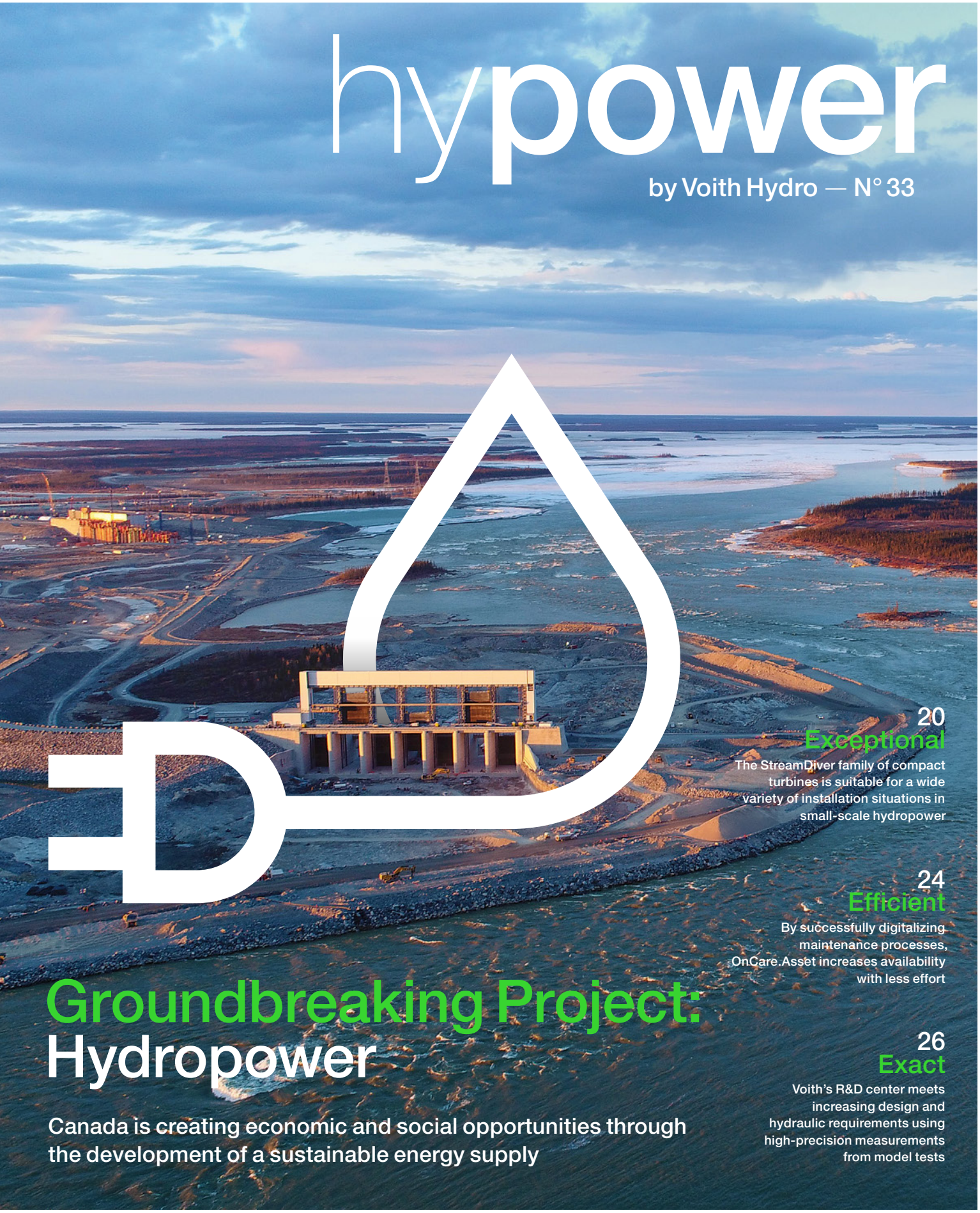
VOITH

hypower

by Voith Hydro — N° 33



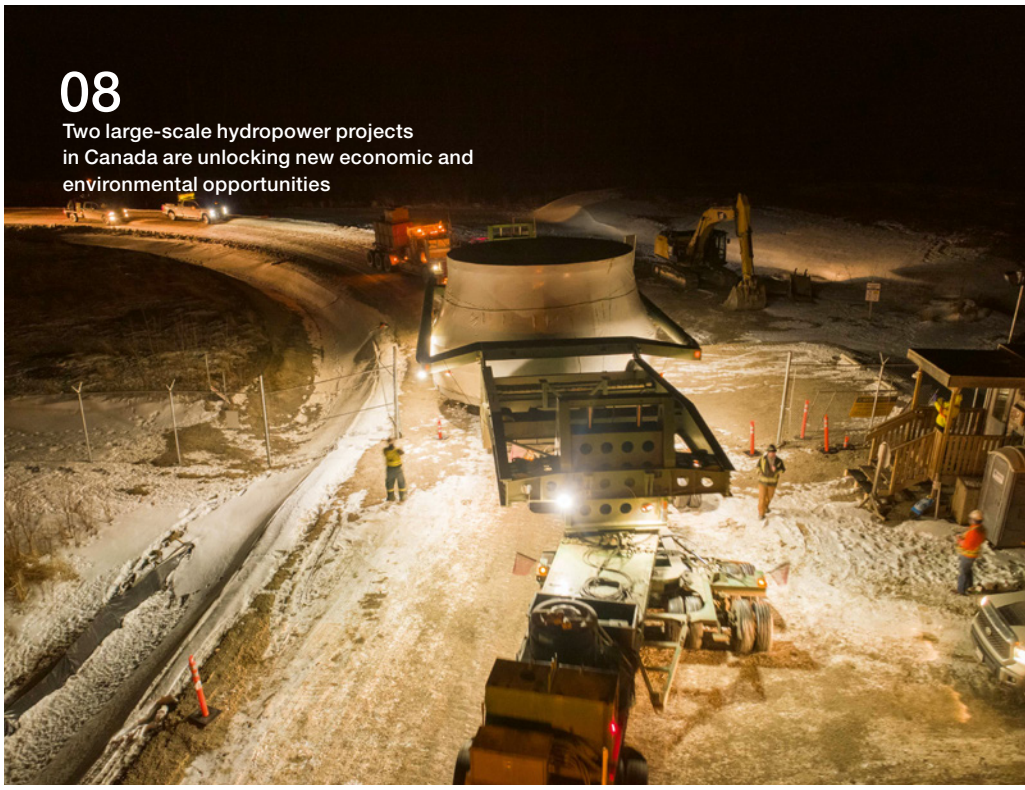
Groundbreaking Project: Hydropower

Canada is creating economic and social opportunities through the development of a sustainable energy supply

Editorial
hypower N° 33

Hydropower is essential to the decarbonization of electricity generation via renewable energy sources. Its key role in both generation and as a form of green storage for intermittent wind and solar power is undisputed. But large-scale and small-scale hydropower plants make important contributions far beyond that. In this issue, we highlight the improvements they bring about, ranging from outstanding large-scale projects in North America that are giving the development of remote regions a major boost to a successful industrial partnership in Africa that is driving electrification forward. Examples from Europe illustrate how intelligent digitalization is increasing the efficiency of existing plants. In addition, you'll learn how Voith Hydro's intensive research and development efforts are not only helping to maximize hydropower's potential but are also further improving the sustainability of the energy source itself.
Happy reading!

Uwe Wehnhardt
President & CEO, Voith Hydro



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Two large-scale hydropower projects in Canada are unlocking new economic and environmental opportunities

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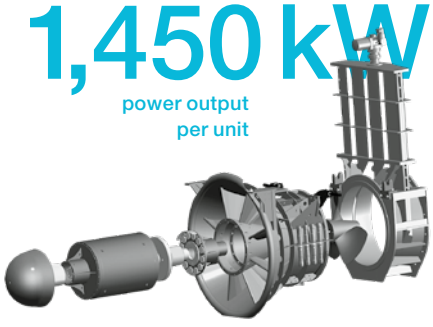
50 to 1,450 kW
power output per unit



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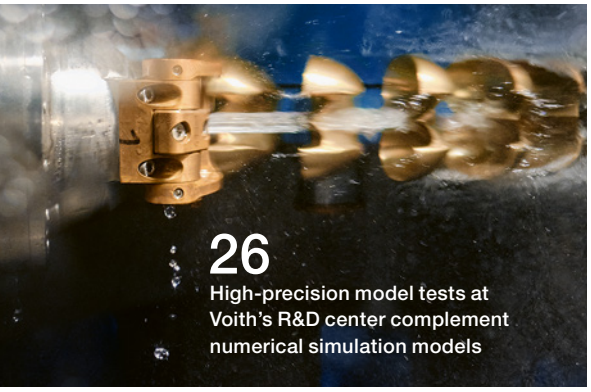

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Perfe

Flexible
The Creaform HandySCAN 3D laser scanner offers more freedom than a 3D measuring arm when scanning hydropower components of different sizes.

40%

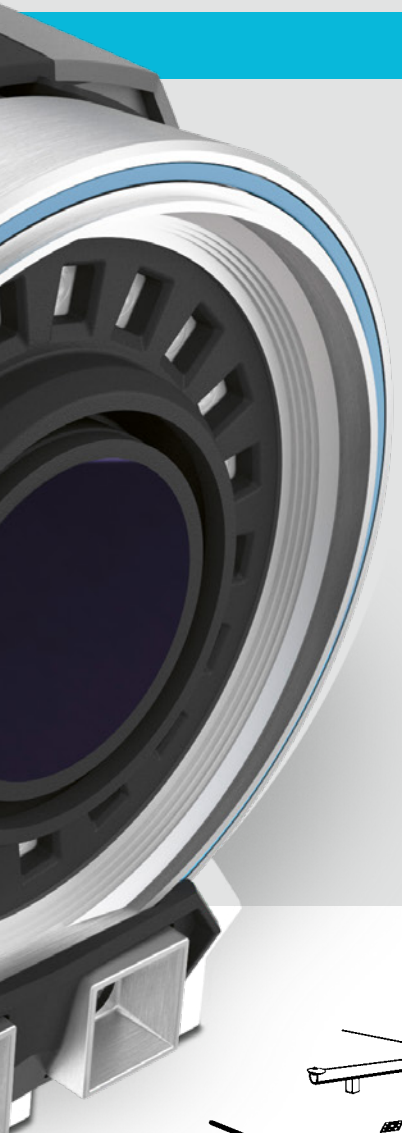
40% time and cost savings potential can be achieved by reverse engineering common hydropower plant components.

0.015 mm/m

The high measuring accuracy makes the optical coordinate measuring system suitable for large projects and components from 2 to 10 meters in length.

ect

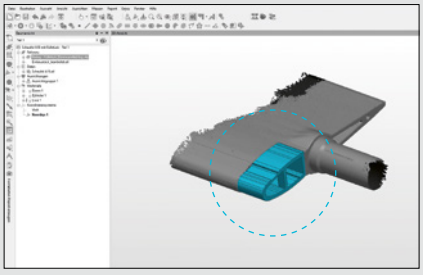
Repro-duction

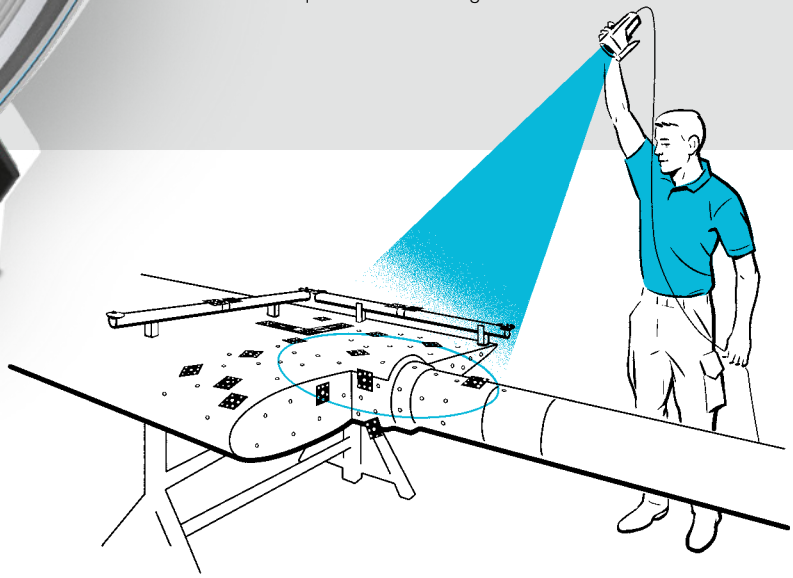


To avoid expensive redesigns, Voith's reverse-engineering service gives operators the option of creating an exact replica of any component, even if it comes from a 100-year-old power plant and is damaged or undocumented. This involves digitizing the respective component with the aid of high-precision photogrammetric images and a subsequent laser scan. The polygon models generated from the scan data are then used as the basis for creating a digital twin of the original using CAD software. It serves as the template for reproducing the component in physical form. The size of the elements is essentially unlimited. "We can, for example, digitize complete Francis impellers with a diameter of several meters," says Daniel Roessler, quality engineer at Voith. Since only laptop, laser scanner and photogrammetry camera are required, the components can be scanned directly on location at the operator's site, saving time.

Exact
The Creaform MaxSHOT 3D optical image measurement system generates photogrammetry images to use as the basis for subsequent laser scanning.

Transparent
In PolyWorks Modeler, the guide vane can be inspected with the added filler piece (in blue).





1 Marking points (positioning targets) and scale bars are attached to and placed on the object as a size reference.

2 A photogrammetry measurement from multiple angles captures the baseline object data.

3 The laser scanner scans the component using the positioning targets captured via photogrammetry as a guide.

News

from the World of Voith Hydro

Underground Reservoirs

As a result of the expansion of wind and solar power, pumped storage power plants are gaining importance as a “green battery” to balance out the power grid and prevent outages. Together with the Swedish company Mine Storage, Voith wants to explore new applications for the technology. The focus is on the use of former mines for hydropower. They offer tremendous potential, especially since there are more than one million abandoned mines worldwide. Adapting the aboveground pumped storage design with higher and lower reservoirs to the mining environment poses a technical challenge. In order to find suitable solutions, the partners are therefore planning initial development projects at two locations in Sweden.

1

Kristinehamn
The town in the central Swedish province of Värmlands has a long tradition of manufacturing turbines.

Planting trees to benefit the environment
On the globally observed World Environment Day 2021, Voith Hydro employees planted 110 trees in Vadodara, India.

2

Constructive Environmental Protection

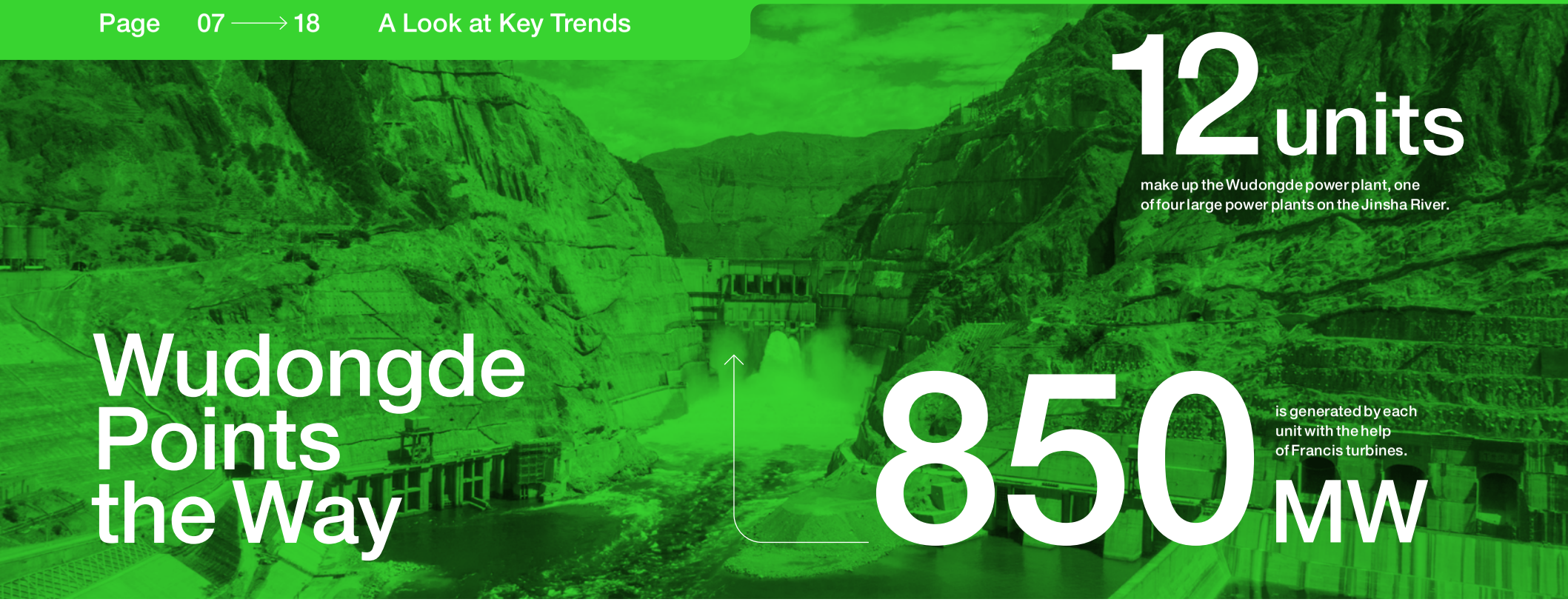
Employees at Voith Hydro’s Indian location in Vadodara made a lasting contribution on World Environment Day 2021 (celebrated on June 5). Not only did they use posters to educate the public about environmental protection and its importance, but they also planted 110 trees on the factory site. The grounds now boast a total of around 2,600 trees spread over an area of 200,000 square meters. The initiative was aligned with the United Nations Environment Program’s focus this year on restoring ecosystems, including through reforestation.

1

10 Years of Outstanding Performance

Voith Hydro’s location in Kristinehamn, Sweden, celebrated its 10th anniversary in 2021. The site opened in 2011 with two employees who brought their many years of experience in turbine manufacturing to the table. With growing success came the expansion of the Voith Hydro location here, which boasts a turbine manufacturing tradition stretching back more than 100 years. In 2015, it moved into the Norra Verken building complex. Today, 13 employees here provide a range of services for water turbines including overhauls. At the same time, Kristinehamn is the center of Voith’s turbine business in the Nordic region. In this exceptional year, the subsidiary will be carrying out the Sallsjö modernization project for the utility company Skellefteå Kraft, which recently also awarded Voith a similar contract for the Selsfors power plant. In both projects, Kristinehamn is modernizing the turbine, while Voith Hydro’s Swedish headquarters in Västerås is overhauling the generator.

innovate



12 units

make up the Wudongde power plant, one of four large power plants on the Jinsha River.

Wudongde Points the Way

850 MW

is generated by each unit with the help of Francis turbines.

China's first hydropower plant was equipped with Voith technology back in 1910. Now, after more than 100 years and 54,000 MW of installed capacity, Voith's work with Chinese operators has reached a new high – on July 1, the Wudongde impoundment hydropower plant on the Jinsha River began commercial operations. With a total capacity of 10.2 GW, it is the seventh largest of its kind globally. The plant, which is owned by the utility company China Three Gorges (CTG), features 12 turbine-driven generator units with a capacity of 850 MW each. Voith designed, manufactured and brought six of them into operation on site. These rank among the highest-capacity generators in the world and are the most powerful ever built by Voith. The high-precision design of all the components allowed Voith to not only meet but even exceed CTG's stringent requirements with respect to operating parameters such as vibration, oscillation and temperature. The outstanding results in trial operation and the close collaboration in spite of the pandemic contributed to a high level of customer satisfaction. Once all of the units have been brought on stream, Wudongde will generate 38.9 TWh of renewable energy per year. As a result, it is also playing a major role in reducing China's carbon emissions, as the power it generates will save 12.2 million metric tons of standard coal each year, reducing the country's carbon emissions by 30.5 million metric tons.

A Big

Canada is not only expanding hydropower to generate even more sustainable electricity. Major new projects are also giving the energy industry additional options in the North American market and providing important employment opportunities for the people in the provinces. Voith is laying the foundations for this by supplying the complete electromechanical equipment for two power plants.

1 Site C is a large-scale hydropower project operated by the utility company BC Hydro in the Canadian province of British Columbia.

2 Keeyask is a partnership between Manitoba Hydro and four First Nation communities being built in the province of Manitoba.

Impact

The Keeyask hydroelectric generating station is being built on Indigenous land and involving the local population in the value creation process.

Keeyask

4,400 GWh

per year will be generated by Keeyask.

7 Units

that Voith developed and installed on site feature a new, particularly efficient turbine design.

The future is not only built in major metropolitan areas. Often the things that advance the socioeconomic development of a society are developed far away. Particularly in the field of energy supply – and especially in Canada. More than 700 kilometers north of the provincial capital Winnipeg, the Keeyask hydroelectric power station is being built on the Nelson River that will not only produce electricity but also further increase the share of renewable energy in Canada's electricity mix. At the same time, it is also a new source of value creation, jobs and prospects for the future.

The development of the Keeyask Project is a partnership between Manitoba Hydro and four Manitoba First Nations – Tataskweyak Cree Nation, War Lake First Nation, York Factory First Nation, and Fox Lake Cree Nation – working together as the Keeyask Hydropower Limited Partnership (KHLP).

On behalf of Manitoba Hydro, Voith will be responsible for designing, supplying and installing seven propeller turbine generator units. With a total capacity of 695 MW, they are expected to generate around 4,400 GWh of green power annually once the station comes on stream – and make the future more secure. This is because the province is growing and, with it, the demand for energy, the company states. Keeyask will be able to supply power to an additional 400,000 households.

Dykes 23 kilometers long
border the north and south sides of the Keeyask reservoir.

695 MW
rated power is achieved by each of the seven turbines.

400,000
households can be supplied with power from Keeyask.

98 %
of Manitoba Hydro's electricity is already generated by hydropower.

-25° C
outside temperature and only 6.5 hours of daylight make construction work difficult in the winter.

More than 60 %
of Canada's electricity is generated by hydropower.

More than 30 %
of the hydropower technology installed across Canada is from Voith.

A cost-optimized generating station
To keep concrete and earthwork costs down, Manitoba Hydro asked bidders to optimize the dimensions of the generating station using a 3D model during the bidding phase.

Since the summer of 2014, hundreds of workers have been working on this site day in and day out to make this vision a reality, the majority of them from Manitoba, including many Indigenous people from the region. A project labour agreement was utilized to create consistent terms and conditions of employment, and included a centralized recruitment service. As well, training and vocational programs were established.

The engineering requirements are high, but can be easily met with Voith Hydro's expertise and range of products. "As with any large hydropower project, it's a matter of finding a customized solution that fits the specific circumstances," says Project Director David Latour. Due to the low head, some of the seven units' main components were designed quite large, resulting in the runners reaching a diameter of 8.35 meters and the generator rotors measuring 13.67 meters each. A new, highly efficient turbine design ensures that the units operate particularly cost-effectively.

→

Employment and Training

Keeyask provides important employment opportunities for the four First Nations involved – Indigenous people from the region make up a large portion of the construction workforce, accounting for 39% of total hires on the project are Indigenous. In addition, vocational training programs offer career development opportunities.

The real challenges lie in completely different areas. On the one hand, the necessary parts are sourced from suppliers all over the world. This requires excellent coordination, logistics and special technical attention to ensure that a missing bolt doesn't slow down construction progress as a result of Keeyak's isolated location. "Voith has the knowledge, experience and capacity to plan and manage such megaprojects, including coordinating procurement and installation processes," Latour affirms.

On the other hand, the COVID-19 pandemic has reached Keeyask and delayed work there. The job site had a temporary reduction in workforce for eight weeks. Because many workers nevertheless decided to remain on site and continue working without physical contact with the outside world for safety reasons, construction activities didn't come to a standstill. "Extensive measures were taken to protect them," says the Voith manager. "Even though the work was a little slower, it was still progressing."

And milestones were also successfully reached, as the first unit was handed over by Voith to Manitoba Hydro for commissioning in April 2020, six months ahead of schedule. In the meantime, five more units have been handed over to Manitoba Hydro. The last one is scheduled to follow in December 2021. At that point, Keeyask will no longer be just a dot on the Canadian map, but a major producer of sustainable energy on North America's power grid.

Jump-Starting the Energy Transition

Lower electricity prices for companies that go green – this is the concept the Canadian government, the government of British Columbia, and the utility company BC Hydro are using to reduce greenhouse gas emissions and entice companies to relocate to this province. New clean industries – such as those producing hydrogen or biofuels – are expected to benefit, as are existing companies that switch from fossil fuels to electricity. In return, BC Hydro is offering industrial customers a 20 percent discount off of its standard rates. This will be locked in for five years, after which the price will gradually increase to the normal level by the eighth year.

Site C is one of Canada's largest infrastructure projects and is helping to make green power available on particularly favorable terms.

Site C

12,875
kilometers

is the distance that two turbine runners produced by Voith in São Paulo, Brazil, had to travel by sea to the Port of Prince Rupert in British Columbia.

81
meters

is the length of the heavy-duty truck that was used to transport the runners to the job site. In the process, one truck pulled the cargo while two others pushed at the rear.

About 2,000 kilometers by car to the west, the objective is the same. In the province of British Columbia near Fort St. John, one of Canada's largest infrastructure projects is currently under construction: the Site C Clean Energy Project. As the third power plant along the Peace River, it will generate around 5,100 GWh of electricity per year with a capacity of 1,100 MW, thus creating carbon-neutral supply security over the long term.

Because of its track record in similarly complex projects, Voith was contracted by the operator BC Hydro to design, manufacture and install six Francis turbines together with the generators and electromechanical equipment. "Site C will help reduce British Columbia's carbon emissions and provide enough sustainably produced power for 450,000 homes annually," sums up Lawson Crichton, Business Development Manager at Voith Hydro in Canada.

Work on Site C began all the way back in July 2015. Voith built a temporary production facility directly on site to manufacture the steel structures needed for the turbines and generators. At the same time, the earthworks were underway. Because Voith optimized the space requirements of the turbine-generator solution, BC Hydro was able to reduce the dimensions of the generating station and thus its construction costs.

Heavy transport in the dead of winter
A partially rehabilitated private road was used to transport the runners. The two-week drive had to take place in January 2021 in order for the frozen roads to even be able to support the load.

1,100 MW
the total capacity by which the regional utility company BC Hydro is expanding power generated at Site C.

5,100 GWh
of renewable energy is expected to be supplied annually by the hydroelectric plant once it is completed.

450,000
households can be supplied with electricity from Site C.

13,000
person-years of direct employment during the construction means the power plant is having a major impact on the region.

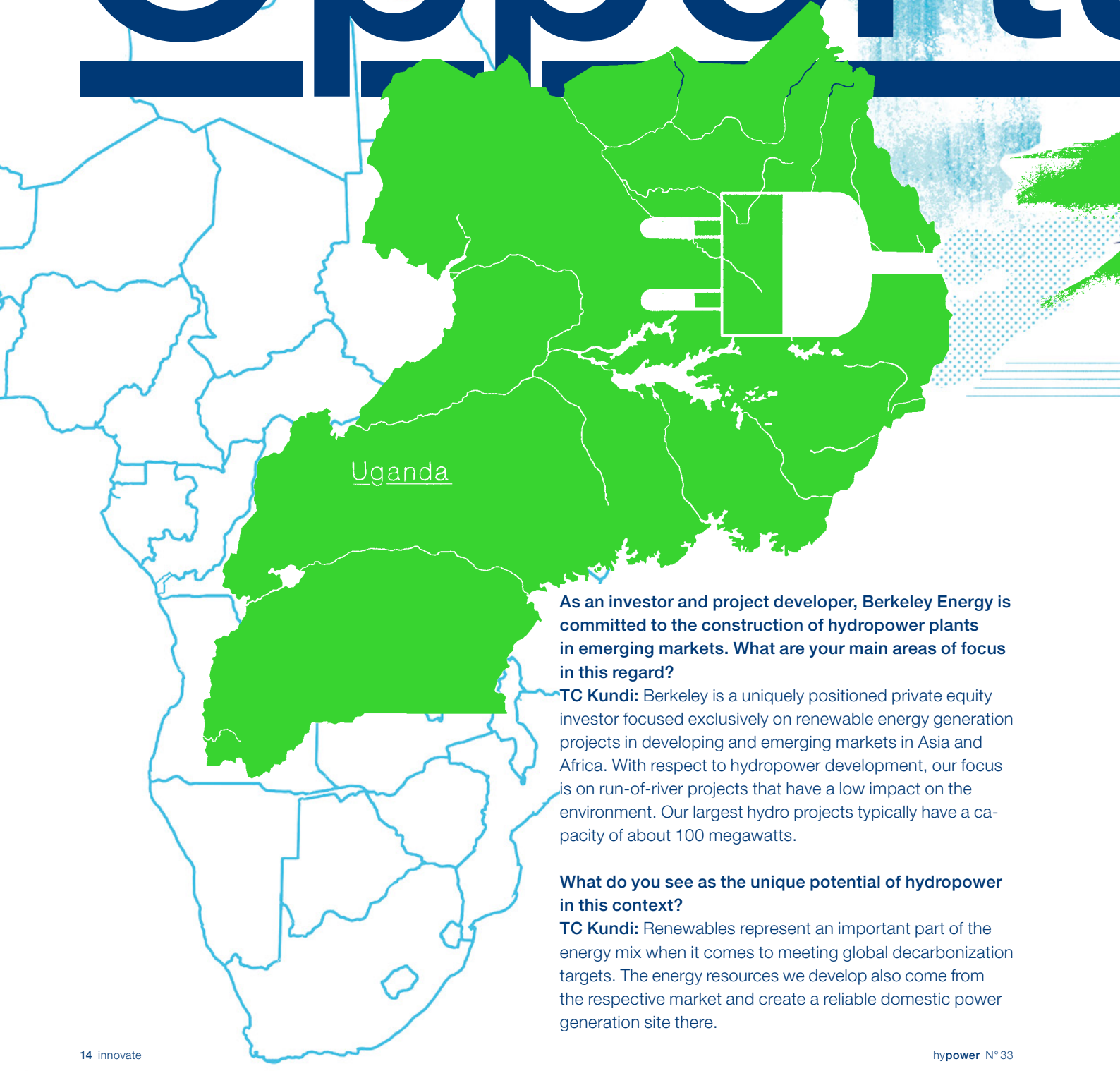
Generating station under construction
For the Site C project, Voith is supplying and installing six vertically arranged Francis turbines and generators as well as the electromechanical equipment.

The turbines for units 1 and 2 were delivered in March 2021. While the Voith team is now busy assembling their components in parallel in the new generating station, the remaining equipment is being completed and held in a storage area until it can also be installed according to the project schedule.

Similar to Keeyask, the coronavirus pandemic has caused uncertainty and delays at Site C, but it has not brought manufacturing and construction to a standstill. "With up to 4,500 workers on site for the main construction activities, the generating station, and turbine and generator construction, COVID-19 caused a few minor disruptions but had little impact on Voith's overall schedule," Crichton clarifies.

Today, the workforce already includes many members of the Indigenous population of the surrounding area, including many in training. After the hydroelectric generating station comes on stream, they will continue to be involved in the project through ongoing employment opportunities in fields such as operations or maintenance – the results of which will then benefit the entire province.

Energy for New Opportu



As an investor and project developer, Berkeley Energy is committed to the construction of hydropower plants in emerging markets. What are your main areas of focus in this regard?

TC Kundi: Berkeley is a uniquely positioned private equity investor focused exclusively on renewable energy generation projects in developing and emerging markets in Asia and Africa. With respect to hydropower development, our focus is on run-of-river projects that have a low impact on the environment. Our largest hydro projects typically have a capacity of about 100 megawatts.

What do you see as the unique potential of hydropower in this context?

TC Kundi: Renewables represent an important part of the energy mix when it comes to meeting global decarbonization targets. The energy resources we develop also come from the respective market and create a reliable domestic power generation site there.

Voith is working with Berkeley Energy to drive the expansion of hydropower in Africa. An interview on the partnership's prospects for the region and both companies.

unities

Ravi Kalra: Solar and wind power are playing an increasingly important role around the globe. But hydropower remains an indispensable tool to integrate intermittent energy sources into a stable grid.

Berkeley Energy and Voith have been working together for some time. When and how did the collaboration begin, and what were the most important criteria for you in choosing Voith as your technical project partner?

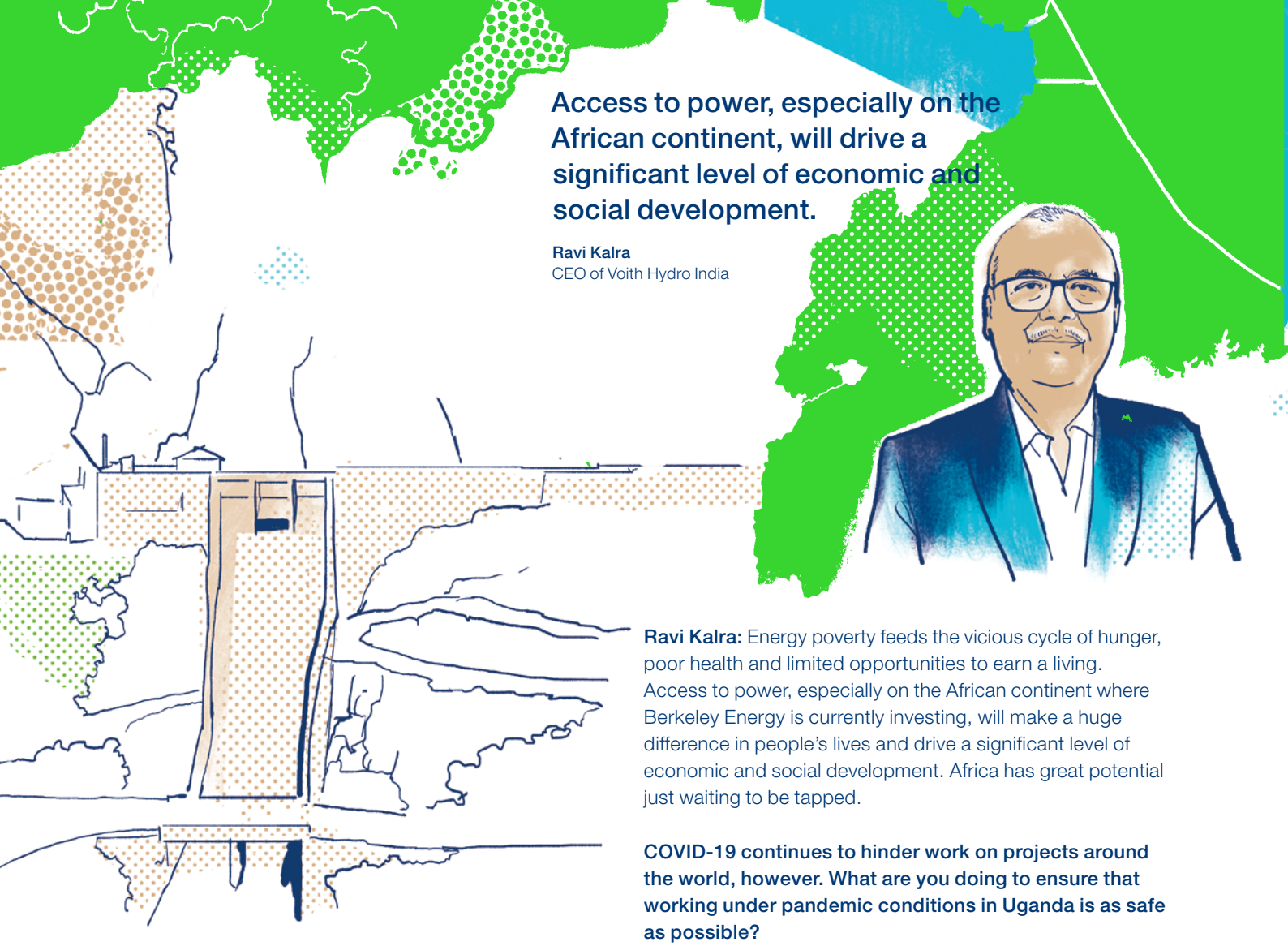
TC Kundi: Berkeley began investing in Asia in 2009, and we were looking for a loyal and powerful partner in each of our technologies of focus. We wanted to work with market-leading OEMs to ensure a best-in-class approach, underpinned by deep and relevant experience. All these factors were arguments in favor of Voith when it came to choosing a hydropower partner. →

Ravi Kalra

Ravi Kalra is the CEO of Voith Hydro India. Having worked in the global hydropower sector for more than 15 years, he has extensive industry knowledge, especially in the field of small-scale and medium-scale plants.

TC Kundi

TC Kundi is the CEO of Berkeley Energy and a board member of the holding company, Berkeley Energy Limited. In his different roles, he can draw on his expertise from 30 years of experience as an owner and operator of renewable energy systems.



Access to power, especially on the African continent, will drive a significant level of economic and social development.

Ravi Kalra
CEO of Voith Hydro India

Ravi Kalra: I can still remember our first meeting in 2012. Berkeley was excited to be able to invest in a small Indian hydropower project. Berkeley's team was extremely clear, focused, highly professional and transparent in their selection of a vendor for the electrical and mechanical equipment. Although the project in India ultimately failed to materialize, both companies gained a solid understanding of each other's strengths and soon a new opportunity arose in the Philippines. I think there was always a sense of mutual trust and confidence that worked well for our relationship.

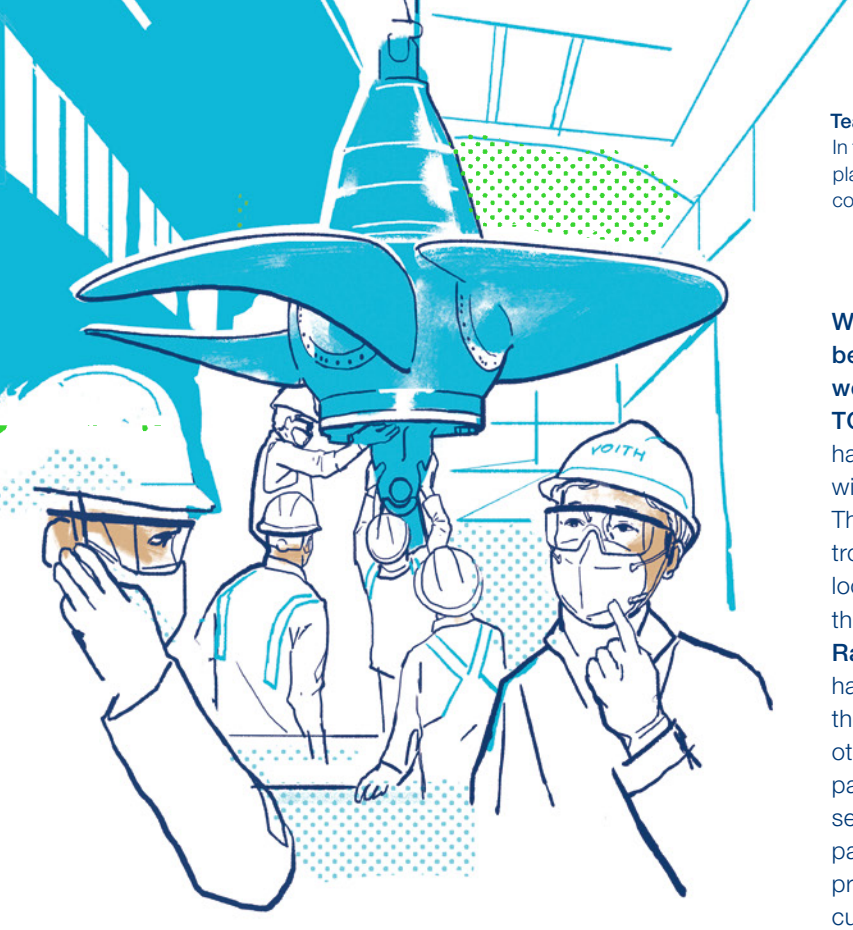
You are currently working on three hydropower projects in Uganda. Less than 15 percent of the population there has access to electricity. Can electrification also contribute to social development?
TC Kundi: Run-of-river hydropower and other renewables already account for a significant share of power generation throughout Uganda. This diversity is helping establish a central grid. Our development projects also create grid stability and build "energy highways" that provide access to power to everyone along their entire length. The Ugandan investments prove it.

Ravi Kalra: Energy poverty feeds the vicious cycle of hunger, poor health and limited opportunities to earn a living. Access to power, especially on the African continent where Berkeley Energy is currently investing, will make a huge difference in people's lives and drive a significant level of economic and social development. Africa has great potential just waiting to be tapped.

COVID-19 continues to hinder work on projects around the world, however. What are you doing to ensure that working under pandemic conditions in Uganda is as safe as possible?
TC Kundi: We work hard to protect the safety of all our contractors and employees by following the best available international guidelines. We have also developed a local, site-specific approach with strict quarantining backed up by regular testing. Our approach to testing and contact tracing has proven to be very effective. We also have on-site medical teams to support the workforce and separate quarantine facilities to protect the safety of returning or new employees.

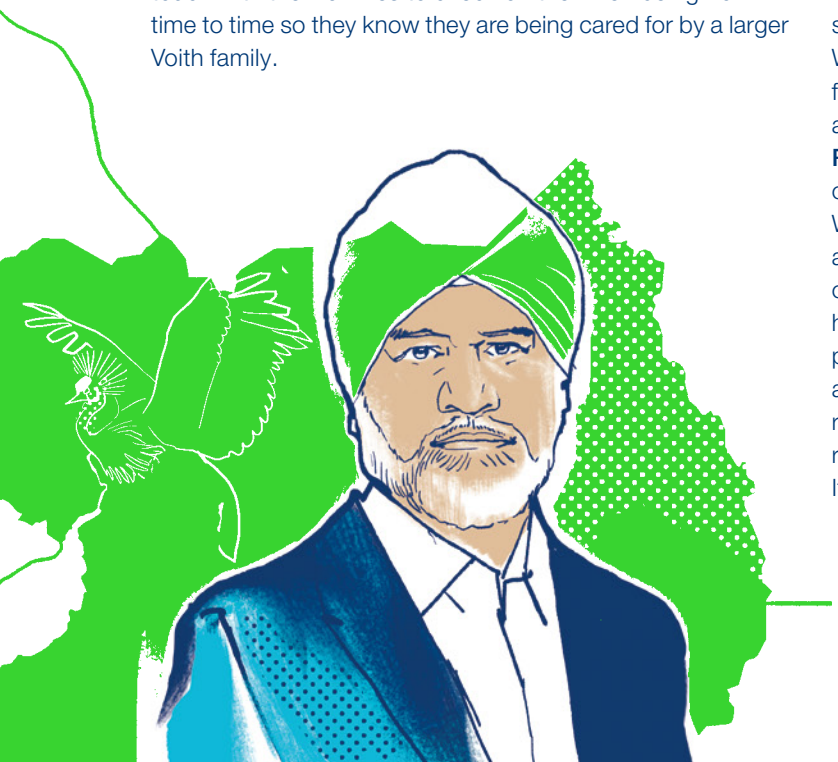
Berkeley's goal is to become a major investor in the field of small-scale to medium-scale hydropower plants worldwide. We can only achieve this goal by collaborating with Voith for the long term.

TC Kundi
CEO of Berkeley Energy



Teamwork
In the Kikagati project, Berkeley and Voith are building a power plant along the Tanzanian-Ugandan border that will supply both countries with electricity.

Ravi Kalra: COVID-19 poses unprecedented challenges, and there isn't a single set of tools that can be used to respond to every situation. Protecting the safety and health of our employees is our top priority. We appreciate the way Berkeley has organized measures across all of its sites and its strict adherence to protocols. This has built confidence. In addition, we communicate with our employees at the sites on a daily basis to keep them up to date on measures to protect their health and well-being. We also keep in touch with their families to check on their well-being from time to time so they know they are being cared for by a larger Voith family.



What are your highlights in terms of collaboration between the teams, especially when it comes to recent work on site?
TC Kundi: What impressed me most was that we did not have to stop work on any of our development projects with Voith. All of them have continued to make progress. There have been delays caused by factors beyond our control. But we have continued to make progress and are looking to begin commercial operations at all of our sites this year.
Ravi Kalra: The connection between the two companies has gotten stronger at every level. In difficult times like these, the first priority is to understand and acknowledge each other's issues and concerns, and to address them with transparent communication and understanding. Teams representing all of the stakeholders met on site, discussed the impact of the pandemic, considered all health and safety protocols, and formalized all of the processes on site. The current status and any new measures being taken in the event of evolving situations are regularly reviewed during meetings. And both Berkeley's and Voith's offices are available to provide assistance around the clock.

How satisfied is Berkeley with its partnership with Voith? What benefits can it bring to both companies over the long term?
TC Kundi: We are extremely satisfied with our partnership with Voith. The most impressive aspect of our collaboration is that we have achieved the same strong level of partnership across all sites, and the partner teams have been able to overcome every single challenge they have faced. Berkeley's goal is to become a major investor in the field of small-scale to medium-scale hydropower plants worldwide. We can only achieve this goal by collaborating with Voith for the long term. And this partnership will help both Berkeley and Voith to secure a leading position in the market.
Ravi Kalra: Both companies have developed a good sense of teamwork in all activities from planning to initial operation. Work together is highly cooperative and characterized by a great sense of accountability. This goes far beyond a normal client/contractor relationship and is a good sign. Berkeley has the peace of mind of knowing it has a reliable technology partner it can trust to provide the best possible equipment and execution. At Voith, we are proud to be working with a respected global investor and are eager to continue this relationship beyond the projects we have completed to date. It's truly a win-win situation for both companies.

With its acquisition of Sintaksa, Voith continues to develop in the direction of a small hydro systems integrator. Customers benefit from the ability to obtain innovative complete E&M packages from a single source.

A Perfect Pair

Sintaksa has considerable expertise in automation systems. 1

Petar Jelinčić heads up the group of small hydro specialists 2

Great things in small hydro – this is what Voith and Sintaksa have set out to achieve together. In July 2020, Voith acquired a majority stake in the Croatian small hydro specialist that focuses on products and services for electromechanical and automation systems. The relationship has already proven its worth in initial projects, such as at the Brúarvirkjun power plant (2×6 MVA) in Iceland, where the island's operational capability could only be tested remotely due to the pandemic, and employee training had to be conducted online. Both went so successfully that they will serve as blueprints for remotely bringing plants into operation in the future.

With regard to the Boen Foss power plant (1×4.1 MVA), which was developed in accordance with Norwegian standards and norms, Sintaksa was responsible for implementation planning and supplied, among other equipment, the control technology as well as safety and auxiliary systems. In collaboration with Voith, the company succeeded in bringing the plant into operation on time despite the coronavirus pandemic. Sintaksa brought Palmafossen, another Norwegian power plant with the same underlying specifications, on stream in the fall of 2021. In order to serve the important Norwegian market even better, Sintaksa has now established a subsidiary there. The company intends to collaborate just as closely with Voith in Southern and Western Europe as well as Latin America, in addition to conducting joint R&D activities. "Our customers benefit from receiving everything from a single source," explains Patric Sailer, head of the Small Hydro division at Voith Hydro. Sintaksa President Petar Jelinčić agrees, noting that "the special value of our partnership lies in the mutual use of the technologies, expertise and experience of both companies – which we can combine in the best possible way according to the customer's specific requirements."

transform

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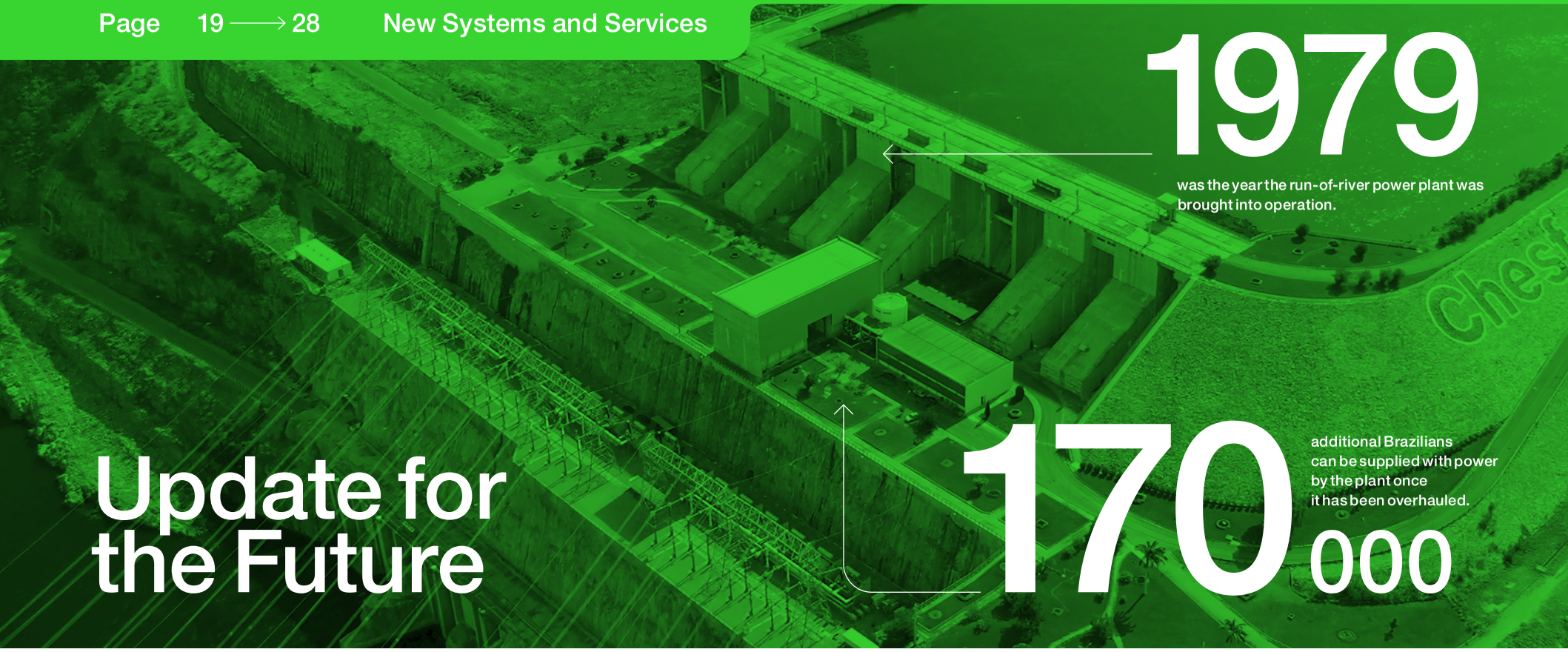
New Systems and Services



Update for the Future

1979

was the year the run-of-river power plant was brought into operation.

170 000

additional Brazilians can be supplied with power by the plant once it has been overhauled.

Voith is comprehensively modernizing the Brazilian run-of-river power plant Paulo Afonso IV to make it more efficient and fit for the future. The country's fourth-largest energy supplier has been on stream since 1979. Voith has been providing technology and engineering services for the plant since the start of the project. In order to increase the total rated output of its six generator sets to 2.5 gigawatts, the operator has engaged Voith to overhaul the turbines, including upgrading the Francis runners with the latest hydraulic profiles. In conjunction with upgrading the electromechanical equipment, the digitalization of the measurement, safety, control and monitoring systems will also increase efficiency and safety. This will not only extend the service life of the power plant but also increase the reliability of Brazil's interconnection. Around 120 jobs are expected to be created over the course of the six-year project. After its modernization, the plant, which is operated by the utility company Chesf, will be able to supply another 170,000 Brazilians with power.

New Options for Small Hydro

50 to 1,450 kW

power output per unit

The low-maintenance StreamDiver compact turbine has grown into its own product family. It can be integrated into a wide variety of installation scenarios extremely affordably.

Compact, flexible, extremely low-maintenance and particularly environmentally friendly – endowed with these features, the StreamDiver propeller turbine even opens up flowing waters with low heads for energy production. Since coming onto the market in 2013, the number of installations has risen steadily, not least because the StreamDiver can be integrated into existing dams and weirs at low cost. To further facilitate this integration and also completely new projects, Voith Hydro has expanded the compact turbine into an entire product family. Hydropower plant operators can now choose from a total of five StreamDiver models with a power output of approximately 50 kW up to 1,450 kW per unit. In combination with four modular solutions for a wide variety of installation situations, these turbines can be used to meet virtually any requirement. “Compared to conventional Kaplan solutions, the StreamDiver allows projects to be completed with significantly lower construction costs for concreting and earthworks,” says Sales and Project Engineer Albin Atzmüller. “This can cut overall project costs by up to 25 percent.”

The four installation scenarios predefined by Voith include a version with an inclined inlet and conventional screen system, a compact shaft power plant with horizontally aligned turbine, a vertical solution, and an in-pipe version that allows StreamDiver to be integrated into closed pipe systems. The cost benefits associated with them result from a number of features. The standardized layouts for each installation situation, for example, shorten the planning stage. A lower deep foundation compared to other turbine concepts reduces construction costs. And the fact that there is only one point of contact with the civil engineering team speeds up processes during the construction stage. In addition, there’s the benefit that comes from the fundamental design of all the StreamDiver models – they do not require a generating station. Instead, a space-saving electrical container is all that is needed to house the control electronics and monitor the operating data. “We’re creating a very different structure – a silent, inconspicuous power plant with the least amount of construction work,” Atzmüller emphasizes. The only minor structural changes at the respective site of operation and,

→

1 **Ready-to-ship unit**
with extra durable marine bronze underwater plugs.

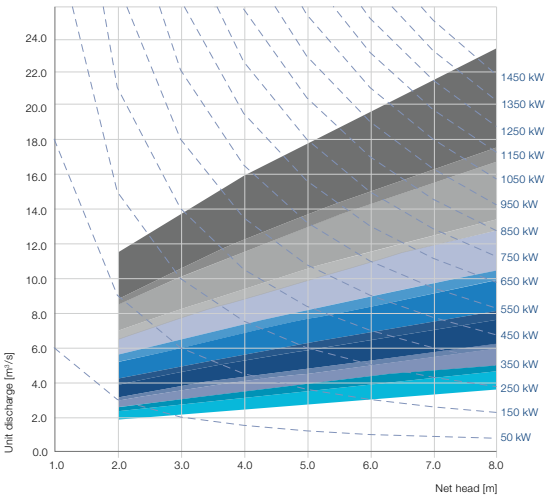
2 **The StreamDiver is manufactured**
at the Voith factory in St. Georgen, Austria.

Compared to a conventional plant, the StreamDiver cuts operating and maintenance costs by more than half.

Albin Atzmüller
Sales and Project Engineer,
Voith Hydro

StreamDiver Application Diagram

Sizes and operating areas,
based on the standard StreamDiver

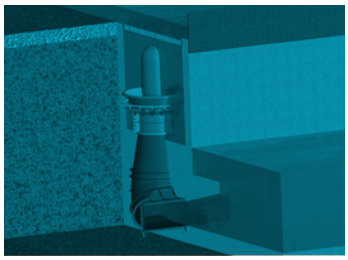


Standard Solution

The water flows through a conventional screen system and via an inclined inlet to the StreamDiver turbine.

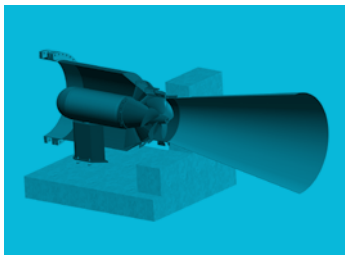
Shaft Power Plant

Because it channels the water through a shaft and a horizontal screen with underwater screen cleaning unit, the shaft power plant is short and compact. This significantly reduces construction costs.



Vertical Layout

The vertical configuration of the turbine with swiveling draft tube makes it possible to change the direction of the water flow. This results in a high degree of flexibility, for example, when replacing turbines in existing plants.

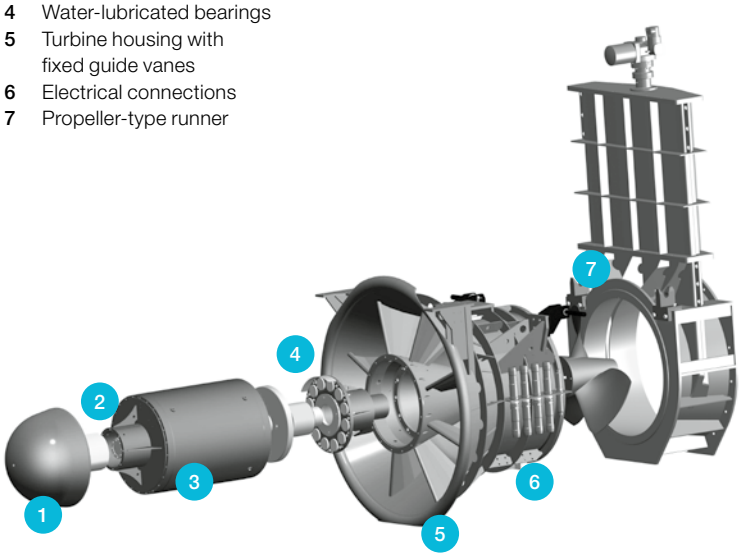


In-Pipe

The in-pipe solution offers the ability to integrate the StreamDiver turbine into closed pipe systems as well.

StreamDiver Base Model

1 Machine cap made of fiberglass-reinforced plastic
2 Water-lubricated bearings
3 Permanent-magnet generator in water-filled turbine nacelle
4 Water-lubricated bearings
5 Turbine housing with fixed guide vanes
6 Electrical connections
7 Propeller-type runner



In addition to the base model with rigid guide vane, the following alternative models are available:

StreamDiver RV
For applications with a fluctuating water supply, it has an electrically adjustable guide vane and speed control.

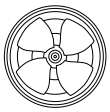
StreamDiver HP
Optimized for high-head applications, it is equipped with adapted hydraulics and reinforced water-lubricated bearings.

StreamDiver RVT
The model is designed to be installed vertically with a positive setting. It features an electrically adjustable guide vane and speed control.

StreamDiver iP
The iP version of the StreamDiver can be perfectly integrated into pipes or used in siphon applications.

StreamDiver Runner Dimensions

1



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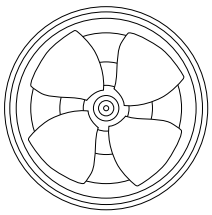

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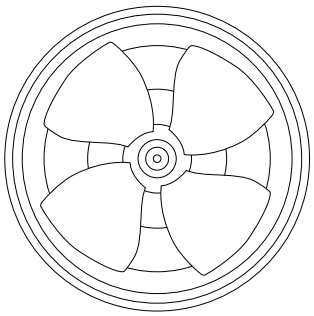

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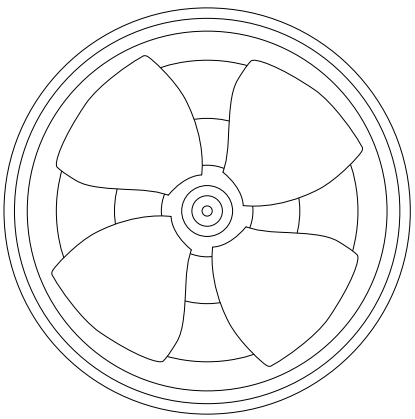

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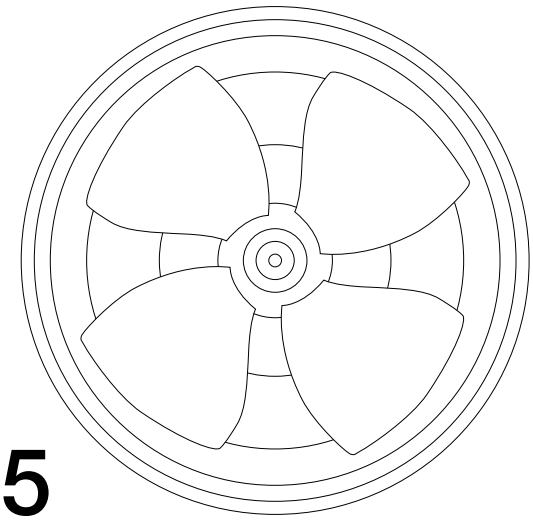


Five sizes from a runner diameter of

0.79

meters

The StreamDiver range includes five runners with a diameter of up to 1.31 meters. In addition, two XL sizes are available that reach a maximum diameter of 1.695 meters. This means that it's possible to select the perfect StreamDiver solution depending on the volume of water and the head.

up to a runner diameter of

1.31

meters

3 The StreamDiver's design with reduced complexity means low capital investment and operating costs.

above all, the environmentally friendly StreamDiver design with an oil and grease-free, exclusively water-lubricated drivetrain also allow the models to be used in environments that are particularly sensitive from an ecological point of view.

The cost benefits of the concept continue in maintenance and servicing. Thanks to its special design, the compact propeller turbine doesn't require an excitation, coolant or lubricating oil system, among other components, and requires neither gears nor dynamic seals. The reduced system complexity compared to conventional turbines results in easy-to-plan on-site inspection intervals of five years; an overhaul to replace sliding bearing modules is only due every 10 years or so, depending on actual load. "Compared to a conventional plant, the StreamDiver cuts operating and maintenance costs by more than half," the engineer points out.

Atzmüller believes that the combination of lower overall project costs, minimal maintenance effort and added flexibility when integrating the turbine into existing structures means the StreamDiver has tremendous potential for the future: "We now have an entire product family that covers a very broad range of applications."

Two XL sizes up to a runner diameter of

1.695

meters

Digital Maintenance with OnCare.Asset

OnCare.Asset: Roadmap to Predictive Maintenance

1 **Tablet replaces clipboard**
Mobile apps make systematic digitalization possible.

2 **Gilgel Gibe II**
OnCare.Asset will optimize maintenance at the power plant in the future.

1

Data Pool
Digitalization of existing data, implementation of the plant structure, material master data and key figures

2

Relevant Equipment
Definition of important equipment and, if necessary, outfitting the equipment with QR codes to access property information

3

Sensor Integration
Integration of existing sensors, e.g., to measure vibrations, pressure or temperatures; retrofitting of additional sensors, if necessary

1

2

OnCare.Asset digitalizes hydropower maintenance processes within a centralized software application. Following its introduction at Voith's manufacturing facilities in Heidenheim and York, the solution is now being used by the company's first customers. Experts expect improved plant availability at a significantly reduced cost.

Maintenance in hydropower – this still includes handwritten maintenance protocols and checklists. However, "companies without mobile and digitalized maintenance almost always suffer from poor data quality. Documentation is usually only paper-based and correspondingly error-prone," notes Waldemar Schombera, Technical Sales Manager Digitalization at Voith Hydro. This means that important information may be missing in the event of a malfunction – a critical shortcoming in the eyes of the expert. "If you want to successfully digitalize processes, you avoid switching between different media formats," says Schombera. "This makes it easier for employees to embrace digitalization."

That's why Voith consolidates all of the information relevant to maintenance on a single digital platform: OnCare.Asset. With the scalable solution for asset performance management, the company has already successfully digitized its own maintenance processes in Heidenheim, Germany, and York, PA, USA. Now customers are also using it – the pumped-storage plant in Vianden, Luxembourg, and the Gilgel Gibe II hydroelectric station in Ethiopia are both being equipped with OnCare.Asset.

In newer plants, machines are connected via the Industrial Internet of Things, and sensors generate real-time data that is analyzed in the cloud or on site. This basis for predictive maintenance is missing at the Vianden power plant. "Retrofitting older power plants with smart sensors and edge devices and connecting them to OnCare.Asset is, however, no problem at all," Schombera emphasizes.

In this context, mobile apps play a crucial role, as they enable employees to receive their work assignments directly on their tablets instead of receiving them in paper form from the maintenance manager. Using OnCare.Asset, they have access to all the information about the asset at the same time. Digital maintenance plans, spare parts lists and checklists make documentation and implementation easier. "In order to meet different requirements depending on the power plant, OnCare.Asset has a modular structure," emphasizes Jörg Lochschmidt, Vice President Digital Hydro at Voith. "Today, our product suite gives operators the ability to select from eight modules in order to configure a customized asset performance solution. One highlight is the live data connection to our OnPerformance.Lab, where experts from Voith Hydro provide recommendations on how to optimize plant operation."

In Vianden, technical stations and components such as pumps will initially be tagged with QR codes. When an employee scans the code, the app provides exploded-view drawings, repair instructions and spare parts information, among other details. "OnCare.Asset serves as the foundation for the digitalization of maintenance processes," Schombera states. "Using a tablet instead of a clipboard, employees can capture data and information directly and digitally, including photos. This seamless documentation then leads to improved maintenance processes."

OnCare.Asset shows the maintenance scheduler each employee's workload so they can accurately schedule the assignments. OnCare.Asset prioritizes notifications with damage codes and triggers further steps, such as a spare parts order. The system ideally distributes maintenance tasks across all employees. "The challenge for the future will be to digitize their knowledge and make it readily available," Schombera explains. For this purpose, at both Vianden and Gilgel Gibe II, relevant information such as checklists for inspection rounds is being digitized and plant and maintenance knowledge is gradually being saved locally.

OnCare.Asset is still being implemented at the two hydropower stations. There is no question, however, that it will lead to much more efficient maintenance processes once complete. The system's benefits on a global scale are equally beyond question. "With annual maintenance costs in the hydropower sector of around 35 billion euros worldwide, OnCare.Asset offers enormous savings potential," digitalization expert Schombera makes clear.

→4

System Integration
Interface connection for ERP and process control systems, integration with other OnCare products

→5

Training and Testing
Training and consulting with the maintenance team, test runs of the newly launched OnCare.Asset system

→6

Ideal Maintenance Strategy
An increasing amount of data and connecting with Maintenance Excellence Consulting to optimize the maintenance strategy

Hydropower projects pose increasingly stringent design and hydraulic requirements. The importance of high-quality measurements in model tests is correspondingly high. Voith consolidates its hydro expertise in an R&D center in Heidenheim that is the only of its kind in the world.

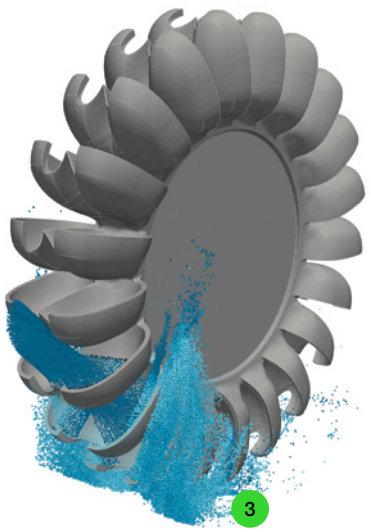
Putting the Futu

1 **Test rig**
Voith has consolidated its entire hydro expertise at the “Brunnenmühle” R&D center.

2 **Optical measurement**
A laser scanner scans the model of a Pelton wheel bucket.

ire to the Test

3 Numerical simulation models are supplemented by conclusive model tests at the R&D center.



Securing the energy supply for an entire region, feeding the rail power grid for rail services at the same time, and all while increasing the share of power generated from sustainable sources – it would be hard to place much higher demands on a single hydropower project. Ritom is supposed to meet them. The pumped-storage power plant in the Swiss canton of Ticino, which Voith is equipping with two 60-megawatt Pelton turbines, is regarded locally as the most important energy project of the last 50 years. The first generating unit is scheduled to come on stream in 2023, supplying power for the 16.7-hertz grid used by Swiss Federal Railways (SBB) to operate its trains, while the second will feed power into the public 50-hertz grid. In addition, a 60-megawatt storage pump will be installed in the plant. Together with the turbine, it will make a highly flexible contribution to rapid grid regulation and stabilization.

Due to the special significance of this power plant, the operator Ritom SA stipulated that all of the components had to meet the most stringent design requirements. Accordingly, Voith created a comprehensive simulation model to calculate the transient surge pressure for the entire range of electromechanical components the company would supply; in addition, corresponding analyses were carried out in advance. Above all, Voith was able to make use of its many years of model testing expertise, as the technology corporation has been operating a research and development center for hydropower, the “Brunnenmühle,” at its headquarters in Heidenheim since 1908. Here, the company has consolidated all its hydro expertise, giving engineers and customers the opportunity to validate their specific developments on a high-performance test bed for all turbine types. “Because Voith Hydro has consolidated expert knowledge across multiple fields in one place, we can pull together all the specialists needed to solve a problem in the shortest possible time,” says Dr. Jörg Necker, Head of Hydraulic Development, describing the extremely powerful concept.

In the case of the new Ritom power plant, it paid off. In three fully homologous model acceptance tests, the Voith experts were able to determine, among other things, the efficiency, maximum output and throughput speed, as well as the hydraulic forces. The results confirmed the guaranteed values: “Ritom is highly efficient and represents a milestone; this was an extremely demanding development process at Brunnenmühle,” says Necker. →

Demanding Development

In three fully homologous model acceptance tests for the new Swiss power plant Ritom, the Voith experts were able to determine, among other things, the efficiency, maximum capacity and throughput speed as well as the hydraulic forces. The results confirmed the guaranteed values.

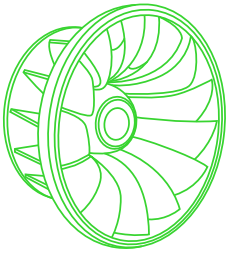
But the benefits of centralized research and development go far beyond just optimizing efficiency. This is because the requirements new hydropower projects need to meet are also constantly increasing with respect to other parameters. In China, for example, pressure fluctuations are a major issue – and they can only be identified by means of numerical models in simulations with great effort, so measurements on the real model are often still preferred. “We are moving closer and closer to the limits of what is physically achievable without reducing safety,” explains the mechanical engineer, who holds a doctorate in engineering.

What can be achieved through the combination of centralized research and development, a high-performance test bed, and links to international Voith teams in the customer’s respective region was impressively demonstrated in another model acceptance test. At Brunnenmühle, Voith developed a runner with 15 blades for the Chinese power plant Laxiwa 4 that covers a power range from 0 to 100 percent (equivalent to 0 to 711 megawatts). At the same time, it stands out thanks to its extremely low levels of mechanical stress and low hydraulic pressure fluctuations with excellent efficiency. Due to travel restrictions in place as a result of the pandemic, however, an acceptance process involving all of the participants in Heidenheim was not an option. In collaboration with their colleagues from Voith Hydro Shanghai, the R&D center’s employees organized a premiere; during the first online model acceptance process, they were able to demonstrate all of the hydraulic characteristics to the customer, share measurement results and exchange documents with the customer digitally. They had previously gained the necessary confidence on the part of the customer through high-quality test preparations and transparent documentation, as well as live recordings at the test bed. “The remote acceptance process went very smoothly,” Necker says.

4

4 **Ritom pumped storage plant**
Voith is supplying two Pelton turbines, each with 60 megawatts, and a 60-megawatt storage pump for the new construction project.

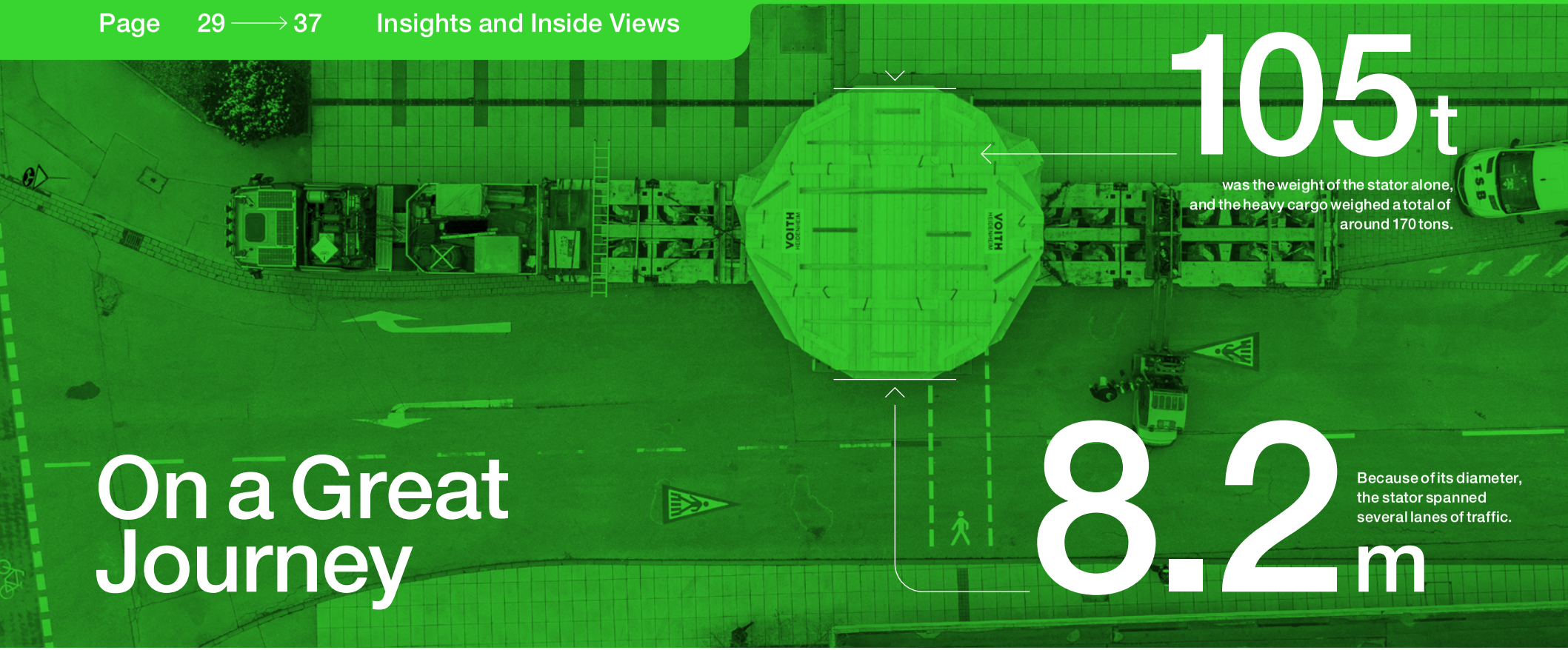
There is no question in his mind that Voith’s centralized approach to R&D with interdisciplinary exchange also equips the company to meet the ever-increasing demands placed on testing technology: “We have an extremely large analysis toolbox, for example, it includes laser or transient operation.”



Snowy 2.0: High-Precision Measurements for the Megaproject

Not only will Snowy 2.0 be one of the world’s largest pumped-storage power plants, it will also play a major role in Australia’s energy revolution. Voith is supplying the pump turbines, among other components. In line with the scale of the megaproject, the customer’s acceptance test for the two runners designed to operate in a variable-speed and fixed-speed unit was also extremely tough. In Heidenheim, the team measured extreme operating conditions as well as radial forces, axial forces, pressure fluctuations and guide vane torques; cavitation was also observed. An online briefing was held every morning with the client in Australia, which was represented by European consultants on site. The acceptance process was completed after five weeks. An independent laboratory confirmed the excellent conformity of the measurement results, and the customer was fully satisfied that all of its hydraulic requirements had been met.

reflect



105 t

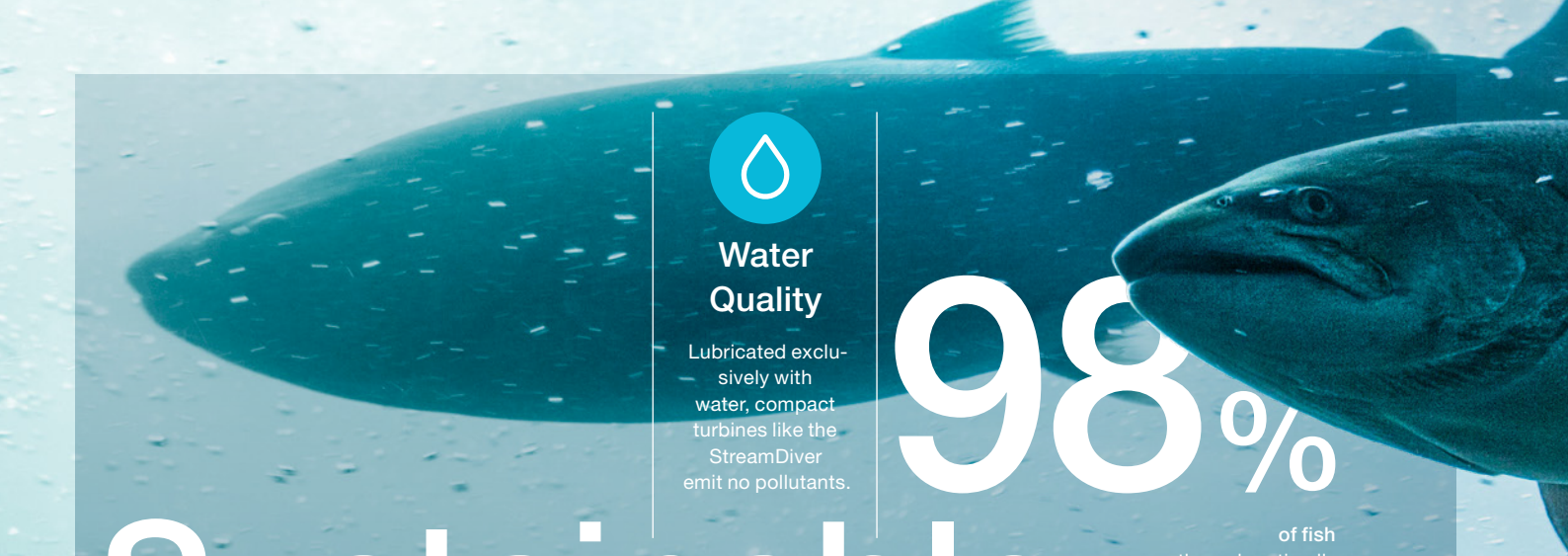
was the weight of the stator alone, and the heavy cargo weighed a total of around 170 tons.

8.2 m

Because of its diameter, the stator spanned several lanes of traffic.

On a Great Journey

Hydropower's colossal dimensions are sometimes revealed on the road. This was also the case in April 2021, when the widest transport in the history of Voith Hydro Heidenheim left the factory premises: a fully assembled stator with a diameter of 8.2 meters and a weight of 105 tons destined for Töging am Inn in the German state of Bavaria. The logistical effort was correspondingly complex. Because the stator protruded 2.6 meters beyond each side of the heavy-duty convoy, which itself was already three meters wide, traffic lights and traffic signs had to be dismantled along the meticulously planned route, as did the signaling equipment in a tunnel. In addition, the heavy load had to make the 250-kilometer journey within one night because there was no suitable place to park along the route. At its destination, the convoy overcame the last obstacle, the steep descent to the generating station, via a specially constructed access road. The stator is part of the first of three 55 MVA generators that Voith is installing as part of a modernization project to increase energy production by 139 GWh at the almost 100-year-old power plant on the Inn river.



Water Quality

Lubricated exclusively with water, compact turbines like the StreamDiver emit no pollutants.

98%

of fish
pass through optimally designed hydropower facilities.

Sustainable Through and Through

Focused research makes hydropower even more sustainable. With its comprehensive approach, Voith covers everything from protecting fish to water quality and energy efficiency.

Sustainability lies in the very nature of hydropower. But even in this sector, it can still be increased – through the development of turbines with improved fish passage, for example. "The design of the rotor blade naturally plays a major role in this regard," says Ulli Stoltz, development engineer at Voith Hydro. "This allows us to optimize the pressure patterns, shear forces and turbulence that affect fish as they swim through the turbine." Voith has been specifically taking environmental aspects into account when developing mechanical and electrical power plant equipment for more than 50 years. Just recently, Stoltz oversaw two research programs to develop innovative concepts and methods to protect fish: the EU project FITHydro, coordinated by the Technical University of Munich, and the FINI project led by the University of Innsbruck.

Within the scope of the FITHydro (Fishfriendly Innovative Technologies for Hydropower) project, 17 hydropower plants in eight European countries were studied, including three Voith plants, in order to improve the evaluation of fish protection measures, among other objectives. The researchers took a close look at methods and technologies and sent fish-like sensors through the systems, for example, to determine what stresses the animals are exposed to in the process. In the FINI project (fish protection at low-pressure power plants), numerical 3D simulations and experiments were used to evaluate the effectiveness of bypass systems and turbines at a run-of-river power plant as well as their effect on fish protection. By combining compact turbines with fish passage systems, low-cost and low-maintenance power plants can be built that have a low impact on the fish population and thus river ecology. In addition, the Voith StreamDiver compact turbine has water-lubricated bearings and therefore does not emit any lubricant into the flowing water – an important detail, because even the smallest amounts of oil can cause significant damage in sensitive hydrophilic ecosystems. Voith is incorporating the results of this research into its development processes. "Thanks to these projects, we can offer concrete recommendations both when retrofitting existing and building new hydropower plants," Stoltz explains.

Operators are also given the opportunity to use new assessment methods such as a fish threat index for fish populations, analysis of fish passage at the power plant, and software to plan their fish protection concepts. These and

Fish Passage

Innovative assessment methods take power plant operation, fish behavior and flow simulation data into account. Optimized runner designs reduce collision-related fish deaths.

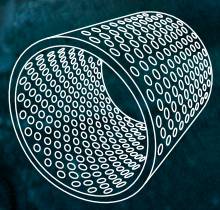
Thanks to these research projects, we can offer concrete recommendations both when retrofitting existing and building new hydropower plants.

Ulrich Stoltz
Development Engineer, Voith Hydro

other analytical methods are also used to develop new types of turbines with improved fish protection, for example on the Columbia River and Snake River in the Northeastern United States. In addition, there are innovative concepts such as the Alden turbine, which operates with only three rotor blades and at a reduced speed, reducing collision-related injuries to fish. In turn, the minimum gap runner turbines developed by Voith use a completely spherical hub and periphery so that the gap between the turbine runner and the inner and outer contours remains constant over the entire blade length. This reduces mechanical injuries to fish, and the improved flow quality also reduces the impact of shear forces and turbulent flows on the animals. In addition, the shape of the rotor blade can reduce pressure changes and optimize the minimum pressure levels for fish passing through the turbine. The fact that these design ideas are effective in large-scale applications has already been demonstrated at a run-of-river power plant in Washington State. Here, researchers have been able to demonstrate that more than 98 percent of the fish pass through the system alive. Aerating turbines, in turn, use the blades to oxygenate the water, benefiting fish populations in the river's ecosystem.

But the aspirations go far beyond that. Voith's customized HyCon automation solutions also improve the sustainability of power plants by increasing their efficiency. This is achieved, for example, via Kaplan optimization modules that automatically correct small deviations in the interaction between the guide vanes and the runner, allowing turbines to run even more productively. Water level control optimizes the operation of barrages and entire cascades. All in all, water consumption can be reduced by up to 10 percent or, depending on the need, 10 percent more energy can be generated with the same amount of water.

This focus on sustainability is not an end in itself. Further increasing environmental protection standards and more stringent regulatory requirements also demand a greater contribution from hydropower. Not only does Voith provide customers with the necessary technology, but it also leads the way itself. The rating agency ISS ESG has again awarded the company Prime Status, placing it among the most sustainable 20 percent of the world's machinery and plant manufacturers.



10%

less energy
is consumed by environmentally friendly components from Voith Hydro, which at the same time improve environmental protection.

Knowledge is (Hydro) Power

The world of hydropower is becoming more complex, more digital and more international. Voith has developed the Hydro Development Program to secure existing knowledge for the future and to systematically develop young talent.

Jürgen Häckel
CEO Voith Hydro Heidenheim

The engineer and trained industrial mechanic got his start at Voith completing his final degree project at the company. With his wife and children in tow, he completed lengthy assignments abroad in the USA and Sweden. In his free time, he enjoys spending time with his family and hiking in the mountains.

Hydropower is more than just a high-tech means of generating energy. Hydropower is also the people who design and build it, maintain it and continuously make advancements to it. But while the demand for this sustainable form of electricity production is growing, the industry is simultaneously threatened by an outflow of knowledge due to demographic change. Experienced employees who enter retirement cannot easily be replaced by younger ones. This “brain drain” isn’t a problem exclusive to hydropower, but it demands new solutions from this industry as well.

Voith recognized this development early on. Back in 2003, the company set up the Management Trainee Program (MTP) to systematically foster young hydro talent. The objective was not only to expand their technical knowledge but also for them to become familiar with the unique aspects of the global hydropower markets through their international assignments, to work together with coworkers and customers in the respective regions, and also to acquire intercultural skills. Voith Hydro has continuously developed the program and its content since then. The MTP became what is now the HDP, the Hydro Development Program. It provides participants selected according to performance and diversity criteria as well as leadership potential with career prospects in addition to qualifications, but it is not purely an HR development measure. “The program is focused on customer benefits,” emphasizes Markus Mader, Chief Financial Officer of Voith Hydro. “Each candidate goes through foreign assignments and works in sister companies, which broadens their horizons to the maximum. This makes it much easier to understand the pain points of a consortium partner, the sales unit or even the holding company. And this helps them overcome challenges together even better.”

The program’s structure reflects its high degree of practical and customer relevance. The HDP is divided into three training periods of six months each, at least one of which must be completed in a region other than the participant’s home region. The content and business cases that the participant will work on during the program are defined during a two-month planning phase beforehand. Each participant has a mentor to provide support in professional or technical matters. In the 13 years that the HDP has been conducted to date, participants have worked on the development of generator modernization options, improved collaboration in international project execution, and optimization of the balance of plant and quality documentation. Development meetings are scheduled between training segments to review the participants’ progress. The culmination of their work on the business scenarios is a final presentation of the results. The location and audience underline the importance of the program – participants present their results directly to the Executive Board of Voith Hydro in Heidenheim. This is followed by the two-month final phase of the program. What the HDP participants have acquired in terms of professional qualifications, market knowledge and contacts forms the basis for their further careers at Hydro – and is already extremely well developed.

→


hy, my name is...
Jürgen Tödel

Jennifer Stütz
Project Manager
Voith Hydro

The industrial engineer has been with Voith since 2012 and has worked as a bid project manager for Voith Hydro since 2015, having held this role for some time in Montreal, Canada. Outside of work, Jennifer Stütz races in rallies, skis and also spends her free time doing Zumba, hiking and spending time with her dog.

The Hydro Development Program aims to continually develop participants in the direction of customer centricity.

Harikumar Kathirvel
Vice President
Project Execution Voith Hydro

Like Jürgen Häckel, for example. The engineer was one of the first participants in 2006. “I saw it as an excellent opportunity to become familiar with Hydro locations around the world, foreign countries and their cultures outside of day-to-day business,” recalls the 47-year-old. “In addition, I was able to explore new fields of activity relevant to hydropower and acquire professional knowledge that would help me in my future tasks.” His assignments took him from his home base in Heidenheim to York in the United States, São Paulo in Brazil and Noida in India. In the US, he gained insights into the hydraulic development and design of turbines, and in Brazil he was involved in generator production. “That’s where I acquired detailed knowledge that you can’t get working purely in engineering,” Häckel notes. And he still benefits from this today. “All my experiences from the program

Harikumar Kathirvel
Vice President
Project Execution
Voith Hydro

The mechanical engineer has worked for Voith for 21 years. In his spare time, he enjoys playing golf, woodworking and spending time on his model railroad.

help me in my work every day, whether it's the technical knowledge, the personal contacts at the sites or the experience with different cultures – which turned out to be a huge benefit," says Häckel, now CEO of Voith Hydro Heidenheim.

Jennifer Stütz also emphasizes how the program expanded her expertise on many levels. When the current project manager joined Voith in 2012 as part of her cooperative degree program in industrial engineering, she first trained in various departments at Voith Hydro. Participation in the Hydro Development Program was then another important step in her professional development, she says. "I was particularly attracted to the opportunity to discover new areas of Voith Hydro, to expand my network, and also to look beyond the horizons of my own field of work for once," she says, describing her motivation.

Stütz cites the first stop on her HDP journey, Research & Development, as an example. Here she was trained in the hydraulic design of various types of turbines. "Up until then, I had only ever used the results from this department. Today, I understand the process behind them and all the hard work my colleagues do to select an ideal solution for customers that is tailored specifically to each power plant site."

But the program expanded her expertise even beyond that. In her second HDP stint, Stütz had the chance to work at Voith Hydro Shanghai in China, familiarizing herself with the market situation in Asia and becoming familiar with the cultural differences firsthand. During her third assignment, she led an R&D project team working on electric motors. All of the skills she acquired benefit her today, says the 28-year-old. "The knowledge I gained from the theoretical training sessions helps me deal with challenging situations. The personal connections and especially the technical background knowledge from the trainee program help me in my daily decisions."

This is an opinion shared by Stütz's 45-year-old coworker Harikumar Kathirvel. "The program helps you develop in many different ways," states the mechanical engineer. During his HDP assignments in Brazil, North America and Germany, he had to prove himself in the sales and quotation department as well as in the modernization of a power plant unit and the production of synchronous generators. In addition to the technical aspects, he emphasizes the importance of cultural awareness, not least from the perspective of a globally active technology group. Working shoulder to shoulder with people from other cultural backgrounds is becoming increasingly frequent and therefore more important, says the current Vice President Project Execution at Voith Hydro. That's why the HDP's structure with trainees working at various international locations is so important – both today and even more so in the future.

"The focus is on the customer," emphasizes Kathirvel. "The Hydro Development Program aims to continually develop participants in the direction of customer centricity and ensures that we can deliver our sustainable technologies for generations to come."

Markus Mader
CFO Voith Hydro

The industrial engineer has been with the Voith Group since 1999. After holding various management positions in different divisions of the group, he was appointed to the Executive Board of Voith Hydro in 2018. In this role, he is head of Finance and Human Resources, among other duties. As the head of HR, he is simultaneously in charge of the Hydro Development Program.

We need the best employees who have been broadly trained and have gained experience in many areas. HDP offers talented employees these opportunities.

Markus Mader
Chief Financial Officer
Voith Hydro

Out of the box

Hydropower has a long tradition in Canada – and sometimes bears artistic fruit.

Mechanical and organic
Long stems sprout from the Pelton turbine, with nozzles adorning their tips instead of flowers.

Canada's Hydropower History

1881

Premiere
Canada's first hydraulic generator, the Ottawa Electric Light Co. water wheel at Chaudière Falls, enters operation

1898

Built to Last
In southern Ontario, DeCew Falls 1 is built, now the oldest continuously operating hydropower plant in Canada.

1920

Record High
More than 97 percent of electricity in Canada is generated by hydropower.

Canadian Water Art

A fascinating object
As a roadside installation, the discarded Allis-Chalmers turbine catches visitors' interest.

The Pacific Ocean to the west, the Atlantic Ocean to the east. And in between, Canada, the country with the largest freshwater body of water in the world. It comes as little surprise that the wet element plays a key role in life in this large North American country whose motto is "From Sea to Sea." In fact, the importance of water here goes far beyond its use in the context of basic services, fishing, shipping and sports. This is because Canada began to tap into hydropower as early as 140 years ago. Amidst an abundance of renewable energy sources available to the country through its diverse geography, this method of energy generation continues to dominate today. Six out of 10 Canadian businesses and households are powered by electricity generated by hydropower. As such, it is also an extremely important economic factor. "Hydropower creates tremendous economic opportunities and provides thousands of jobs in communities across the country," Canada's Minister of Natural Resources Amarjeet Sohi put it succintly in 2019.

1930

Superlative
Construction of Beauharnois, the largest run-of-river power plant in Canada, begins (completed in 1961).

1957

Technological Leap
The country's first pumped-storage power plant, Sir Adam Beck, begins operating at Niagara Falls.

1981

Cavernous
The world's largest underground hydropower plant, Robert-Bourassa, is brought on stream.

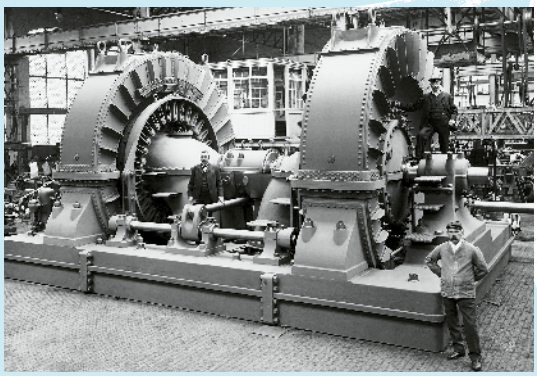
1998

Partnership
The Canadian Hydropower Association (today: Waterpower Canada) is founded.

2019

Sustainability
Canada joins the International Renewable Energy Agency (IRENA).

But hydropower not only shapes the energy supply and professional lives of many Canadians; it also supports the development of remote communities in partnership with local Indigenous peoples. And anyone who drives attentively through the country will often find evidence of just how strongly people identify with the most sustainable form of of energy generation – like in Lillooet in the province of British Columbia. Located about four hours northeast of Vancouver, this small community has big things to show its guests. Eye-catching metal sculptures placed along the roadside capture the eye. Colorfully painted and decorated, they only reveal what they are at second glance: end-of-life hydroelectric components. Lillooet transforms them into sculptures and proudly puts them on display. For example, an object that, in its first life, was an Allis-Chalmers turbine. Manufactured in York, Pennsylvania, in 1953, it now radiates from afar in the colors of the regional utility company BC Hydro. The main attraction is a Pelton runner complete with nozzles that virtually sprout out of it as floral-looking decorations on green metal tubes. A symbol of the effect of renewable energy – and a proud reference to the nearby Bridge River power plant.



A long history
Voith supplied turbines for power generation at Niagara Falls way back in 1911.


The future
depends on
what we do
in the
present.
Mahatma Gandhi
VOITH