data, Voith has also integrated its industry-leading IIoT platform, OnCumulus, into MyVoith. The addition will allow users to utilize the power of value-driven data intelligence to control state-of-the-art IIoT applications from the global platform. When using OnCumulus, and across MyVoith, customers will also rely on the highest industry standards in privacy and security.

Contact

In order to provide access to Voith specialists, irrespective of time zone or region, the MyVoith platform will also serve as a central point of digital communication. All digital contact with Voith, including OnCall – Voith's 24/7 hotline and remote diagnostic support – will be easily available for customers who require expert advice, assistance or exclusive, personalized information.

Big data, cyber security and digital twins – Voith Hydro CTO, Dr. Norbert Riedel, and Head of AXPO's Hydro Division, Jörg Huwyler, sit down to discuss digitalization and the future.

That digitalization will define the hydro-power industry of tomorrow is certain. What shape it might take is not as clear.



Dr. Norbert Riedel
Chief Technical Officer at Voith Hydro

Jörg Huwyler
Head of Hydro at AXPO

Voith Hydro and Swiss energy company AXPO have joined forces to ask the big questions and lead the industry toward a brave new digital world.

Why digitalize together?

Dr. Norbert Riedel: When we speak about digitalization, we speak about future opportunities for hydropower. We don't know all of the details yet, but we know that it is gaining momentum. Direct interaction and exchange is extremely important and for that we need customers who want to join the journey, like AXPO.

Jörg Huwyler: We have a great deal of

curiosity: What does digitalization mean? What potential does it hold and how can we utilize it? When we started these discussions, Voith was already relatively far into the topic. We were convinced by their ideas and wanted to work with people who shared our curiosity. We felt it was something we could cultivate together.

How do you go from where you are, to where you want to be?

Huwyler: This is exactly what we don't currently know. We are trialing things, but we don't have a precise definition of what we want to achieve or how the

finalized process will look. That is the project: to identify opportunities and define an approach.

Riedel: Digitalization brings entirely new experiences; something a digital approach must consider while also addressing the needs of the workforce. Through this process, we are trying to understand as many sides as possible, to develop a solution that can react to different requirements, while nevertheless combining them in one digitalized product.

Huwyler: An important aspect for us are costs. If we are to invest in →



digital tools and solutions, we have to know their value. To reach this goal, we will spend 2019 exploring which approaches and propositions make sense. Only then can we make a decision about what we want to use, what we don't want to use and what needs more development before we use it.

Workforce management applications are a certainty. Digitalization offers more streamlined and efficient processes, remote possibilities, better networks and sophisticated communication channels. The rest, like asset management and the powerplant itself, leaves me a little skeptical about what can be done and how useful it might be. Ultimately, digitalization has to deliver tangible benefits.

Riedel: I'm very optimistic that we will go further in the direction of a digital

“We are trying to understand as many sides as possible, to develop a solution that can react to different requirements, while nevertheless combining them in one digitalized product.”

Dr. Norbert Riedel
Chief Technical Officer at Voith Hydro

twin. We know how accurately we can draw on figures to develop projections of a plant's immediate future, so this is something that should work well.

Why is a digital twin so compelling?

Huwylar: Currently, we perform maintenance and regular inspections periodically. Digitalization delivers data to compare and contrast and allows us to do calculations that come much closer to determining risk. We want to develop this area so that we don't have to open the machine and – even if an anomaly is detected – have the intelligence to make an accurate judgment.

Riedel: The digital twin – a virtual replica of a physical asset – gives an appraisal of the present situation and offers the possibility to play out different future scenarios. We just have to

address operational planning considerations. Voith can develop the technical side but AXPO holds the information about how and why a power plant runs. Here, we are faster and more effective when exploring the topic and gathering feedback together.

What are the challenges?

Riedel: In the past we always delivered products; if we built a turbine, we installed it and then carried out periodic service activities on site. When we speak about a digital twin, we have to ask: where would it be located? Another question: how much intelligence can be local and how much should be centralized? The current trend is to connect local power plants to a cloud system for further analysis.

Huwylar: For me there are two elements of digitalization that we need to address. The first is the networking, being made possible by modern technology. The second is big data, which isn't limited to power plants and requires intelligent evaluation. We didn't have these before, so we have to ask questions we haven't resolved yet.

Cyber security is also a big topic that goes beyond hydropower plants. There are some concerns about hackers and what a breach would mean but, equally, introducing too many restrictions could make working difficult. Ultimately, some small risks will remain, but I think we can find a way to manage it.

Riedel: Cybersecurity is a top priority in all of our digitalization activities. When we connect a power plant to a cloud system, for example, it can be done with a data diode – a unidirectional network that only allows communication from the plant to the cloud.

Let's talk gadgets: which fit into the new digital world?

Riedel: Some technologies, like tablets,

offer opportunities to streamline processes and support the workforce. Others do not. This is also a part of the journey: to find out which could work. For example, VR glasses could be used to simulate an upcoming plant activity or perform staff training. The question is: is that useful?

Huwylar: From my perspective, VR glasses could find a place in plant design optimization. Inside the plants, I could really picture drones. One could fly to a water catchment to identify an obstruction and take pictures. I see huge potential.

Riedel: Drones are a good example of how plant owners and suppliers can define the best use of new technology. They are already in use, and I think we will see increased applications in the next three to five years. I can also see robotics becoming more involved. A typical characteristic of digital development is the bringing together of different perspectives and ideas to create entirely new possibilities. Open dialogue and cooperation are imperative, and this is working well with AXPO.

I'm really looking forward to trying out the possibilities together.

“We were convinced by the ideas Voith had and felt that this was a topic we could cultivate together. We wanted to work with people who shared our digital curiosity.”

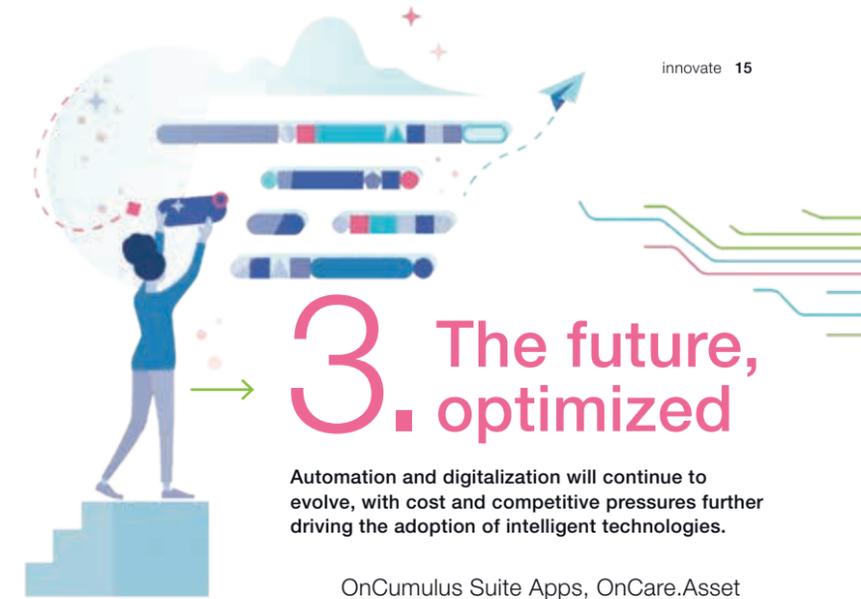
Jörg Huwylar
Head of Hydro at AXPO





1. Specialists now

Diagnostic experts, data scientists, developers, and technical- and sales-focused leadership teams support the journey of each client.



3. The future, optimized

Automation and digitalization will continue to evolve, with cost and competitive pressures further driving the adoption of intelligent technologies.

OnCumulus Suite Apps, OnCare.Asset and OnCare.Health Hydro. "The new digital service layers support the journey of our client. Independent of where they are, we step in with our digital services and lift them to the next level," Lochschmidt says.

More than 40 customers are currently connected remotely, while six power plants are connected online and streaming data daily. "That means we can see what the operator sees, take control, and walk through the data and configuration to give in-depth guidance," Weber explains. Health assessments, which take advantage of monitoring and control system data, offer customers a basis to reduce maintenance costs through big optimization potential. Advanced analytics, based on artificial intelligence and mathematic models, are also being used to perform predictions and identify anomalies. "This will allow us to better plan overhauls on a real-conditions basis and detect failures early," he says. "Our client will benefit not only from reduced maintenance costs, but also reduced standstill times."

COLLABORATING ON PERFORMANCE

As digitalization continues its onward march, the OnPerformance.Lab unlocks the true potential of hydropower plant data.

2. Tasks in development



A series of collaborations between clients and the OnPerformance.Lab delivered important insights.



Maintenance and overhaul planning optimization emerged as a key area of interest and development.

Tasks in development

Innovation takes collaboration. Knowing this, Voith engaged its customers, through a series of phone interviews and workshops. Afterwards, the first clients agreed to take part in collaborative pilot projects, which are still underway. As part of these, Voith experts are working with customers to analyze

"We've done our homework, we did the research, and we now have a much clearer understanding of what customers are after," says Dr. Paul Weber, Technical Lead OnPerformance.Lab at Voith Hydro, speaking about the collaborative process helping to shape the exciting new project. "We have customers

who are willing to direct us in what they actually need. Now it's on us to deliver."

Specialists now

"Our OnPerformance.Lab team currently consists of full-time diagnostic experts, data scientists, front- and back-end developers, and technical- and sales-focused professionals" says

Jörg Lochschmidt, Vice President Digital Hydro and Manager of the OnPerformance.Lab. The core team, which will continue to evolve, focuses on four service layers: hydro expert support, health assessments for Voith core equipment, data analytics and data security, which are backed by products such as OnCare.Acoustic,

4. Prognosis on screen



OnCumulus
The platform provides a secure continuous streaming and storage data hub for customers.

OnCare.Health
Sensitive measuring systems produce data, such as rotation speed, power, water level and gate opening, which is exchanged with the OnPerformance.Lab for analysis and interpretation.

OnCare.Acoustic
The sound monitoring system continuously streams acoustic data to the OnCumulus platform, where machine learning algorithms alert the OnPerformance.Lab team to anomalies.

OnCare.Asset
OnCare.Asset provides maintenance process control to ensure the optimized management of machines, plants and processes through advanced systems and solutions.

and interpret data and refine the OnPerformance.Lab offering. A key theme to have emerged is the need for maintenance and overhaul planning optimization. Customers expressed interest in predictive capabilities for smart, targeted scheduling, to help avoid unnecessary stoppages and reduce costs.

“Hydropower plants are fully automated already, from an operation point of view, but the maintenance part still happens on a scheduled, knowledge basis,” Lochschmidt explains. “Our customers want to have more transparency, especially when planning overhauls. OnCare.Asset provides the basis to manage the process. The question is how to use data to create relevant recommendations. This is where we jump in with the OnPerformance.Lab.”

Another critical area is data security. “From the point of plant connectivity, the technology is there. The main concern is that it’s not secure enough, so the majority of customers prefer a lightweight step,” Weber explains. As such, refining and automating the OnPerformance.Lab web interface to enable easy data-set upload has been an important part of the collaboration.

The future, optimized

“In the first year we aim to have 20 power plants connected online, where we perform health assessments and system diagnosis on a continuous basis,” Lochschmidt says, confident that automation and digitalization will continue to flourish. He predicts that a combination of costs and competitive pressures will drive adoption of more intelligent technologies.

p. 17 —————> p. 26

transform

Insight into the people and technologies shaping the future of hydropower

Engineering change

Inspired by Voith’s unique brand of innovation and efficiency, Emilie Lavoie followed the company all the way from her home in Montreal, Canada, to Heidenheim, Germany. Now, as an active part of Voith Hydro’s dynamic R&D department, she utilizes her technical expertise to continue to ensure Voith’s technology leadership. “In being a part of hydropower development, I like to play an active part in transforming the world. I am just one engineer in a bigger team, but together we can change things for the better.”

Emilie Lavoie
Project Engineer, Voith Hydro

Pragmatic, result-driven and client-oriented, Voith Hydro's charismatic new CSO is often on the go. Without skipping a step, he speaks about where he came from and where he's planning to take Voith Hydro.



On the move with Markus Rieck



Voith Hydro's new CSO, Markus Rieck, at Munich's Franz Josef Strauss Airport.

What do airports, high-level strategy, marine engineering, business acumen and kitesurfing have in common? Markus Rieck. Voith Hydro's new Chief Sales Officer, and the board member responsible for market development and product management, has a diverse set of skills that reflect the needs of a rapidly changing industry. "This is a fantastic time to be joining Voith and driving exciting topics like digitalization, while supporting and developing key growth markets such as Southeast Asia and small hydropower," he says, easing back into a chair at Munich's Franz Josef Strauss Airport, from which he will fly to his next customer visit. Rieck, who spends as much as 60% to 70% of his time traveling, is dedicated to making himself available to customers all over the world.

Although he spends most of his travel time in Southeast Asia, a key growth market where face-to-face interaction is important for business, he remains connected to Europe. "The two markets are very interesting," he says. "Europe is geared towards modernizing and optimizing existing plants, whereas emerging growth markets in Southeast Asia present incredible opportunities for brand-new project development."

Luckily, an understanding of individual market needs and opportunities underpins Rieck's illustrious career. The CSO, who holds a degree in naval and marine engineering as well as business administration, has always maintained

a balance between technical, managerial and financial aspects. His experience within the energy industry, particularly in the renewables sector, features not only a range of roles at global companies, but also esteemed university, government and official-body collaborations. "One of the skills I believe will come in useful in this role, and secure better results for our customers, is the organization of financing for renewable energy projects," he says. "It's a complex area and there are many highly skilled people involved, in both the public and private sectors."

Traveling in the right direction

One of Rieck's main responsibilities at Voith Hydro is to identify, prioritize and

develop the most important industry trends. As a technology enthusiast who regularly conducts feedback meetings with key account customers using communication technologies, he does not hide his passion for further digital development.

"We are working hard on innovations in the digital services space," he says. "Speed and efficiency are the benefits we are applying to our digital initiatives, like the remote analytics and diagnostics in the OnPerformance.Lab and the management concept, OnCare.Asset. It's a top priority for us to develop products and services with which our customers can manage their

hydropower plants more effectively – and cut costs at the same time."

Growing industry interest in small and medium hydropower as well as hybrid renewable-energy projects are also on Rieck's radar. This is where his experience with government bodies, financiers and other nontechnical groups will undoubtedly prove invaluable.

As the boarding call sounds and Rieck prepares to continue his journey, one thing is certain: he and Voith Hydro are traveling in the right direction. _____



In transit with Markus Rieck

- Favorite airport:**
Singapore Changi
- One item you can't fly without:**
Books
- Traveling pet-peeve:**
People with insane hand luggage
- Window or aisle?**
Aisle
- Favorite pastime:**
Kitesurfing

"This is a fantastic time to drive digital initiatives, while developing key growth markets."



INDONESIA: A land of clean energy potential

Pusaka Landscape
Abundant rainfall feeds the many rivers in the Cianjur Regency.

As one of the world's largest archipelagos, Indonesia has enormous renewable potential, but also faces considerable geographical and administrative challenges. In delivering its innovative hydropower solutions, Voith Hydro has illustrated its commitment to the country's clean-energy sector.

_____ Natural and urban, densely populated and sparse, abundant in rainfall but experiencing dry seasons, Indonesia presents an interesting paradox. It is home to some of the world's last uncontacted tribes and most remote locations, but also its most populated islands. More than 80% of the country's current energy mix comes from fossil fuels, yet it has enormous clean-power potential and an ambitious renewable-energy target of 23% by 2025.

Currently, Indonesia's total power generation is estimated to be 56.5 GW, with renewables representing just 12% of the energy mix. However, according to Abhishek Mehta, Country Manager for Voith Hydro Indonesia, the Indonesian appetite for power is growing, with demand expected to increase by 6.42% per year, offering an opportunity for renewables. "It is estimated that there is currently about 8 GW of economically viable undeveloped hydropower potential," he explains, adding that the need to commercialize inexpensive domestic power sources, such as hydropower, is becoming key for Indonesia's economic development.

"By far the most inexpensive solution, in terms of costs per kWh of electricity delivered, is hydropower, which currently supplies 11% of the country's electricity each year," he says. Eka Satira, CEO of energy supplier PT Medco Power, confirms that hydropower will be an important part of Indonesia's future energy mix. "Indonesia is blessed with lots of rivers that can provide renewable energy; hydropower will play a very big role in the country," he says.

Supporting renewable development

Despite the potential, a host of barriers stand in the way of Indonesia's hydropower development. For one, the remote locations of many sites pose technical and fiscal difficulties in connecting to the national transmission grid. "Obtaining financing for →

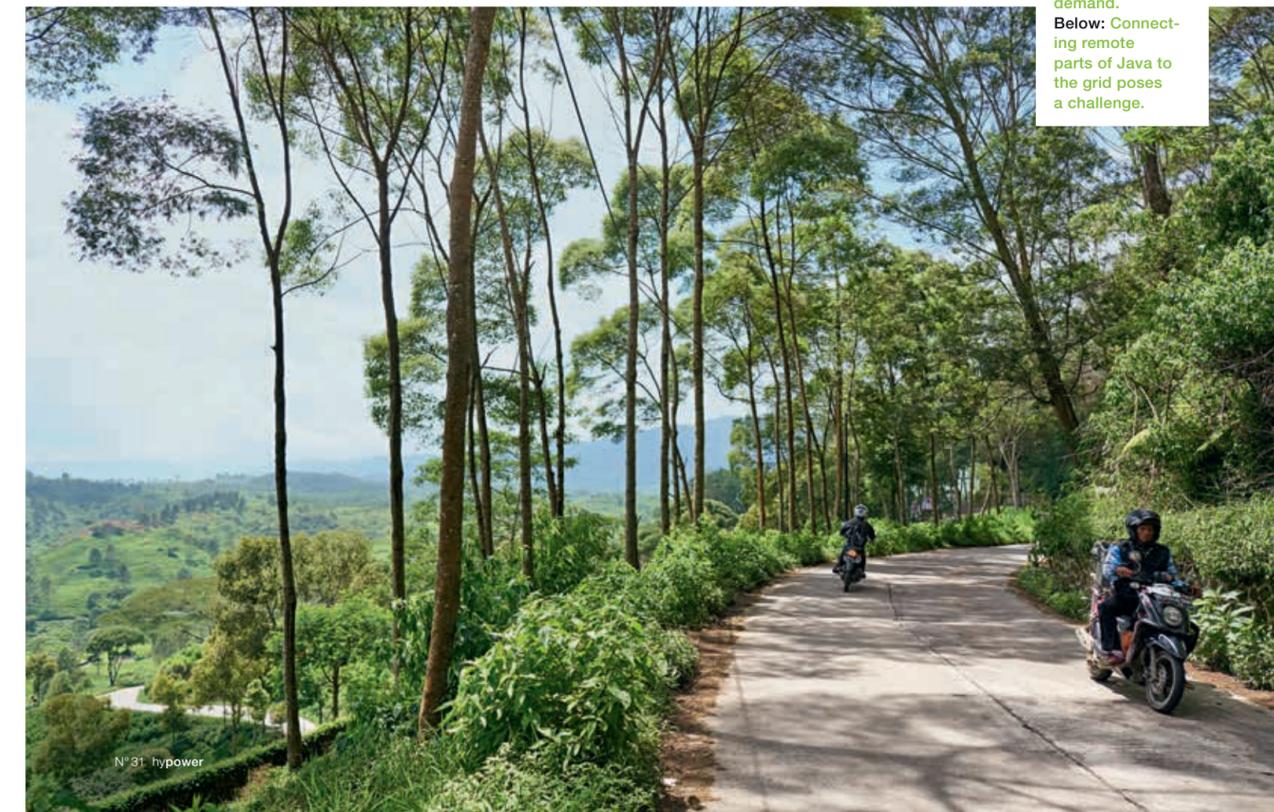
“

Indonesia is blessed with lots of rivers that can provide renewable energy.”

Eka Satira
CEO at PT Medco Power



Above: Densely populated Indonesian cities, like Jakarta, are experiencing a growth in energy demand.
Below: Connecting remote parts of Java to the grid poses a challenge.



Pusaka 1
Seasonal changes in the quality of water led to a modification in unit design.



1
Pusaka 1
Customer: PT Medco Power, Indonesia
Location: Cianjur Regency, West Java Province, Indonesia
Units: 2 horizontal Francis turbines
Head: 155.4 m
Output: 2 x 4.4 MW
Project duration: 2013-18

capital-intensive projects, and administrative hurdles, can also be significant," adds Mehta, "with dozens of permits and approvals required for the construction of a hydropower plant, which is complicated by challenges in coordinating federal, regional, provincial and local authorities."

In effect, while over 90% of Indonesia's installed hydropower base comprises large hydro, with projects in constant development, Small Hydro is an attractive and viable option – particularly where funding is concerned and infrastructure already exists. According to Mehta, Indonesia currently has as many as 2,200 dams, primarily used for flood control and irrigation, which

Indonesia's first StreamDiver



In 2019, Java's Small Hydro plant Serayu is set to receive Indonesia's first ever StreamDiver. The compact, modular and highly reliable design of the unit – six of which will be incorporated into the existing weir infrastructure – eliminated the need to create a diversion channel at the site, making it an attractive and fiscally viable way for the plant to capitalize on its hydropower potential.



"There is currently about 8 GW of economically viable undeveloped hydropower potential in Indonesia."

Abhishek Mehta
Country Manager at Voith Hydro Indonesia

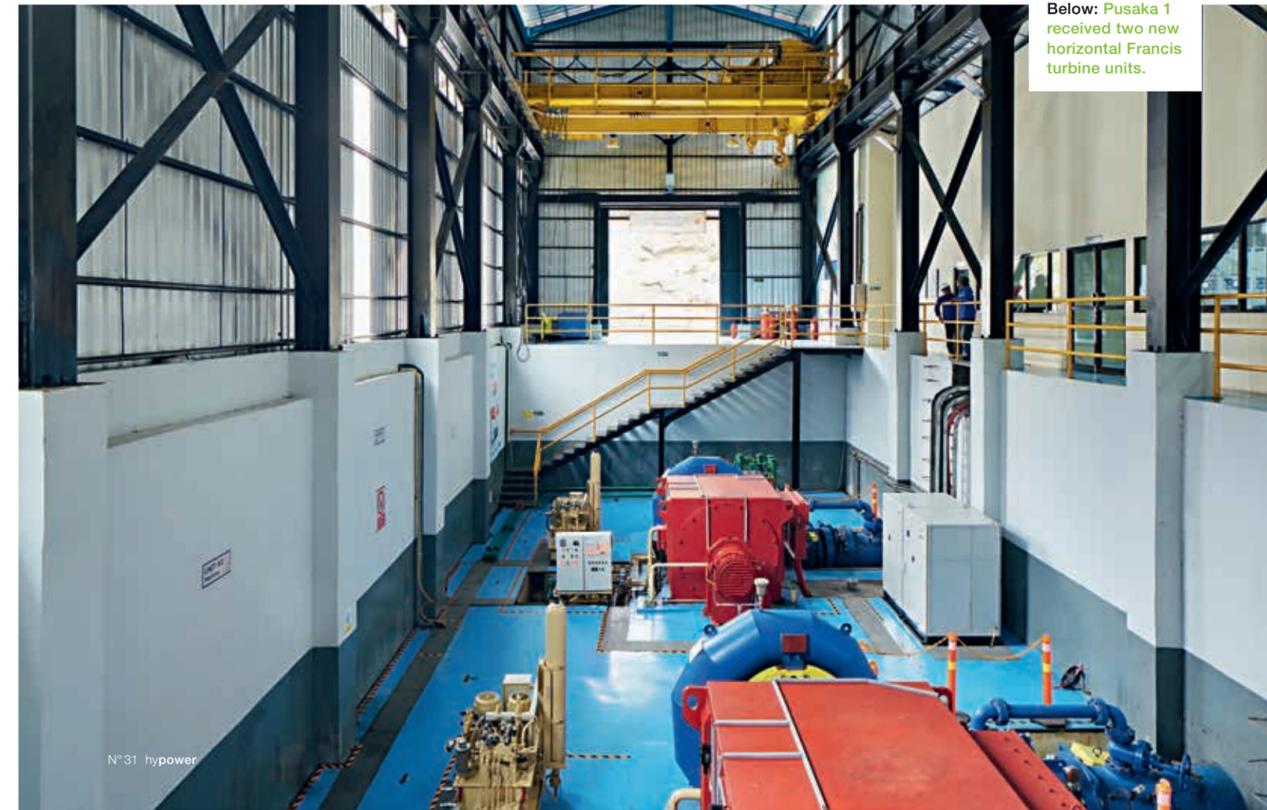
could lend themselves to Small Hydro and Mini Hydro solutions – potential Voith is helping to realize.

Voith's first Indonesian project, took place almost 100 years ago with the delivery of turbines for the Ciiedil Hydropower Plant (0.5 MW) in 1921 – a plant that is still generating electricity today. More recently, Voith has been involved in a range of activities, including the installation of Indonesia's first StreamDiver units (to be completed in 2019) and three hydropower projects that were commissioned in 2018. "Indonesia is a growing economy," Mehta says. "Voith's wide range of customized systems and services are perfectly suited to meet the country's growing demand for a stable and reliable, efficient and clean source of power."

Powering Pusaka
Lying 700 meters above sea level, surrounded by mountains, the Cianjur Regency, on the Indonesian island of Java, receives abundant rainfall. Located in its least densely populated →



Above: two PT Medco Power staff operate the Pusaka 1 system provided by Voith.
Below: Pusaka 1 received two new horizontal Francis turbine units.





Above: PT Tanggamus Electric Power staff walk through the Semangka powerhouse.
Below: The Semangka run-of-river hydropower plant as seen from above.

2 Semangka

Customer: PT Tanggamus Electric Power
Plant location: Tanggamus Regency, Lampung Province, Sumatra, Indonesia
Units: 2 vertical Francis turbines

Head: 110.73 m
Output: 2 x 28.3 MW
Project duration: 2014-18



southern part is Pusaka 1. In 2013 Voith was awarded the contract for the complete electromechanical equipment of the Small Hydro plant, including generators, automation technology, all associated systems and two horizontal Francis turbines, which had to be adapted to suit the unique Indonesian climate.

“The original cooling water design was an open-loop system,” explains Cahyono Kusumo Aji, Deputy Manager at Pusaka. “According to our team, this had some drawbacks. During the rainy season, the condition of the water is not particularly good and would have seriously affected our operations.” In collaboration with Voith, the design was changed to a closed-loop system. “We monitor the water quality, and the unit is not reliant on whether it is the dry or wet season; there’s always good-quality water available,” he says. The mechanical installation of the turbine began in late 2017 and, after comprehensive commissioning and reliability tests, Pusaka 1 went into commercial operation in May 2018.

Success in Semangka

On the opposite side of the country, in the Tanggamus Regency on Sumatra – the largest island entirely located in Indonesia – another Voith Small Hydro project was commissioned. Voith equipped the run-of-river Semangka Hydropower Plant with two new generating units, comprising vertical Francis turbines. “Voith Hydro has extensive experience in hydropower, that’s why we chose them as our provider from water-to-wire,” says Fahmi Shalas, Operation Manager at PT Tanggamus Electric Power, speaking about the project, which went into



“Voith’s wide range of customized systems and services are perfectly suited to meet the country’s growing demand for a stable and reliable, efficient and clean source of power.”

Abhishek Mehta
Country Manager at Voith Hydro Indonesia

commercial operation in the second half of 2018.

“Our Semangka hydroelectric power plant is supplying high-quality electricity without interruption,” says Yoo Sung Jong, President Director of PT Tanggamus Electric Power. With a total output of 56.6 MW, Semangka is contributing to reliable, stable and clean electricity and bringing Indonesia a step closer to meeting its renewable-energy targets.

Small Hydro solutions for big challenges

In the northern part of Sumatra, in the highlands of the Simalungun Regency, where rubber, cacao →



Sumatra Landscape
The area near Karai boasts tropical forests and complex river systems.

Giving hope: a Semangka school project



The Francis turbines of the Semangka hydropower plant were not the only object in the area to be modernized. As part of a corporate social responsibility initiative, dubbed “Asa” (the Indonesian word for “hope”), Voith also turned its attention to the local Printis School – the only source of education for children in the area.

The school, located in Umbul Seno village, seven kilometers from the Semangka powerhouse and

attended by 22 students, aged seven to nine, was ill equipped and lacked basic infrastructure. Through the Asa initiative, Voith provided new tables and chairs for the teacher and children, as well as a large wooden cabinet for books and supplies. The initiative created a bond between Voith personnel and the local community, strengthening collaboration on the Semangka hydropower project.

and tea plantations dominate, the Karai Hydropower Plant was experiencing a host of problems. Both Francis units of the Small Hydro plant faced erosion and cavitation issues, a reduced power output, and heavy leakage through the shaft seal. “We had a problem with affordability, which drew us to modernize our plant to a better quality of product,” says Mohammad Riza Husni, President Director at Bumi Investco Energi, parent company of PT Global Hidro Energi. “We wanted to work with Voith because of its turbine and generator expertise.”

Voith used its HyService solutions to replace the runner, minimizing cavitation and erosion, while also replacing the complete distributor assembly and thrust relief pipes, and delivering a new shaft seal design. A special coating was also applied to turbine parts. The modernization, which commenced in late 2016 and was completed in mid-2018, secured a 25% increase in revenue. “I’m very satisfied with the service and hope to work with Voith on future projects,” Riza says.

Also seeking solutions, albeit to a problem of another nature, was Serayu. The site, located in the Nanyumas Regency in central Java, faced spatial and financial limitations in the development of its hydropower potential. By utilizing the modular design of its StreamDiver unit, Voith was able to use the existing Serayu weir infrastructure without compromising functionality, to drastically reduce civil efforts and

costs. “The StreamDiver is a complete submerged turbine, which means the entire unit, including the generator, operates under water. This opens up many new possibilities – something we could capitalize on in Serayu,” says Stefan Reich, Voith Hydro Business Development Manager, adding that six StreamDiver units, with a combined output of 4.5 MW, will be installed at the site by the end of 2019.

3 Karai 13

Customer: PT Global Hidro Energi
Plant location: Kariahan Usang Village, Simalungun Regency, North Sumatra
Units: 2 Francis turbines

Head: 155.65 m
Output: 2 x 4.44 MW
Project duration: 2016-18

4 Serayu

Customer: PT Daya Mulia Turangga
Plant location: Banyumas Regency, Central Java Province, Indonesia
Units: 6 StreamDiver units

Head: 7.57 m
Output: 6 x 762.7 kW
Project duration: 2018-19

p. 27 —————> p. 34

reflect

Technologies and approaches that demonstrate how the industry is evolving

Advancing sustainable hydropower

The new Hydropower Sustainability Guidelines on Good International Industry Practice, published by the nonprofit International Hydropower Association (IHA) and governed by the Hydropower Sustainability Assessment Council, define expected sustainability performance for the hydropower sector across a range of environmental, social, technical and governance topics. The IHA has spent more than 20 years steering the hydropower industry toward more sustainable development. As a platinum corporate member of the IHA, Voith has been a key participant in these efforts, contributing to workshops, information sessions, events and initiatives. In doing so, the company supported the IHA in advancing sustainability strategies, guidelines, tools and standards. In addition, Voith has helped to unite renewable-energy sectors in hybrid-solution development, while continuing to address the industry’s carbon footprint and the need for worldwide access to electricity and clean water.



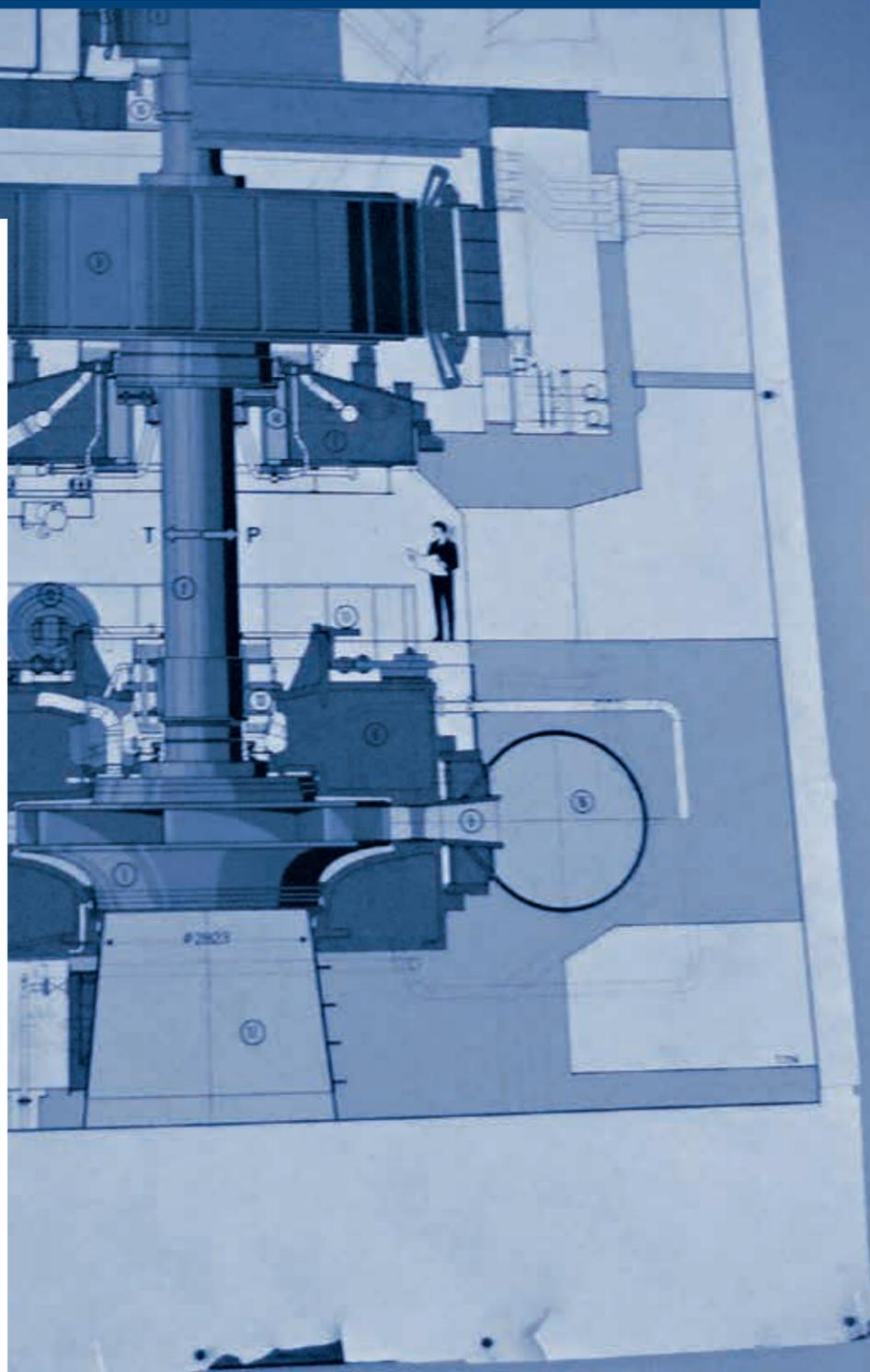
www.hydropower.org

PARTNERSHIP in action

An extensive modernization of the Wanjii Small Hydro plant is the latest milestone in a rich 40-year partnership between Kenya's largest electricity producer and Voith Hydro.

_____ The inclined elevator is loaded and ready to traverse the steep dam of the Wanjii Reservoir. The Small Hydro plant located on the Maragua River in Murang'a County, Kenya, is receiving an extensive modernization after being in operation for more than 60 years. The structural conditions are such that all components have to be transported in this unconventional way. Voith is leading the project, which involves the replacement of the plant's turbines, generators, control technology and electromechanical equipment and will see the plant achieve an output approximately 20% higher than before.

Luckily, in undertaking the challenging project, Voith holds three main advantages: a longstanding history of technical expertise, the original 1952 Wanjii plans, and a 40-year partnership



1952

Wanjii on grid

Small hydropower plant Wanjii Power Plant machines, supplied by Morgan Smith, is transferred into commercial operation.

1954

KenGen founded

Kenya Power Company, which would later become the Kenya Electricity Generating Company (KenGen), is founded.

The butterfly valve installed ahead of the turbine, at Gitaru (1977).

1975

Gitaru awarded

Voith, in consortium with Siemens, is awarded the Gitaru contract to design, deliver and erect two Francis turbines, including governors, butterfly valves, hydraulic steel structure and engineering equipment.

The spillway structure at Gitaru viewed from the downstream side (1978).



with the owner, Kenya's largest electricity producer, Kenya Electricity Generating Company (KenGen).

Forty years of cooperation

Long before tackling the extensive Wanjii modernization, Voith caught the attention of KenGen at the Gitaru Power Station, where it erected two Francis turbines in the late 1970s. "I was impressed by the machines at Gitaru. They were very reliable and modern and ran for long

periods," recalls Richard Nderitu Mwangi, who was Operations Director at KenGen until 2016. "The standard of engineering was excellent and dependable."

Following the 1978 completion of the project, Voith continued to support the site. Having secured trust with KenGen, in 1998 the company was commissioned to erect a third, 84 MW, Francis turbine in Gitaru. This was swiftly succeeded by the installation of 10 digital governors at the Gitaru, Kamburu, Kindaruma and Kimambere hydropower plants. When three additional plants within the Seven Forks Scheme required modernizing in 2008, KenGen once again contracted Voith for the works. As a result, the Kimambere Power Station had its output increased from 144 MW to 168 MW.

Wanjii is the latest milestone in the long-lasting partnership. Once completed, the Small Hydro plant will boast state-of-the-art electromechanical equipment and a remote control →



“Trust is the basis of good communication.”

Markus Kaufmann
Sales Manager at Voith Hydro

system which can be regulated from KenGen’s Nairobi headquarters, placing Wanjii among the most modern plants of its kind.

The secret to longevity

“Trust is the basis of good communication,” says Markus Kaufmann, Sales Manager at Voith Hydro, speaking about the key to maintaining a solid partnership across time and continents. “KenGen feels like family. We trust and respect each other.”

Mwangi agrees that trust, communication and strong, cordial personal ties have seen the partnership thrive. In the years between projects, Voith conducted frequent plant visits and trainings to ensure a constant presence and continuous support. “Because we are not personally on site, it is important that either our agents or our East Africa Hub stay in contact. We are good at listening,

1998-1999

Gitaru extension

Voith, in consortium with Siemens, completes the extension of Gitaru Machine Number 3 (84 MW).

Gitaru commissioned

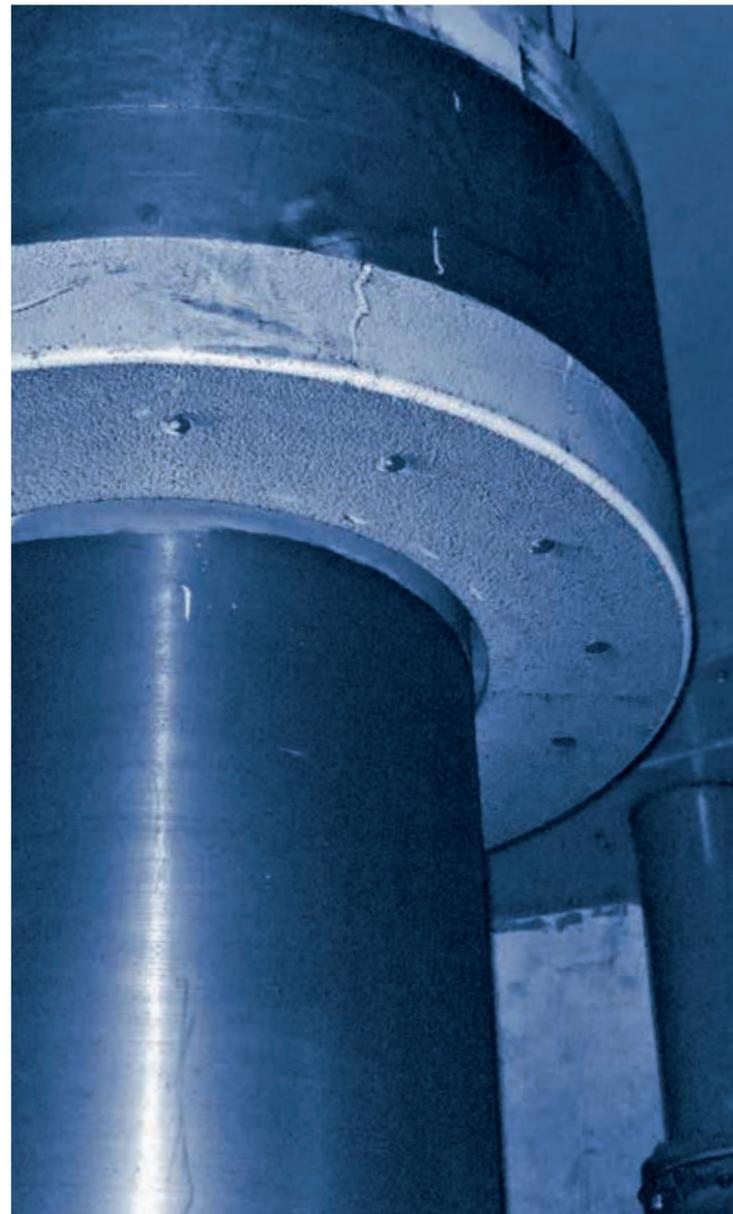
In March the Tana River is impounded. Four months later, Machine Number 1 is transferred into commercial operation. In September, Machine Number 2 is transferred into commercial operation at Gitaru.

1978

1977

Gitaru begins

The erection of Gitaru starts with the spiral case, wheel operating ring, connecting components and turbine cover.



A part of the turbine shaft at Gitaru (1977).



Governance units

Voith installs a total of 10 digital governors: three at the Kamburu and Gitaru hydropower plants, and two at the Kindaruma and Kimambere facilities. Voith completes the modernization at Kimambere, increasing the output from 144 MW to 168 MW.

2003-2008

understand customer needs and challenges, and offer solutions,” Kaufmann says. This, according to Mwangi, established Voith as a trusted partner. “Good working relations mean that both companies reap rewards and it’s a win-win situation – never the winner takes it all,” he says.

2018

HYDRO 2018

Voith and KenGen build on their cordial partnership at the HYDRO 2018 conference in Gdansk, Poland.

Hydropower for Kenya
As Kenya’s largest electricity producer, KenGen is responsible for 67% of the nation’s total energy supply – an impressive 1,631 MW of 2,431 MW. It is also the owner of all 21 of the country’s hydropower plants, which represent the largest part (roughly 860 MW) of the total energy production. Thanks to 40 years of collaboration with KenGen, Voith machines currently produce almost 30% of this total.

2018-2019

Wanjii modernized

Voith completes an extensive modernization of the small hydropower plant Wanjii, delivering new turbines, generators, control technology and electromechanical equipment. As a result, the total energy output of the Wanjii facility is increased by approximately 20%.

However, according to Mwangi, even more potential exists. Recent estimates suggest that as much as 120 MW could be gained by modernizing existing schemes, such as the Gitaru Power Station, which Mwangi says is ripe for an upgrade. “Voith can easily communicate the advantages of upgrades,” he adds, “especially at a time when the country is grappling with the integration of intermittent renewable power from wind and solar. Hydropower will play a big part in ensuring reliability of the system.”

Moreover, he says, Kenya has many remote and mountainous regions, which would benefit from a decentralized power supply. Wanjii, which lies some 80 kilometers north-east of Nairobi, is just one example of how local communities can be supported by sustainable hydropower solutions. “KenGen and Voith will continue working together,” he concludes, confirming that the past 40 years are just the beginning of this partnership.

Voith and KenGen meet at the HYDRO 2018 conference in Gdansk, Poland.

Spreading knowledge, worldwide

Voith HydroSchool is paving the way for a new, knowledge-based future for customers – with the whole world in its sights.

Generational change and international knowledge fragmentation, at a time of rapid technological innovation, mean that the proper training of staff has never been more important. In setting up HydroSchool, Voith brought its industry expertise to the hydropower knowledge economy. Now, to help further elevate and standardize the industry, it has set its sights firmly on globalization.

Knowledge is industry power

Demand for maintenance training, to better understand Voith products following delivery, formed the roots of HydroSchool in 2014. The success of the trainings revealed a need and drove Voith to utilize its industry knowledge to cover other subject areas. The goal?



Dedicated training

Topics: Hydropower Plants, Turbines, Generator, Automation & Control, Governor
Focus: a range of topics across operation, modernization, safety and design
Number of course units: 19
Locations: Brazil, Canada, India, Germany or individually on site

Public courses

Topics: Hydropower Plants, Turbines, Generators, Balance of Plants
Focus: introduction and fundamentals
Number of public courses: 13
Locations: Brazil, Canada, South Africa, Germany

Training programs

INGULA PUMPED STORAGE PLANT, SOUTH AFRICA
 The largest HydroSchool training program for hydropower plant operators
Customer: Eskom
Focus: plant operation and maintenance
Number of course units: 17
Total number of participants: 100

VOITH TRAINING CENTER, GERMANY
 Two-week training focusing on the rehabilitation of Polpitiya (Samanala)
Customer: Ceylon Electricity Board
Focus: Rehabilitation of Turbines, Generators, Main Inlet Valves
Number of course units: 3
Total number of participants: 12

“To deliver training solutions for all hydro-related topics and bridge the gap between technology and industry experience,” says Sabrina Deininger, Customer Training Product Manager at Voith Hydro, adding that it also offers an opportunity to identify customer needs and foster closer working relationships.

HydroSchool includes three types of training: public courses – industry fundamentals open to the general public – and two customized options, tailored to the specific needs of each customer. The first of these are dedicated training courses that can combine theoretical and practical components; the second are training programs that can incorporate apprenticeships and expert mentoring. As such, HydroSchool was a natural fit for HyService and has become a key part of the branch. By accommodating a range of professionals, from engineers to maintenance and repair specialists, technical personnel and members of management, HydroSchool offers customers the opportunity to identify, expand and fully utilize their team’s resources. “We help attendees to understand the machinery they’re working with,” explains Christian

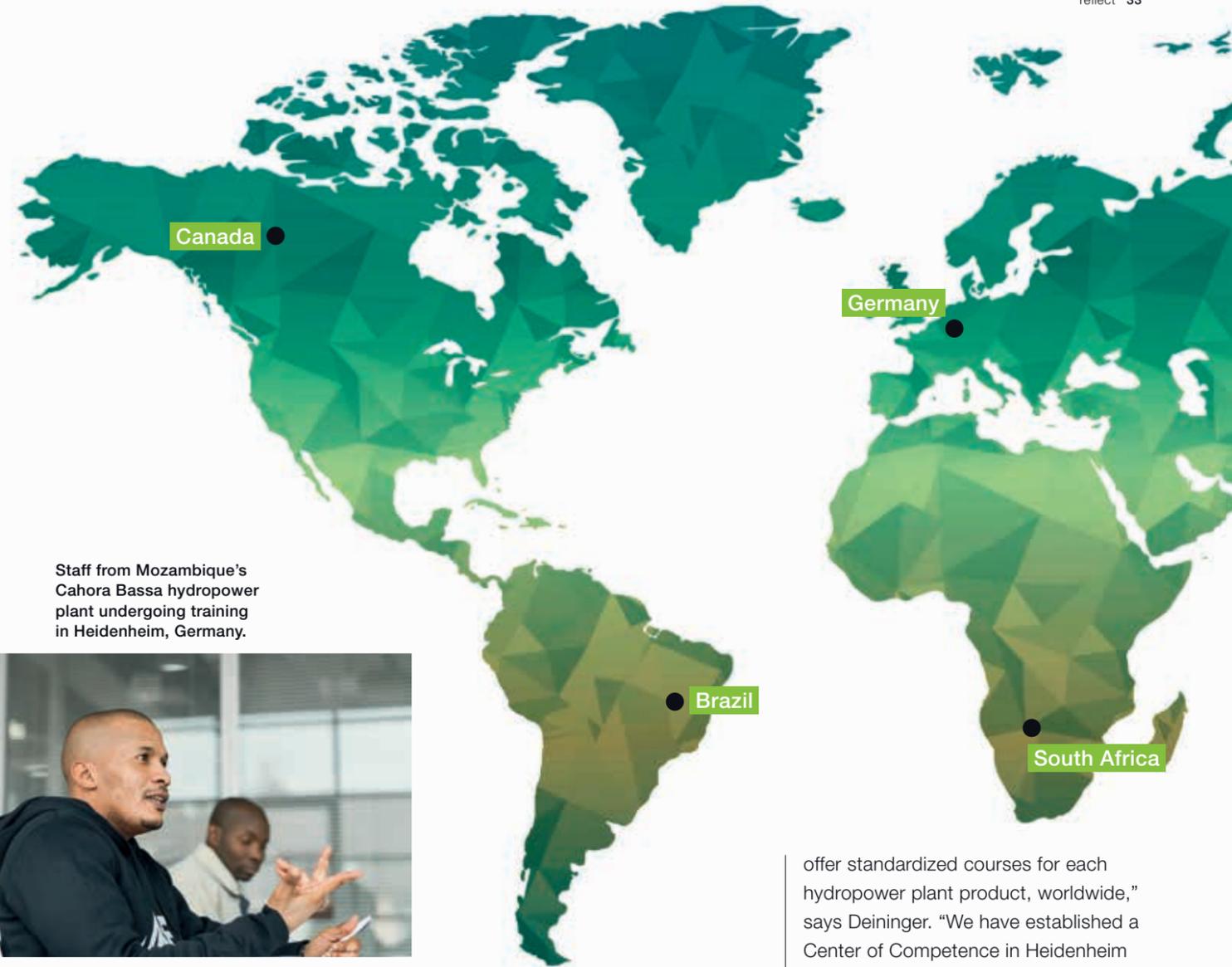


Staff from Mozambique’s Cahora Bassa hydropower plant undergoing training in Heidenheim, Germany.

Fuhrmann, Head of Electrical Support at Voith Hydro and HydroSchool trainer. “They go home and see the machine more clearly, with different eyes than before, which improves their ability to create efficiencies.”

Going global

Although still in its infancy, to date HydroSchool has offered 140 courses to 150 companies and engaged 1,300 participants from as far afield as Africa, South America and Europe – and it is still evolving. Currently, courses are being standardized, meaning students will receive the same level of high-quality training wherever in the world they attend. “In the near future we want to



HydroSchool to date:

140 courses
150 companies
1300 participants



Learn more about HydroSchool trainings at www.voith.com/hydropower31-HydroSchool

offer standardized courses for each hydropower plant product, worldwide,” says Deininger. “We have established a Center of Competence in Heidenheim to structure and organize training globally. We started to bundle our training knowledge to get more exchange and to become more efficient in content and organization.” As a first step toward this goal, HydroSchool has expanded its horizons to the United States, India and parts of Asia, where customers will soon be able to take advantage of on-site trainings at local Voith Hydro production sites.

A global focus also means training content is under constant development. “We’re seeing more and more interest in digitalization in hydropower plants,” says Deininger, “so digital modules are always included in trainings, and we work with expert Voith digital trainers to cover the future approaches at →



● Sri Lanka

hydropower plants, including sensor technology of better automation services.” Innovative digital training tools like on-line eLearnings, simulations, and virtual and augmented reality are also being explored. Even established courses are evolving in response to international insights. “We always get new viewpoints, even when discussing the same topics. This helps us to shape our seminars,” Fuhrmann explains. “If we get good customer input, we include it.” HydroSchool knows that progress stands still for nobody, and it is set to make its mark on the map, globally. —



Individual courses take place at Voith centers well as on site.

“Behind every great training, there’s a great Voith team.”

Christian Fuhrmann

Head of Electrical Support at Voith Hydro and trainer of generator basics and maintenance at HydroSchool



Making the intangible, tangible “The concepts we teach are complex. We speak about things which our senses cannot perceive,” says Christian Fuhrmann, Head of Electrical Support at Voith Hydro and trainer of generator basics and maintenance at HydroSchool. One of HydroSchool’s strengths, and a large part of its success, he adds, is its accessibility to a range of participants. “We avoid using too many mathematical formulas and try to explain concepts in a visual way,” he says. “And our approach seems to work really well.” However, finding ways to make abstract media, such as magnetic flux, tangible requires a lot of work – from the building of models for participants to touch, to the performance of calculations, to organizational tasks. “A single trainer couldn’t do it alone,” Fuhrmann says, “so I’m very thankful to have the support of the whole company.”

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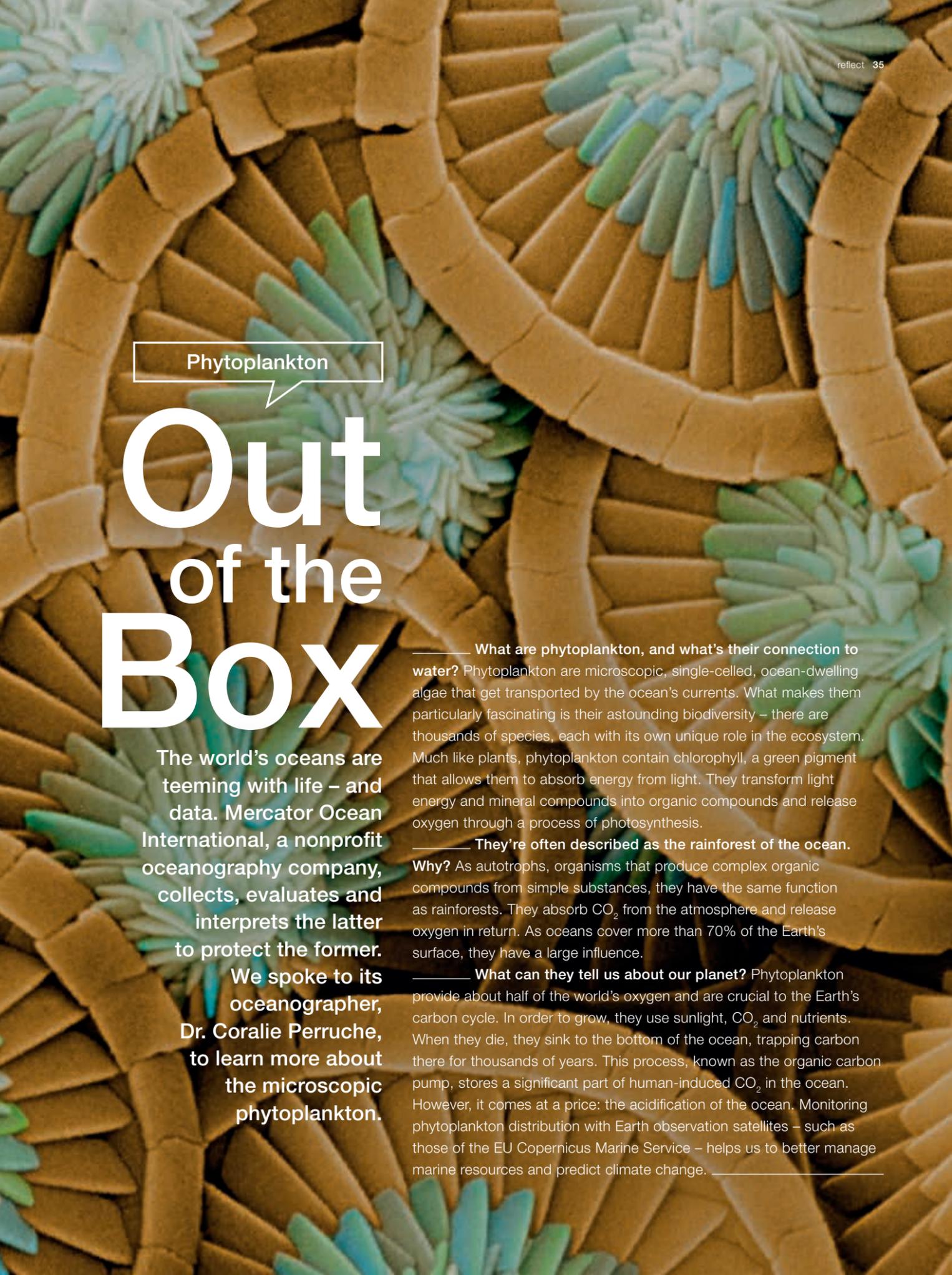
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Phytoplankton

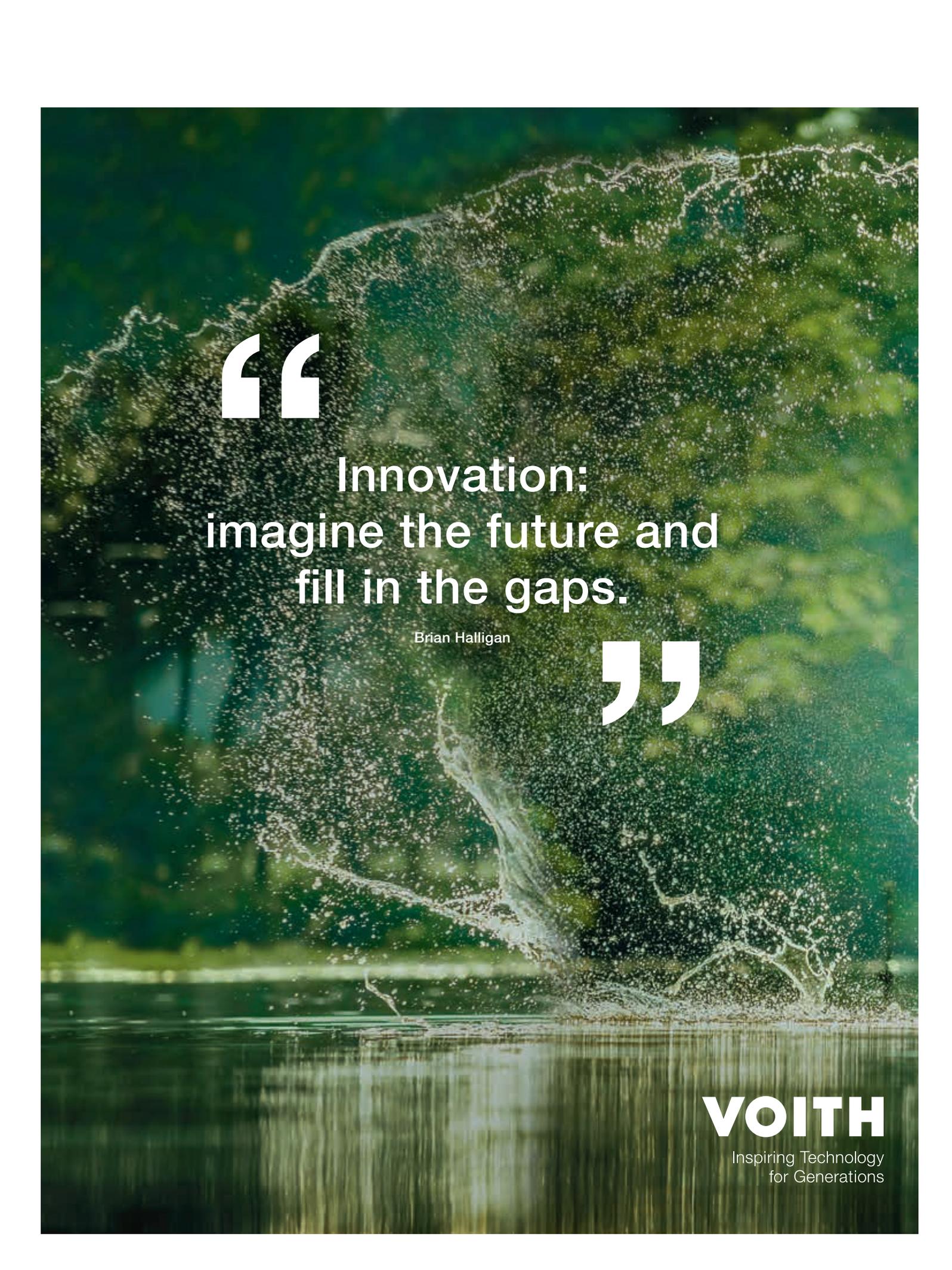
Out of the BOX

The world’s oceans are teeming with life – and data. Mercator Ocean International, a nonprofit oceanography company, collects, evaluates and interprets the latter to protect the former. We spoke to its oceanographer, Dr. Coralie Perruche, to learn more about the microscopic phytoplankton.

What are phytoplankton, and what’s their connection to water? Phytoplankton are microscopic, single-celled, ocean-dwelling algae that get transported by the ocean’s currents. What makes them particularly fascinating is their astounding biodiversity – there are thousands of species, each with its own unique role in the ecosystem. Much like plants, phytoplankton contain chlorophyll, a green pigment that allows them to absorb energy from light. They transform light energy and mineral compounds into organic compounds and release oxygen through a process of photosynthesis.

They’re often described as the rainforest of the ocean. Why? As autotrophs, organisms that produce complex organic compounds from simple substances, they have the same function as rainforests. They absorb CO₂ from the atmosphere and release oxygen in return. As oceans cover more than 70% of the Earth’s surface, they have a large influence.

What can they tell us about our planet? Phytoplankton provide about half of the world’s oxygen and are crucial to the Earth’s carbon cycle. In order to grow, they use sunlight, CO₂ and nutrients. When they die, they sink to the bottom of the ocean, trapping carbon there for thousands of years. This process, known as the organic carbon pump, stores a significant part of human-induced CO₂ in the ocean. However, it comes at a price: the acidification of the ocean. Monitoring phytoplankton distribution with Earth observation satellites – such as those of the EU Copernicus Marine Service – helps us to better manage marine resources and predict climate change.



“

Innovation:
imagine the future and
fill in the gaps.

Brian Halligan

”

VOITH

Inspiring Technology
for Generations